**3GPP TSG-RAN WG4 Meeting #109 R4-23xxxxx**

**Chicago, 13th - 17th Nov, 2023**

**Agenda item:** 8.26.9

**Source:** Moderator (Huawei, HiSilicon)

**Title:** Topic summary for [109][324] NR\_NTN\_enh\_SAN\_UE\_demod

**Document for:** Information

# Introduction

This contribution summarises the open issues for NR\_NTN\_enh\_SAN\_UE\_demod under AI 8.26.8 at RAN4#109.

This topic is introduced in RAN4 demodulation at RAN4#108-bis with a completion by RAN#104 in June 2024.

Three topics are captured:

* Topic #1: General
* Topic #2: UE demodulation performance requirements
* Topic #3: SAN demodulation performance requirements

# Topic #1: General

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| T-doc number | Company | Proposals / Observations |
| [**R4-2318058**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318058.zip) | Nokia, Nokia Shanghai Bell | Proposal 1: RAN4 considers both GEO and LEO constellations in scope, with static UEs for both, and mobile only for GEO constellations.  Observation 1: The doppler shift will vary within the uplink beam.  Observation 2: The doppler spread will be significantly reduced to the beamforming effect of both the SAN and UE.  Proposal 2: RAN4 shall use NTN-TDLC-5-10 for definition of requirements. |
| [**R4-2318059**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318059.zip) | Nokia, Nokia Shanghai Bell | Proposal 1: RAN4 considers both GEO and LEO constallations in scope, with static UEs for both, and mobile only for GEO constalliations.  Observation 1: The doppler shift will vary across the NTN cell.  Observation 2: The doppler spread will be significantly reduced to the beamforming effect of both the SAN and UE.  Proposal 2: RAN4 shall use NTN-TDLC-5-200 for definition of requirements. |
| [**R4-2318582**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318582.zip) | Apple | Observation #1: If Doppler value is derived based on the UE speed, we need to understand the target UE speed for eNTN and analyse the impact of beamforming on Doppler.  Observation #2: If Doppler value is derived based on the residual frequency error of 0.1 ppm, the resulting Doppler would be 3000Hz which is large to define any meaningful demodulation requirements.  Proposal #1: Use Doppler for 200, 300 Hz for FR2 NTN requirements.  Proposal #2: Use NTN-TDLC channel model for FR2 NTN requirements.  Proposal #3: Use delay spread of 5ns with NTN-TDLC channel model for FR2 NTN requirements.  Proposal #4: Use smaller delay spread – like 30ns if NTN-TDLA channel is used for FR2 NTN requirements. |
| [**R4-2318735**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318735.zip) | Qualcomm India Pvt Ltd | Observation 1: Mobile VSAT under LEO scenarios will not be considered in Rel-18.  Observation 2: Since Doppler due to satellite mobility will not be considered in demodulation requirements, GSO scenarios with mobile VSAT may pose more challenges from demodulation perspective compared to the stationary VSAT under LEO scenarios.  Proposal 1: Introduce performance requirements for GSO scenarios.  Observation 3: Doppler derivation based on residual frequency error could lead to very high Doppler value due to high carrier frequency.  Proposal 2: Derive Doppler based on residual frequency error (i.e., 0.1ppm), but Doppler value should not be greater than 0.5% of the SCS (e.g., 600Hz for 120KHz SCS) |
| [**R4-2319223**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319223.zip) | Ericsson | Proposal 1: Do not introduce specific UE demodulation requirements for GSO scenario, legacy TN FR1 and FR2 UE demodulation requirement can be reused.  Proposal 2: Use one set of requirements to cover both GSO and NGSO scenarios for SAN.  Proposal 3: Derive the Doppler value based on the residual frequency error, take 3000Hz for UL and 2000Hz for DL as a starting point. |
| [**R4-2319846**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319846.zip) | Samsung | Proposal 1: Only focus on the NGSO for performance definition, the SAN requirement can be applied for both GSO and NGSO.  Proposal 2: The following channel model can be considered for feasibility evaluation as starting point  - [NTN-TDLA10-3000]  - [NTN-TDLC5-3000] |
| [**R4-2320238**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320238.zip) | Huawei, HiSilicon | Observation 1: GSO scenario is better than Rel-17 and is feasible for Rel-18 above 10 GHz bands.  Proposal 1: Considering one set of requirements for both NGSO and GSO.  Proposal 2: Reuse the same delay spread value as Rel-17 for above 10 GHz bands, i.e. 5ns for LOS condition and 100ns for NLOS condition respectively.  Proposal 3: Consider maximum UE speed 120km/h in Rel-18.  Proposal 4: Derive the Doppler based on residual frequency error, i.e. 3000Hz.  Proposal 5: Use NTN-TDLA100-3000 and NTN-TDLC5-3000 channel model for FR2 NTN demodulation requirements.  Proposal 6: Select both NTN-TDLA100-3000 and NTN-TDLC5-3000 for PDSCH and PUSCH while select only NTN-TDLA100-3000 for other channels. |

## Open issues summary

### Sub-topic 1-1: Scenario and channel model

**Issue 1-1-1: Scenario**

|  |
| --- |
| * *Background (Agreement in RAN4#108bis)*   + *At least NGSO scenario to be considered for requirement definition, companies can check whether GSO can also be considered for NTN demod.*   + *Focus on the mobility scenario assumed by RRM. (Mobility VSAT with LEO is not considered)* |

* Proposals
  + Option 1 (Nokia):
    - GEO static UE
    - LEO static UE
    - GEO mobile UE (up to 1000km/h)
  + Option 2 (Qualcomm): Introduce performance requirements for GSO scenarios
  + Option 3 (Ericsson):
    - Do not introduce specific UE demodulation requirements for GSO scenario, legacy TN FR1 and FR2 UE demodulation requirement can be reused
    - Use one set of requirements to cover both GSO and NGSO scenarios for SAN
  + Option 4 (Samsung): Only focus on the NGSO for performance definition, the SAN requirement can be applied for both GSO and NGSO
  + Option 5 (Huawei):
    - Considering one set of requirements for both NGSO and GSO
    - Consider maximum UE speed 120km/h in Rel-18
* Recommended WF
  + For SAN side and UE side
    - Only focus on the NGSO for performance definition
    - One set of requirements that can be applied for both NGSO and GSO

**Issue 1-1-2: Channel model**

* Proposals
  + Option 1 (Nokia, Apple): NTN-TDLC
  + Option 2 (Samsung, Huawei): NTN-TDLC and NTN-TDLA
    - Option 2a (Huawei):
      * Both NTN-TDLA and NTN-TDLC for PDSCH and PUSCH
      * Only NTN-TDLA for other channels
* Recommended WF
  + NTN-TDLC to be considered, FFS NTN-TDLA
  + FFS combination of the channel models and the physical channels

**Issue 1-1-3: Doppler**

* Proposals
  + Option 1 (Nokia): 10Hz for SAN side, 200Hz for UE side
  + Option 2 (Apple): 200, 300 Hz
  + Option 3 (Qualcomm, Ericsson, Samsung, Huawei): Based on residual frequency error
    - Option 3a (Qualcomm): Not greater than 0.5% of the SCS (e.g., 600Hz for 120KHz SCS)
    - Option 3b (Ericsson, Huawei): 3000Hz for SAN side, 2000Hz for UE side
    - Option 3c (Samsung): 3000Hz as starting point for SAN side
* Recommended WF
  + Further discuss is needed

**Issue 1-1-4: Delay spread**

* Proposals
  + Option 1 (Nokia): 5ns for NTN-TDLC
  + Option 2 (Apple): 5ns for NTN-TDLC, 30ns for NTN-TDLA
  + Option 3 (Ericsson): 5ns
  + Option 4 (Samsung): 5ns for NTN-TDLC, 10ns for NTN-TDLA
  + Option 5 (Huawei): 5ns for NTN-TDLC, 100ns for NTN-TDLA
* Recommended WF
  + 5ns for NTN-TDLC
  + FFS value for NTN-TDLA

# Topic #2: UE demodulation requirements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| T-doc number | Company | Proposals / Observations |
| [**R4-2318059**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318059.zip) | Nokia, Nokia Shanghai Bell | Proposal 3: RAN4 shall use 16 HARQ process for requirements alignment  Observation 3: PDCCH in NTN deployments above 10GHz is expected to have significantly different performance requirements.  Proposal 4: RAN4 to define PDCCH requirements for above 10GHz in NTN.  Observation 4: PBCH in NTN deployments above 10GHz is expected to have significantly different performance requirements.  Proposal 5: RAN4 to define PBCH requirements for above 10GHz in NTN.  Observation 5: Frequency and Timing drift will differ across the NTN cell.  Proposal 6: RAN4 shall use 120 kHz for SCS for requirements alignment.  Proposal 7: RAN4 shall use 100 MHz CBW for requirements alignment.  Observation 6: Current VSAT devices only enable 1Tx1Rx capable antenna configuration.  Proposal 8: RAN4 shall use 1Tx1Rx for the antenna configuration for requirements definition.  Observation 7: Beamforming and Beam Steering does not have direct impact on demodulation requirements and should be included in channel model effects.  Proposal 9: RAN4 shall not explicitly model beamforming effects for NTN deployments above 10GHz.  Observation 8: RAN4 has struggled to gain alignment on Rx Phase Noise models in previous work items  Observation 9: Rx Phase Noise is likely to have little impact on demodulation performance.  Proposal 10: RAN4 shall define impairment requirements including the impact of Rx Phase Noise, but shall not seek alignment on Rx Phase Noise model. |
| [**R4-2318582**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318582.zip) | Apple | Proposal #5: Define requirements with 16HARQ and 32 HARQ processes.  Proposal #6: Do not define requirements with disabled HARQ due to testability concern.  Proposal #7: Evaluate feasibility of reusing FR2 PDCCH demod requirements for eNTN.  Observation #3: The PBCH demod requirements for FR2-1 are defined for SSB SCS of 120KHz and 240KHz. The same SSB SCS/patterns are supported for eNTN.  Proposal #8: Reuse the existing PBCH demod requirements for FR2-1 for eNTN.  Observation #4: CQI reporting in NTN might still be useful.  Observation #5: CQI reporting in fading conditions is not practical/ testable due to long RTT.  Proposal #9: Define CQI reporting in AWGN for FR2 NTN to have coverage for CQI reporting for FR2 NTN UEs.  Observation #6: 120KHz SCS is typically used to define requirements in FR2-1.  Observation #7: Feasibility of 120KHz SCS is under discussion in RRM.  Proposal #10: If feasibility in RRM is confirmed, then define requirements with 120kHz SCS, otherwise define requirements with 60KHz SCS.  Proposal #11: Define requirements with 100MHz CBW for FR2 NTN.  Proposal #12: Need further clarification on impact to demodulation performance with parabolic VSAT antenna configuration.  Observation #8: Demodulation requirements are for baseband performance and beam steering mechanism should have no impact on baseband processing or demodulation requirements.  Proposal #13: Need further clarification on impact of beam steering mechanism of VSAT devices to demodulation performance.  Observation #9: Don’t expect PN impact in low MCS typically targeted for NTN.  Proposal #14: Take PN impact into account in impairment results.  Observation #10: 64QAM is not feasible/ practical in FR2 NTN.  Proposal #15: Use MCS4 (QPSK, 0.30) and MCS13 (16QAM, 0.48) for PDSCH demod requirements.  Proposal #16: Define PDSCH demod requirements for rank 1, mapping Type-A.  Proposal #17: Use AL=8 as baseline for PDCCH demod requirements in FR2 NTN.  Proposal #18: Reuse PDCCH demod requirements from FR2-1 and only define requirements with unknown SSB index for FR2 NTN.  Proposal #19: For CQI reporting requirements in AWGN for FR2 NTN use 1x2 with rank 1 configuration. |
| [**R4-2318735**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318735.zip) | Qualcomm India Pvt Ltd | Proposal 3: Consider 16 HARQ processes for both GSO and NGSO scenarios as a baseline. Further discuss 32 HARQ processes.  Proposal 4: Do not define PDCCH performance requirement for NR NTN enhancements.  Proposal 5: Do not define PBCH performance requirement for NTN enhancements.  Proposal 6: Do not define CQI reporting requirement for NTN enhancements.  Proposal 7: Support Option 1 (120KHz SCS for NR NTN enhancements).  Proposal 8: Support Option 1 (100MHz bandwidth). Further discuss 200MHz bandwidth.  Proposal 9: Support Option 1 (Take 1Tx1Rx for parabolic VSAT antenna configuration for initial demodulation discussion and input from satellite companies is needed).  Proposal 10: Consider beam steering approach as specified in 38.101-4 (Sec B.2.3.2.3).  Proposal 11: Support Option 1 (Take Rx phase noise impact into impairment results and companies could give proper values based on preferred PN model).  Proposal 12: Consider applicability rule after discussion about scenario (Issue 2-1-1 in the WF[1]) is settled.  Proposal 13: Define PDSCH performance requirement for rank 1 transmission.  Proposal 14: Consider 16QAM modulation order as a baseline. Further discuss 64QAM modulation order. |
| [**R4-2319223**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319223.zip) | Ericsson | Observation 1: The DL CNR range is 0.5 ~ 11.6dB and UL CNR range is -3.3 ~ 21.4dB when channel bandwidth <=200MHz.  Proposal 4: Consider 1T1R parabolic VSAT as a starting point  Proposal 5: Further evaluate the feasibility of reusing TN FR2 PDCCH requirements.  Proposal 6: Reuse the existing PBCH demodulation requirements for FR2-1 for eNTN.  Proposal 7: Do not define UE CSI reporting requirement for above 10GHz bands.  Proposal 8: Consider 100MHz for channel bandwidth.  Proposal 9: Take Rx phase noise impact into impairment results and companies can give proper values based on preferred PN model.  Proposal 10: Introduce new PDSCH demodulation requirements with mapping type A for single carrier for Rel-18 NR NTN FR2 demodulation. Consider following common configurations for initial discussion:  • SCS and CBW: Prioritize 120kHz SCS and 100MHz CBW  • Rank: 1  • Modulation level: Prioritize 16QAM and QPSK.  Proposal 11: Introduce new PDCCH demodulation requirements for Rel-18 NR NTN FR2 demodulation. Consider following common configurations for initial discussion:  • SCS and CBW: Prioritize 120kHz SCS and 100MHz CBW  • Aggregation level: 2 and 4  Proposal 12: Reuse the existing PBCH demodulation requirements for FR2 NTN enhancement. |
| [**R4-2320240**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320240.zip) | Huawei,HiSilicon | Proposal 1: Consider 16 HARQ process, 32 HARQ process and HARQ process disabled PDSCH requirements for FR2 NTN.  Proposal 2: Define new PDCCH requirements for FR2 NTN.  Proposal 3: Do not define new PBCH requirements for FR2 NTN.  Proposal 4: Do not define CQI reporting requirements for FR2 NTN.  Proposal 5: Select 200MHz for 120kHz SCS for FR2-NTN.  Proposal 6: Consider both 1Tx1Rx and 1Tx2Rx for FR2-NTN, with antenna type not limit to parabolic, but also phase antenna array.  Proposal 7: Do not consider beamforming and beam steering for FR2 NTN demodulation requirements.  Proposal 8: Do not consider any PN impact in the simulation and in ideal simulation results alignment.  Proposal 9: Adding similar applicability rule for FR2 NTN UE optional capabilities as in Rel-17 FR1 NTN UE.  Proposal 10: Select rank 1 with MCS4 (QPSK, 0.30) and MCS13 (16QAM, 0.48) that is similar as Rel-17 FR1 NTN as the starting point.  Proposal 11: Consider PDSCH mapping type A for FR2 NTN demodulation requirements.  Proposal 12: Consider aggregation level 4, 8 and 16 for FR2 NTN demodulation requirements. |

## Open issues summary

* + 1. Sub-topic 2-1: Test scope

**Issue 2-1-1: HARQ processes for above 10 GHz bands**

* Proposals
  + Option 1 (Nokia): 16 HARQ process for requirements alignment
  + Option 2 (Apple): 16 HARQ process and 32 HARQ process. Do not define requirements with disabled HARQ due to testability concern
  + Option 3 (Qualcomm): 16 HARQ process, FFS 32 HARQ process
  + Option 4 (Huawei): 16 HARQ process, 32 HARQ process and HARQ process disabled
* Recommended WF
  + Consider 16 HARQ process
  + FFS 32 HARQ process and HARQ process disabled

**Issue 2-1-2: Whether to define UE PDCCH demodulation requirements for above 10 GHz bands**

* Proposals:
  + Option 1 (Nokia, Apple, Ericsson, Huawei): Yes
    - Option 1a (Apple, Ericsson): Further evaluate feasibility of reusing TN FR2 PDCCH requirements
  + Option 2 (Qualcomm): No
* Recommended WF
  + Further discuss is needed

**Issue 2-1-3: Whether to define UE PBCH demodulation requirements for above 10 GHz bands?**

* Proposals:
  + Option 1 (Nokia, Apple, Ericsson): Yes
    - Option 1a (Apple, Ericsson): Reuse the existing PBCH demodulation requirements for FR2-1 for eNTN
  + Option 2 (Qualcomm, Huawei): No
* Recommended WF
  + Further discuss is needed

**Issue 2-1-4: Whether to define UE CQI reporting requirements for above 10 GHz bands?**

* Proposals:
  + Option 1 (Apple): Define CQI reporting in AWGN for FR2 NTN to have coverage for CQI reporting for FR2 NTN UEs
  + Option 2 (Qualcomm, Ericsson, Huawei): No
* Recommended WF
  + Do not define UE CQI reporting requirements for above 10 GHz bands based on majority view
    1. Sub-topic 2-2: General issues for above 10 GHz bands

**Issue 2-2-1: SCS (except PBCH testing)**

* Proposals
  + Option 1 (Nokia, Apple, Qualcomm, Ericsson, Huawei): 120kHz
    - Option 1a (Apple): If feasibility in RRM is confirmed, then define requirements with 120kHz SCS, otherwise define requirements with 60KHz SCS
* Recommended WF
  + Start demod work with 120 kHz SCS for initial alignment
  + If RRM concludes that 120 kHz SCS is not feasible, then further discussion is needed at that time on how to proceed

**Issue 2-2-2: Channel bandwidth**

* Proposals
  + Option 1 (Nokia, Apple, Qualcomm, Ericsson): 100MHz
  + Option 2 (Huawei): 200MHz
* Recommended WF
  + Further discuss is needed

**Issue 2-2-3: Antenna configuration**

* Proposals
  + Option 1 (Nokia, Qualcomm, Ericsson): 1Tx1Rx
    - Option 1a (Qualcomm): Take 1Tx1Rx for parabolic VSAT antenna configuration for initial demodulation discussion and input from satellite companies is needed
    - Option 1b (Ericsson): Consider 1T1R parabolic VSAT as a starting point
  + Option 2 (Apple): Need further clarification on impact to demodulation performance with parabolic VSAT antenna configuration
  + Option 3 (Huawei): Both 1Tx1Rx and 1Tx2Rx, with antenna type not limit to parabolic, but also phase antenna array
* Recommended WF
  + Further discuss is needed
  + Input from satellite companies is needed

**Issue 2-2-4: Beamforming and beam steering**

* Proposals
  + Option 1 (Nokia): RAN4 shall not explicitly model beamforming effects for NTN deployments above 10GHz
  + Option 2 (Apple): Need further clarification on impact of beam steering mechanism of VSAT devices to demodulation performance
  + Option 3 (Qualcomm): Consider beam steering approach as specified in 38.101-4 (Sec B.2.3.2.3)
  + Option 4 (Huawei): Do not consider beamforming and beam steering for FR2 NTN demodulation requirements
* Recommended WF
  + Further discuss is needed

**Issue 2-2-5: Rx phase noise**

* Proposals
  + Option 1 (Nokia): RAN4 shall define impairment requirements including the impact of Rx Phase Noise, but shall not seek alignment on Rx Phase Noise model
  + Option 2 (Apple): Take PN impact into account in impairment results
  + Option 3 (Qualcomm, Ericsson): Take Rx phase noise impact into impairment results and companies could give proper values based on preferred PN model
  + Option 4 (Huawei): Do not consider any PN impact in the simulation and in ideal simulation results alignment
* Recommended WF
  + Take Rx phase noise impact into impairment results
  + Do not consider any PN impact in the simulation and in ideal simulation results alignment

**Issue 2-2-6: Applicability rule**

* Proposals
  + Option 1 (Qualcomm): Consider applicability rule after discussion about scenario is settled
  + Option 2 (Huawei): Adding similar applicability rule for FR2 NTN UE optional capabilities as in Rel-17 FR1 NTN UE
* Recommended WF
  + Consider applicability rule after discussion about scenario is settled
    1. Sub-topic 2-3: Test setup for above 10 GHz bands

**Issue 2-3-1: MCS for PDSCH**

* Proposals
  + Option 1 (Apple, Huawei): MCS4 (QPSK, 0.30) and MCS13 (16QAM, 0.48)
  + Option 2 (Qualcomm): 16QAM as baseline, FFS 64QAM
  + Option 3 (Ericsson): QPSK, 16QAM
* Recommended WF
  + MCS4 (QPSK, 0.30) and MCS13 (16QAM, 0.48)
  + Do not consider 64QAM

**Issue 2-3-2: Rank for PDSCH**

* Proposals
  + Option 1 (Apple, Qualcomm, Ericsson, Huawei): Rank 1
* Recommended WF
  + Rank 1

**Issue 2-3-3: PDSCH mapping type**

* Proposals
  + Option 1 (Apple, Ericsson, Huawei): PDSCH mapping type A
* Recommended WF
  + PDSCH mapping type A

**Issue 2-3-4: PDCCH aggregation level (If agreed to be introduced)**

* Proposals
  + Option 1 (Apple): 8 as baseline
  + Option 2 (Ericsson): 2 and 4
  + Option 3 (Huawei):4, 8 and 16
* Recommended WF
  + Further discuss is needed

**Issue 2-3-5: Configuration for PBCH test (If agreed to be introduced)**

* Proposals
  + Option 1 (Apple): Reuse PDCCH demod requirements from FR2-1 and only define requirements with unknown SSB index for FR2 NTN
  + Option 2 (Ericsson): Reuse the existing PBCH demodulation requirements for FR2 NTN enhancement
* Recommended WF
  + Further discussion is needed

**Issue 2-3-6: Configuration for CQI reporting test (If agreed to be introduced)**

* Proposals
  + Option 1 (Apple): 1x2 with rank 1 for AWGN
* Recommended WF
  + Further discussion is needed

1. Topic #3: SAN demodulaton requirements
   1. Companies’ contributions summary

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| --- | --- | --- |
| T-doc number | Company | Proposals / Observations |
| [**R4-2318058**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318058.zip) | Nokia, Nokia Shanghai Bell | Observation 3: DFT-s-OFDM would enable reduced PAPR and as such higher effective transmit powers.  Proposal 3: RAN4 shall define requirements for PUSCH with both CP-OFDM and DFT-s-OFDM  Observation 4: Frequency and Timing drift will differ across the uplink beam, and should be incorporated within channel model effects.  Proposal 4: RAN4 shall use 120 kHz for SCS for requirements alignment.  Proposal 5: RAN4 shall use 100 MHz CBW for requirements alignment.  Observation 5: Current VSAT devices only enable 1Tx1Rx capable antenna configuration.  Proposal 6: RAN4 shall use 1Tx1Rx for the antenna configuration for requirements definition.  Observation 6: Beamforming and Beam Steering does not have direct impact on demodulation requirements and should be included in channel model effects.  Proposal 7: RAN4 shall not explicitly model beamforming effects for NTN deployments above 10GHz.  Observation 7: A rank of 1 is the most sensible choice of rank for NTN enhancements performance requirements derivation  Proposal 8: RAN4 shall use a rank of 1 for NTN performance requirements. |
| [**R4-2319313**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319313.zip) | Ericsson | Observation 1 Both SCS have limitations on Ka band deployment and there is no solid conclusion that which SCS won’t be deployed in future NTN network.  Observation 2 Relative short aTDW might be practical for DM-RS bundling in NTN deployment.  Proposal 1 No need to consider PUSCH repetition type A for SAN PUSCH demodulation performance requirements for above 10GHz bands.  Proposal 2: Prioritize 50 MHz CBW for 60kHz and 120 kHz SCS for SAN PUSCH demodulation requirements.  Proposal 3: Consider 1Tx1Rx as the start point for SAN demodulation requirements.  Proposal 4: Consider Rank 1 MCS 2/16/20 for normal PUSCH for LoS channel with 1Tx1Rx configuration.  Proposal 5: Only consider DM-RS 1+1 for PUSCH requirements.  Proposal 6: Consider both PT-RS enabled and disabled for the PUSCH requirements and disabled for all QPSK cases if introduced.  Proposal 7: Consider configurations in Table 2-2 as the start point for PUSCH demodulation requirements.  Proposal 8: Take configurations except the channel model in Issue 4-3-2 and 4-3-3 in WF [1] as the start point for PUCCH and PRACH requirements.  Proposal 9: Consider parameters in Table 2-3 for initial simulations.  Proposal 10: Do not define PUCCH requirements Msg4 HARQ-ACK for LOS channel. |
| [**R4-2319846**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319846.zip) | Samsung | Proposal 3: Prioritize to define SAN requirement with 1Tx1Rx and 1Tx2Rx antenna configuration for above 10GHz. FFS on 2Tx2Rx pending on conclusion of the 2Tx UE RF requirement  Observation 1: Existing specification cannot meet the performance requirement for PUCCH with Msg4 HARQ-ACK with parameter set-1 for LEO-1200 operating at LOS.  Proposal 4: PUCCH requirement with Msg4 HARQ-ACK with repetition could be introduced  Proposal 5: PUSCH requirement with DMRS bundling can be introduced for NTN-specific UE if no frequency and timing drift modeling.  Proposal 6: PUSCH requirement with repetition Type A can be considered  Proposal 7: Only PUCCH format 1 requirement should be specified  Proposal 8: Introduce multi-slot PUCCH requirement with format 1 under 2 repetition for NTN-TDLC5-200 channel  Proposal 9: Introduce PUCCH requirement with both 1Tx1Rx and 1Tx2Rx for NTN-specific UE with repetition. Apply the same test applicability for 1T1Rx and 1Tx2Rx performance test  Proposal 10: Using the following test parameters for specifying PUCCH requirement for Msg4 HARQ-ACK   |  |  | | --- | --- | | 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 |   Proposal 11: FFS on introduce the timing drift model for specifying the PUSCH requirement with DMRS bundling in NTN scenario.  Proposal 12: The following value for actual TDW and nominal TDW can be considered for PUSCH requirement with DMRS bundling in NTN scenario  - Actual TDW and PUSCH-TimeDomainWindowLength = 2 or 4 for FDD  - Actual TDW and PUSCH-TimeDomainWindowLength 2 for TDD  Proposal 13: The following PRB allocation can be considered for PUSCH requirement with DMRS bundling in NTN scenario  - PRB: 6RBs for both 15KHz and 30KHz  Proposal 14: Introduce PUSCH requirement with mapping type A for NTN-specific UE with DMRS bundling  Proposal 15: Introduce PUSCH requirement with CP-OFDM waveform for NTN-specific UE with DMRS bundling  Proposal 16: Introduce PUSCH requirement with both 1Tx1Rx and 1Tx2Rx for NTN-specific UE with DMRS bundling. Apply the same test applicability for 1T1Rx and 1Tx2Rx performance test  Proposal 17: Introduce PUSCH requirement for NTN-specific UE with 1+1 DMRS symbols.  Proposal 18: Apply the existing test parameters for specifying PUSCH requirement with DMRS bundling for NTN-specific UE with DMRS bundling   |  |  |  | | --- | --- | --- | | Parameter | | Value | | Transform precoding | | Disabled | | Example UL-DL pattern [Note 1] | | 15 kHz SCS: FDD and TDD  7D1S2U, S=6D:4G:4U  30 kHz SCS: FDD and TDD  7D1S2U, S=6D:4G:4U | | HARQ | Maximum number of HARQ transmissions | 4 | | RV sequence [Note 2] | 0, 3, 0, 3 for FDD  0, 3, 0, 3 for TDD | | 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 | | Start symbol | 0 | | Allocation length | 14 | | PUSCH aggregation factor | [n2] or [n8] for FDD  n2 for TDD | | pusch-TimeDomainWindowLength | | [2] or [4] slots for FDD  2 slots for TDD | | Frequency domain resource assignment | RB assignment | Full applicable test bandwidth | | Frequency hopping | Disabled | | Code block group based PUSCH transmission | | Disabled | | Note 1: The same TDD requirements are applicable to different UL-DL patterns with more than one consecutive UL slots when both pusch-TimeDomainWindowLength and PUSCH aggregation factor are configured as 2 slots. The UL (re)transmission of PUSCH is only scheduled for the actual TDW including 2 consecutive UL slots.  Note 2: The effective RV sequence is {0, 2, 3, 1} with slot aggregation. | | |   Proposal 19: The following SCS and CBW can be considered for PUSCH performance evaluation above 10GHz  - 120 KHz SCS, 50MHz  Proposal 20: The following test parameters could be considered for PUSCH performance evaluation for above 10GHz for CP-OFDM waveform  Table 5: Test parameters of PUSCH with CP-OFDM   |  |  |  | | --- | --- | --- | | Parameter | | Value | | Transform precoding | | Disabled | | Default TDD UL-DL pattern (Note 1) | | 60 kHz and 120kHz SCS:  3D1S1U, S=10D:2G:2U | | 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 symbols | [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 | NID=0, nSCID =0 | | Time domain | PUSCH mapping type | B | | resource | Start symbol index | 0 | |  | Allocation length | 10 | | Frequency domain | RB assignment | Full applicable test bandwidth | | resource | Frequency hopping | Disabled | | TPMI index for 2Tx two-layer spatial multiplexing transmission | | 0 | | Code block group based PUSCH transmission | | Disabled | | PT-RS | Frequency density (*KPT-RS*) | 2, | | configuration | Time density (*LPT-RS*) | 1, | | NOTE 1: The same requirements are applicable to TDD with different UL-DL patterns | | |   Proposal 21: The following test parameters could be considered for PUSCH performance evaluation for above 10GHz for DFS-s-OFDM waveform  Table 6: Test parameters of PUSCH with DFT-s-OFDM   |  |  |  | | --- | --- | --- | | Parameter | | Value | | Transform precoding | | Enabled | | Default TDD UL-DL pattern (Note 1) | | N/A | | 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, group hopping and sequence hopping are disabled | | Time domain | PUSCH mapping type | B | | resource | Start symbol | 0 | | assignment | Allocation length | 10 | | Frequency domain resource | RB assignment | FR2-1: 30 PRBs in the middle of the test bandwidth | | assignment | Frequency hopping | Disabled | | Code block group based PUSCH transmission | | Disabled | | PT-RS | | Not configured | | NOTE 1: The same requirements are applicable to TDD with different UL-DL patterns. | | |   Proposal 22: The following test parameters could be considered for PUSCH performance evaluation for above 10GHz for PUSCH repetition type A if introduced  Table 7: Test parameters of PUSCH with repetition type A   |  |  |  | | --- | --- | --- | | Parameter | | Value | | Transform precoding | | Disabled | | Default TDD UL-DL pattern (Note 1) | |  | | HARQ | Maximum number of HARQ transmissions | 4 | |  | RV sequence | 0, 3, 0,3 | | DM-RS | DM-RS configuration type | 1 | |  | DM-RS duration | single-symbol DM-RS | |  | Additional DM-RS symbols | 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 | NID=0, nSCID =0 | | Time domain | PUSCH mapping type | B | | resource | Start symbol index | 0 | |  | Allocation length | 10 | |  | PUSCH aggregation factor | n2 | | Frequency domain | RB assignment | Full applicable test bandwidth | | resource | Frequency hopping | Disabled | | Code block group based PUSCH transmission | | Disabled | | PT-RS | Frequency density (*KPT-RS*) | Disabled | | configuration | Time density (*LPT-RS*) | Disabled | | NOTE 1: The effective RV sequence is {0,2,3,1} with slot aggregation | | |   Proposal 23: The following test parameters could be considered for specifying PUCCH requirement for above 10GHz  Table 8: Test parameters of 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 Enabled for 2 symbols | | 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  12 for 2 symbols | | Test metric | DTX to ACK probability  ACK missed detection probability | | Channel Model | [NTN-TDLA10-3000] |   Table 9: Test parameters of 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 | | Test metric | NACK to ACK probability  ACK missed detection probability |   Table 10 Test parameters of PUCCH format 2   |  |  | | --- | --- | | **Parameter** | **Value** | | Modulation order | QSPK | | Starting RB location | 0 | | Intra-slot frequency hopping | N/A | | 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 | | Test metric | DTX to ACK probability  ACK missed detection probability |   Table 11: Test parameters of PUCCH format 2   |  |  | | --- | --- | | Parameter | Value | | Modulation order | QSPK | | First PRB prior to frequency hopping | 0 | | Intra-slot frequency hopping | enabled | | Frist PRB after frequency hopping | The largest PRB index – (Number of PRBs – 1) | | Number of PRBs | 9 | | Number of symbols | 2 | | The number of UCI information bits | 22 | | First symbol | 12 | | DM-RS sequence generation | *NID*0=0 | | Test metric | BLER |   Table 12: Test parameters of PUCCH format 3   |  |  |  | | --- | --- | --- | | Parameter | Test 1 | Test 2 | | 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 | 3 | | Number of symbols | 14 | 4 | | The number of UCI information bits | 16 | 16 | | First symbol | 0 | 0 | | Test metric | BLER | |   Table 13: Test parameters of 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 | | Test metric | BLER |   Proposal 24: The following test parameters could be considered for specifying PRACH requirement for above 10GHz  - Test preamble configuration   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Burst format | SCS (kHz) | Ncs | Logical sequence index | v | |  | 60 | 69 | 0 | 0 | | B4, C2 | 120 | 69 | 0 | 0 |   - Frequency offset   AWGN: 0Hz,   Fading: 3000Hz  - Time error tolerance   where is the largest delay of the propagation channel  - Channel Model: [NTN-TDLA10-3000] |
| [**R4-2320239**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320239.zip) | Huawei | Proposal 1: Define PUSCH repetition Type A demodulation performance requirements for above 10 GHz bands.  Proposal 2: Confirm to define SAN PUSCH demodulation performance requirements for DMRS bundling for FR1.  Proposal 3: Do not define PUCCH requirements Msg4 HARQ-ACK for LOS channel.  Proposal 4: Select 50MHz and 200MHz for 120kHz SCS for demodulation performance requirements for FR2-NTN.  Proposal 5: Select rank 1 with MCS4 (QPSK, 308/1024) and MCS5 (QPSK, 99/1024, Table 3, for PUSCH repetition Type A case only) that is same as Rel-17 FR1-NTN as the starting point.  Proposal 6: Only consider 1Tx for FR2 NTN demodulation requirements.  Proposal 7: Do not define SAN demodulation requirement for SAN Type 2-H.  Proposal 8: Use the test parameters as above Table 2.3.1-1 for SAN PUSCH demodulation performance requirements and Table 2.3.1-2 for SAN PUSCH repetition Type A demodulation performance requirements.  Proposal 9: Use the test parameters as above Table 2.3.2-1 to Table 2.3.2-6 for SAN PUCCH demodulation performance requirements.  Proposal 10: Use the test parameters as following Table 2.3.3-1 to Table 2.3.3-3 for SAN PUCCH demodulation performance requirements.  Proposal 11: Do not consider timing drift modelling for DMRS bundling demodulation requirements.  Proposal 12: Use the same PUSCH aggregation factor and pusch-TimeDomainWindowLength as the legacy DMRS bundling demodulation requirements.  Proposal 13: Use the test parameters as following Table 2.4.2-1 for SAN PUSCH with DMRS bundling demodulation performance requirements. |

* 1. Open issues summary
     1. Sub-topic 3-1: Test scope

**Issue 3-1-1: Whether to define PUSCH repetition Type A for SAN PUSCH demodulation requirements for above 10 GHz bands?**

* Proposals:
  + Option 1 (Ericsson): No
  + Option 2 (Samsung, Huawei): Yes
* Recommended WF
  + Further discuss is needed

**Issue 3-1-2: Whether to define SAN PUSCH demodulation performance requirements for DMRS bundling?**

|  |
| --- |
| * *Background (Agreement in RF session* in *RAN4#108bis, R4-2317767)*   + *Proposal 2 for agreement: Requirement to be defined in RAN4 for PUSCH DMRS bundling for NR NTN coverage enhancement in Rel-18 with the assumption of the zero Doppler shift and constant delay.* |

* Proposals:
  + Option 1 (Ericsson, Huawei): Yes
  + Option 2 (Samsung):
    - PUSCH requirement with DMRS bundling can be introduced for NTN-specific UE if no frequency and timing drift modeling
    - FFS on introduce the timing drift model for specifying the PUSCH requirement with DMRS bundling in NTN scenario
* Recommended WF
  + Further discuss is needed

**Issue 3-1-3: Whether to define SAN multi-slot PUCCH format 1 demodulation requirements under LOS channel?**

* Proposals
  + Option 1: No (Ericsson, Huawei)
  + Option 2: Yes (Samsung)
* Recommended WF
  + Further discuss is needed
    1. Sub-topic 3-2: General issues for above 10 GHz bands

**Issue 3-2-1: Channel bandwidth**

* Proposals
  + Option 1 (Nokia): 100MHz
  + Option 2 (Ericsson, Samsung): 50MHz
  + Option 2 (Huawei): 50MHz and 200MHz
* Recommended WF
  + Further discussion is needed.

**Issue 3-2-2: Antenna configuration**

|  |
| --- |
| * *Background (Agreement in RAN4#108bis)*   + *For the SAN Rx, we need both 1Rx and 2Rx. For UE Tx, more discussion is needed to cover 1 Tx only or also 2Tx.* |

* Proposals
  + Option 1 (Nokia, Ericsson): 1Tx1Rx
  + Option 2 (Samsung): 1Tx1Rx and 1Tx2Rx, FFS 2Tx2Rx pending on conclusion of the 2Tx UE RF requirement
  + Option3 (Huawei): 1Tx
* Recommended WF
  + Keep the previous agreement to consider both 1Tx1Rx and 1Tx2Rx
  + FFS 2Tx2Rx pending on conclusion of the 2Tx UE RF requirement

**Issue 3-2-3: Rank**

* Proposals
  + Option 1 (Nokia, Ericsson, Samsung, Huawei): Rank 1
* Recommended WF
  + Rank 1

**Issue 3-2-4: MCS**

* Proposals
  + Option 1 (Ericsson): 2/16/20
  + Option 2 (Huawei): MCS4 (QPSK, 308/1024) and MCS5 (QPSK, 99/1024, Table 3, for PUSCH repetition Type A case only)
* Recommended WF
  + Further discuss is needed

**Issue 3-2-5: SAN type**

* Proposals
  + Option 1 (Huawei): Do not define SAN demodulation requirement for SAN Type 2-H
* Recommended WF
  + Option 1
    1. Sub-topic 3-3: Test setup for above 10 GHz bands

**Issue 3-3-1: Test setup for SAN PUSCH demodulation requirements with CP-OFDM**

* Proposals
  + Option 1 (Ericsson, Samsung, Huawei):

|  |  |  |
| --- | --- | --- |
| **Parameter** | | **Value** |
| Transform precoding | | Disabled |
| 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 symbols | Option 1a (Ericsson, Huawei): Pos1  Option 1b (Samsung):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}  {0, 1} (if 2Tx is agreed) |
|  | DM-RS sequence generation | NID0=0, nSCID =0 |
| Time domain | PUSCH mapping type | B |
| resource | Start symbol index | 0 |
|  | Allocation length | 10 |
| Frequency domain | RB assignment | Full applicable test bandwidth |
| resource | Frequency hopping | Disabled |
| TPMI index for 2Tx two-layer spatial multiplexing transmission (If 2Tx is agreed) | | 0 |
| Code block group based PUSCH transmission | | Disabled |
| PT-RS | Frequency density (*KPT-RS*) | Option 1a (Ericsson): 2, Disabled  Option 1b (Samsung): 2  Option 1c (Huawei): Disabled |
| configuration | Time density (*LPT-RS*) | Option 1a (Ericsson): 1, Disabled  Option 1b (Samsung): 1  Option 1c (Huawei): Disabled |

* Recommended WF
  + Further discuss is needed about additional DM-RS symbols and PTRS configuration
  + Other parameters in Option 1 are agreeable

**Issue 3-3-2: Test setup for SAN PUSCH demodulation requirements with DFT-s-OFDM**

* Proposals
  + Option 1 (Ericsson, Samsung, Huawei):

|  |  |  |
| --- | --- | --- |
| **Parameter** | | **Value** |
| Transform precoding | | Enabled |
| 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 symbols | Option 1a (Ericsson, Huawei): Pos1  Option 1b (Samsung):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}  {0, 1} (if 2Tx is agreed) |
|  | DM-RS sequence generation | NID0=0, group hopping and sequence hopping are disabled |
| Time domain | PUSCH mapping type | B |
| resource | Start symbol index | 0 |
|  | Allocation length | 10 |
| Frequency domain | RB assignment | Option 1a (Ericsson, Huawei): Full applicable test bandwidth  Option 1b (Samsung): 30 PRBs in the middle of the test bandwidth |
| resource | Frequency hopping | Disabled |
| TPMI index for 2Tx two-layer spatial multiplexing transmission (If 2Tx is agreed) | | 0 |
| Code block group based PUSCH transmission | | Disabled |
| PT-RS | Frequency density (*KPT-RS*) | Option 1a (Ericsson): 2, Disabled  Option 1b (Samsung): Not configured  Option 1c (Huawei): Disabled |
| configuration | Time density (*LPT-RS*) | Option 1a (Ericsson): 1, Disabled  Option 1b (Samsung): Not configured  Option 1c (Huawei): Disabled |

* Recommended WF
  + Further discuss is needed about additional DM-RS symbols, RB assignment and PTRS configuration
  + Other parameters in Option 1 are agreeable

**Issue 3-3-3: Test setup for SAN PUSCH demodulation requirements with repetition Type A (If agreed to be introduced)**

* Proposals
  + Option 1 (Samsung, Huawei):

|  |  |  |
| --- | --- | --- |
| **Parameter** | | **Value** |
| Transform precoding | | Disabled |
| HARQ | Maximum number of HARQ transmissions | 4 |
| RV sequence | 0, 3, 0, 3 [Note 1] |
| DM-RS | DM-RS configuration type | 1 |
| DM-RS duration | single-symbol DM-RS |
| Additional DM-RS symbols | 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 | NID=0, nSCID =0 |
| Time domain resource | PUSCH mapping type | B |
| Start symbol index | 0 |
| Allocation length | 10 |
| PUSCH aggregation factor | n2 |
| Frequency domain resource | RB assignment | Full applicable test bandwidth |
| Frequency hopping | Disabled |
| Code block group based PUSCH transmission | | Disabled |
| PT-RS configuration | Frequency density (*KPT-RS*) | Disabled |
| Time density (*LPT-RS*) | Disabled |
| NOTE 1: The effective RV sequence is {0,2,3,1} with slot aggregation | | |

* Recommended WF
  + Option 1 is agreeable

**Issue 3-3-4: Test setup for SAN PUCCH demodulation performance requirements**

* Proposals
  + Option 1 (Ericsson, Samsung, Huawei):

Table 3: Test parameters of 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 Enabled for 2 symbols |
| 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  12 for 2 symbols |
| Test metric | DTX to ACK probability  ACK missed detection probability |

Table 4: Test parameters of 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 |
| Test metric | DTX to ACK probability  NACK to ACK probability  ACK missed detection probability |

Table 5 Test parameters of PUCCH format 2

|  |  |
| --- | --- |
| **Parameter** | **Value** |
| Modulation order | QSPK |
| Starting RB location | 0 |
| Intra-slot frequency hopping | N/A |
| 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 |
| Test metric | DTX to ACK probability  ACK missed detection probability |

Table 6: Test parameters of PUCCH format 2

|  |  |
| --- | --- |
| Parameter | Value |
| Modulation order | QSPK |
| First PRB prior to frequency hopping | 0 |
| Intra-slot frequency hopping | enabled |
| Frist PRB after frequency hopping | The largest PRB index – (Number of PRBs – 1) |
| Number of PRBs | 9 |
| Number of symbols | 2 |
| The number of UCI information bits | 22 |
| First symbol | 12 |
| DM-RS sequence generation | *NID*0=0 |
| Test metric | BLER |

Table 7: Test parameters of PUCCH format 3

|  |  |  |
| --- | --- | --- |
| Parameter | Test 1 | Test 2 |
| 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 | 3 |
| Number of symbols | 14 | 4 |
| The number of UCI information bits | 16 | 16 |
| First symbol | 0 | 0 |
| Test metric | BLER | |

Table 8: Test parameters of 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 |
| Test metric | BLER |

* Recommended WF
  + Option 1

**Issue 3-3-5: Test setup for SAN PRACH demodulation performance requirements**

* Proposals
  + Option 1 (Ericsson, Samsung, Huawei):
    - PRACH format: C2 and B4
    - Test preamble configuration

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Burst format | SCS (kHz) | Ncs | Logical sequence index | v |
| B4, C2 | 120 | 69 | 0 | 0 |

* + - Frequency offset
      * AWGN: 0Hz
      * Fading: 3000Hz
    - Time error tolerance
      * where is the largest delay of the propagation channel
* Recommended WF
  + Option 1
    1. Sub-topic 3-4: Test setup for UL coverage enhancement

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

* Proposals
  + Option 1 (Ericsson, Samsung): 1Tx1Rx and 1Tx2Rx
    - Option 1a (Samsung): Apply the same test applicability for 1T1Rx and 1Tx2Rx performance test
* Recommended WF
  + Further discuss is needed

**Issue 3-4-2: Channel model**

* Proposals
  + Option 1 (Ericsson): NTN-TDLC5-200 for DMRS bundling requirement
  + Option 2 (Samsung): NTN-TDLC5-200 for multi-slot PUCCH requirement
* Recommended WF
  + Further discuss is needed

**Issue 3-4-3: Test setup for SAN PUSCH demodulation performance requirements for DMRS bundling (If agreed to be introduced)**

* Proposals
  + Option 1: (Ericsson, Samsung, Huawei)

|  |  |  |
| --- | --- | --- |
| **Parameter** | | **Value** |
| Transform precoding | | Disabled |
| HARQ | Maximum number of HARQ transmissions | 4 |
| RV sequence [Note 1] | Option 1a (Ericsson, Huawei) 0, 0, 0, 0 for FDD  Option 1b (Samsung) : 0, 3, 0, 3 for FDD |
| DM-RS | DM-RS configuration type | 1 |
| DM-RS duration | single-symbol DM-RS |
| Additional DM-RS position | Option 1a (Ericsson): pos0, pos1  Option 1b (Samsung, Huawei): 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 | Option 1a (Ericsson, Samsung): A  Option 1b (Huawei): A, B |
| Start symbol | 0 |
| Allocation length | 14 |
| PUSCH aggregation factor | Option 1a (Ericsson): n4 for FDD  Option 1b (Samsung): [n2] or [n8] for FDD  Option 1c (Huawei): n8 for FDD |
| pusch-TimeDomainWindowLength | | Option 1a (Ericsson): 4 slots for FDD  Option 1b (Samsung): [2] or [4] slots for FDD  Option 1c (Huawei): 8 slots for FDD |
| Frequency domain resource assignment | RB assignment | Option 1 (Ericsson, Samsung, Huawei):Full applicable test bandwidth  Option 2 (Samsung): 6RBs for both 15KHz and 30KHz |
| Frequency hopping | Disabled |
| Code block group based PUSCH transmission | | Disabled |
| Note 1: The effective RV sequence is {0, 2, 3, 1} with slot aggregation. | | |

* Recommended WF
  + Further discuss is needed about RV sequence, additional DM-RS position, PUSCH mapping type, PUSCH aggregation factor, pusch-TimeDomainWindowLength and RB assignment.
  + Other parameters in Option 1 are agreed.

**Issue 3-4-4: Test setup for SAN multi-slot PUCCH format 1 demodulation performance requirements under LOS channel (If agreed to be introduced)**

* Proposals
  + Option 1 (Samsung):

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

* Recommended WF
  + Further discuss is needed.