

1st round summary
Variant of [101-bis-e][322] NR_NTN_Demod_NWM Version 0.0.6
RAN4

3GPP TSG-RAN WG4 Meeting # 101-bis-e R4-2202972

Electronic Meeting, January 17-25, 2022

Agenda item: 6.13.6.1, 6.13.6.2, 6.13.6.3

Source: Moderator (Qualcomm Incorporated)

Title: Email discussion summary for [101-bis-e][322] NR_NTN_Demod

Document for: Information

1 Introduction

The summary covers the contributions submitted under the following agendas

- 6.13.6.1 - General requirements
- 6.13.6.1 - Satellite Access Node demodulation requirements
- 6.13.6.3 - UE demodulation requirements

2 Topic #1: General aspects

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

2.1 Open issues summary and Companies views' collection for 1st round

2.1.1 Issue 1-1: General assumptions on demodulation requirements

Table 1:

T-doc number	Company	Proposals/Observations
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R4-2200475	Ericsson	<p>Observation 1: If baseline architecture introduced by RAN3 is considered and feeder link is assumed as ideal transmission, there would be no difference between transparent and non-transparent architecture from demodulation perspective.</p> <p>Observation 2: In reality, there should be remaining frequency, timing and channel impact after feeder link transmission which might impact on demodulation performance of transparent architecture.</p> <p>Observation 3: It is not clear about the satellite transmission power assumption, “fixed gain” or “fixed PSD”.</p> <p>Proposal 1: Satellite industry deliver a proper error and power model for satellite + feeder link. Companies could further study the impact on demodulation based on the model.</p> <p>Observation 4: GEO and LEO have quite different deployment which might need different demodulation requirements.</p> <p>Observation 5: Only FR1 band is considered for Rel-17 NTN requirement discussion.</p> <p>Observation 6: There should be no difference between earth fixed beam and moving beam from demodulation perspective.</p> <p>Observation 7: The delay spread in feeder link could be ignored due to high direction antenna and LOS propagation. The Doppler shift, frequency error could be pre-compensated by GW and satellite, but it would be good to have a model for the remaining error.</p> <p>Proposal 2: Channel model for service link demodulation requirement could base on NTN-TDL_A/B/C/D.</p> <p>Observation 8: In service UL transmission, the Doppler shift and delay spread at satellite side could be small due to frequency pre-compensation and typical LOS scenario.</p> <p>Observation 9: In service DL transmission, the Doppler shift</p>
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R4- 2201785	Intel Corporation	Proposal 2: RAN4 to decide whether additional Doppler shift due to satellite motion should be taken into account during the requirements definition.
R4-2201420	Ericsson	Proposal 1: Follow the agreement to only consider transparent architecture for RAN4 demodulation part discussion Proposal 2: Only consider <6GHz frequency band for Rel-17 Proposal 3: Only consider FR1 for UE demodulation requirement
R4- 2201786	Intel Corporation	Proposal 2: RAN4 to decide whether additional Doppler shift due to satellite motion should be taken into account during the requirements definition

Issue 1-1-1: Architecture

- Proposals
 - o Option 1: (Ericsson)
 - The architecture defined by RAN3 as baseline. Follow the agreement to only consider transparent architecture for RAN4 demodulation part discussion.
- Recommended WF
 - o Companies are encouraged to provide their views on this issue.

Feedback Form 1: Feedback to Issue 1-1-1

1 – HUGHES Network Systems Ltd Agree option 1
2 – Ericsson Inc. Ericsson: Support Option 1.
3 – Qualcomm Incorporated Support option 1

4 – HiSilicon Technologies Co. Ltd

Option 1.

Issue 1-1-2: Band and frequency

- Proposals
 - Option 1: (Ericsson)
 - Only consider FR1 demodulation requirements in Rel-17
- Recommended WF
 - Companies are encouraged to provide their views on this issue.

Feedback Form 2: Feedback to Issue 1-1-2

1 – HUGHES Network Systems Ltd

Agree Option1

2 – Ericsson Inc.

Ericsson: Support Option 1.

3 – Qualcomm Incorporated

Support option 1

4 – HiSilicon Technologies Co. Ltd

Option 1.

Issue 1-1-3: Frequency/time error and power model.

- Proposals
 - Option 1: (Ericsson)
 - Satellite industry deliver a proper error and power model for satellite + feeder link.
Companies could further study the impact on demodulation based on the model.
- Recommended WF
 - Companies are encouraged to provide their views on this issue.

Feedback Form 3: Feedback to Issue 1-1-3

1 – HUGHES Network Systems Ltd

Agree with WF

2 – Ericsson Inc.

Ericsson: The feeder link is considered as fiber like in RAN1 and RAN4 RF discussion. But it should still has residential error which might impact the demodulation performance, especially for transparent architecture.

Furthermore, the satellite transmission power method is not clear. It could be "fixed gain" to amplify signal with constant gain, or "fixed PSD" to amplify signal to a constant PSD? This would impact the received SNR at the gNB on the earth.

In that case, we ask satellite companies to deliver a practical model for satellite +feeder link. It will help companies to further check the impact on demodulation.

3 – Qualcomm Incorporated

In addition to the error and power model, we would also like to consider how to model a floating timing boundary due to the satellite motion in both service and feeder link. We suggest to adding this issue for further discusion.

4 – HiSilicon Technologies Co. Ltd

For the frequency error, $\pm 0.1\text{ppm}$ of carrier frequency can be considered since there is agreement in RF side that feeder link error is within the total frequency error and is negligible.

For the power assumption, we prefer only consider fixed SNR at the UE or BS side to facilitate testing even if the SNR may be changed in the real network.

Issue 1-1-4: Earth fixed beam and moving beam.

– Proposals

◦ Option 1: (Ericsson)

- No difference between earth fixed beam and moving beam from demodulation perspective.

– Recommended WF

◦ Companies are encouraged to provide their views on this issue.

Feedback Form 4: Feedback to Issue 1-1-4

1 – HUGHES Network Systems Ltd

Agree with WF

<p>2 – Ericsson Inc.</p> <p>Ericsson: Support Option 1.</p>
<p>3 – Qualcomm Incorporated</p> <p>support Option 1</p>
<p>4 – HiSilicon Technologies Co. Ltd</p> <p>We are OK with Option 1. We prefer to only consider one set of cases to cover both earth fixed beam and moving beam.</p>

Issue 1-1-5: General assumptions for service link

- Proposals
 - o Option 1: (Ericsson)
 - For UL demodulation, Small Doppler shift and delay spread for both GEO and LEO deployment.
 - For UE demodulation, NTN-TDL plus Doppler shift for channel model assumptions.
 - o Option 2: (Intel)
 - RAN4 to decide whether additional Doppler shift due to satellite motion should be taken into account during the requirements definition
- Recommended WF
 - o Companies are encouraged to provide their views on this issue.

Feedback Form 5: Feedback to Issue 1-1-5

<p>1 – HUGHES Network Systems Ltd</p> <p>Agree Option2</p>
<p>2 – Ericsson Inc.</p> <p>Ericsson: Currently, we think Option 1 could be reasonable, but we are open for further discussion.</p>
<p>3 – Qualcomm Incorporated</p> <p>Perfer option 1, for UE demodulation, Doppler shift for GEO and LEO might be different.</p>

4 – HiSilicon Technologies Co. Ltd

From our understanding, both for uplink and downlink, there is small Doppler shift and delay spread since UE is mandatory to perform time and frequency compensation based on GNSS and satellite ephemeris.

Issue 1-1-6: UE speed on NTN demodulation

- Proposals
 - o Option 1: (Ericsson)
 - Consider normal speed UE in Rel-15 (up to 120km/h) as start point.
- Recommended WF
 - o Companies are encouraged to provide their views on this issue.

Feedback Form 6: Feedback to Issue 1-1-6

<p>1 – HUGHES Network Systems Ltd</p> <p>Agree with recommended WF</p>
<p>2 – Ericsson Inc.</p> <p>Ericsson: We support Option 1. High speed train and aircraft are not considered in current RAN4 discussion.</p>
<p>3 – Qualcomm Incorporated</p> <p>Option 1</p>
<p>4 – HiSilicon Technologies Co. Ltd</p> <p>This issue is related to Issue 1-1-5. By UE compensation, the residual time and frequency offset can be very small regardless the UE speed.</p>

2.2 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.

2.2.1 Issue 1-1: General impact on demodulation requirements

Issue 1-1-1: Architecture

Tentative agreements:

The architecture defined by RAN3 as baseline. Follow the agreement to only consider transparent architecture for RAN4 demodulation part discussion.

Recommendations for 2nd round:

None

Issue 1-1-2: Band and frequency

Tentative agreements:

Only consider FR1 demodulation requirements in Rel-17

Recommendations for 2nd round:

None

Issue 1-1-3: Frequency/time error and power model.

Tentative agreements:

N/A

Recommendations for 2nd round:

Further discuss the frequency/timing error and power model in the 2nd round

For frequency/timing error, the following options can be discussed:

Option 1: For service link, ± 0.1 ppm of carrier frequency is consider. For feeder link, the frequency error is negligible.

Option 2: Satellite companies to deliver a practical frequency/timing model for service link and feeder link.

Option 3: Consider the floating boundary model due to the satellite motion

For power model, the following options can be discussed:

Option 1: Satellite companies to deliver a practical power model, e.g., fixed gain or fixed PSD

Option 2: Fixed SNR at UE and SAN side

Issue 1-1-4: Earth fixed beam and moving beam.

Tentative agreements:

No difference between earth fixed beam and moving beam from demodulation perspective. RAN4 to only consider one set of cases to cover both earth fixed beam and moving beam

Recommendations for 2nd round

None

Issue 1-1-5: General assumptions for service link

Tentative agreements:

N/A

Recommendations for 2nd round:

Further discuss the doppler shift and delay spread for service link in the 2nd round:

Option 1: For UL, Small Doppler shift and delay spread is assumed. For DL, Doppler shift should be considered.

Option 2: For UL and DL, Small Doppler shift and delay spread is assumed after UE time and frequency compensation

Option 3: For UL and DL, RAN4 to decide whether additional Doppler shift due to satellite motion should be taken into account.

Issue 1-1-6: UE speed on NTN demodulation

Tentative agreements:

N/A

Recommendations for 2nd round:

Further discuss the UE speed assumptions in the 2nd round:

Option 1: Up to 120km/h is the start point for UE speed

Option 2: No need to define the UE speed since the residual time and frequency offset can be very small regardless the UE speed

2.2.2 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.

2.3 Discussion on 2nd round (if applicable)

3 Topic #2: Satellite Access Node demodulation requirements

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

3.1 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.

3.1.1 Issue 2-1: Scope of requirements

Table 2:

T-doc number	Company	Proposals/Observations
R4-2201016	Huawei, HiSilicon	Proposal 1: Do not specify K_offset and K_mac parameters for satellite performance requirements definition. Proposal 2: Do not define satellite performance requirements with HARQ Processes 32. Proposal 3: For satellite performance requirements derived from legacy BS requirements, only consider Rel-15 and Rel-16 features. Case by case to decide whether to reuse or modify some test parameters if needed. Most of test parameters should be reused as much as possible to reduce simulation workload.
R4- 2201785	Intel Corporation	Proposal 3: NTN Satellite Access Node is not required to pass legacy Rel-15/Rel-16 tests

R4-2200476	Ericsson	Observation 5: It is not clear whether the principle of applicability method in Rel-15/16 TN gNB demodulation requirements could be the same for satellite access node demodulation requirement.
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Issue 2-1-1: Legacy BS Rel-15/Rel-16 demodulation requirements apply to NTN Satellite Access Node or not?

- Proposals
 - o Option 1: (Huawei)
 - Yes. Most of test parameters from legacy BS should be reused as much as possible to reduce simulation workload.
 - o Option 2: (Intel)
 - No
 - o Option 3: (Ericsson)
 - FFS
- Recommended WF
 - o Companies are encouraged to provide the views on this issue.

Feedback Form 7: Feedback Issue to 2-1-1

<p>1 – Ericsson Inc.</p> <p>Ericsson: We still think FFS could be suitable at current stage. It is agreed to use separate specification for satellite access node requirements. But it seems too early to say if we can reuse legacy TN BS demodulation parameters for NTN satellite access node demodulation or not. Analysis on case by case should be needed.</p>
<p>2 – HiSilicon Technologies Co. Ltd</p> <p>Here we want to clarify that we prefer to define new requirements for NTN Satellite, most of test parameters are reused from legacy BS requirements as much as possible.</p>

Issue 2-1-2: Enhancement on time relationship

- Proposals
 - Option 1: (Huawei)
 - Do not specify K_offset and K_mac parameters for satellite performance requirements definition.
- Recommended WF
 - Companies are encouraged to provide the views on this issue.

Feedback Form 8: Feedback to Issue 2-1-2

<p>1 – Ericsson Inc.</p> <p>Ericsson: We support Option 1. K_offset and K_mac shouldn't impact on UL demodulation algorithm itself.</p>
<p>2 – HiSilicon Technologies Co. Ltd</p> <p>Option 1.</p>

Issue 2-1-3: Enhancement on HARQ

- Proposals
 - Option 1: (Huawei)
 - Do not define satellite performance requirements with HARQ Processes 32.
- Recommended WF
 - Companies are encouraged to provide the views on this issue

Feedback Form 9: Feedback to Issue 2-1-3

<p>1 – Ericsson Inc.</p> <p>Ericsson: We support Option 1 that HARQ process number shouldn't impact on UL demodulation algorithm itself.</p>
<p>2 – HiSilicon Technologies Co. Ltd</p> <p>Option 1.</p>

3.1.2 Issue 2-2: General assumptions

Table 3:

T-doc number	Company	Proposals/Observations
R4-2200171	CATT	Proposal 1: To discuss channel model for NTN PUSCH demodulation and its parameters such as maximum DS and maximum Doppler.
R4-2200476	Ericsson	<p>Observation 1: Small Doppler shift and delay spread in UL demodulation for both GEO and LEO deployment because pre-compensation for Doppler is mandatory and satellites are LOS condition.</p> <p>Observation 2: Same channel model might be applied for UL demodulation requirement for both GEO and LEO deployment if satellite companies confirm the remaining Doppler error is similar in both deployments after pre-compensation.</p> <p>Proposal 1: Start with FR1 FDD band SCS 15kHz for UL demodulation requirements. The selection of bandwidth could depend on the simulation results.</p> <p>Observation 3: Similar UE assumption as Rel-15/16 could be reused for NTN demodulation requirement.</p> <p>Proposal 2: 1Tx2Rx could be the start point for NTN UL demodulation discussion</p>

R4-2201016	Huawei, HiSilicon	<p>Proposal 4: To simplify the test setup, the synchronization method during the test can be reused from the legacy BS testing for satellite performance requirements definition.</p> <p>Proposal 5: For NTN satellite performance requirements, introduce NTN-TDL-A/B/C/D for satellite performance requirements definition and select 100ns and 300ns as delay spread. Permutation and combination can be used such as: NTN-TDLA100, NTN-TDLB300, NTN-TDLC100, NTN-TDLD300.</p> <p>Proposal 6: NTN-TDL fading channel model should be selected to replace the legacy TDL fading channel model for NTN requirements definition when applicable.</p> <p>Proposal 7: Doppler can be select as 200Hz that is 0.1 ppm of carrier frequency corresponding to n256.</p> <p>Proposal 8: For NTN satellite performance requirements, select 5MHz, 10MHz and 20MHz bandwidth for 15kHz SCS while 10MHz and 20MHz bandwidth for 30kHz SCS.</p>
R4- 2201785	Intel Corporation	<p>Proposal 1: RAN4 to define the requirements for PUSCH, PUCCH and PRACH for NTN-TDL channel models</p>

Issue 2-2-1: Channel model

- Proposals
 - o Option 1: (Ericsson, Huawei, Intel)
 - NTN-TDL-A/B/C/D.
- Recommended WF
 - o Companies are encouraged to provide the views on this issue.

Feedback Form 10: Feedback to Issue 2-2-1

1 – Ericsson Inc. Ericsson: We support Option 1. Further discussion on which one are better for requirement could be needed.
2 – HiSilicon Technologies Co. Ltd We are OK with Option 1.
3 – CATT We are OK with option 1

Issue 2-2-2: Delay spread

- Proposals
 - Option 1: (Huawei)
 - Select 100ms and 300ms delay spread, i.e., NTN-TDLA100, NTN-TDLB300, NTN-TDLC100, NTN-TDLD300.
 - Option 2: (CATT)
 - To further discuss the maximum delay spread
- Recommended WF
 - Companies are encouraged to provide the views on this issue.

Feedback Form 11: Feedback to Issue 2-2-2

1 – Ericsson Inc. Ericsson: Considering the satellite condition, maybe very small delay spread could be seen for UL. Support Option 2 at current stage.
2 – THALES Suggestion to use TR 38.811 reference. The delay spread is currently defined for different elevation angles. Further discussion might be required for the elevation angle to be considered.
3 – HUGHES Network Systems Ltd Agree with Thales proposal
4 – HiSilicon Technologies Co. Ltd We are OK to further discuss based on TR 38.811.

5 – CATT

we are fine to further dicuss based on TR 38.811.

Issue 2-2-3: Doppler shift

- Proposals
 - o Option 1: (Huawei)
 - 200Hz for n256
 - o Option 2: (CATT)
 - To further discuss the maximum Doppler shift
- Recommended WF
 - o Companies are encouraged to provide the views on this issue.

undefined

Feedback Form 12: Feedback to Issue 2-2-3

1 – Ericsson Inc.

Ericsson: RAN1 has agreement that NTN UE is mandatory to support Doppler pre-compensation for UL. In that case, small remaining Doppler shift could be seen. We ask Satellite companies to clarify the residential Doppler error on the whole link path (service and feeder link) after UE pre-compensation. So we support Option 2 at current stage.

2 – THALES

Option 1 should be possible.

3 – THALES

(after compensation). Do we refer to Doppler shift residual error?

4 – HiSilicon Technologies Co. Ltd

Option 1. From our understanding the Doppler shift is refer to the residual error after UE pre-compensation.

5 – CATT

we agree with Ericsson and Huawei comments. we support to further disccuss.

Issue 2-2-4: Tx and Rx assumptions for UL demodulation

- Proposals

- Option 1: (Ericsson)
 - 1Tx, 2Rx as the start point.
- Option 2: (Huawei)
 - 1/2Tx, 2/4/8Rx
- Option 3: (Intel)
 - 1Tx, 2/4/8Rx
- Recommended WF
 - Companies are encouraged to provide the views on this issue.

Feedback Form 13: Feedback to Issue 2-2-4

<p>1 – Ericsson Inc.</p> <p>Ericsson: Regarding power limitation could an typical issue for NTN UL transmission, 1Tx could be more suitable than 2Tx. For Rx, we think 2Rx could be start point. It would be better that satellite companies can clarify the practical antenna setting for satellite and also implementation in feeder link.</p>
<p>2 – THALES</p> <p>Option 1</p>
<p>3 – HiSilicon Technologies Co. Ltd</p> <p>We prefer Option 2. It is feasible for 2Tx and 4/8Rx for some cases based on our link budget evaluation.</p>
<p>4 – CATT</p> <p>From our understanding, the 1Tx, 1Rx can be as starting point. We think that one beam for UL can be considered as 1 RX.</p>

Issue 2-2-5: UL time and frequency synchronization

- Proposals
 - Option 1: (Huawei)
 - Reuse the synchronization method from legacy BS testing.
- Recommended WF
 - Companies are encouraged to provide the views on this issue.

Feedback Form 14: Feedback to Issue 2-2-5

<p>1 – Ericsson Inc.</p> <p>Ericsson: Option 1 could be OK.</p>
<p>2 – HiSilicon Technologies Co. Ltd</p> <p>Option 1.</p>
<p>3 – CATT</p> <p>Option 1 is fine</p>

3.1.3 Issue 2-3: PUSCH assumptions

Table 4:

T-doc number	Company	Proposals/Obvervations
R4-2200171	CATT	<p>Proposal 1: To discuss channel model for NTN PUSCH demodulation and its parameters such as maximum DS and maximum Doppler.</p> <p>Proposal 2: To discuss the channel model with frequency offset for NTN PRACH demodulation.</p> <p>Proposal 3: To discuss timing offset value for NTN PRACH demodulation.</p>
R4-2200476	Ericsson	<p>Observation 4: New demodulation requirements for PUSCH, PUCCH, PRACH and UL TA could be considered for NTN due to new channel model and new scenarios. The detailed assumptions need further discussion.</p> <p>Observation 5: It is not clear whether the principle of applicability method in Rel-15/16 TN gNB demodulation requirements could be the same for satellite access node demodulation requirement.</p>

R4-2201016	Huawei,HiSilicon	<p>Proposal 9: Do not consider high speed train scenario, URLLC scenario and interlaced PUSCH scenario for NTN PUSCH requirements definition. Do not consider UCI multiplexed on PUSCH cases for NTN PUSCH requirements definition. Other PUSCH requirements can be reused.</p> <p>Proposal 10: For NTN satellite performance requirements, consider QPSK and 16QAM with high priority and follow outcome from RF side to decide whether 64QAM is considered.</p> <p>Proposal 11: Only consider QPSK for NTN PUSCH requirements for NTN PUSCH requirements definition.</p>
R4-2201785	Intel Corporation	Shown in Table 2-1. Scope of PUSCH requirements

Issue 2-3-1: PUSCH requirements

– Proposals

○ Option 1: (Huawei)

- To reuse the following Rel-15/16 requirements except SCS/CBW set and modulation order
 - Transform precoding disabled, rank 1/2, 2/4/8 Rx
 - Transform precoding enabled, rank 1, 2/4/8 Rx
 - UL timing adjustment, rank 1, 2 Rx
 - repetition Type A, rank 1, 2 Rx
 - mapping Type B with non-slot transmission, rank 1, 2 Rx
 - 2-step RA type, rank 1, 2 Rx

○ Option 2: (Intel)

- To reuse the following Rel-15/16 requirements except SCS/CBW set and modulation order
 - Transform precoding disabled, rank 1, 2/4/8 Rx

- Transform precoding enabled, rank 1, 2/4/8 Rx
 - UCI multiplexed on PUSCH, rank 1, 2 Rx
 - UL timing adjustment, rank 1, 2 Rx
- Recommended WF
- Companies are encouraged to provide the views on this issue.

Feedback Form 15: Feedback to Issue 2-3-1

1 – Ericsson Inc.

Ericsson: Currently, we think following requirement could be suitable for NTN UL demodulation. Further discussion on other Rx configurations and test cases mentioned in Option 1 is also needed.

- Transform precoding disabled, rank 1, 2 Rx
- Transform precoding enabled, rank 1, 2 Rx
- UL timing adjustment, rank 1, 2 Rx
- repetition Type A, rank 1, 2 Rx
- FFS on 4RX / 8RX depending on clarification from Satellite companies of Satellite / feeder link capability
- FFS on mapping Type B with non-slot transmission, rank 1, 2 Rx
- FFS on 2-step RA type, rank 1, 2 Rx

2 – HiSilicon Technologies Co. Ltd

We clarify that we prefer not to define mapping Type B with non-slot transmission, rank 1, 2 Rx requirements. So the requirement list we propose to define is:

- Transform precoding disabled, rank 1/2, 2/4/8 Rx
- Transform precoding enabled, rank 1, 2/4/8 Rx
- UL timing adjustment, rank 1, 2 Rx
- repetition Type A, rank 1, 2 Rx
- 2-step RA type, rank 1, 2 Rx

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

- Proposals
- Option 1: (Huawei)
 - 15kHz SCS: 5/10/20MHz, 30kHz SCS: 10/20MHz
 - Option 2: (Intel)

- 15kHz SCS: 5/10/15/20MHz, 30kHz SCS: 10/15/20MHz for fraction of maximum throughput 70% for requirements for PUSCH with transform precoding disabled
 - 15 kHz SCS: 5MHz, 30 kHz SCS: 10MHz for fraction of maximum throughput 30% for requirements for PUSCH with transform precoding disabled
 - 15 kHz SCS: 5MHz, 30 kHz SCS: 10MHz for requirements for PUSCH with transform precoding enabled
 - 30 kHz SCS: 10MHz for requirements for UCI multiplexed on PUSCH
 - 15 kHz SCS: 5MHz, 30 kHz SCS: 10MHz for requirements for UL timing adjustment
- Option 3 (Ericsson)
 - 15kHz SCS: CBW is FFS
- Recommended WF
- Companies are encouraged to provide the views on this issue.

Feedback Form 16: Feedback to Issue 2-3-2

1 – Ericsson Inc.

Ericsson: We can accept considering both 15kHz and 30kHz SCS. But we need to check if full bandwidth allocation is typical for NTN UL transmission with link budget. If non-full bandwidth is typical, then it might not be necessary to define requirements for different bandwidth.

2 – HiSilicon Technologies Co. Ltd

We prefer Option 1 to consider both 15kHz SCS and 30kHz SCS. For the test metric, we prefer to only consider 70% of maximum throughput. For the bandwidth, based on our link budget evaluation, it is feasible for 20MHz full bandwidth allocation with QPSK, so we prefer to define 5/10/20MHz requirement for 15kHz SCS and 10/20MHz requirements for 30kHz SCS. We prefer to not consider 15MHz requirements to align with the legacy BS requirements.

Issue 2-3-3: Modulation order for PUSCH requirements

- Proposals
- Option 1: (Huawei)
 - QPSK for all cases
 - Option 2: (Intel)
 - QPSK, 16QAM for fraction of maximum throughput 70% for requirements for PUSCH with transform precoding disabled

- QPSK for fraction of maximum throughput 30% for requirements for PUSCH with transform precoding disabled
- QPSK for requirements for PUSCH with transform precoding enabled
- 16QAM for requirements for UCI multiplexed on PUSCH
- 16QAM for requirements for UL timing adjustment

– Recommended WF

- Companies are encouraged to provide the views on this issue.

Feedback Form 17: Feedback to Issue 2-3-3

<p>1 – Ericsson Inc.</p> <p>Ericsson: Link budget and PRB allocation should be checked and also maybe some simulation is needed to see which MCS and metric could be better for requirement, e.g. 16QAM might be feasible with small PRB allocation etc.</p>
<p>2 – THALES</p> <p>Agree with Ericsson, but Option 1 is easier.</p>
<p>3 – HiSilicon Technologies Co. Ltd</p> <p>We prefer Option 1 based on our link budget evaluation.</p>
<p>4 – CATT</p> <p>we are OK with option 1</p>

3.1.4 Issue 2-4: PUCCH assumptions

Table 5:

T-doc number	Company	Proposals/Observations
R4-2201016	Huawei,HiSilicon	Proposal 12: Do not consider interlaced PUCCH for NTN PUCCH requirements definition. Other PUCCH requirements can be reused.

R4-2201785	Intel Corporation	Proposal 5: RAN4 to define requirements for PUCCH Formats 0-4 and for the same test parameters as for Rel-15 PUCCH requirements except propagation conditions (NTN TDL should be used) and CBW set. The CBW set for requirement definition should follow Table 2-2
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Issue 2-4-1: PUCCH requirements

- Proposals
 - o Option 1: (Huawei, Intel)
 - To reuse the following legacy TN BS requirements except SCS/CBW set
 - PUCCH format 0/1/2/3/4, 2/4/8 Rx
 - Multi-slot PUCCH format 1, 2 Rx
- Recommended WF
 - o Companies are encouraged to provide the views on this issue.

Feedback Form 18: Feedback 2-4-1

<p>1 – Ericsson Inc.</p> <p>Ericsson: Considering new channel model and test coverage, requirement for PUCCH format 0/1/2/3/4 could be OK. But we need to check with satellite companies if 4/8 Rx is realistic or not in baseband.</p>
<p>2 – HiSilicon Technologies Co. Ltd</p> <p>Option 1.</p>

Issue 2-4-2: SCS/CBW set for PUCCH requirements

- Proposals
 - o Option 1: (Huawei)
 - 15kHz SCS: 5/10/20MHz, 30kHz SCS: 10/20MHz

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

Feedback Form 19: Feedback to Issue 2-4-2

<p>1 – Ericsson Inc.</p> <p>Ericsson: Same comments as PUSCH part Issue 2-3-2, further check on small PRB allocation scenario is needed.</p>
<p>2 – HiSilicon Technologies Co. Ltd</p> <p>Option 1, similar view as Issue 2-3-2.</p>

3.1.5 Issue 2-5: PRACH assumptions

Table 6:

T-doc number	Company	Proposals/Observations
R4-2201016	Huawei,HiSilicon	<p>Proposal 13: Do not consider AWGN channel and do not consider high speed train scenario for NTN PRACH requirements definition. Other PRACH requirements can be reused.</p> <p>Proposal 14: Only consider typical B4/C2 preamble format for NTN satellite requirements.</p>

R4-2201785	Intel Corporation	<p>Proposal 6: For NTN PRACH, RAN4 to reuse Rel-15 requirements for false alarm probability and missed detection in AWGN channel</p> <p>Proposal 7: RAN4 to define requirements for PRACH time error tolerance and missed detection for NTN TDL channel considering the same set of test parameters as in Rel-15 except the set of PRACH preambles to be tested.</p> <p>Proposal 8: RAN4 to define the set of PRACH preambles to be tested for NR NTN.</p>
R4-2200171	CATT	<p>Proposal 2: To discuss the channel model with frequency offset for NTN PRACH demodulation.</p> <p>Proposal 3: To discuss timing offset value for NTN PRACH demodulation.</p>

Issue 2-5-1: PRACH requirements

– Proposals

- Option 1: (Huawei)
 - Do not consider AWGN channel and do not consider high speed train scenario for NTN PRACH requirements definition. Other PRACH requirements can be reused.
 - Only consider typical B4/C2 preamble format for NTN satellite requirements.
- Option 2: (Intel)
 - For NTN PRACH, RAN4 to reuse Rel-15 requirements for false alarm probability and missed detection in AWGN channel
 - RAN4 to define requirements for PRACH time error tolerance and missed detection for NTN TDL channel considering the same set of test parameters as in Rel-15 except the set of PRACH preambles to be tested.
 - RAN4 to define the set of PRACH preambles to be tested for NR NTN.
- Option 3: (CATT)
 - To discuss the channel model with frequency offset for NTN PRACH demodulation

- To discuss timing offset value for NTN PRACH demodulation
- Recommended WF
 - Companies are encouraged to provide the views on this issue

Feedback Form 20: Feedback to Issue 2-5-1

<p>1 – Ericsson Inc.</p> <p>Ericsson: If Rel-15/16 requirement can't be reused for satellite access node, AWGN could also be considered for PRACH. Agree not to consider high speed train scenario for NTN. More discussions are needed on which preambles should be defined.</p>
<p>2 – HiSilicon Technologies Co. Ltd</p> <p>We prefer Option 1 to select typical propagation and typical preamble format for NTN scenario.</p>
<p>3 – CATT</p> <p>We support option 3 to further discuss. agree with Ericsson's comment.</p>

3.2 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.

3.2.1 Issue 2-1: Scope of requirements

Issue 2-1-1: Legacy BS Rel-15/Rel-16 demodulation requirements apply to NTN Satellite Access Node or not?

Tentative agreements:

N/A

Recommendations for 2nd round:

Further discuss if the following option is acceptable for companies in the 2nd round:

Option 1: For SAN, RAN4 to define the new demodulation requirements. Whether the legacy test parameters can be reused is FFS.

Issue 2-1-2: Enhancement on time relationship

Tentative agreements:

Do not specify K_offset and K_mac parameters for SAN performance requirements definition.

Recommendations for 2nd round:

None

Issue 2-1-3: Enhancement on HARQ

Tentative agreements:

Do not define satellite performance requirements with HARQ Processes

Recommendations for 2nd round:

None

3.2.2 Issue 2-2: General assumptions

Issue 2-2-1: Channel model

Tentative agreements:

NTN-TDL-A/B/C/D.as the starting point.

Recommendations for 2nd round:

Further discuss whether down-selection is needed or not.

Option 1: Yes, specify the down-selection channel model

Option 2: No

Issue 2-2-2: Delay spread

Tentative agreements:

N/A

Recommendations for 2nd round:

Further discuss the Delay spread based on TR38.811. Companies can provide the proposals in the 2nd round if any.

Issue 2-2-3: Doppler shift

Tentative agreements:

N/A

Recommendations for 2nd round:

Further discuss the residual error after UE pre-compensation in the 2nd round:

Option 1: 200Hz for n256

Option 2: FFS

Issue 2-2-4: Tx and Rx assumptions for UL demodulation

Tentative agreements:

N/A

Recommendations for 2nd round:

Further discuss the Tx and Rx assumptions for SAN demodulation in the 2nd round:

Option 1: 1Tx, 2Rx as the starting point

Option 2: 1Tx/2Tx, 2/4/8Rx

Issue 2-2-5: UL time and frequency synchronization

Tentative agreements:

Reuse the synchronization method from legacy BS testing

Recommendations for 2nd round:

N/A

3.2.3 Issue 2-3: PUSCH assumptions

Issue 2-3-1: PUSCH requirements

Tentative agreements:

To define the following requirements and further discuss on Tx/Rx configurations

- Transform precoding disabled*
- Transform precoding enabled*
- UL timing adjustment*
- repetition Type A*

FFS on other requirements.

Recommendations for 2nd round:

To further discuss whether to define the following requirements

Option 1: To further consider 2-step RA type requirement

Option 2: To further consider mapping Type B with non-slot transmission requirements

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

Tentative agreements:

To consider both 15khz and 30khz SCS. FFS on CBW and test metric.

Recommendations for 2nd round:

Option 1: 15kHz SCS: 5/10/20MHz, 30kHz SCS: 10/20MHz

Option 2: FFS based on the link budget

Issue 2-3-3: Modulation order for PUSCH requirements

Tentative agreements:

N/A

Recommendations for 2nd round:

Option 1: QPSK for all cases

Option 2: QPSK, 16QAM

Moderator's note:

Agreement from RF session:

- Include 64QAM as optional with manufacture declaration basis for SAN.

- Include 64QAM (DL and UL) for NTN satellite UE as optional feature with granularity [per UE]

3.2.4 Issue 2-4: PUCCH assumptions

Issue 2-4-1: PUCCH requirements

Tentative agreements:

To define the requirements for PUCCH format 0/1/2/3/4. The Rx configuration is FFS.

Recommendations for 2nd round:

Whether to define Multi-slot PUCCH format 1, 2 Rx requirement

Issue 2-4-2: SCS/CBW set for PUCCH requirements

Tentative agreements:

N/A

Recommendations for 2nd round:

Option 1: 15kHz SCS: 5/10/20MHz, 30kHz SCS: 10/20MHz

Option 2: FFS based on the link budget

3.2.5 Issue 2-5: PRACH assumptions

Issue 2-5-1: PRACH requirements

Tentative agreements:

Do not consider high speed train scenario for NTN PRACH requirements definition

Recommendations for 2nd round:

To further discuss whether to consider the AWGN and preambles in the 2nd round

Option 1: Do not consider the AWGN and only consider typical B4/C2 preamble format

Option 2: FFS

3.2.6 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.

3.3 Discussion on 2nd round (if applicable)

4 Topic #3: NTN UE demodulation requirements

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

4.1 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.

4.1.1 Issue 3-1: Scope of requirements

Table 7:

T-doc number	Company	Proposals/Observations
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R4-2201015	Huawei, HiSilicon	<p>Proposal 1: Only define incremental performance requirements for NTN.</p> <p>Proposal 2: Consider satellite-based NTN scenario as high priority.</p> <p>Proposal 3: Time relationship between uplink and downlink should be modified for the following cases if new requirements are defined for NTN scenario, selecting K_{offset} equal to the propagation delay defined in the channel model.</p> <ul style="list-style-type: none"> - PDSCH cases: Type 2 HARQ codebook based HARQ-ACK/NACK feedback via PUCCH - PDCCH cases: Type 2 HARQ codebook based HARQ-ACK/NACK feedback via PUCCH (Same as PDSCH cases, it is RAN5 test setup design to collecting PDCCH BLER statistics by counting HARQ-ACK/NACK feedback for PDCCH scheduling PDSCH) - CSI reporting case: Periodic CSI reporting via PUCCH or aperiodic CSI reporting via PUSCH <p>Proposal 5: Define PDSCH performance requirements with HARQ Processes 32.</p> <p>Proposal 6: Define PDSCH performance requirements with the condition that half HARQ process is enabled while another half HARQ process is disabled.</p> <p>Proposal 7: Study a new test method for PDSCH test with disabled HARQ feedback.</p>
R4-2201420	Ericsson	<p>Proposal 5: Evaluate all three satellite deployments and down select before defining test cases and requirement, e.g. define requirement for GEO and LEO 600</p>

R4- 2201786	Intel Corporation	<p>Proposal 3: NTN UE is required to pass legacy Rel-15/Rel-16 tests</p> <p>Proposal 4: RAN4 to define two sets of requirements – one for disabled HARQ and one for increased number of HARQ processes.</p> <p>Proposal 5: There is no need to repeat all the tests from the legacy set for new NTN channel models. Limited set of tests can be defined for NTN PDSCH and PDCCH</p>
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Issue 3-1-1: Legacy TN UE Rel-15/Rel-16 demodulation requirements apply to NTN UE or not?

- Proposals
 - o Option 1: (Huawei, Intel)
 - Yes. Only consider the incremental performance requirements for NTN.
- Recommended WF
 - o Companies are encouraged to provide the views on this issue.

Feedback Form 21: Feedback to Issue 3-1-1

<p>1 – Ericsson Inc.</p> <p>Ericsson: We need to understand what the “incremental” requirement is mentioned in Option 1. Considering possible different channel model and deployment scenario, new requirements for PDSCH, PDCCH and PBCH could be needed.</p>
<p>2 – HiSilicon Technologies Co. Ltd</p> <p>Only incremental requirements should be defined that means only Rel-17 features can be considered, since UE supporting NTN shall also pass requirements defined in TS 38.101-4. We don’t see any algorithm changed for receiving PDCCH and PBCH, in addition PBCH is untestable for the legacy Rel-15/16 UE, so we don’t think it necessity to define PDCCH/PBCH requirements for NTN.</p>
<p>3 – Qualcomm Incorporated</p> <p>We support option 1</p>

Issue 3-1-2: Satellite-based NTN and HAPS scenarios

- Proposals
 - Option 1: (Huawei)
 - Consider satellite-based NTN scenario as high priority.
 - Option 2: (Ericsson)
 - Evaluate all three satellite deployments and down select before defining test cases and requirement, e.g. define requirement for GEO and LEO 600
- Recommended WF
 - Companies are encouraged to provide the views on this issue

Feedback Form 22: Feedback to Issue 3-1-2

<p>1 – Ericsson Inc.</p> <p>Ericsson: We agree that satellite-based NTN scenario requirements, such as GEO and LEO600/1200, are defined by RAN4. And we furtherly propose companies to check if separate requirements are needed for GEO and LEO.</p>
<p>2 – HiSilicon Technologies Co. Ltd</p> <p>We prefer Option 1. For Option 2, we prefer to only consider one set of cases to cover all deployments.</p>
<p>3 – Qualcomm Incorporated</p> <p>Define requirements for LEO 600. GEO would be same as legacy BS as the satellite is static.</p>

Issue 3-1-3: Enhancement on time relationship

- Proposals
 - Option 1: (Huawei)
 - Time relationship between uplink and downlink should be modified for the following cases if new requirements are defined for NTN scenario, selecting K_{offset} equal to the propagation delay defined in the channel model.
 - PDSCH cases: Type 2 HARQ codebook based HARQ-ACK/NACK feedback via PUCCH
 - PDCCH cases: Type 2 HARQ codebook based HARQ-ACK/NACK feedback via PUCCH (Same as PDSCH cases, it is RAN5 test setup design to collecting PDCCH BLER statistics by counting HARQ-ACK/NACK feedback for PDCCH scheduling PDSCH)
 - CSI reporting case: Periodic CSI reporting via PUCCH or aperiodic CSI reporting via PUSCH

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

Feedback Form 23: Feedback to Issue 3-1-3

<p>1 – Ericsson Inc.</p> <p>Ericsson: Depend on the conclusion of NTN UE demodulation scope.</p>
<p>2 – HiSilicon Technologies Co. Ltd</p> <p>We prefer Option 1.</p>
<p>3 – Qualcomm Incorporated</p> <p>K_offset should be large enough to ensure UL/DL timeline is met.</p>

Issue 3-1-4: Enhancement on HARQ

- Proposals
 - Option 1: (Huawei)
 - Define PDSCH performance requirements with HARQ Processes 32.
 - Define PDSCH performance requirements with the condition that half HARQ process is enabled while another half HARQ process is disabled
 - Study a new test method for PDSCH test with disabled HARQ feedback.
 - Option 2: (Intel)
 - Define two sets of requirements – one for disabled HARQ and one for increased number of HARQ processes.
- Recommended WF
 - Companies are encouraged to provide the views on this issue.

Feedback Form 24: Feedback to Issue 3-1-4

<p>1 – Ericsson Inc.</p> <p>Ericsson: We tend to agree with Option 2 at current stage. Further evaluation is needed.</p>
<p>2 – THALES</p> <p>What does it mean "increased number of HARQ processes"? Could you please provide an example?</p>

3 – HiSilicon Technologies Co. Ltd

We prefer Option 1. For disabled HARQ feedback, it is invalid to disable all HARQ process since the network should ensure the signalling transmitted via PDSCH is correctly received by UE, so we propose to consider half HARQ process enabled while another half HARQ process disabled. In addition, with disabled HARQ feedback for downlink transmission, it is difficult to collecting throughput statistics, so we propose to study a new test method with disabled HARQ feedback.

4 – Qualcomm Incorporated

We think that 32 HARQ processes can be optionally tested as it is not a mandatory feature. Also, disabled HARQ can be tested with the number of re-Tx set to 1, i.e. only initial transmission, without requiring a special test.

4.1.2 Issue 3-2: General assumptions

Table 8:

T-doc number	Company	Proposals/Observations
R4-2201015	Huawei, HiSilicon	Proposal 8: For NTN UE performance requirements, select one NLOS conditions channel model from NTN-TDL-A/B and one LOS conditions channel model NTN-TDL-C/D. Proposal 9: For NTN UE performance requirements, select 300ns as delay spread.
R4-2201420	Ericsson	Proposal 6: Consider only NTN-TDL-A/B/C/D plus Doppler shift for channel model assumption.
R4- 2201786	Intel Corporation	Proposal 1: RAN4 to define the requirements for PDSCH and PD-CCH for NTN-TDL channel models

Issue 3-2-1: Channel model

– Proposals

◦ Option 1: (Ericsson, Intel)

▪ NTN-TDL-A/B/C/D

- Option 2: (Huawei)
 - Select one NLOS conditions channel model from NTN-TDL-A/B and one LOS conditions channel model NTN-TDL-C/D
- Recommended WF
 - Companies are encouraged to provide the views on this issue.

Feedback Form 25: Feedback to Issue 3-2-1

<p>1 – Ericsson Inc.</p> <p>Ericsson: Option1 could be start point. It needs further discussion based on evaluation once candidate parameters are agreed.</p>
<p>2 – HiSilicon Technologies Co. Ltd</p> <p>We prefer Option 2 to reduce test efforts. We are also OK with Option 1 if same test effort can be achieved by parameter combination for cases.</p>
<p>3 – Qualcomm Incorporated</p> <p>Option 2. We should downscope channel models to select one LOS and one NLOS channel.</p>

Issue 3-2-2: Delay spread

- Proposals
 - Option 1: (Ericsson)
 - Discusses the time and frequency offset for UE demodulation test cases, and takes UE speed into account
 - Option 2: (Huawei)
 - Select 300ns as delay spread
- Recommended WF
 - Companies are encouraged to provide the views on this issue.

Feedback Form 26: Feedback to Issue 3-2-2

1 – Ericsson Inc.

Ericsson: We think further discussion is needed.

2 – THALES

We believe 300ns is still quite high for NTN scenarios.

The worst case seems to be around $7.3 \times T_s = 7.3 \times 64 \times T_c = 7.3 \times 64 \times 0.509 \text{ ns} = 237 \text{ ns}$ at low elevation (10°).
The result depends on the elevation angle. Please also refer to TR 38.811.

3 – HiSilicon Technologies Co. Ltd

For the doppler spread, maybe 250ns is reasonable value to cover the worst case. In addition, we prefer not to consider time and frequency offset since UE is mandatory to perform time and frequency compensation based on GNSS and satellite ephemeris.

Issue 3-2-3: Doppler shift

– Proposals

◦ Option 1: (Ericsson)

- Discusses the time and frequency offset for UE demodulation test cases, and takes UE speed into account

– Recommended WF

- Companies are encouraged to provide the views on this issue.

Feedback Form 27: Feedback to Issue 3-2-3

1 – Ericsson Inc.

Ericsson: We also suggest satellite companies clarify the residential Doppler error in the feeder link.

2 – THALES

Option 1 + we could maybe define some channel model that could be used (similar as for HST for example).

3 – Qualcomm Incorporated

Option 1

4 – HiSilicon Technologies Co. Ltd

We prefer to not consider time and frequency offset since UE is mandatory to perform time and frequency compensation based on GNSS and satellite ephemeris.

4.1.3 Issue 3-3: PDSCH/PDCCH/PBCH assumptions

Table 9:

T-doc number	Company	Proposals/Observations
R4-2201015	Huawei, HiSilicon	Proposal 10: For NTN UE performance requirements, select 10MHz bandwidth for 15kHz SCS and 20MHz bandwidth for 30kHz SCS. Proposal 11: For NTN UE performance requirements, consider QPSK and 16QAM with high priority and follow outcome from RF side to decide whether 64QAM is considered.
R4-2201420	Ericsson	Proposal 4: Suggest considering FDD 10MHz bandwidth and 15kHz SCS for initial evaluation Proposal 8: New demodulation requirement for PBCH, PDSCH and PDCCH can be considered for NTN. The detailed assumptions need further discussion
R4- 2201786	Intel Corporation	Proposal 1: RAN4 to define the requirements for PDSCH and PDCCH for NTN-TDL channel models

Issue 3-3-1: PDCSH/PDCCH/PBCH requirements

- Proposals
 - o Option 1: (Ericsson)
 - Define new demodulation requirements for PDCSH/PDCCH/PBCH
 - o Option 2: (Intel)
 - Define new demodulation requirements for PDSCH/PDCCH
- Recommended WF
 - o Companies are encouraged to provide the views on this issue.

Feedback Form 28: Feedback to Issue 3-3-1

1 – Ericsson Inc.

Ericsson: Except PDSCH and PDCCH, we also think PBCH demodulation performance is also worthy to be checked to make sure the MIB acquisition by NTN UE receiver.

2 – THALES

Agree with Ericsson, Option 1, PDSCH/PDCCH/PBCH.
The latter is important for the ephemeris acquisition.

3 – HiSilicon Technologies Co. Ltd

Only incremental requirements should be defined that means only Rel-17 features can be considered, since UE supporting NTN shall also pass requirements defined in TS 38.101-4. We don't see any algorithm changed for receiving PDCCH and PBCH, in addition PBCH is unstable for the legacy Rel-15/16 UE, so we don't think it necessary to define PDCCH/PBCH requirements for NTN.

4 – Qualcomm Incorporated

We suggest to define requirements only for PDSCH. A successful decoding of PDSCH inherently implies successful decoding of PDCCH. Therefore, a separate PDCCH test may not be needed.

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

- Proposals
 - Option 1: (Huawei)
 - 15kHz SCS: 10MHz, 30kHz SCS: 20MHz
 - Option 2: (Ericsson)
 - 15kHz SCS: 10MHz as the starting point
- Recommended WF
 - Companies are encouraged to provide the views on this issue.

Feedback Form 29: Feedback to Issue 3-3-2

1 – Ericsson Inc.

Ericsson: the title of this Issue should be "SCS/CBW set for PDSCH requirements"
Considering we only define 15kHz SCS for FDD, we prefer Option 2 at current stage.

2 – HiSilicon Technologies Co. Ltd

We prefer Option 1. Both 15kHz SCS and 30kHz should be considered if requirements for NTN is defined.

3 – Qualcomm Incorporated

Option 2

Issue 3-3-3: Modulation order

- Proposals
 - Option 1: (Huawei)
 - Consider QPSK and 16QAM with high priority and follow outcome from RF side to decide whether 64QAM is considered
- Recommended WF
 - Companies are encouraged to provide the views on this issue

Feedback Form 30: Feedback to Issue 3-3-3

1 – Ericsson Inc.

Ericsson: We can support Option 1 as start point.

2 – THALES

Option 1.

3 – HiSilicon Technologies Co. Ltd

Option 1.

4 – Qualcomm Incorporated

Option 1

5 – HiSilicon Technologies Co. Ltd

As per GTW in RF side, agreement achieved that

- *Agreement:*
- *Include 64QAM as optional with manufacture declaration basis for SAN.*
- *Include 64QAM (DL and UL) for NTN satellite UE as optional feature with granularity [per UE]*

So we propose to define performance requirements for 64QAM for PDSCH.

4.1.4 Issue 3-4: CSI reporting assumptions

Table 10:

T-doc number	Company	Proposals/Observations
R4-2201015	Huawei,HiSilicon	Proposal 4: Do not consider any CSI reporting requirements for NTN scenario.
R4-2201420	Ericsson	Observation 3: The time shift could be large due to the long distance between UE and the NTN-payload and the quickness of the NTN-payload Proposal 9: Evaluate the time shift of CSI reporting before having any decision on whether to have CSI reporting requirement for NTN

Issue 3-4-1: CSI reporting requirements

- Proposals
 - o Option 1: (Huawei)
 - Do not consider any CSI reporting requirements for NTN scenario.
 - o Option 2: (Ericsson)
 - Evaluate the time shift of CSI reporting before having any decision on whether to have CSI reporting requirement for NTN
- Recommended WF
 - o Companies are encouraged to provide the views on this issue.

Feedback Form 31: Feedback to Issue 3-4-1

<p>1 – Qualcomm Incorporated</p> <p>Option 1. it might not be useful due to the large delay.</p>
<p>2 – HiSilicon Technologies Co. Ltd</p> <p>We prefer Option 1 since there is tens of milliseconds and hundreds of milliseconds delay for LEO and GEO scenario respectively, and then the reporting CSI is outdated.</p>
<p>3 – Ericsson Inc.</p> <p>Ericsson: We don't see the necessary for PMI and RI report, but FFS for CQI report for LEO. It seems</p>

worthy to check it under NTN channel.

4.2 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.

4.2.1 Issue 3-1: Scope of requirements

Issue 3-1-1: Legacy TN UE Rel-15/Rel-16 demodulation requirements apply to NTN UE or not?

Tentative agreements:

Legacy TN UE Rel-15/Rel-16 demodulation requirements shall also apply for NTN UE.

Recommendations for 2nd round:

None. The new requirements for NTN UE will be handled in issue 3-3.

Issue 3-1-2: Satellite-based NTN and HAPS scenarios

Tentative agreements:

Satellite-based requirements is with high priority.

Recommendations for 2nd round:

Further discuss whether to define the sperate requirements for GEO and LEO

Option 1: To define the separate requirements for GEO and LEO1200/600

Option 2: Only to define the requirements for LEO600

Issue 3-1-3: Enhancement on time relationship

Tentative agreements:

N/A

Recommendations for 2nd round:

To further discuss the enhancement on time relationship

Option 1: selecting K_{offset} equal to the propagation delay defined

Option 2: selecting K_{offset} large enough to ensure UL/DL timeline is met

Issue 3-1-4: Enhancement on HARQ

Tentative agreements:

N/A

Recommendations for 2nd round:

Option 1:

- Define PDSCH performance requirements with HARQ Processes 32. FFS on optional or mandatory testing
- Define PDSCH performance requirements with the condition that half HARQ process is enabled while another half HARQ process is disabled
- FFS on test method for PDSCH test with disabled HARQ feedback.

Option 2:

- Define two sets of requirements – one for disabled HARQ and one for increased number of HARQ processes (To clarify what is the number of HARQ progress) .

4.2.2 Issue 3-2: General assumptions

Issue 3-2-1: Channel model

Tentative agreements:

N/A

Recommendations for 2nd round:

To further discuss the possible down-selectin from NTN-TDL-A/B/C/D

Option 1: one NLOS conditions channel model from NTN-TDL-A/B and one LOS conditions

channel model NTN-TDL-C/D

Option 2: FFS

Issue 3-2-2: Delay spread

Tentative agreements:

N/A

Recommendations for 2nd round:

Option 1: 250ns

Option 2: FFS

Issue 3-2-3: Doppler shift

Tentative agreements:

N/A

Recommendations for 2nd round:

Option 1: To discuss the residual time and frequency offset for UE demodulation, and takes UE speed into account.

Option 2: Not to consider the residual time and frequency offset for UE demodulation

4.2.3 Issue 3-3: PDSCH/PDCCH/PBCH assumptions

Issue 3-3-1: PDCSH/PDCCH/PBCH requirements

Tentative agreements:

N/A

Recommendations for 2nd round:

Option 1: Define new demodulation requirements for PDCSH/PDCCH/PBCH

Option 2: Define new demodulation requirements for PDCSH

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

Tentative agreements:

N/A

Recommendations for 2nd round:

Option 1: 15kHz SCS: 10MHz as the starting point

Option 2: 15kHz SCS: 10MHz, 30kHz SCS: 20MHz

Issue 3-3-3: Modulation order

Tentative agreements:

N/A

Recommendations for 2nd round:

Option 1: consider QPSK and 16QAM for PDSCH

Option 2: consider QSPK, 16QAM and 64QAM for PDSCH

Moderator's note:

Agreement from RF session:

- Include 64QAM as optional with manufacture declaration basis for SAN.
- Include 64QAM (DL and UL) for NTN satellite UE as optional feature with granularity [per UE]

4.2.4 Issue 3-4: CSI reporting assumptions

Issue 3-4-1: CSI reporting requirements

Tentative agreements:

N/A

Recommendations for 2nd round:

Option 1: Do not consider any CSI reporting requirements

Option 2: Do not consider PMI and RI reporting requirements, FFS for CQI reporting for LEO.

4.2.5 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.

4.3 Discussion on 2nd round (if applicable)

5 Recommendations for Tdocs

5.1 1st round

New tdocs

Table 11:

Title	Source	Comments
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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

Table 12:

Tdoc number	Title	Source	Recommendation	Comments
R4-2200171	Discussion on Satellite Access Node demodulation requirements	CATT	Noted	
R4-2200475	Discussion on general issue for NTN NR	Ericsson	Noted	
R4-2200476	Discussion on satellite access node demodulation requirement for NTN NR	Ericsson	Noted	
R4-2201015	Discussion on UE NTN demod	Huawei,HiSilicon	Noted	
R4-2201016	Discussion on satellite NTN demod	Huawei,HiSilicon	Noted	
R4-2201420	Discussion on UE demodulation for NTN	Ericsson	Noted	
R4-2201785	Discussion on Satellite Access Node demodulation requirements for NR NTN	Intel Corporation	Noted	

R4-2201786	Discussion on UE demodulation requirements for NR NTN	Intel Corporation	Noted	
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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:
 - a) CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
 - b) 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

5.2 2nd round

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:
 - a) CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
 - b) Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents

6 Annex

Contact information

Feedback Form 32: Contact information (Company, Name, Email address)

1 – Ericsson Inc.

Ericsson, Nicholas Pu, nicholas.pu@ericsson.com

2 – HiSilicon Technologies Co. Ltd

Huawei, HiSilicon, Zehan Zhao, zhaozehan@hisilicon.com

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)