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

**Chicago, America, November 13 – November 17, 2023**

**Agenda item:** 9.6.7

**Source:** Moderator (MediaTek)

**Title:** Topic summary for [109][332] IoT\_NTN\_Demod

**Document for:** Information

# Introduction

This summary covers the contributions submitted under the agenda 6.2.4.1.4 and 9.6.6 for IoT-NTN demodulation requirements.

# Topic #1: Work Plan

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2318666 | MediaTek Inc. | Work plan |

## Open issues summary

**Issue 1: Work plan**

* Proposal (MTK)

|  |
| --- |
| **UE Demodulation performance part (36.102)*** **November, 2023 (RAN4#109)**
	+ Approve the work plan.
	+ Discuss UE demodulation requirements for IoT-NTN enhancement.
	+ Discuss simulation assumptions.
* **February 2024 (RAN4#110)**
	+ Continue discussion on UE demodulation requirements for IoT-NTN enhancement.
	+ Agree on simulation assumptions.
	+ Discuss possible work split for the CR work, if needed.
* **April 2024 (RAN4#110bis)**
	+ Collect the simulation results.
	+ Provide CR/Draft CR based on work split and discuss CRs/Draft CRs.
* **May 2024 (RAN4#111)**
	+ Update simulation assumptions if necessary.
	+ Finalize CRs and close the performance part.

**SAN Demodulation performance part (36.108)*** **November, 2023 (RAN4#109)**
	+ Approve the work plan.
	+ Discuss SAN demodulation requirements for IoT-NTN enhancement.
	+ Discuss simulation assumptions.
* **February 2024 (RAN4#110)**
	+ Continue discussion on SAN demodulation requirements for IoT-NTN enhancement.
	+ Agree on simulation assumptions.
	+ Discuss possible work split for the CR work, if needed.
* **April 2024 (RAN4#110bis)**
	+ Collect the simulation results.
	+ Provide CR/Draft CR based on work split and discuss CRs/Draft CRs.
* **May 2024 (RAN4#111)**
	+ Update simulation assumptions if necessary.
	+ Finalize CRs and close the performance part.
 |

* Recommended WF
	+ Discuss the proposed work plan is agreeable or not.

# Topic #2: UE Demodulation requirements for IoT-NTN enhancement

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2318232 | Nokia, Nokia Shanghai Bell | [**Observation 1:** Disabling of HARQ will impact both PDSCH and PUSCH performance.](#_Toc149678118)[**Proposal 9: RAN 4 shall use NTN-TDLC5-30, NTN-TDLA100-200, and NTN-TDLA100-10 for PUSCH performance requirements for IOT-NTN with HARQ disabled.**](#_Toc149678127)[**Proposal 10: RAN4 shall use Rank 1 for PUSCH performance requirements for IOT-NTN with HARQ disabled.**](#_Toc149678128)[**Proposal 11: RAN4 shall use 1Tx for PUSCH performance requirements for IOT-NTN with HARQ disabled.**](#_Toc149678129)[**Proposal 12: RAN4 shall use 1Rx for PUSCH performance requirements for IOT-NTN with HARQ disabled.**](#_Toc149678130)[**Proposal 13: RAN4 shall use QPSK Modulation for PUSCH performance requirements for IOT-NTN with HARQ disabled.**](#_Toc149678131)[**Proposal 14: RAN4 shall use QPSK modulation with both 1/3 and 1/10 code rate for PUSCH performance requirements for IOT-NTN with HARQ disabled.**](#_Toc149678132)[Proposal 15: RAN4 shall use 16QAM Modulation with 1/2 code rate for PUSCH performance requirements for IOT-NTN with HARQ disabled.](#_Toc149678133) |
| R4-2318667 | MediaTek Inc. | ***Observation 1***: For NB-IoT, there is only one HARQ process. If there is no ACK/NACK feedback from UE with disabled HARQ feedback, TE cannot have throughput statistics to verify the UE demodulation performance.***Observation 2***: The operation of disabled HARQ feedback is to turn off the ACK/NACK for HARQ process. It is kind of some functionality and not related to the UE demodulation performance.***Proposal***: Do not introduce demodulation requirements for operation with disabled HARQ feedback for NB-IoT/eMTC. |
| R4-2318734 | Qualcomm Incorporated | **Observation 1: Disabled HARQ feedback was considered in Rel-17 NR NTN and performance requirements were defined.****Observation 2: A similar approach can be followed to define performance requirements for NB-IoT/eMTC devices.****Proposal 1: Introduce PDSCH performance requirements with disabled HARQ feedback for NB-IoT/eMTC devices.****Proposal 2: For disabled HARQ feedback, consider reTx disabled for all HARQ processes.****Proposal 3: Consider NTN-TDLA (NLOS) and NTN-TDLC (LOS) channel models used during Rel-17 IoT NTN performance requirements with disabled HARQ feedback.****Proposal 4: Consider 1x1 antenna configuration for simulation assumptions.** |
| R4-2319749 | Ericsson | **Observation 1: RAN1 introduced DCI-based HARQ feedback enable/disable indication for both eMTC and NB-IoT. For eMTC, it is only applicable for CE Mode B.****Observation 2: Maximum number of HARQ processes for eMTC CE Mode B is 2. Maximum number of HARQ processes for NB-IoT is 1 or 2.****Proposal 1: RAN4 does not define new UE demodulation and CSI reporting requirements for Rel-18 IoT NTN enhancements WI.** |
| R4-2320229 | Huawei, HiSilicon | 1. Do not define any demodulation performance requirements for IoT NTN enhancements.
 |

Moderator: In R4-2318232, the “PUCSH” in proposals 9~14 should be “PDSCH”.

## Open issues summary

**Issue 2-1: Whether to define PDSCH requirements with HARQ disabled?**

* Proposals
	+ Option 1 (Nokia, QC): Yes
	+ Option 2 (MTK, Ericsson, HW): No
* Recommended WF
	+ Moderator recommends discussing this issue first.
		- Nokia: Disabling of HARQ will impact PDSCH performance.
		- MTK: The operation of disabled HARQ feedback is to turn off the ACK/NACK for HARQ process. It is kind of some functionality and not related to the UE demodulation performance.
		- Huawei: No impact on demodulation since only HARQ feedback is different comparing to the legacy procedure.

**Issue 2-2: Maximum number of HARQ transmission**

* Proposals
	+ Option 1 (QC): reTx disabled for all HARQ processes
* Recommended WF
	+ Need discussion if agreed to define requirements
		- Ericsson: The maximum number of HARQ processes for eMTC CE Mode B and NB-IoT is up to 2

**Issue 2-3: Antenna configuration for PDSCH requirements**

* Proposals
	+ Option 1 (Nokia, QC): 1T1R
* Recommended WF
	+ Option 1 if agreed to define requirements

**Issue 2-4: Channel model for PDSCH requirements**

* Proposals
	+ Option 1 (Nokia, QC): NTN-TDLA and NTN-TDLC
		- Option 1a (Nokia): NTN-TDLC5-30, NTN-TDLA100-200, and NTN-TDLA100-10
* Recommended WF
	+ Need discussion if agreed to define requirements

**Issue 2-5: MCS for PDSCH requirements**

* Proposals
	+ Option 1 (Nokia):
		- QPSK, code rate 1/3
		- QPSK, code rate 1/10
		- 16QAM, code rate 1/1
* Recommended WF
	+ Need discussion if agreed to define requirements

# Topic #3: SAN demodulation requirements for IoT-NTN enhancement

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2318232 | Nokia, Nokia Shanghai Bell | [**Observation 1:** Disabling of HARQ will impact both PDSCH and PUSCH performance.](#_Toc149678118)[**Proposal 1: RAN4 shall define requirements for IOT NTN PDSCH with HARQ disabled.**](#_Toc149678119)[**Proposal 2: RAN4 shall define requirements for IOT NTN PUSCH with HARQ disabled.**](#_Toc149678120)[**Proposal 3: RAN 4 shall use NTN-TDLA100-5 and NTN-TDLC-5 for PUSCH performance requirements for IOT-NTN with HARQ disabled.**](#_Toc149678121)[**Proposal 4: RAN4 shall use Rank 1 for PUSCH performance requirements for IOT-NTN with HARQ disabled.**](#_Toc149678122)[**Proposal 5: RAN4 shall use 1Tx for PUSCH performance requirements for IOT-NTN with HARQ disabled.**](#_Toc149678123)[**Proposal 6: RAN4 shall use both 1 and 2Rx for PUSCH performance requirements for IOT-NTN with HARQ disabled.**](#_Toc149678124)[**Proposal 7: RAN4 shall use QPSK Modulation for PUSCH performance requirements for IOT-NTN with HARQ disabled.**](#_Toc149678125)[**Proposal 8: RAN4 shall use 1/3 code rate for PUSCH performance requirements for IOT-NTN with HARQ disabled.**](#_Toc149678126) |
| R4-2319749 | Ericsson | **Proposal 2: RAN4 does not define new SAN demodulation requirements for Rel-18 IoT NTN enhancements WI.** |
| R4- 2319847 | Samsung | **Proposal 1: only consider eMTC PUSCH and NB-IoT NPUSCH format 1 for test scope with disabled HARQ.****Proposal 2: RAN4 only consider the basic feature of Rel-13 eMTC and NB-IoT for SAN requirement with HARQ disabled.*** **eMTC PUSCH CE mode A**
* **eMTC PUSCH CE mode B**
* **NPUSCH format 1 with 15KHz, 12 tones**
* **NPUSCH format 1 with 3.75KHz, 1 tone**

**Proposal 3: RAN4 consider the same channel model for Rel-18 IoT SAN requirement** * **eMTC PUSCH CE mode A with NTN TDLA100-5 and NTN-TDLC5-5**
* **eMTC PUSCH CE mode B with NTN TDLA 100-5 and NTN-TDLC5-5**
* **NPUSCH format 1 with 15KHz, 12 tones with NTN TDLA100-1 and NTN TDLC5-1**
* **NPUSCH format 1 with 3.75KHz, 1 tone with NTN TDLA100-1 and NTN TDLC5-1**

**Proposal 4: RAN4 consider the same additional doppler shift and timing offset modeling for Rel-18 IoT SAN requirement.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Channel** | **Repetition** | **Tx duration in one segment** | **Largest frequency offset value (Hz)** |
| **eMTC PUSCH CE mode A** | 8 | 8ms | 4 |
| **eMTC PUSCH CE mode B** | 256 | 256ms | 128 |
| **NPUSCH format 1, 3.75KHz, 1 tone** | 4 | 256ms | 128 |
| **NPUSCH format 1, 15KHz, 12 tones** | 16 | 16ms | 8 |

**Proposal 5: RAN4 consider the following simulation assumption for Rel-18 IoT SAN requirement.****Table 1: simulation assumption for eMTC PUSCH CE mode A**

|  |  |
| --- | --- |
| **Parameters** | **CE Mode A** |
| **Max number of HARQ transmissions** | **1** |
| **RV sequences** | **0, 2, 3, 1, 0, 2, 3, 1** |
| **Number of PUSCH repetitions** | **8** |
| **Frequency hopping** | **OFF** |
| **Duplex mode** | **FDD only** |
| **Number of Tx antennas** | **1** |
| **Number of Rx antennas** | **1 and 2** |
| **Propagation channel** | **Case 1: NTN-TDLA100-5****Case 2: NTN-TDLC5-5** |
|  **FRC** | **TS36.104 A3-2** |
| **System BW** | **1.4MHz only** |
| **Doppler shift offset** | **4Hz** |
| **Transmit timing offset** | **[0.01] us per subframe** |
| **Fraction of maximum throughput** | **70%** |

**Table 2: simulation assumption for eMTC PUSCH CE mode B**

|  |  |
| --- | --- |
| **Parameters** | **CE Mode B** |
| **Max number of HARQ transmissions** | **1** |
| **RV sequences** | **0,0,0,0,2,2,2,2, 3,3,3,3,1,1,1,1** |
| **Number of PUSCH repetitions** | **256** |
| **Frequency hopping** | **OFF** |
| **Duplex mode** | **FDD only** |
| **Number of Tx antennas** | **1** |
| **Number of Rx antennas** | **1 and 2** |
| **Propagation channel** | **Case 1: NTN-TDLA100-5****Case 2: NTN-TDLC5-5** |
|  **FRC** | **TS36.104 A3-1** |
| **System BW** | **1.4MHz only** |
| **Doppler shift offset** | **128** |
| **Transmit timing offset** | **[0.01] us per subframe** |
| **Fraction of maximum throughput** | **70%** |

**Table 3: Simulation assumption for NB-IoT PUSCH 1**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Case**  | **Antenna configuration** | **Repetition**  | **Channel**  | **Tone** | **SCS** | **Additional** **Doppler**  | **Additional** **Timing offset** | **FRC** |
| **1** | **1T1R** | **4** | **NTN TDLC5-1** | **1** | **3.75KHz** | **128** | **[0.32:0.32:2.56]** | **A16-1** |
| **2** | **1T1R** | **4** | **NTN TDLA100-1** | **1** | **3.75KHz** | **128** | **[0.32:0.32:2.56]** | **A16-1** |
| **3** | **1T2R** | **4** | **NTN TDLC5-1** | **1** | **3.75KHz** | **128** | **[0.32:0.32:2.56]** | **A16-1** |
| **4** | **1T2R** | **4** | **NTN TDLA100-1** | **1** | **3.75KHz** | **128** | **[0.32:0.32:2.56]** | **A16-1** |
| **5** | **1T1R** | **16** | **NTN TDLC5-1** | **12** | **15KHz** | **8** | **[0.01:0.01:0.16]** | **A16-5** |
| **6** | **1T1R** | **16** | **NTN TDLA100-1** | **12** | **15KHz** | **8** | **[0.01:0.01:0.16]** | **A16-5** |
| **7** | **1T2R** | **16** | **NTN TDLC5-1** | **12** | **15KHz** | **8** | **[0.01:0.01:0.16]** | **A16-5** |
| **8** | **1T2R** | **16** | **NTN TDLA100-1** | **12** | **15KHz** | **8** | **[0.01:0.01:0.16]** | **A16-5** |

 |

## Open issues summary

**Issue 3-1: Whether to define PUSCH requirements with HARQ disabled**

* Proposals
	+ Option 1 (Nokia, Samsung): Yes
		- Option 1a (Samsung):
			* eMTC PUSCH CE mode A
			* eMTC PUSCH CE mode B
			* NPUSCH format 1 with 15KHz, 12 tones
			* NPUSCH format 1 with 3.75KHz, 1 tone
	+ Option 2 (Ericsson, Huawei): No
* Recommended WF
	+ Moderator recommends discussing this issue first.

**Issue 3-2: Antenna and rank configuration for PUSCH requirements**

* Proposals
	+ Option 1 (Nokia): 1T1R and 1T2R, rank 1
* Recommended WF
	+ Option 1 if agreed to define requirements

**Issue 3-3: Channel model for PUSCH requirements**

* Proposals
	+ Option 1 (Nokia): NTN-TDLA100-5 and NTN-TDLC-5
		- Option 1a (Samsung):
			* eMTC PUSCH CE mode A with NTN TDLA100-5 and NTN-TDLC5-5
			* eMTC PUSCH CE mode B with NTN TDLA 100-5 and NTN-TDLC5-5
			* NPUSCH format 1 with 15KHz, 12 tones with NTN TDLA100-1 and NTN TDLC5-1
			* NPUSCH format 1 with 3.75KHz, 1 tone with NTN TDLA100-1 and NTN TDLC5-1
* Recommended WF
	+ Need discussion if agreed to define requirements

**Issue 3-4: MCS for PUSCH requirements**

* Proposals
	+ Option 1 (Nokia): QPSK, code rate1/3
* Recommended WF
	+ Need discussion if agreed to define requirements

**Issue 3-5: Doppler shift and timing offset for PUSCH requirements**

* Proposals
	+ Option 1 (Samsung):

|  |  |  |  |
| --- | --- | --- | --- |
| **Channel** | **Repetition** | **Tx duration in one segment** | **Largest frequency offset value (Hz)** |
| **eMTC PUSCH CE mode A** | 8 | 8ms | 4 |
| **eMTC PUSCH CE mode B** | 256 | 256ms | 128 |
| **NPUSCH format 1, 3.75KHz, 1 tone** | 4 | 256ms | 128 |
| **NPUSCH format 1, 15KHz, 12 tones** | 16 | 16ms | 8 |

* Recommended WF
	+ Need discussion if agreed to define requirements

**Issue 3-6: Simulation assumption for PUSCH requirements**

* Proposals
	+ Option 1 (Samsung):

**Table 1: simulation assumption for eMTC PUSCH CE mode A**

|  |  |
| --- | --- |
| **Parameters** | **CE Mode A** |
| **Max number of HARQ transmissions** | **1** |
| **RV sequences** | **0, 2, 3, 1, 0, 2, 3, 1** |
| **Number of PUSCH repetitions** | **8** |
| **Frequency hopping** | **OFF** |
| **Duplex mode** | **FDD only** |
| **Number of Tx antennas** | **1** |
| **Number of Rx antennas** | **1 and 2** |
| **Propagation channel** | **Case 1: NTN-TDLA100-5****Case 2: NTN-TDLC5-5** |
|  **FRC** | **TS36.104 A3-2** |
| **System BW** | **1.4MHz only** |
| **Doppler shift offset** | **4Hz** |
| **Transmit timing offset** | **[0.01] us per subframe** |
| **Fraction of maximum throughput** | **70%** |

**Table 2: simulation assumption for eMTC PUSCH CE mode B**

|  |  |
| --- | --- |
| **Parameters** | **CE Mode B** |
| **Max number of HARQ transmissions** | **1** |
| **RV sequences** | **0,0,0,0,2,2,2,2, 3,3,3,3,1,1,1,1** |
| **Number of PUSCH repetitions** | **256** |
| **Frequency hopping** | **OFF** |
| **Duplex mode** | **FDD only** |
| **Number of Tx antennas** | **1** |
| **Number of Rx antennas** | **1 and 2** |
| **Propagation channel** | **Case 1: NTN-TDLA100-5****Case 2: NTN-TDLC5-5** |
|  **FRC** | **TS36.104 A3-1** |
| **System BW** | **1.4MHz only** |
| **Doppler shift offset** | **128** |
| **Transmit timing offset** | **[0.01] us per subframe** |
| **Fraction of maximum throughput** | **70%** |

**Table 3: Simulation assumption for NB-IoT PUSCH 1**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Case**  | **Antenna configuration** | **Repetition**  | **Channel**  | **Tone** | **SCS** | **Additional** **Doppler**  | **Additional** **Timing offset** | **FRC** |
| **1** | **1T1R** | **4** | **NTN TDLC5-1** | **1** | **3.75KHz** | **128** | **[0.32:0.32:2.56]** | **A16-1** |
| **2** | **1T1R** | **4** | **NTN TDLA100-1** | **1** | **3.75KHz** | **128** | **[0.32:0.32:2.56]** | **A16-1** |
| **3** | **1T2R** | **4** | **NTN TDLC5-1** | **1** | **3.75KHz** | **128** | **[0.32:0.32:2.56]** | **A16-1** |
| **4** | **1T2R** | **4** | **NTN TDLA100-1** | **1** | **3.75KHz** | **128** | **[0.32:0.32:2.56]** | **A16-1** |
| **5** | **1T1R** | **16** | **NTN TDLC5-1** | **12** | **15KHz** | **8** | **[0.01:0.01:0.16]** | **A16-5** |
| **6** | **1T1R** | **16** | **NTN TDLA100-1** | **12** | **15KHz** | **8** | **[0.01:0.01:0.16]** | **A16-5** |
| **7** | **1T2R** | **16** | **NTN TDLC5-1** | **12** | **15KHz** | **8** | **[0.01:0.01:0.16]** | **A16-5** |
| **8** | **1T2R** | **16** | **NTN TDLA100-1** | **12** | **15KHz** | **8** | **[0.01:0.01:0.16]** | **A16-5** |

* Recommended WF
	+ Need discussion if agreed to define requirements

# Topic #4: Maintainace for IoT-NTN demodulation requirements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| ***SAN Demod*** |
| R4-2318509 |  | Update of requirements in clause 8.2 – 8.4 |
| R4-2319735 | Ericsson | Remove [] from eMTC SAN demodulation requirements. |
| R4-2319848 | Samsung | Simulation results |
| R4-2320227 | Huawei, HiSilicon | For removing the square brackets, update clause 8.5. |
| R4-2320228 | Huawei, HiSilicon | Simulation results |
| ***UE Demod*** |
| R4-2319736 | Ericsson | 1. Correct Note 3 to align with R4-2305879. 2. Note 1 is set to void. |
| R4-2320654 | MediaTek | Add a table for downlink physical channels for connection set-up for Cat NB1 and NB2 |

**Moderator:**

* SAN demod:
	+ The simulation results in R4-2319848 and R4-2320228 are the same as pervious meeting. RAN4 can discuss whether to remove brackets in this meeting.
* UE demod:
	+ Discuss whether CRs can be agreed.