**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.