**3GPP TSG-RAN WG4 Meeting # 116bis R4-251xxxx**

**Prague, Czech Republic, October 13th ‒ October 17th, 2025**

**Agenda item: 6.23**

**Source:** Moderator (Ericsson)

**Title:** AH MoM for [116bis][328] Rel-19 Demodulation\_Part3

**Document for:** Approval

# NTN testing for NGSO (AI 6.6.3.1 and 6.6.3.3)

## Open issues summary

### Sub-topic 2-2 Demodulation requirements

**Issue 2-2-1: Additional margin to IoT-NTN UE demodulation requirements when the time-varying Doppler shift and propagation delay model is applied**

* Observations:
  + Around 1.5dB performance degradation compared with Rel-17/18 Cat M NTN demodulation requirement (Samsung)
  + Around 0.5dB performance degradation compared with Rel-17/18 NB-IoT NTN demodulation requirement (Samsung)
  + The degradation of NPDSCH with residual frequency offset and time delay is about 0.4dB for TS 36.102 Table 8.3.1.1.1.1-2 Test 1 (Ericsson)
* Proposals
  + For Cat-M PDSCH demodulation requirements
    - Option 1: Add 1.5dB
    - Option 2: Add 0.5dB
  + For NB-IoT NPDSCH demodulation requirements
    - Add 0.5dB.
* Recommended WF
  + For Cat-M PDSCH demodulation requirements, discuss the additional margin between 0.5dB to 1.5dB.
  + For NB-IoT, add 0.5dB to the existing NPDSCH requirements.

Discussion

Tentative agreements.

* + For NB-IoT, add 0.5dB to the existing NPDSCH requirements.

**Issue 2-2-3: Applicability of Rel-19 tests with time-varying Doppler shift and propagation delay model for pre-Rel-19 UEs**

* Proposals
  + Option 1 (Samsung):
    - For Rel-19 UE, the requirement for selected test cases with applying time-varying doppler shift and propagation delay channel model should be met.
    - For Rel-17/18 UEs, if the UE can declare to meet the requirements with time-varying doppler shift and propagation delay, the UE can skip the same test case specified in Rel-17/18. Other cases are still be tested pending on UE capability for NR NTN and IoT NTN with the assumption of zero doppler and constant propagation delay condition.
  + Option 2 (Huawei, HiSilicon):
    - The new NGSO requirements should applied only for Rel-19 UE. If UE can pass new NGSO requirements applying the timing varying new channel model, then it can skip the corresponding NGSO requirements defined in Rel-17/Rel-18. All other test cases defined in Rel-17/18 are only applicable for testing under NTN-TDL channel model.
    - Not allow Rel-17/18 UE to test the NGSO requirements under timing varying channel model, considering the heavy workload to re-simulate all test cases for RAN4 demodulation requirements, the selected RF/RRM/Demodulation tests can well meet the test purpose and no technical feasibility issues to conduct the NGSO testing under NTN-TDL as per the Rel-17/18 NTN NGSO testing in the market.
  + Option 2 (Ericsson):
    - Introduce test applicability between Rel-19 tests with the time-varying Doppler shift and propagation delay model and Rel-17/Rel-18 tests without the time-varying Doppler shift and propagation delay model.
    - Rel-19 tests with the time-varying Doppler shift and propagation delay model are release independence from Rel-17 for NR NTN and from Rel-18 for IoT-NTN.
    - Rel-17/Rel-18 NTN UEs need to pass either tests with or without the time-varying Doppler shift and propagation delay model.
  + Option 3 (Qualcomm):
    - The satellite motion-based time varying channel model can be retroactively applied to pre-Rel-19 test cases subject to DUT declaration.
* Recommended WF
  + Introduce test applicability between Rel-19 tests with the time-varying Doppler shift/propagation delay model and the corresponding Rel-17/18 tests without the time-varying Doppler shift/propagation delay model.
  + For Rel-19 UE,
    - If UE can pass new UE demodulation requirements with the time-varying Doppler shift and propagation delay model, then it can skip the corresponding requirements defined in Rel-17/18.
  + For Rel-17/18 UEs
    - Option 1: If UE declares to meet the requirements with time-varying Doppler shift and propagation delay, the UE can skip the corresponding requirements without time-varying Doppler shift and propagation delay defined in Rel-17/18.
      * Rel-19 tests with the time-varying Doppler shift and propagation delay model are release independence from Rel-17 for NR NTN and from Rel-18 for IoT-NTN.
    - Option 2: The new UE demodulation requirements with time-varying Doppler shift and propagation delay are not applicable for Rel-17/18 UEs.

**Background**

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| --- |
| **Agreement in RAN4#115 (R4-2508625)**  **Issue 2-1-2 Test cases for NR NTN with applying time varying Doppler Shift and propagation delay model**   * agreement   + Only apply the time-varying Doppler shift and propagation delay model with LEO-600 30 degrees elevation angle condition to TS 38.101-5 Clause 8.2.1.2.2.1 Test 1-1 and Test 1-2.   **Issue 2-1-3 Test case for NB-IoT NTN with applying the time-varying Doppler shift and propagation delay model**   * agreement   + Only apply the time-varying Doppler shift and propagation delay model with LEO-600 30 degrees elevation angle condition to TS 36.102 Clause 8.3.1.1 Test 1.   **Issue 2-1-4 Test case for eMTC NTN with applying the time-varying Doppler shift and propagation delay model**   * agreement   + Only consider test 1 and test 2 for Cat-M1 demodulation requirement with applying time varying Doppler shift and propagation delay model.   **Agreement in RAN4#116 (R4-2512525)**  **Issue 2-1-2 NR NTN demodulation requirement with applying time-varying channel model**   * agreement   + Introduce an additional margin of 0.5 dB to the Rel-17 NR NTN UE demodulation performance requirements |

Discussion

**NR NTN**

Rel-17 Minimum performance for Rank 1 (without time-varying Doppler shift and propagation time model)

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| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
|  |  |  |  |  |  | Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.1-1.1 FDD | 10 / 15 | QPSK, 0.30 | NTN-TDLA100-200 | 1x2, ULA Low | 70 | 0.3 |
| 1-2 | R.PDSCH.1-2.1 FDD | 10 / 15 | 16QAM, 0.48 | NTN-TDLC5-200 | 1x2, ULA Low | 70 | 7.6 |
| 1-3 | R.PDSCH.1-1.1 FDD | 10 / 15 | QPSK, 0.30 | NTN-TDLC5-200 | 1x2, ULA Low | 70 | -0.4 |
| 1-4 | R.PDSCH.1-1.1 FDD(1) | 10 / 15 | QPSK, 0.30 | NTN-TDLA100-200 | 1x2, ULA Low | 70 | 1.1 |
| 1-5 | R.PDSCH.1-1.1 FDD | 10 / 15 | QPSK, 0.30 | NTN-TDLA100-200 | 1x2, ULA Low | 70 | [0.3+0.5] |
| 1-6 | R.PDSCH.1-2.1 FDD | 10 / 15 | 16QAM, 0.48 | NTN-TDLC5-200 | 1x2, ULA Low | 70 | [7.6+0.5] |
| Note 1: The Maximum throughput is based on the HARQ processes with HARQ feedback enabled.  Note 2: For Tests 1-5 and 1-6, the time-varying Doppler shift and propagation delay model, specified in Annex E, is applied. | | | | | | | |

For UE declaring Rel-19 UE,

Option 1

* Applicable tests are 1-5, 1-6, 1-3 and 1-4.

Option 2

* Applicable tests are 1-5, 1-6.

For UE declaring Rel-17/18 UE,

Option 1a:

* If UE declares to meet the requirements with time-varying Doppler shift and propagation delay, applicable tests are 1-5, 1-6, 1-3 and 1-4.
* Otherwise, applicable tests are 1-1, 1-2, 1-3 and 1-4.

Option 1b:

* If UE declares to meet the requirements with time-varying Doppler shift and propagation delay, applicable tests are 1-5, 1-6.
* Otherwise, applicable tests are 1-1, 1-2, 1-3 and 1-4.

Option 2:

* Applicable tests are 1-1, 1-2, 1-3 and 1-4.

**IoT NTN Cat-M1**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test number** | **Bandwidth and MCS** | **Reference Channel** | **OCNG Pattern** | **Propagation Condition** | **Correlation Matrix and Antenna Configuration** | **Reference value** | | **UE Category** |
| **Fraction of Maximum**  **Throughput (%)** | **SNR (dB)** |
| 1 | 1.4MHz 16QAM 1/2 | R.1 FDD | OP.1 FDD | NTN-TDLC5-30 | 1x1 | 70 | 10.4 | M1 |
| 2 | 1.4MHz QPSK 1/3 | R.2 FDD | OP.1 FDD | NTN-TDLA100-200 | 1x1 | 70 | -4.2 | M1 |
| 3 | 1.4MHz QPSK 1/10 | R.3 FDD | OP.1 FDD | NTN-TDLA100-10 | 1x1 | 70 | -11.5 | M1 |
| 4 | 1.4MHz 16QAM 1/2 | R.1 FDD | OP.1 FDD | NTN-TDLC5-30 | 1x1 | 70 | [10.4+X] | M1 |
| 5 | 1.4MHz QPSK 1/3 | R.2 FDD | OP.1 FDD | NTN-TDLA100-200 | 1x1 | 70 | [-4.2+X] | M1 |
| Note 1: For Tests 4 and 5, the time-varying Doppler shift and propagation delay model, specified in Annex E, is applied. | | | | | | | | |

For UE declaring Rel-19 UE,

Option 1

* Applicable tests are 4, 5, and 3

Option 2

* Applicable tests are 4 and 5.

For UE declaring Rel-18 UE,

Option 1a:

* If UE declares to meet the requirements with time-varying Doppler shift and propagation delay, applicable tests are 4, 5, and 3.
* Otherwise, applicable tests are 1, 2, and 3.

Option 1b:

* If UE declares to meet the requirements with time-varying Doppler shift and propagation delay, applicable tests are 4 and 5
* Otherwise, applicable tests are 1, 2, and 3.

Option 2:

* Applicable tests are 1, 2, and 3.

**IoT NTN Cat-NB1/NB2**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test number** | **Bandwidth** | **Carrier Type** | **Reference Channel** | **Repetition number** | **Propagation condition** | **Number of NRS ports** | **Antenna Configuration** | **Reference value** | | **UE Category** |
| **Fraction of Maximum**  **Throughput (%)** | **SNR (dB)** |
| 1 | 200kHz | Anchor | R.NB.1 FDD | 32 | NTN-TDLC5-200 | 1 | 1x1 | 70% | -4.7 | NB1, NB2 |
| 2 | 200kHz | Non-anchor | R.NB.2 FDD | 128 | NTN-TDLA100-10 | 1 | 1x1 | 70% | -10.6 | NB1, NB2 |
| 3 | 200kHz | Anchor | R.NB.1 FDD | 32 | NTN-TDLC5-200 | 1 | 1x1 | 70% | [-4.7+0.5] | NB1, NB2 |
| Note 1: For Test 3, the time-varying Doppler shift and propagation delay model, specified in Annex E, is applied. | | | | | | | | | | |

For UE declaring Rel-19 UE,

Option 1

* Applicable tests are 3 and 2.

Option 2

* Applicable test is 3.

For UE declaring Rel-18 UE,

Option 1a:

* If UE declares to meet the requirements with time-varying Doppler shift and propagation delay, applicable tests are 3 and 2.
* Otherwise, applicable tests are 1 and 2.

Option 1b:

* If UE declares to meet the requirements with time-varying Doppler shift and propagation delay, applicable tests are 3 and 2
* Otherwise, applicable tests are 1 and 2.

Option 2:

* Applicable tests are 1 and 2.