**3GPP TSG-RAN WG4 Meeting #98bis-e R4-2106155**

**Electronic Meeting, Apr. 12th – 20th, 2021**

**Agenda item:** 8.14.3.1

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

**Title:** Email discussion summary for [98-bis-e][324] NR\_perf\_enh2\_Demod\_Part2\_NWM

**Document for:** Information

# Introduction

The discussion on the WI NR\_demod\_enh2-Perf is scheduled to be started from RAN4 #98-bis-e. According to the latest revised WID in RP-210920, BS PUSCH demodulation requirements for FR1 256QAM is one of the objectives of this WI:

|  |
| --- |
| ***BS demodulation requirements:***   * *PUSCH demodulation requirements for FR1 256QAM*   + - *Note 1: low mobility is considered for requirements definition*     - *Note 2: Realistic phase noise modelling is left up to the contributing entities* |

# Topic #1: Test parameters

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2104483**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104483.zip) | China Telecommunications | ***Proposal 1:***Cover both 1Tx 1-layer and 2Tx 2-layer transmission with 2/4/8Rx in the 256QAM PUSCH demodulation requirements.  **Proposal 2:** Reuse the existing test applicability for different BS supported antenna connectors defined in clause 8.1.2.0 of TS38.141-1.  **Proposal 3:** Reuse the existing configuration for Rel-15 2Tx UL transmission scheme, i.e., codebook-based transmission with TPMI index 0 as a start point.  **Proposal 4:** Use MCS 24 (R = 841/1024) or MCS25 (R = 885/1024) in MCS Table 2 for NR PUSCH 256QAM test cases.  **Proposal 5:** Use TDLA30-10 channel model for NR PUSCH 256QAM test cases.  **Proposal 6:** Reuse the other parameters for 64QAM PUSCH demodulation in Table 1.  **Table 1.** Proposed Other Parameters for 256QAM PUSCH Demodulation Requirements   |  |  | | --- | --- | | **Other Parameters** | **Configuration** | | MIMO correlation | Low | | Transform precoding | Disabled | | Default TDD UL-DL pattern for simulation result alignment | 15 kHz SCS:  3D1S1U, S=10D:2G:2U  30 kHz SCS:  7D1S2U, S=6D:4G:4U | | DMRS type | type 1 | | DMRS additional position | Pos1 | | DMRS duration | single-symbol DM-RS | | Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB | | Symbol length | 14 | | Start symbol index | 0 | | Time domain resource allocation type | type A and B | | Frequency domain resource | Full applicable test bandwidth | | SCS and CBW | 15kHz: 5MHz, 10MHz, 20MHz;  30kHz: 10MHz, 20MHz, 40MHz, 100MHz | | PTRS | Not configured | | SRS | Not configured | | Timing offset | 0 | | Frequency offset | 0 | | Code block group, Frequency hopping, Limited buffer rate matching | Disabled | | Number of HARQ transmissions | 4 | | RV sequence | 0, 2, 3, 1 |   ***Proposal 7:***Reuse the existing applicability rules for PUSCH performance requirements for different SCS and CBW defined in 8.1.2.1.1 and 8.1.2.1.2 in TS 38.141-1 if the proposed ‘SCS and CBW’ configuration in the above Table1 can be agreed.  **Proposal 8:** Reuse the existing applicability rules for PUSCH performance requirements for different PUSCH mapping types defined in 8.1.2.1.3 in TS 38.141-1 if the proposed ‘time domain resource allocation type’ in the above Table1 can be agreed.  **Proposal 9:** Reuse the existing applicability rules for PUSCH performance requirements for different TDD UL-DL pattern as defined in clause 8.1.2.1.5 of TS38.141-1.  **Proposal 10:** Reuse the existing MU and TT values for PUSCH demodulation test cases defined in TS38.141-1 |
| [**R4-2104557**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104557.zip) | Ericsson | **Proposal 1:** PUSCH demodulation performance requirements for 256QAM is applied for BS manufacturers declaring that 256QAM is supported for uplink.  **Proposal 2:** To define the demodulation requirements for 256QAM on FR1 UL, simulation assumptions defined for that for 64QAM can be reused, except that a new corresponding MCS needs to be considered, e.g. MCS#24 in the Rel-15 256QAM-specific MCS table as the starting point.  Table 1: Parameters for PUSCH performance requirements for 256QAM   |  |  |  | | --- | --- | --- | | **Parameter** | | **Value** | | Bandwidth | | 15kHz SCS: 5, 10, 20 MHz  30kHz SCS: 10, 20, 40, 100 MHz | | CP | | Normal | | Transform precoding | | Disabled | | Duplex mode | | FDD, TDD | | Default TDD UL-DL pattern | | 15 kHz SCS: 3D1S1U, S=10D:2G:2U  30 kHz SCS: 7D1S2U, S=6D:4G:4U | | HARQ | Maximum number of HARQ transmissions | 4 | | RV sequence | 0, 2, 3, 1 | | DM-RS | DM-RS configuration type | 1 | | DM-RS duration | 1-symbol DM-RS | | Additional DM-RS position | pos1 | | Number of DM-RS CDM group(s) without data | 2 | | Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB | | DM-RS port | {0} | | DM-RS sequence generation | NID0=0, nSCID =0 | | TD-RA | PUSCH mapping type | A, B | | Start symbol | 0 | | Allocation length | 14 | | FD-RA | RB assignment | Full applicable test bandwidth | | FH | Disabled | | CBG-based PUSCH transmission | | Disabled | | MCS | | #24 as the starting point | | Number of Tx antennas | | 1 | | Number of Rx antennas | | 2, 4, 8 | | Channel | | TDLA30-10 Low | | Test metric | | 70% of max. throughput | |
| [**R4-2104608**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104608.zip) | CMCC | **Proposal 1:** Use both CP-OFDM and DFT-s-OFDM waveform.  **Proposal 2:**   * + The test parameters for CP-OFDM can take the following parameters as the starting point   + For MCS, we propose to down-selection from 256QAM MCS20, 256QAM MCS24 and 256QAM MCS27 for evaluation assumption, and make the final decision based on evaluation results.   + For propagation condition, we can use TDL-A 30-10 Low as the starting point, further study based on simulation results.  |  |  | | --- | --- | | **Parameter** | **value** | | Transform precoding | Disabled | | Number of Tx | 1, 2 | | Number of Rx | 2, 4, 8 | | Number of layers | 1, 2 | | Transmission scheme | Identity matrix (TPMI index 0) | | DMRS type | type 1 | | Number of DMRS symbols | 1, 1+1 | | symbols length | 14 | | start symbol index | 0 | | Time domain resource allocation type | type A, type B | | Frequency domain resource | Full applicable test bandwidth | | MCS index | TBD  Down-selection from the following options:  256QAM MCS20  256QAM MCS24  256QAM MCS27 | | Carrier frequency (GHz) | 4 | | Propagation condition | TBD  TDL-A 30-10 Low as the starting point | | SCS and BW | 15kHz: 5MHz, 10MHz, 20MHz;  30kHz: 10MHz, 20MHz, 40MHz, 100MHz | | Default TDD UL-DL pattern | 15 kHz SCS:  3D1S1U, S=10D:2G:2U  30 kHz SCS:  7D1S2U, S=6D:4G:4U | | PTRS | Not configured | | Timing offset | 0 | | Frequency offset | 0 | | Code block group, Frequency hopping, Limited buffer rate matching | Disabled | | Number of HARQ transmissions,  RV sequence | 4  0,2,3,1 | | Testing metric | SNR @70% of maximum throughput |   **Proposal 3:**   * + The test parameters for DFT-s-OFDM can take the following parameters as the starting point   + For MCS, we propose to down-selection from 256QAM MCS20, 256QAM MCS24 and 256QAM MCS27 for evaluation assumption, and make the final decision based on evaluation results.   + For propagation condition, we can use TDLB100-400 Low as the starting point, further study based on simulation results.  |  |  | | --- | --- | | **Parameter** | **value** | | Transform precoding | enabled | | Number of Tx | 1 | | Number of Rx | 2, 4, 8 | | Number of layers | 1 | | DMRS type | type 1 | | Number of DMRS symbols | 1+1, 1 | | symbols length | 14 | | start symbol index | 0 | | Time domain resource allocation type | type A | | Frequency domain resource | 15kHz: 25 PRBs in the middle of the test bandwidth  30kHz: 24 PRBs in the middle of the test bandwidth | | MCS index | TBD  Down-selection from the following options:  256QAM MCS20  256QAM MCS24  256QAM MCS27 | | Carrier frequency (GHz) | 4 | | Propagation condition | TBD  TDLB100-400 Low as the starting point | | SCS and BW | 15kHz: 5 MHz;  30kHz: 10 MHz | | Default TDD UL-DL pattern | 15 kHz SCS:  3D1S1U, S=10D:2G:2U  30 kHz SCS:  7D1S2U, S=6D:4G:4U | | PTRS | Not configured | | Timing offset | 0 | | Frequency offset | 0 | | Code block group, Frequency hopping, Limited buffer rate matching | Disabled | | Number of HARQ transmissions  RV sequence | 4  0,2,3,1 | | Testing metric | SNR @70% of maximum throughput | |
| [**R4-2104730**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104730.zip) | CATT | **Proposal 1:** To adopt CP-OFDM for 256QAM demodulation.  **Proposal 2:** To adopt the number of RX antennas 2, 4, 8 for 256QAM demodulation.  **Proposal 3:** To adopt the number of TX antennas 1 for 256QAM demodulation.  **Proposal 4:** To adopt single symbol DM-RS with pos1 additional DM-RS position for 256QAM demodulation.  **Proposal 5:** To adopt 15 kHz SCS: 5MHz, 10MHz, 20MHz and 30 kHz SCS: 10MHz, 20MHz, 40MHz, 100MHz for 256QAM demodulation.  **Proposal 6:** To adopt MCS index =24 in Table 5.1.3.1-2: MCS index table 2 for PDSCH in TS 38.214 for 256QAM demodulation.  **Proposal 7:** To adopt FRC parameters listed in Table 2-1 for 256QAM demodulation.  **Proposal 8:** To adopt the PUSCH time domain resource allocation type: type A and type B for 256QAM demodulation.  **Proposal 9:** To adopt TDLA30-10 Low for 256QAM demodulation.  **Proposal 10**：To adopt other parameters listed in Table 2-2 for 256QAM demodulation. |
| [**R4-2105031**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2105031.zip) | Samsung | **Proposal 1:**  Define PUSCH requirement with 256QAM :   * Waveform: CP-OFDM only * Time resource allocation: Mapping type A * DMRS configuration: 1+1 * Antenna configuration: 1Tx, 1Rx/8Rx * SCS&BW: 15 KHz SCS and 5MHz CBW, 30 KHz SCS and 10MHz CBW * Channel Model: TDLA30-10 * MCS: MCS 24 as starting point * Tx EVM: FFS with assumption Tx EVM as 3.5% * Phase noise modeling: No explicitly modeling at Rx side * PTRS: No PTRS configuration |
| [**R4-2106347**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106347.zip) | NTT DOCOMO, INC. | **Observation 1:** In LTE specification, the performance requirements for PUSCH 256QAM in multipath fading propagation conditions are defined in the same combinations as those of 64QAM except the requirements on propagation condition “EVA 5Hz Low”.  **Proposal 1:** RAN4 should reuse the test parameters defined in Table 8.2.1.1-1 in TS 38.104 as a baseline for consideration of the requirements for PUSCH 256QAM.  **Proposal 2:** Fro 256QAM tests, RAN4 should consider the same combinations of test cases (SCS, CBW and number of TRx) for PUSCH 64QAM defined in clause 8.2.1.2 in TS 38.104.  **Proposal 3:** RAN4 consider TDLA 30-10 Low same with 64QAM as the propagation condition for PUSCH FR1 256QAM. |
| [**R4-2106428**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106428.zip) | Intel Corporation | **Proposal 1:** Consider the following assumptions for FR1 PUSCH requirements with 256QAM modulation   * Waveform: CP-OFDM only * CBW/SCS combinations: 15 kHz with 5, 10 MHz and 30 kHz with 10, 40 MHz including existing applicability rule * TDD UL/DL configuration: Reuse Rel-15 PUSCH requirements assumptions * PUSCH configuration: Type A and B mapping, S = 0, L = 14, Rank 1, MCS 4 * DMRS configuration: Type 1, Single symbol, 1 additional DMRS, Number of CDM groups without data = 2 * Channel model and antenna configuration: TDLA30-10 and 1x2 |
| [**R4-2106782**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106782.zip) | Nokia, Nokia Shanghai Bell | 1. RAN4 to study, if configuration of PT-RS results in a significant demodulation performance improvement in FR1 256QAM PUSCH. 2. Have requirements for MCS 22 (table 2, 754/1024). 3. Have requirements for 1 and 2 layers. 4. Have requirements for 2 Tx and {2, 4, 8} Rx. 5. Have requirements for full slot allocation only. 6. Have requirements with 70% TPUT KPI only. 7. Have requirements for CP-OFDM only. 8. Have requirements for type A PUSCH mapping type only. 9. Have requirements for the TDL A 30-10 Low channel model only. 10. Have requirements for both DM-RS addPos1 and addPos2. |
| [**R4-2106835**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106835.zip) | Huawei, HiSilicon | **Proposal 1:** We propose the following parameters for PUSCH configuration:   * Mapping type: Type B * Starting symbol: 0 * Length: 14 * PUSCH aggregation factor: 1   **Proposal 2:** Use propagation condition TDLA30-10 for PUSCH 256QAM performance requirements definition.  **Proposal 3:** Define PUSCH 256QAM performance requirements for SCS and bandwidth of 15 kHz/10 MHz and 30 kHz/40 MHz  **Proposal 4:** We propose to use TDD pattern of 3D1S1U for 15 kHz and 7D1S2U for 30 kHz.  **Proposal 5:** We propose to use MCS21.  **Proposal 6:** Only consider CP-OFDM waveform for performance requirements definition.  **Proposal 7:** Define performance requirements with antenna configuration of 1x2, 1x4 and 1x8 for PUSCH 256QAM.  **Proposal 8:** Reuse the configurations of PUSCH 64QAM for the following parameters:   |  |  |  | | --- | --- | --- | | **Parameter** | | **Value** | | PUSCH DMRS configuration | DMRS Type | Type 1 | | DMRS duration | Single-symbol DM-RS | | Number of additional DMRS | 1 | | Frequency domain resource | | Full Bandwidth | | Maximum number of HARQ transmissions | | 4 | | Testing metric | | 70% maximum throughput | |

## Open issues summary

In this section, test parameters for PUSCH 256QAM demodulation performance requirements will be discussed.

*Open issues and candidate options before e-meeting:*

**Issue 1: Applicability for PUSCH 256QAM demodulation performance requirements:**

* Proposals
  + Option 1: Only applied for BS manufacturers declaring that uplink 256QAM is supported. (Ericsson, Nokia, CTC, Samsung, CATT, ZTE, CMCC)
  + Option 2: Uplink 256QAM minimum performance is mandatory for Rel-17 compliant BSs (Nokia)
* Recommended WF
  + TBD

**Issue 2: Antenna configurations**

* Proposals
  + Option 1: Both of 1Tx and 2Tx with 2/4/8 Rx. (CTC, CMCC)
  + Option 2: 1Tx with 2/4/8 Rx. (Ericsson, CATT, DoCoMo, Huawei, ZTE)
  + Option 3: 1Tx with 2/8 Rx (Samsung, Ericsson, CATT)
  + Option 4: 1Tx with 2Rx (Intel, Samsung)
  + Option 5: 2Tx with 2/4/8 Rx (Nokia)
* Recommended WF

**Issue 3: Number of layers**

* Proposals
  + Option 1: Both of 1 and 2 layers. (CMCC, Nokia, CTC)
  + Option 2: Only 1 layer (Intel, Huawei, Samsung, Ericsson)
* Recommended WF
  + This issue can be discussed after Issue 2: Antenna configuration is finalized

**Issue 4: UL transmission scheme for 2Tx:**

* Proposals
  + Option 1: Codebook-based transmission with TPMI index 0. (CTC, CMCC, DoCoMo, Nokia)
  + Option 2:
* Recommended WF
  + This issue can be discussed after Issue 2: Antenna configuration is finalized

**Issue 5: MCS:**

* Proposals
  + Option 1: MCS20 (CMCC)
  + Option 2: MCS21 (Huawei)
  + Option 3: MCS22 (Nokia)
  + Option 4: MCS24 (CTC, Ericsson, CMCC, CATT, Samsung, Intel)
  + Option 5: MCS25 (CTC)
  + Option 6: MCS27 (CMCC)
* Recommended WF
  + TBD

**Issue 6: Waveform:**

* Proposals
  + Option 1: CP-OFDM only. (CTC, Ericsson, CATT, Samsung, DoCoMo, Nokia, Huawei)
  + Option 2: Both of CP-OFDM and DFT-s-OFDM (CMCC)
* Recommended WF
  + TBD

**Issue 7: Propagation condition**

* Proposals
  + Option 1: TDLA30-10 Low. (CTC, Ericsson, CMCC, CATT, Nokia, Huawei, Samsung, Intel)
  + Option 2: TDLA30-10 Low for CP-OFDM, TDLB100-400 Low for DFT-s-OFDM. (CMCC)
* Recommended WF
  + TBD

**Issue 8: SCS and bandwidth:**

* Proposals

15 kHz:

* + Option 1: Cover 5MHz, 10MHz and 20MHz. (CTC, Ericsson, CMCC, CATT, DoCoMo, Nokia)
  + Option 2: 5MHz (Samsung)
  + Option 3: Cover 5MHz and 10MHz (Intel)
  + Option 4: 10MHz (Huawei)

30 kHz:

* + Option 1: Cover 10MHz, 20MHz, 40MHz and 100MHz. (CTC, Ericsson, CMCC, CATT, DoCoMo, Nokia)
  + Option 2: 10MHz (Samsung)
  + Option 3: Cover 10MHz and 40MHz. (Intel)
  + Option 4: 40MHz (Huawei)
* Recommended WF
  + TBD

**Issue 9: TDD pattern**

* Proposals

15 kHz:

* + Option 1: 3D1S1U, S=10D:2G:2U (CTC, Ericsson, CMCC, CATT, DoCoMo, Intel, Nokia, Huawei)

30 kHz:

* + Option 1: 7D1S2U, S=6D:4G:4U (CTC, Ericsson, CMCC, CATT, DoCoMo, Intel, Nokia, Huawei)
* Recommended WF
  + 15kHz SCS: 3D1S1U, S=10D:2G:2U
  + 30kHz SCS: 7D1S2U, S=6D:4G:4U

**Issue 10: PUSCH Mapping Type**

* Proposals
  + Option 1: Type A and Type B with applicability rule. (CTC, Ericsson, CMCC, CATT, DoCoMo, Intel)
  + Option 2: Type A. (Samsung, Nokia)
  + Option 3: Type B. (Huawei)
* Recommended WF
  + TBD

**Issue 11: PUSCH symbol length**

* Proposals
  + Option 1: 14 (CTC, Ericsson, CMCC, CATT, DoCoMo, Intel, Nokia, Huawei)
* Recommended WF
  + L = 14 symbols

**Issue 12: PUSCH start symbol**

* Proposals
  + Option 1: 0 (CTC, Ericsson, CMCC, CATT, DoCoMo, Intel, Nokia, Huawei)
* Recommended WF
  + S = 0

**Issue 13: Frequency domain allocation**

* Proposals
  + Option 1: Full bandwidth (CTC, Ericsson, CMCC, CATT, DoCoMo, Nokia, Huawei)
* Recommended WF
  + Full bandwidth

**Issue 14: DM-RS Type**

* Proposals
  + Option 1: Type 1 with single-symbol (CTC, Ericsson, CMCC, CATT, DoCoMo, Intel, Nokia, Huawei)
* Recommended WF
  + Type 1 with single-symbol DM-RS

**Issue 15: Additional DMRS (*dmrs-AdditionalPosition*):**

* Proposals
  + Option 1: pos1 (Ericsson, CMCC, CATT, DoCoMo, Intel, Huawei, CTC, Samsung)
  + Option 2: pos1 and pos2 (Nokia)
* Recommended WF
  + TBD

**Issue 16: PT-RS configuration**

* Proposals
  + Option 1: No PT-RS configured (Samsung, CTC)
  + Option 2: Further study. (Nokia)
* Recommended WF
  + TBD

**Issue 17: Phase noise modelling**

* Proposals
  + Option 1: No explicitly modelling at Rx side (Samsung)
  + Option 2:
* Recommended WF
  + TBD

**Issue 18: Number of HARQ transmissions with RV sequence**

* Proposals
  + Option 1: 4 with RV sequence {0,2,3,1} (CTC, Ericsson, CMCC, CATT, DoCoMo, Nokia, Huawei)
* Recommended WF
  + 4 HARQ transmission with RV sequence {0,2,3,1}

**Issue 19: Tx EVM**

* Proposals
  + Option 1: FFS on the assumption of Tx EVM with 3.5% (Samsung)
  + Option 2:
* Recommended WF
  + TBD

**Issue 20: Test metric**

* Proposals
  + Option 1: 70% of max. throughput (Ericsson, CMCC, Nokia, Huawei)
* Recommended WF
  + 70% of max. throughput

**Issue 21: Applicability rule for different antenna configurations**

* Proposals
  + Option 1: Reusing the existing test applicability rule defined in *cl*ause 8.1.2.0 of TS38.141-1. (CTC)
  + Option 2:
* Recommended WF
  + TBD

**Issue 22: Applicability rules for different SCS and CBW**

* Proposals
  + Option 1: Reuse the existing applicability rules defined in 8.1.2.1.1 and 8.1.2.1.2 in TS 38.141-1 (CTC)
* Recommended WF
  + TBD

**Issue 23: Applicability rules for different PUSCH mapping types**

* Proposals
  + Option 1: Reuse the existing applicability rules defined in 8.1.2.1.3 in TS 38.141-1 (CTC)
* Recommended WF
  + TBD

**Issue 24: Applicability rules for TDD with different TDD patterns**

* Proposals
  + Option 1: Reuse the existing applicability rules defined in 8.1.2.1.5 in TS 38.141-1 (CTC, Nokia)
* Recommended WF
  + TBD

**Issue 25: Other parameters:**

* Proposals
  + Option 1: (CATT, CTC)

|  |  |  |
| --- | --- | --- |
| Parameter | | Value |
| CP | | Normal |
| SRS | | Not configured |
| DM-RS | Number of DM-RS CDM group(s) without data | 2 |
| Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB |
| DM-RS port | {0} or {0,1} |
| DM-RS sequence generation | NID0=0, nSCID =0 |
| FD-RA | Frequency hopping | Disabled |
| CBG-based PUSCH transmission | | Disabled |
| Timing offset | | 0 |
| Frequency offset | | 0 |
| Limited buffer rate matching | | disabled |

* Recommended WF
  + Except the DM-RS port that is related to Issue 4: Number of layers, all other parameters are agreeable

**Issue 26: FRC parameters:**

* Proposals
  + Option 1: (CATT)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Reference channel** | **G-FR1-A6-8** | **G-FR1-A6-9** | **G-FR1-A6-10** | **G-FR1-A6-11** | **G-FR1-A6-12** | **G-FR1-A6-13** | **G-FR1-A6-14** |
| Subcarrier spacing [kHz] | 15 | 15 | 15 | 30 | 30 | 30 | 30 |
| Allocated resource blocks | 25 | 52 | 106 | 24 | 51 | 106 | 273 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Modulation | 256QAM | 256QAM | 256QAM | 256QAM | 256QAM | 256QAM | 256QAM |
| Code rate (Note 2) | 841/1024 | 841/1024 | 841/1024 | 841/1024 | 841/1024 | 841/1024 | 841/1024 |
| Payload size (bits) | 23568 | 49176 | 100392 | 22536 | 48168 | 100392 | 258144 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of code blocks - C | 3 | 6 | 12 | 3 | 6 | 12 | 31 |
| Code block size including CRC (bits) (Note 2) | 7888 | 8224 | 8392 | 7544 | 8056 | 8392 | 8352 |
| Total number of bits per slot | 28800 | 59904 | 122112 | 27648 | 58752 | 122112 | 314464 |
| Total symbols per slot | 3600 | 7488 | 15264 | 3456 | 7344 | 15264 | 39308 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos1*, *l0*= 2 and *l* =11 for PUSCH mapping type A, *l0*= 0 and *l* =10 for PUSCH mapping type B as per table 6.4.1.1.3-3 of TS 38.211 [5].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [15]. | | | | | | | |

* Recommended WF
  + This can be discussed after the other test parameters are finalized

**Issue 27: Test parameters for DFT-s-OFDM: (CMCC)**

* Proposals

|  |  |
| --- | --- |
| **Parameter** | **Value** |
| Transform precoding | enabled |
| Number of Tx | 1 |
| Number of Rx | 2, 4, 8 |
| Number of layers | 1 |
| DMRS type | type 1 |
| Number of DMRS symbols | 1+1, 1 |
| symbols length | 14 |
| start symbol index | 0 |
| Time domain resource allocation type | type A |
| Frequency domain resource | 15kHz: 25 PRBs in the middle of the test bandwidth  30kHz: 24 PRBs in the middle of the test bandwidth |
| MCS index | TBD  Down-selection from the following options:  256QAM MCS20  256QAM MCS24  256QAM MCS27 |
| Carrier frequency (GHz) | 4 |
| Propagation condition | TBD  TDLB100-400 Low as the starting point |
| SCS and BW | 15kHz: 5 MHz;  30kHz: 10 MHz |
| Default TDD UL-DL pattern | 15 kHz SCS:  3D1S1U, S=10D:2G:2U  30 kHz SCS:  7D1S2U, S=6D:4G:4U |
| PTRS | Not configured |
| Timing offset | 0 |
| Frequency offset | 0 |
| Code block group, Frequency hopping, Limited buffer rate matching | Disabled |
| Number of HARQ transmissions  RV sequence | 4  0,2,3,1 |
| Testing metric | SNR @70% of maximum throughput |

* Recommended WF
  + This can be discussed after Issue 6 waveform is finalized

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 1:  Issue 2:  Issue 3: |
|  |  |
|  |  |
|  |  |
|  |  |

## Summary for 1st round

### Open issues

*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.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1: Applicability for PUSCH 256QAM demodulation performance requirements** | *Tentative agreements:*   * Only applied for BS manufacturers declaring that uplink 256QAM is supported.   *Recommendations for 2nd round*   * No further discussion is needed |
| **Sub-topic#2: Antenna configurations, number of layers and UL transmission scheme for 2Tx** | *Tentative agreements: None*  *Candidate options:*   * Number of Tx * Option 1: Only 1Tx (Ericsson, Samsung, Huawei, CATT, ZTE) * Option 2:Both 1Tx and 2Tx (Nokia, CTC, CMCC) * Number of Rx   + Option 1: 2/8Rx (Ericsson, Nokia, Samsung, Huawei, CATT)   + Option 2: 2/4/8 Rx (Ericsson, Nokia, Intel, CTC, CATT, ZTE. CMCC) * Number of layers * Option 1: Only 1 layer (Intel, Huawei, Samsung, Ericsson, CATT, ZTE) * Option 2: Both of 1 and 2 layers. (CMCC, Nokia, CTC)   *Recommendations for 2nd round:*   * Further discuss the listed options for the number of Tx, Rx and layer. * If 2 layers are included, the UL transmission scheme will be codebook-based transmission with TPMI index 0. |
| **Sub-topic#3: MCS** | *Tentative agreements:*  Company is welcome to check if the following tentative agreement is acceptable?   * Evaluate {MCS24, MCS22} as starting point for next meeting, based on the simulation results to decide if MCS24 is feasible, otherwise to check lower MCS22 is feasible or not.   *Candidate options:*  *Recommendations for 2nd round:*   * *No more discussion. Based on simulation results to decide the MCS for next meeting.* |
| **Sub-topic#4: Waveform** | *Tentative agreements:*   * Only 1 out of 10 companies supports Option 2, to move forward, is it acceptable to agree on Option 1?   *Candidate options:*   * Option 1: CP-OFDM only. (CTC, Ericsson, CATT, Samsung, DoCoMo, Nokia, Huawei, Intel, ZTE) * Option 2: Both of CP-OFDM and DFT-s-OFDM (CMCC)   *Recommendations for 2nd round:* Continue discussion |
| **Sub-topic#5: Propagation condition** | *Tentative agreements:*   * Only 1 out of 9 companies supports Option 2, to move forward, is it acceptable to agree Option 1?   *Candidate options:*   * Option 1: TDLA30-10 Low. (CTC, Ericsson, CATT, Nokia, Huawei, Samsung, Intel, ZTE) * Option 2: TDLA30-10 Low for CP-OFDM, TDLB100-400 Low for DFT-s-OFDM. (CMCC)   *Recommendations for 2nd round:* Continue discussion |
| **Sub-topic#6: SCS and bandwidth** | *Tentative agreements:*  *Candidate options:*   * 15kHz SCS   + Option 1:5MHz and 10MHz (Intel, Samsung, Nokia, Huawei, CATT, ZTE )   + Option 2: 5MHz, 10MHz and 20MHz.(Nokia, Intel, CTC, CMCC) * 30kHz SCS   + Option 1:10MHz and 40MHz (Intel, Samsung, Nokia, Huawei, CATT, ZTE )   + Option 2:10MHz, 20MHz, 40MHz and 100MHz.(Nokia, Intel, CTC, CMCC)   *Recommendations for 2nd round:* Continue discussion |
| **Sub-topic#7: TDD pattern** | *Tentative agreements:*  15kHz SCS: 3D1S1U, S=10D:2G:2U  30kHz SCS: 7D1S2U, S=6D:4G:4U  *Recommendations for 2nd round: No further discussion is needed.* |
| **Sub-topic#8: PUSCH mapping type** | *Tentative agreements:*  *Candidate options:*   * Option 1: Only Type A. (Samsung, Nokia) * Option 2: Type A and Type B with applicability rule. (CTC, Ericsson, CMCC, CATT, DoCoMo, Intel, Huawei, ZTE, Nokia)   *Recommendations for 2nd round:* Continue discussion |
| **Sub-topic#9: PUSCH start symbol and symbol length** | *Tentative agreements:*   * *S = 0* * *L=14*   *Recommendations for 2nd round:* *No further discussion is needed.* |
| **Sub-topic#10: Frequency domain allocation** | *Tentative agreements:*   * Full bandwidth frequency domain resource allocation   *Recommendations for 2nd round:* *No further discussion is needed* |
| **Sub-topic#11: DM-RS type** | *Tentative agreements:*   * Type 1 with single-symbol DM-RS   *Recommendations for 2nd round: No further discussion is needed* |
| **Sub-topic#12: Additional DM-RS (*dmrs-AdditionalPosition*)** | *Tentative agreements: Two companies would like to further study any benefits from addPos=2.*   * *pos1* * *FFS pos2*   *Recommendations for 2nd round:* No further discussion in the 2nd round and can decided based on interesting companies’ feedback for next meeting*.* |
| **Sub-topic#13: PT-RS configuration** | *Tentative agreements: Two companies would like to study the PN impact to demodulation for 256QAM, we can discuss and decide to whether to configure PT-RS or not based on interesting companies’ feedback in next meeting.*   * *FFS configure PT-RS*   *Recommendations for 2nd round:* No further discussion |
| **Sub-topic#14: Phase Noise modelling** | *Tentative agreements:*   * *Realistic phase noise modelling is left up to the contributing entities.* * *Phase noise impact can be either considered in ideal simulations or included in impairment results based on further discussion and evaluations.* * *Interesting company is welcome to do investigation on the PN impact on 256QAM performance for next meeting.*   *Recommendations for 2nd round:* No further discussion |
| **Sub-topic#15: Number of HARQ transmission and RV sequence** | *Tentative agreements:*   * *4 HARQ transmission with RV sequence {0,2,3,1}*   *Recommendations for 2nd round:* No further discussion |
| **Sub-topic#16: Tx EVM** | *Tentative agreements:*   * *Interesting companies are welcome to check the performance difference with and without Tx EVM (3.5% as baseline?) impact considered. RAN4 will discuss and decide whether additional margin should be considered in alignment results if no Tx EVM modelling in next meeting as per the evaluations results.*   *Recommendations for 2nd round:* No further discussion |
| **Sub-topic#17: Test metric** | *Tentative agreements:*   * *70% max throughput*   *Recommendations for 2nd round:* No further discussion |
| **Sub-topic#18: Applicability rule for different antenna configurations** | *Tentative agreements:*   * *FFS on reusing the existing test applicability rule defined in clause 8.1.2.0 of TS38.141-1.*   *Recommendations for 2nd round:* Will discuss this after Sub-topic#2 for number of Tx, Rx and Layer is finalized. |
| **Sub-topic#19: Applicability rules for different SCS and CBW** | *Tentative agreements:*   * *FFS on reusing the existing applicability rules defined in* *8.1.2.1.1 and 8.1.2.1.2 in TS 38.141-1*   *Recommendations for 2nd round:* Will discuss this issue after Sub-topic#6 for different SCS and bandwidth is finalized. |
| **Sub-topic#20: Applicability rules for different PUSCH mapping types** | *Tentative agreements:*   * *FFS on reusing the existing applicability rules defined in 8.1.2.1.3 in TS 38.141-1 if RAN4 agreed to define performance requirements for both PUSCH mapping type A and type B.*   *Recommendations for 2nd round:* Will discuss this issue after Sub-topic#8 for different PUSCH mapping type is finalized. |
| **Sub-topic#21: Applicability rules for TDD with different TDD patterns** | *Tentative agreements:*   * *Reuse the existing applicability rules defined in 8.1.2.1.5 in TS 38.141-1*   *Recommendations for 2nd round:* No further discussion. |
| **Sub-topic#22: Other test parameters** | *Tentative agreements: Agree with the following other test parameters by removing DM-RS port that is related to the number of layers:*   |  |  |  | | --- | --- | --- | | Parameter | | Value | | CP | | Normal | | SRS | | Not configured | | DM-RS | Number of DM-RS CDM group(s) without data | 2 | | Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB | | DM-RS sequence generation | NID0=0, nSCID =0 | | FD-RA | Frequency hopping | Disabled | | CBG-based PUSCH transmission | | Disabled | | Timing offset | | 0 | | Frequency offset | | 0 | | Limited buffer rate matching | | disabled |   *Recommendations for 2nd round: No further discussion* |
| **Sub-topic#23: FRC** | *Tentative agreements:*   * *Discuss the FRC after MCS, DM-RS pattern, BW and Rank firstly*   *Recommendations for 2nd round: Focus on the discussion for MCS, DM-RS pattern, CBW and Rank.* |
| **Sub-topic#24: Test parameters for DFT-s-OFDM** | *Tentative agreements:*   * *Discuss the specific test parameters for DFT-s-OFDM after RAN4 agrees to introduce requirements for FR1 PUSCH 256QAM with DFT-s-OFDM.*   *Recommendations for 2nd round: Focus on the discussion on the waveform.* |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| R4-2106120 | Way forward for FR1 PUSCH 256QAM performance requirements | Huawei, HiSilicon |

## Summary for 2nd round

### Open issues

*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.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1: Antenna configurations, number of layers and UL transmission scheme for 2Tx** | *Tentative agreements: None*  *Candidate options:*   * Number of Tx * Option 1: Only 1Tx (Ericsson, Samsung, Huawei, CATT, ZTE) * Option 2:Both 1Tx and 2Tx (Nokia, CTC, CMCC) * Number of Rx   + Option 1: 2/8Rx (Ericsson, Nokia, Samsung, Huawei, CATT)   + Option 2: 2/4/8 Rx (Ericsson, Nokia, Intel, CTC, CATT, ZTE, CMCC, DCM) * Number of layers * Option 1: Only 1 layer (Intel, Huawei, Samsung, Ericsson, CATT, ZTE) * Option 2: Both of 1 and 2 layers. (CMCC, Nokia, CTC)   *Recommendations for next meeting:*   * Further discussions on introduction of 2 Layers can be based on the evaluations from companies about the required SNR level, the feasibility and other factors for 256QAM with 2 Layers in the next meeting. * If 2 layers are included, the UL transmission scheme will be codebook-based transmission with TPMI index 0.   + Number of Rx: companies can share view on possible Option 3: 2/4/8 Rx with Rel-15 test applicability rule that the tests with low MIMO correlation level shall apply only for the lowest and highest numbers of supported connectors in the next meeting. |
| **Sub-topic#2: Waveform** | *Tentative agreements:*   * CP-OFDM only |
| **Sub-topic#3: Propagation condition** | *Tentative agreements:*   * TDLA30-10 Low |
| **Sub-topic#4: SCS and bandwidth** | *Tentative agreements: None*  *Candidate options:*   * 15kHz SCS   + Option 1:5MHz and 10MHz (Intel, Samsung, Nokia, Huawei, CATT, ZTE, Ericsson)   + Option 2: 5MHz, 10MHz and 20MHz.(Nokia, Intel, CTC, CMCC, CATT, DCM) * 30kHz SCS   + Option 1:10MHz and 40MHz (Intel, Samsung, Nokia, Huawei, CATT, ZTE, Ericsson)   + Option 2:10MHz, 20MHz, 40MHz and 100MHz.(Nokia, Intel, CTC, CMCC, CATT, DCM)   *Recommendations for next meeting:* Continue discussion |
| **Sub-topic#5/8: PUSCH mapping type and Applicability rules for different PUSCH mapping types** | *Tentative agreements:*   * Type A and Type B with reusing the existing applicability rule defined in 8.1.2.1.3 in TS 38.141-1. |
| **Sub-topic#6: Applicability rule for different antenna configurations** | *Tentative agreements:*   * *FFS on reusing the existing test applicability rule defined in clause 8.1.2.0 of TS38.141-1.*   *Recommendations for next meeting:* Majority view is ok to reuse the existing test applicability rule, one company prefer to keep it open and have more time to check. Continue discussion in next meeting. |
| **Sub-topic#7: Applicability rules for different SCS and CBW** | *Tentative agreements:*   * *FFS on reusing the existing applicability rules defined in 8.1.2.1.1 and 8.1.2.1.2 in TS 38.141-1*   *Recommendations for 2nd round:* Continue discussion in next meeting. Maybe can be discussed by combing with topic about SCS and bandwidth. |
| **Sub-topic#8: FRC** | *Tentative agreements:*   * *Discuss the FRC after parameters of MCS, DM-RS pattern, BW and Rank are finalized* |
| **Sub-topic#8: Test parameters for DFT-s-OFDM** | *Tentative agreements:*   * *No discussion is needed considering only CP-OFDM is agreed.* |

### Recommendations for Tdocs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-2106120 | Way forward for FR1 PUSCH 256QAM performance requirements | Huawei, HiSilicon | Agreeable |  |
| R4-2104483 | Views on PUSCH FR1 256QAM demodulation requirements | China Telecommunications | Noted |  |
| R4-2104557 | Discussion on FR1 PUSCH 256QAM demodulation requirement | Ericsson | Noted |  |
| R4-2104608 | Discussion on BS demodulation enhancement for FR1 256QAM | CMCC | Noted |  |
| R4-2104730 | Discussion on PUSCH demodulation requirements for FR1 256QAM | CATT | Noted |  |
| R4-2105031 | View on PUSCH demodulation requirement with FR1 256QAM | Samsung | Noted |  |
| R4-2106347 | Views on FR1 PUSCH 256QAM | NTT DOCOMO, INC. | Noted |  |
| R4-2106428 | Discussion on PUSCH requirements for FR1 256QAM | Intel Corporation | Noted |  |
| R4-2106782 | On PUSCH demodulation requirements for FR1 256QAM | Nokia, Nokia Shanghai Bell | Noted |  |
| R4-2106835 | Discussion on PUSCH demodulation requirements for FR1 256QAM | Huawei, HiSilicon | Noted |  |

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