**3GPP TSG-RAN4 Meeting #97-e *R4-2015846***

 **Electronic Meeting, 2nd - 13th November 2020**

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
|  |
|  | **38.141-2** | **CR** | **0245** | **rev** | **-** | **Current version:** | **16.5.0** |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network | **x** | Core Network |  |

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|  |
| ***Title:***  | Additional test cases and FRC tables for HST PUSCH |
|  |  |
| ***Source to WG:*** | Ericsson |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_HST-Perf |  | ***Date:*** | 2020-11-02 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***Release:*** | Rel-16 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
|  |  |
| ***Reason for change:*** | Resubmission of endorsed Draft CR R4-2012681. In RAN4#96-e, requirements for HST PUSCH under fading channel was agreed to be introduced in separate tables under the same section of AWGN channel requirements |
|  |  |
| ***Summary of change:*** | Adding applicability rule for HST PUSCHChange statement text according to adding test casesAdding 5MHz SCS 15kHz and 10MHz SCS 30kHz requirements under AWGN channel and fading channelAdding FRC tables for additional bandwidth requirementsAdding multipath fading channel TDLC300-600 and TDLC300-1200 in Annex JReplace TBD requirements with SNR valuesTable format adjustment |
|  |  |
| ***Consequences if not approved:*** | PUSCH HST lowest BW requirements for AWGN and fading channel and FRC tables for 15kHz SCS and 30kHz SCS are not availiable.  |
|  |  |
| ***Clauses affected:*** | 8.2.1, 8.2.4, A.3, A.4, J.2.2 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** | **x** |  |  Other core specifications  | TS/TR 38.104 CR ...  |
| ***affected:*** | **x** |  |  Test specifications | TS/TR 38.141-1 CR ...  |
| ***(show related CRs)*** |  | **x** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

######################### Start of change#1 ############################

### 8.1.2 Applicability rule

#### 8.1.2.0 General

Unless otherwise stated, for a BS declared to support more than 2 demodulation branches (for *BS type 1-O* and *BS type 2-O*), the performance requirement tests for 2 demodulation branches shall apply, and the mapping between connectors and demodulation branches is up to BS implementation.

The tests requiring more than [20] dB SNR level are set to N/A in the test requirements.

#### 8.1.2.1 Applicability of PUSCH performance requirements

##### 8.1.2.1.1 Applicability of requirements for different subcarrier spacings

Unless otherwise stated, PUSCH requirement tests shall apply only for each subcarrier spacing declared to be supported (see D.7 in table 4.6-1).

Unless otherwise stated, PUSCH requirement tests with 30% of maximum throughput shall apply only for the lowest subcarrier spacing declared to be supported (see D.7 in table 4.6-1) for each frequency range.

##### 8.1.2.1.2 Applicability of requirements for different channel bandwidths

For each subcarrier spacing declared to be supported, the tests for a specific channel bandwidth shall apply only if the BS supports it (see D.7 in table 4.6-1).

Unless otherwise stated, for each subcarrier spacing declared to be supported, the tests shall be done only for the widest supported channel bandwidth. If performance requirement is not specified for this widest supported channel bandwidth, the tests shall be done by using performance requirement for the closest channel bandwidth lower than this widest supported bandwidth; the tested PRBs shall then be centered in this widest supported channel bandwidth.

##### 8.1.2.1.3 Applicability of requirements for different configurations

Unless otherwise stated, for *BS type 1-O*, PUSCH requirement tests shall apply only for the mapping type declared to be supported (see D.100 in table 4.6-1). If both mapping type A and type B are declared to be supported, the tests shall be done for either type A or type B; the same chosen mapping type shall then be used for all tests.

Unless otherwise stated, for *BS type 2-O*, PUSCH requirement tests shall apply only for the additional DM-RS position declared to be supported (see D.101 in table 4.6-1). If both options (i.e., pos0 and pos1) are declared to be supported, the tests shall be done for pos1.

Unless otherwise stated, for *BS type 2-O*, PUSCH requirement tests with transform precoding disabled shall apply for the PT-RS option declared to be supported (see D.106 in table 4.6-1). If both PT-RS options (without and with PT-RS) are declared to be supported, the tests shall be done for either without or with PT-RS only; the same chosen option shall then be used for all tests.

Unless otherwise stated, for *BS type 2-O*, PUSCH requirement tests with transform precoding enabled shall be done for without PT-RS.

##### 8.1.2.1.4 Applicability of requirements for uplink carrier aggregation

The tests for uplink carrier aggregation shall be carried out according to the declaration (see D.108 in table 4.6-1).

Unless otherwise stated, the tests for uplink carrier aggregation shall apply only for PUSCH with transform precoding disabled, and shall be conducted on per component carrier basis.

##### 8.1.2.1.5 Applicability of requirements for TDD with different UL-DL patterns

Unless otherwise stated, for each subcarrier spacing declared to be supported, if BS supports multiple TDD UL-DL patterns, only one of the supported TDD UL-DL patterns shall be used for all tests.

#### 8.1.2.2 Applicability of PUCCH performance requirements

##### 8.1.2.2.1 Applicability of requirements for different formats

Unless otherwise stated, PUCCH requirement tests shall apply only for each PUCCH format declared to be supported (see D.102 in table 4.6-1).

##### 8.1.2.2.2 Applicability of requirements for different subcarrier spacings

Unless otherwise stated, PUCCH requirement tests shall apply only for each subcarrier spacing declared to be supported (see D.7 in table 4.6-1).

##### 8.1.2.2.3 Applicability of requirements for different channel bandwidths

For each subcarrier spacing declared to be supported by the BS, the tests for a specific channel bandwidth shall apply only if the BS supports it (see D.7 in table 4.6-1).

Unless otherwise stated, for each subcarrier spacing declared to be supported, the tests shall be done only for the widest supported channel bandwidth. If performance requirement is not specified for this widest supported channel bandwidth, the tests shall be done by using performance requirement for the closest channel bandwidth lower than this widest supported bandwidth; the tested PRBs shall then be centered in this widest supported channel bandwidth.

##### 8.1.2.2.4 Applicability of requirements for different configurations

Unless otherwise stated, PUCCH format 3 requirement tests shall apply only for the additional DM-RS configuration declared to be supported (see D.104 in table 4.6-1). If both options (without and with additional DM-RS) are declared to be supported, the tests shall be done for either without or with additional DM-RS; the same chosen option shall then be used for all tests.

Unless otherwise stated, PUCCH format 4 requirement tests shall apply only for the additional DM-RS configuration declared to be supported (see D.105 in table 4.6-1). If both options (without and with additional DM-RS) are declared to be supported, the tests shall be done for either without or with additional DM-RS; the same chosen option shall then be used for all tests.

##### 8.1.2.2.5 Applicability of requirements for multi-slot PUCCH

Unless otherwise stated, multi-slot PUCCH requirement tests shall apply only if the BS supports it (see D.107 in table 4.6-1).

#### 8.1.2.3 Applicability of PRACH performance requirements

##### 8.1.2.3.1 Applicability of requirements for different formats

Unless otherwise stated, PRACH requirement tests shall apply only for each PRACH format declared to be supported (see D.103 in table 4.6-1).

##### 8.1.2.3.2 Applicability of requirements for different subcarrier spacings

Unless otherwise stated, for each PRACH format with short sequence declared to be supported, for each FR, the tests shall apply only for the smallest supported subcarrier spacing in the FR (see D.103 in table 4.6-1).

##### 8.1.2.3.3 Applicability of requirements for different channel bandwidths

Unless otherwise stated, for the subcarrier spacing to be tested, the tests shall apply only for anyone channel bandwidth declared to be supported (see D.7 in table 4.6-1).

##### 8.1.2.3.4 Applicability of requirements for different restricted set types of long PRACH format 0

Unless otherwise stated, PRACH requirement tests for long PRACH preamble format 0 with restricted set Type A and B shall apply only for the restricted set type declared to be supported (see D.110 in table 4.6-1). If both restricted set type A and type B are declared to be supported, the tests shall be done for type B; the same chosen mapping type shall then be used for all tests.

#### 8.1.2.4 Applicability of PUSCH for high speed train performance requirements

##### 8.1.2.4.1 Appliability of requirements for different speeds

Unless otherwise stated, a BS that declares to support 500km/h (see D.110 in table 4.6-1) and passes the tests for 500km/h, can also consider the tests for 350km/h as passed.

##### 8.1.2.4.2 Applicability of requirements for 1T1R

In high speed train requirements, unless otherwise stated, for a BS supporting different numbers of antenna connectors (for BS type1-C) or TAB connectors (for BS type 1-H) (see D.37 in table 4.6-1), if the BS supports 1RX, the tests with low MIMO correlation level shall apply only for either one connector or the second lowest number of supported connectors, in addition to the highest numbers of supported connectors, and the specific connectors used for testing are based on manufacturer declaration.

If the BS doesn't support 1RX, the tests with low MIMO correlation level shall apply only for the lowest and highest numbers of supported connectors, and the specific connectors used for testing are based on manufacturer declaration.

Note: The highest number of connectors can simultaneously be second lowest number.

######################### End of change#1 ############################

######################### Start of change#2 ############################

### 8.2.4 Performance requirements for PUSCH for high speed train

#### 8.2.4.1 Definition and applicability

The performance requirement of PUSCH is determined by a minimum required throughput for a given SNR. The required throughput is expressed as a fraction of maximum throughput for the FRCs listed in annex A. The performance requirements assume HARQ re-transmissions. The performance requirements for High Speed Train conditions are optional.

Which specific test(s) are applicable to BS is based on the test applicability rules defined in clause 8.1.2.1 and clause 8.1.2.4.

The performance requirements for PUSCH for high speed train only apply to Wide Area Base Stations and Medium Range Base Stations (subject to declaration).

#### 8.2.4.2 Minimum Requirement

The minimum requirement is in TS 38.104 [2] clause 11.2.1.4.

#### 8.2.4.3 Test Purpose

The test shall verify the receiver's ability to achieve throughput under high speed train and multipath fading propogation conditions for a given SNR.

#### 8.2.4.4 Method of test

##### 8.2.4.4.1 Initial Conditions

Test environment: Normal, see annex B.2.

RF channels to be tested: M; see clause 4.9.1.

RF channels to be tested for carrier aggregation: MBW Channel CA; see clause 4.9.1.

Direction to be tested: OTA REFSENS *receiver target reference direction* (see D.54 in table 4.6-1).

##### 8.2.4.4.2 Procedure

1) Place the BS with its manufacturer declared coordinate system reference point in the same place as calibrated point in the test system, as shown in annex E.3.

2) Align the manufacturer declared coordinate system orientation of the BS with the test system.

3) Set the BS in the declared direction to be tested.

4) Connect the BS tester generating the wanted signal, multipath fading simulators and AWGN generators to a test antenna via a combining network in OTA test setup, as shown in annex E.3. Each of the demodulation branch signals should be transmitted on one polarization of the test antenna(s).

5) The characteristics of the wanted signal shall be configured according to the corresponding UL reference measurement channel defined in annex A, and according to additional test parameters listed in table 8.2.4.4.2-1.

Table 8.2.4.4.2-1: Test parameters for testing PUSCH under HST conditions

|  |  |
| --- | --- |
| Parameter | Value |
| Transform precoding | Disabled |
| Uplink-downlink allocation for TDD (Note1) | 15 kHz SCS:3D1S1U, S=10D:2G:2U30 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 | single-symbol DM-RS |
|  | First DM-RS position | pos 2 or pos 3 (NOTE 2) |
|  | Additional DM-RS position | Pos2 |
|  | 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 |
| Time domain | PUSCH mapping type | A |
| resource | Start symbol | 0  |
| assignment | Allocation length | 14  |
| Frequency domain resource | RB assignment | Full applicable test bandwidth |
| assignment | Frequency hopping | Disabled |
| Code block group based PUSCH transmission | Disabled |
| NOTE 1: The same requirements are applicable to FDD and TDD with different UL-DL pattern.Note 2: Either pos2 or pos3 may be selected for conformance testing. |

 The channel emulators shall be configured according to the corresponding channel model defined in annex J. Unless stated otherwise, the MIMO correlation matrices for the gNB are defined in annex J for low correlation.

7) Adjust the test signal mean power so the calibrated radiated SNR value at the BS receiver is as specified in clause 8.2.4.5 and that the SNR at the BS receiver is not impacted by the noise floor.

 The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level in table 8.2.4.4.2-2.

Table 8.2.4.4.2-2: AWGN power level at the BS input

|  |  |  |  |
| --- | --- | --- | --- |
| BS type | Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| 1-O | 15 | 5 | -86.5 - ΔOTAREFSENS dBm / 4.5MHz |
| 10 | -83.3 - ΔOTAREFSENS dBm / 9.36 MHz |
| 30 | 10 | -83.6 - ΔOTAREFSENS dBm / 8.64MHz |
| 40 | -77.2 - ΔOTAREFSENS dBm / 38.16 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.53 in table 4.6-1 and clause 7.1. |

8) For reference channels applicable to the BS, measure the throughput.

#### 8.2.4.5 Test Requirement

The throughput measured according to clause 8.2.4.4.2 shall not be below the limits for the SNR levels specified in table 8.2.4.5-1 to 8.2.4.5-10. Unless stated otherwise, the MIMO correlation matrices for the gNB are defined in annex J for low correlation.

Table 8.2.4.5-1: Test requirements for PUSCH, Type A, 10 MHz channel bandwidth, 15 kHz SCS, 350km/h

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions (Annex J) | Fraction of maximum throughput | FRC(Annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | HST Scenario 1-NR350 | 70 % | G-FR1-A3-33 | pos2 | -3.4 |
|  |  | Normal | HST Scenario 1-NR350 | 70 % | G-FR1-A4-29 | pos2 | 8.7 |
|  |  | Normal | HST Scenario 3-NR350 | 70 % | G-FR1-A3-33 | pos2 | -3.3 |
|  |  | Normal | HST Scenario 3-NR350 | 70 % | G-FR1-A4-29 | pos2 | 9.0 |

Table 8.2.4.5-2: Test requirements for PUSCH, Type A, 40 MHz channel bandwidth, 30 kHz SCS, 350km/h

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions (Annex J) | Fraction of maximum throughput | FRC(Annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | HST Scenario 1-NR350 | 70 % | G-FR1-A3-34 | pos2 | -3.4 |
|  |  | Normal | HST Scenario 1-NR350 | 70 % | G-FR1-A4-30 | pos2 | 8.8 |
|  |  | Normal | HST Scenario 3-NR350 | 70 % | G-FR1-A3-34 | pos2 | -3.3 |
|  |  | Normal | HST Scenario 3-NR350 | 70 % | G-FR1-A4-30 | pos2 | 9.0 |

Table 8.2.4.5-3: Test requirements for PUSCH, Type A, 10 MHz channel bandwidth, 15 kHz SCS, 500km/h

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions (Annex J) | Fraction of maximum throughput | FRC(Annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | HST Scenario 1-NR500 | 70 % | G-FR1-A3-33 | pos2 | -3.6 |
|  |  | Normal | HST Scenario 1-NR500 | 70 % | G-FR1-A4-29 | pos2 | 8.8 |
|  |  | Normal | HST Scenario 3-NR500 | 70 % | G-FR1-A3-33 | pos2 | -3.3 |
|  |  | Normal | HST Scenario 3-NR500 | 70 % | G-FR1-A4-29 | pos2 | 9.5 |

Table 8.2.4.5-4: Test requirements for PUSCH, Type A, 40 MHz channel bandwidth, 30 kHz SCS, 500km/h

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions (Annex J) | Fraction of maximum throughput | FRC(Annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | HST Scenario 1-NR500 | 70 % | G-FR1-A3-34 | pos2 | -3.6 |
|  |  | Normal | HST Scenario 1-NR500 | 70 % | G-FR1-A4-30 | pos2 | 9.0 |
|  |  | Normal | HST Scenario 3-NR500 | 70 % | G-FR1-A3-34 | pos2 | -3.3 |
|  |  | Normal | HST Scenario 3-NR500 | 70 % | G-FR1-A4-30 | pos2 | 8.3 |

Table 8.2.4.5-5: Test requirements for PUSCH, Type A, 5 MHz channel bandwidth, 15 kHz SCS, 350km/h

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions (Annex J) | Fraction of maximum throughput | FRC(Annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | HST Scenario 1-NR350 | 70 % | G-FR1-A3-33A | pos2 | [-3.4] |
| Normal | HST Scenario 1-NR350 | 70 % | G-FR1-A4-29A | pos2 | [8.8] |
| Normal | HST Scenario 3-NR350 | 70 % | G-FR1-A3-33A | pos2 | [-3.3] |
| Normal | HST Scenario 3-NR350 | 70 % | G-FR1-A4-29A | pos2 | [8.8] |

Table 8.2.4.5-6: Test requirements for PUSCH, Type A, 10 MHz channel bandwidth, 30 kHz SCS, 350km/h

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions (Annex J) | Fraction of maximum throughput | FRC(Annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | HST Scenario 1-NR350 | 70 % | G-FR1-A3-34A | pos2 | [-3.4] |
| Normal | HST Scenario 1-NR350 | 70 % | G-FR1-A4-30A | pos2 | [8.6] |
| Normal | HST Scenario 3-NR350 | 70 % | G-FR1-A3-34A | pos2 | [-3.4] |
| Normal | HST Scenario 3-NR350 | 70 % | G-FR1-A4-30A | pos2 | [8.7] |

Table 8.2.4.5-7: Test requirements for PUSCH, Type A, 5 MHz channel bandwidth, 15 kHz SCS, 500km/h

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions (Annex J) | Fraction of maximum throughput | FRC(Annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | HST Scenario 1-NR500 | 70 % | G-FR1-A3-33A | pos2 | [-3.3] |
| Normal | HST Scenario 1-NR500 | 70 % | G-FR1-A4-29A | pos2 | [9.0] |
| Normal | HST Scenario 3-NR500 | 70 % | G-FR1-A3-33A | pos2 | [-3.2] |
| Normal | HST Scenario 3-NR500 | 70 % | G-FR1-A4-29A | pos2 | [9.1] |

Table 8.2.4.5-8: Test requirements for PUSCH, Type A, 10 MHz channel bandwidth, 30 kHz SCS, 500km/h

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions (Annex J) | Fraction of maximum throughput | FRC(Annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | HST Scenario 1-NR500 | 70 % | G-FR1-A3-34A | pos2 | [-3.4] |
| Normal | HST Scenario 1-NR500 | 70 % | G-FR1-A4-30A | pos2 | [8.8] |
| Normal | HST Scenario 3-NR500 | 70 % | G-FR1-A3-34A | pos2 | [-3.3] |
| Normal | HST Scenario 3-NR500 | 70 % | G-FR1-A4-30A | pos2 | [8.7] |

Table 8.2.4.5-9: Test requirements for PUSCH, Type A, 5 MHz channel bandwidth, 15 kHz SCS, multi-path fading channel

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions (Annex J) | Frequency offset (Hz) | Fraction of maximum throughput | FRC(Annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | TDLC300-600 | 0 | 70 % | G-FR1-A3-33A | pos2 | [-1.4] |

Table 8.2.4.5-10: Test requirements for PUSCH, Type A, 10 MHz channel bandwidth, 30 kHz SCS, multi-path fading channel

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions (Annex J) | Frequency offset (Hz) | Fraction of maximum throughput | FRC(Annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | TDLC300-1200 | 0 | 70 % | G-FR1-A3-34A | pos2 | [-1.2] |

######################### End of change#2 ############################

######################### Start of change#3 ############################

# A.3 Fixed Reference Channels for performance requirements (QPSK, R=193/1024)

The parameters for the reference measurement channels are specified in table A.3-2, table A.3-2A, table A.3-4 and table A.3-6 for FR1 PUSCH performance requirements:

- FRC parameters are specified in table A.3-2 for FR1 PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer.

 FRC parameters are specified in table A.3-2A for FR1 PUSCH with transform precoding disabled, additional DM-RS position = pos2 and 1 transmission layer.

- FRC parameters are specified in table A.3-4 for FR1 PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 2 transmission layers.

- FRC parameters are specified in table A.3-6 for FR1 PUSCH with transform precoding enabled, additional DM-RS position = pos1 and 1 transmission layer.

The parameters for the reference measurement channels are specified in table A.3-7 to table A.3-12 for FR2 PUSCH performance requirements:

- FRC parameters are specified in table A.3-7 for FR2 PUSCH with transform precoding disabled, additional DM-RS position = pos0 and 1 transmission layer.

- FRC parameters are specified in table A.3-8 for FR2 PUSCH with transform precoding disabled, additional DM-RS position = pos0 and 2 transmission layer.

- FRC parameters are specified in table A.3-9 for FR2 PUSCH with transform precoding enabled, additional DM-RS position = pos0 and 1 transmission layer.

- FRC parameters are specified in table A.3-10 for FR2 PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer.

- FRC parameters are specified in table A.3-11 for FR2 PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 2 transmission layer.

- FRC parameters are specified in table A.3-12 for FR2 PUSCH with transform precoding enabled, additional DM-RS position = pos1 and 1 transmission layer.

Table A.3-1: Void

Table A.3-2: FRC parameters for FR1 PUSCH performance requirements, transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer (QPSK, R=193/1024)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Reference channel | G-FR1-A3-8 | G-FR1-A3-9 | G-FR1-A3-10 | G-FR1-A3-11 | G-FR1-A3-12 | G-FR1-A3-13 | G-FR1-A3-14 |
| 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 | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK |
| Code rate (Note 2) | 193/1024 | 193/1024 | 193/1024 | 193/1024 | 193/1024 | 193/1024 | 193/1024 |
| Payload size (bits) | 1352 | 2856 | 5768 | 1320 | 2792 | 5768 | 14856 |
| Transport block CRC (bits) | 16 | 16 | 24 | 16 | 16 | 24 | 24 |
| Code block CRC size (bits) | - | - | 24 | - | - | 24 | 24 |
| Number of code blocks - C | 1 | 1 | 2 | 1 | 1 | 2 | 4 |
| Code block size including CRC (bits) (Note 2) | 1368 | 2872 | 2920 | 1336 | 2808 | 2920 | 3744 |
| Total number of bits per slot | 7200 | 14976 | 30528 | 6912 | 14688 | 30528 | 78624 |
| Total symbols per slot | 3600 | 7488 | 15264 | 3456 | 7344 | 15264 | 39312 |
| 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 [20].NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [19]. |

Table A.3-2A: FRC parameters for FR1 PUSCH performance requirements, transform precoding disabled, additional DM-RS position = pos2 and 1 transmission layer (QPSK, R=193/1024)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Reference channel | G-FR1-A3-33 | G-FR1-A3-33A | G-FR1-A3-34 | G-FR1-A3-34A |
| Subcarrier spacing [kHz] | 15 | 15 | 30 | 30 |
| Allocated resource blocks | 52 | 25 | 106 | 24 |
| Data bearing CP-OFDM Symbols per slot (Note 1) | 11 | 11 | 11 | 11 |
| Modulation | QPSK | QPSK | QPSK | QPSK |
| Code rate (Note 2) | 193/1024 | 193/1024 | 193/1024 | 193/1024 |
| Payload size (bits) | 2600 | 1256 | 5256 | 1192 |
| Transport block CRC (bits) | 16 | 16 | 24 | 16 |
| Code block CRC size (bits) | - | - | 24 | - |
| Number of code blocks - C | 1 | 1 | 2 | 1 |
| Code block size including CRC (bits) (Note 2) | 2616 | 1272 | 2664 | 1208 |
| Total number of bits per slot | 13728 | 6600 | 27984 | 6336 |
| Total resource elements per slot | 6846 | 3300 | 13992 | 3168 |
| 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 = pos2*, and *l0*= 2 or 3 for PUSCH mapping type A, as per table 6.4.1.1.3-3 of TS 38.211 [20].NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [19]. |

Table A.3-3: Void

######################### End of change#3 ############################

######################### Start of change#4 ############################

# A.4 Fixed Reference Channels for performance requirements (16QAM, R=658/1024)

The parameters for the reference measurement channels are specified in table A.4-2, table A.4-2A, table A.4-2B and table A.4-4 for FR1 PUSCH performance requirements:

- FRC parameters are specified in table A.4-2 for FR1 PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer.

- FRC parameters are specified in table A.4-2A for FR1 PUSCH with transform precoding disabled, additional DM-RS position = pos 2 and 1 transmission layer.

- FRC parameters are specified in table A.4-2B for FR1 UL timing adjustment, PUSCH with transform precoding disabled, additional DM-RS position = pos2 and 1 transmission layer.

- FRC parameters are specified in table A.4-4 for FR1 PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 2 transmission layers.

The parameters for the reference measurement channels are specified in table A.4-5 to table A.4-8 for FR2 PUSCH performance requirements:

- FRC parameters are specified in table A.4-5 for FR2 PUSCH with transform precoding disabled, additional DM-RS position = pos0 and 1 transmission layer.

- FRC parameters are specified in table A.4-6 for FR2 PUSCH with transform precoding disabled, additional DM-RS position = pos0 and 2 transmission layers.

- FRC parameters are specified in table A.4-7 for FR2 PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer.

- FRC parameters are specified in table A.4-8 for FR2 PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 2 transmission layers.

Table A.4-1: Void

Table A.4-2: FRC parameters for FR1 PUSCH performance requirements, transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer (16QAM, R=658/1024)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Reference channel | G-FR1-A4-8 | G-FR1-A4-9 | G-FR1-A4-10 | G-FR1-A4-11 | G-FR1-A4-12 | G-FR1-A4-13 | G-FR1-A4-14 |
| 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 | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Code rate (Note 2) | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 |
| Payload size (bits) | 9224 | 19464 | 38936 | 8968 | 18960 | 38936 | 100392 |
| 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 | 2 | 3 | 5 | 2 | 3 | 5 | 12 |
| Code block size including CRC (bits) (Note 2) | 4648 | 6520 | 7816 | 4520 | 6352 | 7816 | 8392 |
| Total number of bits per slot | 14400 | 29952 | 61056 | 13824 | 29376 | 61056 | 157248 |
| Total symbols per slot | 3600 | 7488 | 15264 | 3456 | 7344 | 15264 | 39312 |
| 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 [20].NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [19]. |

Table A.4-2A: FRC parameters for FR1 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos2* and 1 transmission layer (16QAM, R=658/1024)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Reference channel | G-FR1-A4-29 | G-FR1-A4-29A | G-FR1-A4-30 | G-FR1-A4-30A |
| Subcarrier spacing [kHz] | 15 | 15 | 30 | 30 |
| Allocated resource blocks | 52 | 25 | 106 | 24 |
| Data bearing CP-OFDM Symbols per slot (Note 1) | 11 | 11 | 11 | 11 |
| Modulation | 16QAM | 16QAM | 16QAM | 16QAM |
| Code rate (Note 2) | 658/1024 | 658/1024 | 658/1024 | 658/1024 |
| Payload size (bits) | 17424 | 8456 | 35856 | 8064 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | - | 24 | - |
| Number of code blocks - C | 3 | 1 | 5 | 1 |
| Code block size including CRC (bits) (Note 2) | 5840 | 8480 | 7200 | 8080 |
| Total number of bits per slot | 27456 | 13200 | 55968 | 12672 |
| Total resource elements per slot | 6846 | 3300 | 13992 | 3168 |
| 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 = pos2*, and *l0*= 2 or 3 for PUSCH mapping type A, as per table 6.4.1.1.3-3 of TS 38.211 [20].NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [19]. |

Table A.4-2B: FRC parameters for FR1 UL timing adjustment, PUSCH with transform precoding disabled, *Additional DM-RS position = pos2* and 1 transmission layer (16QAM, R=658/1024)

|  |  |  |
| --- | --- | --- |
| Reference channel | G-FR1-A4-31 | G-FR1-A4-32 |
| Subcarrier spacing [kHz] | 15 | 30 |
| Allocated resource blocks | 25 | 50 |
| Data bearing CP-OFDM Symbols per slot (Note 1) | 11 | 11 |
| Modulation | 16QAM | 16QAM |
| Code rate (Note 2) | 658/1024 | 658/1024 |
| Payload size (bits) | 8456 | 16896 |
| Transport block CRC (bits) | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 |
| Number of code blocks - C | 2 | 3 |
| Code block size including CRC (bits) (Note 2) | 4264 | 5664 |
| Total number of bits per slot | 13200 | 26400 |
| Total data bearing resource elements per slot | 3300 | 6600 |
| 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 = pos2*, and *l0* = 2 for PUSCH mapping type A, *l0* = 0 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]. |

Table A.4-3: Void

######################### End of change#4 ############################

######################### Start of change#5 ############################

## J.2.2 Combinations of channel model parameters

The propagation conditions used for the performance measurements in multi-path fading environment are indicated as a combination of a channel model name and a maximum Doppler frequency, i.e., TDLA<DS>-<Doppler>, TDLB<DS>-<Doppler> or TDLC<DS>-<Doppler> where '<DS>' indicates the desired delay spread and '<Doppler>' indicates the maximum Doppler frequency (Hz).

Table J.2.2-1 and J.2.2-2 show the propagation conditions that are used for the performance measurements in multi-path fading environment for low, medium and high Doppler frequencies for FR1 and FR2, respectively.

Table J.2.2-1: Channel model parameters for FR1

|  |  |  |
| --- | --- | --- |
| Combination name | Model | Maximum Doppler frequency |
| TDLA30-5 | TDLA30 | 5 Hz |
| TDLA30-10 | TDLA30 | 10 Hz |
| TDLB100-400 | TDLB100 | 400 Hz |
| TDLC300-100 | TDLC300 | 100 Hz |
| TDLC300-600 | TDLC300 | 600 Hz |
| TDLC300-1200 | TDLC300 | 1200 Hz |

Table J.2.2-2: Channel model parameters for FR2

|  |  |  |
| --- | --- | --- |
| Combination name | Model | Maximum Doppler frequency |
| TDLA30-75 | TDLA30 | 75 Hz |
| TDLA30-300 | TDLA30 | 300 Hz |

######################### End of change#5 ############################