**3GPP TSG-RAN WG4 Meeting #94-e****R4-2002400**

**Online, 24th February- 6th March, 2020**

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| *CR-Form-v12.0* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.141-2** | **CR** | **0170** | **rev** |  | **Current version:** |  |  |
|  | | | | | | | | |
| *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:*** | CR for TS38.141-2: Introduce PUSCH performance requirements at 30% throughput testing point | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | CATT | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_perf\_enh-Perf | | | | |  | ***Date:*** | | | 2020-02-14 |
|  |  | | | |  | |  | | |  |
| ***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 can be 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-12 (Release 12)* *Rel-13 (Release 13) Rel-14 (Release 14) Rel-15 (Release 15) Rel-16 (Release 16)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | PUSCH performance requirements at 30% throughput testing point should be added to the specification. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Add PUSCH performance requirements at 30% throughput testing point. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | PUSCH performance requirements would be incomplete. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 8.1.2.1.1, 8.2.1.5.1, 8.2.1.5.2 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  | **X** | Test specifications | | | | TS/TR … 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 requirements with 30% maximum throughput testing point shall apply only for the lowest subcarrier spacing declared to be supported (see D.14 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.

<End of Change 1>

<Start of Change 2>

## 8.2 OTA performance requirements for PUSCH

### 8.2.1 Performance requirements for PUSCH with transform precoding disabled

#### 8.2.1.1 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.

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

#### 8.2.1.2 Minimum Requirement

For *BS type 1-O*, the minimum requirement is in TS 38.104 [2], subclause11.2.1.1.

For *BS type 2-O*, the minimum requirement is in TS 38.104 [2], subclause11.2.2.1.

#### 8.2.1.3 Test purpose

The test shall verify the receiver's ability to achieve throughput under multipath fading propagation conditions for a given SNR.

#### 8.2.1.4 Method of test

##### 8.2.1.4.1 Initial conditions

Test environment: Normal, see annex B.2.

RF channels to be testedfor single carrier: M, see subclause 4.9.1.

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

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

##### 8.2.1.4.2 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 table8.2.1.4.2-1.

Table 8.2.1.4.2-1: Test parameters for testing PUSCH

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | ***BS type 1-O*** | ***BS type 2-O*** |
| Transform precoding | | Disabled | |
| Default TDD UL-DL pattern (Note 1) | | 15 kHz SCS:  3D1S1U, S=10D:2G:2U  30 kHz SCS:  7D1S2U, S=6D:4G:4U | 60 kHz and 120kHz SCS:  3D1S1U, S=10D:2G:2U |
| 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 | |
| Additional DM-RS position | pos1 | {pos0, pos1} |
| Number of DM-RS CDM group(s) without data | 2 | |
| Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB | |
| DM-RS port(s) | {0}, {0,1} | |
| DM-RS sequence generation | *NID0*=0,*nSCID*=0 | |
| Time domain resource assignment | PUSCH mapping type | A, B | B |
| Start symbol | 0 | 0 |
| Allocation length | 14 | 10 |
| Frequency domain resource assignment | RB assignment | Full applicable test bandwidth | |
| Frequency hopping | Disabled | |
| TPMI index for 2Tx two layer spatial multiplexing transmission | | 0 | |
| Code block group based PUSCH transmission | | Disabled | |
| PTRS configuration | Frequency density (*KPT-RS*) | N.A. | *2* |
| Time density (*LPT-RS*) | N.A. | 1 |
| Note 1: The same requirements are applicable to FDD and TDD with different UL-DL patterns for BS type 1-O, and the same requirements are applicable to TDD with different UL-DL patterns for BS type 2-O. | | | |

6) The multipath fading emulators shall be configured according to the corresponding channel model defined in annex J.

7) Adjust the test signal mean power so the calibrated radiated SNR value at the BS receiver is as specified in subclause8.2.1.5.1 and 8.2.1.5.2 for *BS type 1-O* and *BS type 2-O* respectively, 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 8.2.1.4.2-2.

Table 8.2.1.4.2-2: AWGN power level at the BS input

|  |  |  |  |
| --- | --- | --- | --- |
| BS type | Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| *BS type 1-O* | 15 | 5 | -86.5 - ΔOTAREFSENSdBm / 4.5 MHz |
| 10 | -83.3 - ΔOTAREFSENSdBm / 9.36 MHz |
| 20 | -80.2 - ΔOTAREFSENSdBm / 19.08 MHz |
| 30 | 10 | -83.6 - ΔOTAREFSENSdBm / 8.64 MHz |
| 20 | -80.4 - ΔOTAREFSENSdBm / 18.36 MHz |
| 40 | -77.2 - ΔOTAREFSENSdBm / 38.16 MHz |
| 100 | -73.1 - ΔOTAREFSENSdBm / 98.28 MHz |
| *BS type 2-O* | 60 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 47.52 MHz |
| 100 | EISREFSENS\_50M + ΔFR2\_REFSENS + 18 dBm / 95.04 MHz |
| 120 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 46.08 MHz |
| 100 | EISREFSENS\_50M + ΔFR2\_REFSENS + 18 dBm / 95.04 MHz |
| 200 | EISREFSENS\_50M + ΔFR2\_REFSENS + 21 dBm / 190.08 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.53 in table 4.6-1 and subclause 7.1.  NOTE 2: ΔFR2\_REFSENS = -3 dB as described in subclause 7.1, since the OTA REFSENS reference direction (as declared in D.54 in table 4.6-1) is used for testing.  NOTE 3: EISREFSENS\_50M as declared in D.28 in table 4.6-1. | | | |

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

#### 8.2.1.5 Test Requirement

##### 8.2.1.5.1 Test requirement for *BS type 1-O*

The throughput measured according to subclause 8.2.1.4.2 shall not be below the limits for the SNR levels specified in table 8.2.1.5.1-1 to table 8.2.1.5.1-14 for 1Tx and for 2Tx two layer spatial multiplexing transmission.

Table 8.2.1.5.1-1: Test requirements for PUSCH, Type A, 5 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditionsand correlation matrix (annex J) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-8 | pos1 | -1.7 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-8 | pos1 | 10.7 |
| 30 % | G-FR1-A4-8 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-8 | pos1 | 12.9 |
| 2 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-22 | pos1 | 1.8 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-22 | pos1 | 19.0 |

Table 8.2.1.5.1-2: Test requirements for PUSCH, Type A, 10 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditionsand correlation matrix (annex J) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-9 | pos1 | -1.9 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-9 | pos1 | 10.8 |
| 30 % | G-FR1-A4-8 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-9 | pos1 | 12.8 |
| 2 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-23 | pos1 | 2.5 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-23 | pos1 | 19.1 |

Table 8.2.1.5.1-3: Test requirements for PUSCH, Type A, 20 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditionsand correlation matrix (annex J) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-10 | pos1 | -1.5 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-10 | pos1 | 10.6 |
| 30 % | G-FR1-A4-8 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-10 | pos1 | 13.0 |
| 2 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-24 | pos1 | 2.9 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-24 | pos1 | 19.1 |

Table 8.2.1.5.1-4: Test requirements for PUSCH, Type A, 10 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditionsand correlation matrix (annex J) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-11 | pos1 | -1.7 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-11 | pos1 | 10.8 |
| 30 % | G-FR1-A4-11 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-11 | pos1 | 13.4 |
| 2 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-25 | pos1 | 2.1 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-25 | pos1 | 19.2 |

Table 8.2.1.5.1-5: Test requirements for PUSCH, Type A, 20 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditionsand correlation matrix (annex J) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-12 | pos1 | -2.3 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-12 | pos1 | 10.8 |
| 30 % | G-FR1-A4-11 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-12 | pos1 | 13.1 |
| 2 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-26 | pos1 | 2.1 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-26 | pos1 | 18.9 |

Table 8.2.1.5.1-6: Test requirements for PUSCH, Type A, 40 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditionsand correlation matrix (annex J) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-13 | pos1 | -1.9 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-13 | pos1 | 10.6 |
| 30 % | G-FR1-A4-11 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-13 | pos1 | 13.0 |
| 2 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-27 | pos1 | 2.1 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-27 | pos1 | 20.3 |

Table 8.2.1.5.1-7: Test requirements for PUSCH, Type A, 100 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditionsand correlation matrix (annex J) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-14 | pos1 | -2.2 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-14 | pos1 | 10.8 |
| 30 % | G-FR1-A4-11 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-14 | pos1 | 13.6 |
| 2 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-28 | pos1 | 2.2 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-28 | pos1 | 20.0 |

Table 8.2.1.5.1-8: Test requirements for PUSCH, Type B, 5 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditionsand correlation matrix (annex J) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-8 | pos1 | -1.7 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-8 | pos1 | 10.8 |
| 30 % | G-FR1-A4-8 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-8 | pos1 | 13.1 |
| 2 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-22 | pos1 | 2.3 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-22 | pos1 | 19.1 |

Table 8.2.1.5.1-9: Test requirements for PUSCH, Type B, 10 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditionsand correlation matrix (annex J) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-9 | pos1 | -1.7 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-9 | pos1 | 11.1 |
| 30 % | G-FR1-A4-8 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-9 | pos1 | 13.2 |
| 2 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-23 | pos1 | 2.8 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-23 | pos1 | 19.5 |

Table 8.2.1.5.1-10: Test requirements for PUSCH, Type B, 20 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditionsand correlation matrix (annex J) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-10 | pos1 | -1.5 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-10 | pos1 | 11.0 |
| 30 % | G-FR1-A4-8 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-10 | pos1 | 12.9 |
| 2 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-24 | pos1 | 2.4 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-24 | pos1 | 18.9 |

Table 8.2.1.5.1-11: Test requirements for PUSCH, Type B, 10 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditionsand correlation matrix (annex J) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-11 | pos1 | -1.8 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-11 | pos1 | 10.7 |
| 30 % | G-FR1-A4-11 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-11 | pos1 | 13.1 |
| 2 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-25 | pos1 | 1.9 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-25 | pos1 | 19.3 |

Table 8.2.1.5.1-12: Test requirements for PUSCH, Type B, 20 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditionsand correlation matrix (annex J) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-12 | pos1 | -2.3 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-12 | pos1 | 10.7 |
| 30 % | G-FR1-A4-11 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-12 | pos1 | 13.1 |
| 2 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-26 | pos1 | 2.1 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-26 | pos1 | 19.0 |

Table 8.2.1.5.1-13: Test requirements for PUSCH, Type B, 40 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditionsand correlation matrix (annex J) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-13 | pos1 | -1.9 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-13 | pos1 | 10.6 |
| 30 % | G-FR1-A4-11 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-13 | pos1 | 13.1 |
| 2 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-27 | pos1 | 2.5 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-27 | pos1 | 19.5 |

Table 8.2.1.5.1-14: Test requirements for PUSCH, Type B, 100 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditionsand correlation matrix (annex J) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-14 | pos1 | -1.9 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-14 | pos1 | 10.7 |
| 30 % | G-FR1-A4-11 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-14 | pos1 | 13.7 |
| 2 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-28 | pos1 | 2.4 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-28 | pos1 | 20.1 |

NOTE: If the above Test Requirement differs from the Minimum Requirement then the Test Tolerance applied for this test is non-zero. The Test Tolerance for this test and the explanation of how the Minimum Requirement has been relaxed by the Test Tolerance is given in annex C.

##### 8.2.1.5.2 Test requirement for *BS type 2-O*

The throughput measured according to subclause 8.2.1.4.2 shall not be below the limits for the SNR levels specified in table 8.2.1.5.2-1 to 8.2.1.5.2-5.

Table 8.2.1.5.2-1: Test requirements for PUSCH, 50 MHz Channel Bandwidth, 60 kHz SCS

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | PT-RS | SNR  (dB) |
| 1 | 2 | Normal | TDLA30-300 Low | 70 % | G-FR2-A3-1 | pos0 | No | -1.4 |
| G-FR2-A3-13 | pos1 | No | -1.6 |
| Normal | TDLA30-300 Low | 70 % | G-FR2-A4-1 | pos0 | Yes | 12.6 |
| No | 12.1 |
| G-FR2-A4-11 | pos1 | Yes | 11.3 |
| No | 11.3 |
| 30 % | G-FR2-A4-1 | pos0 | Yes | [TBD] |
| No | [TBD] |
| G-FR2-A4-11 | pos1 | Yes | [TBD] |
| No | [TBD] |
| Normal | TDLA30-75 Low | 70 % | G-FR2-A5-1 | pos0 | Yes | 14.3 |
| No | 13.7 |
| G-FR2-A5-6 | pos1 | Yes | 14.0 |
| No | 13.5 |
| 2 | Normal | TDLA30-300 Low | 70 % | G-FR2-A3-6 | pos0 | No | 2.3 |
| G-FR2-A3-18 | pos1 | No | 2.0 |
| G-FR2-A4-16 | pos1 | Yes | N/A |
| No | 18.9 |

Table 8.2.1.5.2-2: Test requirements for PUSCH, 100 MHz Channel Bandwidth, 60 kHz SCS

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | PT-RS | SNR  (dB) |
| 1 | 2 | Normal | TDLA30-300 Low | 70 % | G-FR2-A3-2 | pos0 | No | -1.5 |
| G-FR2-A3-14 | pos1 | No | -1.8 |
| Normal | TDLA30-300 Low | 70 % | G-FR2-A4-2 | pos0 | Yes | 12.8 |
| No | 11.8 |
| G-FR2-A4-12 | pos1 | Yes | 11.8 |
| No | 11.2 |
| 30 % | G-FR2-A4-1 | pos0 | Yes | [TBD] |
| No | [TBD] |
| G-FR2-A4-11 | pos1 | Yes | [TBD] |
| No | [TBD] |
| Normal | TDLA30-75 Low | 70 % | G-FR2-A5-2 | pos0 | Yes | 14.8 |
| No | 13.9 |
| G-FR2-A5-7 | pos1 | Yes | 14.3 |
| No | 13.7 |
| 2 | Normal | TDLA30-300 Low | 70 % | G-FR2-A3-7 | pos0 | No | 2.3 |
| G-FR2-A3-19 | pos1 | No | 2.0 |
| G-FR2-A4-17 | pos1 | Yes | 19.6 |
| No | 19.1 |

Table 8.2.1.5.2-3: Test requirements for PUSCH, 50 MHz Channel Bandwidth, 120 kHz SCS

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | PT-RS | SNR  (dB) |
| 1 | 2 | Normal | TDLA30-300 Low | 70 % | G-FR2-A3-3 | pos0 | No | -1.2 |
| G-FR2-A3-15 | pos1 | No | -1.5 |
| Normal | TDLA30-300 Low | 70 % | G-FR2-A4-3 | pos0 | Yes | 12.2 |
| No | 11.5 |
| G-FR2-A4-13 | pos1 | Yes | 11.5 |
| No | 11.1 |
| 30 % | G-FR2-A4-3 | pos0 | Yes | [TBD] |
| No | [TBD] |
| G-FR2-A4-13 | pos1 | Yes | [TBD] |
| No | [TBD] |
| Normal | TDLA30-75 Low | 70 % | G-FR2-A5-3 | pos0 | Yes | 14.3 |
| No | 13.7 |
| G-FR2-A5-8 | pos1 | Yes | 13.8 |
| No | 13.6 |
| 2 | Normal | TDLA30-300 Low | 70 % | G-FR2-A3-8 | pos0 | No | 2.2 |
| G-FR2-A3-20 | pos1 | No | 2.1 |
| Normal | TDLA30-300 Low | 70 % | G-FR2-A4-8 | pos0 | Yes | N/A |
| No | 19.4 |
| G-FR2-A4-18 | Pos1 | Yes | N/A |
| No | 18.4 |

Table 8.2.1.5.2-4: Test requirements for PUSCH, 100 MHz Channel Bandwidth, 120 kHz SCS

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | PT-RS | SNR  (dB) |
| 1 | 2 | Normal | TDLA30-300 Low | 70 % | G-FR2-A3-4 | pos0 | No | -1.8 |
| G-FR2-A3-16 | pos1 | No | -1.9 |
| Normal | TDLA30-300 Low | 70 % | G-FR2-A4-4 | pos0 | Yes | 12.5 |
| No | 11.1 |
| G-FR2-A4-14 | pos1 | Yes | 11.7 |
| No | 11.1 |
| 30 % | G-FR2-A4-3 | pos0 | Yes | [TBD] |
| No | [TBD] |
| G-FR2-A4-13 | pos1 | Yes | [TBD] |
| No | [TBD] |
| Normal | TDLA30-75 Low | 70 % | G-FR2-A5-4 | pos0 | Yes | 14.1 |
| No | 13.5 |
| G-FR2-A5-9 | pos1 | Yes | 14.0 |
| No | 13.4 |
| 2 | Normal | TDLA30-300 Low | 70 % | G-FR2-A3-9 | pos0 | No | 2.2 |
| G-FR2-A3-21 | pos1 | No | 2.0 |
| Normal | TDLA30-300 Low | 70 % | G-FR2-A4-9 | pos0 | Yes | N/A |
| No | N/A |
| G-FR2-A4-19 | pos1 | Yes | 19.3 |
| No | 18.8 |

Table 8.2.1.5.2-5: Test requirements for PUSCH, 200 MHz Channel Bandwidth, 120 kHz SCS

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | PT-RS | SNR  (dB) |
| 1 | 2 | Normal | TDLA30-300 Low | 70 % | G-FR2-A3-5 | pos0 | No | -1.5 |
| G-FR2-A3-17 | pos1 | No | -1.8 |
| Normal | TDLA30-300 Low | 70 % | G-FR2-A4-5 | pos0 | Yes | 11.9 |
| No | 11.5 |
| G-FR2-A4-15 | pos1 | Yes | 11.8 |
| No | 11.3 |
| 30 % | G-FR2-A4-3 | pos0 | Yes | [TBD] |
| No | [TBD] |
| G-FR2-A4-13 | pos1 | Yes | [TBD] |
| No | [TBD] |
| Normal | TDLA30-75 Low | 70 % | G-FR2-A5-5 | pos0 | Yes | 14.7 |
| No | 14.0 |
| G-FR2-A5-10 | pos1 | Yes | 14.3 |
| No | 13.9 |
| 2 | Normal | TDLA30-300 Low | 70 % | G-FR2-A3-10 | pos0 | No | 2.2 |
| G-FR2-A3-22 | pos1 | No | 1.9 |
| Normal | TDLA30-300 Low | 70 % | G-FR2-A4-10 | pos0 | Yes | N/A |
| No | N/A |
| G-FR2-A4-20 | pos1 | Yes | 19.8 |
| No | 19.0 |

NOTE: If the above Test Requirement differs from the Minimum Requirement then the Test Tolerance applied for this test is non-zero. The Test Tolerance for this test and the explanation of how the Minimum Requirement has been relaxed by the Test Tolerance is given in annex C.

<End of Change 2>