**3GPP TSG-<TSG/WG> Meeting # 104-bis-e *R4-2216020***

**Electronic Meeting, Oct 10th – 19th , 2022**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **TS 38.141-2** | **CR** | **<CR#>** | **rev** | **1** | **Current version:** | **17.7.0** |  |
|  | | | | | | | | |
| *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:*** | Introduction of FR2-2 PUSCH conformance testing requirements | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Huawei.HiSilicon | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_ext\_to\_71GHz-Perf | | | | |  | ***Date:*** | | | 2022-09-30 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-17 |
|  | *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-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | It’s time to submit the FR2-2 PUSCH conformance testing requirements in this meeting. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Introduce FR2-2 PUSCH conformance testing requirments in TS 38.141-2 | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | The requirements will be missing | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 8.2.1.5 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **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:*** | |  | | | | | | | | |

## 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 clause 8.1.2.1.

#### 8.2.1.2 Minimum Requirement

For *BS type 1-O*, the minimum requirement is in TS 38.104 [2], clause 11.2.1.1.

For *BS type 2-O*, the minimum requirement is in TS 38.104 [2], clause 11.2.2.1.

#### 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 tested for single carrier: 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).

##### 8.2.1.4.2 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 table 8.2.1.4.2-1.

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  480kHz SCS:14D2S4U,S1=12D:2G0U,S2=0D:6G:8U |
| 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 | PUSCH mapping type | A, B | B |
| domain | Start symbol | 0 | 0 |
| resource assignment | Allocation length | 14 | 10 |
| Frequency | RB assignment | Full applicable test bandwidth | |
| domain resource assignment | Frequency hopping | Disabled | |
| TPMI index for 2Tx two layer spatial multiplexing transmission | | 0 | |
| Code block group based PUSCH transmission | | Disabled | |
| PTRS | Frequency density (*KPT-RS*) | N.A. | *2*, Disabled |
| configuration | Time density (*LPT-RS*) | N.A. | 1, Disabled |
| 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 clause 8.2.1.5.1 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  (Note 4) | 15 | 5 | -86.5 - ΔOTAREFSENS dBm / 4.5 MHz |
|  |  | 10 | -83.3 - ΔOTAREFSENS dBm / 9.36 MHz |
|  |  | 20 | -80.2 - ΔOTAREFSENS dBm / 19.08 MHz |
|  | 30 | 10 | -83.6 - ΔOTAREFSENS dBm / 8.64 MHz |
|  |  | 20 | -80.4 - ΔOTAREFSENS dBm / 18.36 MHz |
|  |  | 40 | -77.2 - ΔOTAREFSENS dBm / 38.16 MHz |
|  |  | 100 | -73.1 - ΔOTAREFSENS dBm / 98.28 MHz |
| BS type 2-O (Note 5) | 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 |
| 480 | 400 | TBD |
| NOTE 1: ΔOTAREFSENS as declared in D.53 in table 4.6-1 and clause 7.1.  NOTE 2: ΔFR2\_REFSENS = -3 dB as described in clause 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.  NOTE 4: The AWGN power level contains an AWGN offset of 16dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 16dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level.  NOTE 5: The AWGN power level contains an AWGN offset of 15dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 15dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level. | | | |

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*

***<Unchanged skipped>***

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

The throughput measured according to clause 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 8.2.1.5.2-10.

Table 8.2.1.5.2-1: Test requirements for PUSCH with 70% of maximum throughput, 50 MHz Channel Bandwidth, 60 kHz SCS in FR2-1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 |
|  |  | 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 |
|  |  | Normal | TDLA30-300 Low | 70 % | G-FR2-A7-1 | pos0 | Yes | 16.0 |
|  |  |  |  |  |  |  | No | 15.1 |
|  |  |  |  |  | G-FR2-A7-6 | pos1 | Yes | 14.6 |
|  |  |  |  |  |  |  | No | 13.8 |

Table 8.2.1.5.2-2: Test requirements for PUSCH with 70% of maximum throughput, 100 MHz Channel Bandwidth, 60 kHz SCS in FR2-1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 |
|  |  | 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 |
|  |  | Normal | TDLA30-300 Low | 70 % | G-FR2-A7-2 | pos0 | Yes | 16.8 |
|  |  |  |  |  |  |  | No | 15.7 |
|  |  |  |  |  | G-FR2-A7-7 | pos1 | Yes | 14.6 |
|  |  |  |  |  |  |  | No | 13.9 |

Table 8.2.1.5.2-3: Test requirements for PUSCH with 70% of maximum throughput, 50 MHz Channel Bandwidth, 120 kHz SCS in FR2-1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 |
|  |  | 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-A7-3 | pos0 | Yes | 15.0 |
|  |  |  |  |  |  |  | No | 14.4 |
|  |  |  |  |  | G-FR2-A7-8 | Pos1 | Yes | 14.7 |
|  |  |  |  |  |  |  | No | 13.9 |

Table 8.2.1.5.2-4: Test requirements for PUSCH with 70% of maximum throughput, 100 MHz Channel Bandwidth, 120 kHz SCS in FR2-1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 |
|  |  | 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-A7-4 | pos0 | Yes | 14.7 |
|  |  |  |  |  |  |  | No | 14.0 |
|  |  |  |  |  | G-FR2-A7-9 | pos1 | Yes | 14.3 |
|  |  |  |  |  |  |  | No | 13.7 |

Table 8.2.1.5.2-5: Test requirements for PUSCH with 70% of maximum throughput, 200 MHz Channel Bandwidth, 120 kHz SCS in FR2-1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 |
|  |  | 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-A7-5 | pos0 | Yes | 14.8 |
|  |  |  |  |  |  |  | No | 14.1 |
|  |  |  |  |  | G-FR2-A7-10 | pos1 | Yes | 14.4 |
|  |  |  |  |  |  |  | No | 13.8 |

Table 8.2.1.5.2-6: Test requirements for PUSCH with 30% of maximum throughput, 50 MHz channel bandwidth, 60 kHz SCS in FR2-1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | 30 % | G-FR2-A4-1 | pos0 | Yes | 4.6 |
|  |  |  |  |  |  |  | No | 4.1 |
|  |  |  |  |  | G-FR2-A4-11 | pos1 | Yes | 4.3 |
|  |  |  |  |  |  |  | No | 3.7 |

Table 8.2.1.5.2-7: Test requirements for PUSCH with 30% of maximum throughput, 50 MHz channel bandwidth, 120 kHz SCS in FR2-1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | 30 % | G-FR2-A4-3 | pos0 | Yes | 4.6 |
|  |  |  |  |  |  |  | No | 4.2 |
|  |  |  |  |  | G-FR2-A4-13 | pos1 | Yes | 4.3 |
|  |  |  |  |  |  |  | No | 3.8 |

Table 8.2.1.5.2-8: Test requirements for PUSCH with 70% of maximum throughput, 100 MHz Channel Bandwidth, 120 kHz SCS in FR2-2

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | TDLA30-650 | 70 % | TBD | pos1 | [No] | TBD |
|  |  | Normal | TDLA30-650 | 70 % | TBD | pos1 | Yes | TBD |
|  |  | Normal | TDLD30-200 | 70 % | TBD | pos1 | Yes | TBD |
| 2 |  | Normal | TDLA30-650 | 70 % | TBD | pos1 | [No] | TBD |
|  |  | Normal | [TDLA30-650] | 70 % | TBD | pos1 | Yes | TBD |
|  |  | Normal | TDLD30-200 | 70 % | TBD | pos1 | Yes | TBD |

Table 8.2.1.5.2-9: Test requirements for PUSCH with 70% of maximum throughput, 400 MHz Channel Bandwidth, 120 kHz SCS in FR2-2

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | TDLA10-650 | 70 % | TBD | pos1 | [No] | TBD |
|  |  | Normal | TDLA10-650 | 70 % | TBD | pos1 | Yes | TBD |
|  |  | Normal | TDLD10-200 | 70 % | TBD | pos1 | Yes | TBD |
| 2 |  | Normal | TDLA10-650 | 70 % | TBD | pos1 | [No] | TBD |
|  |  | Normal | [TDLA10-650] | 70 % | TBD | pos1 | Yes | TBD |
|  |  | Normal | TDLD10-200 | 70 % | TBD | pos1 | Yes | TBD |

Table 8.2.1.5.2-10: Test requirements for PUSCH with 70% of maximum throughput, 400 MHz Channel Bandwidth, 480 kHz SCS in FR2-2

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | TDLA10-650 | 70 % | TBD | pos1 | [No] | TBD |
|  |  | Normal | TDLA10-650 | 70 % | TBD | pos1 | Yes | TBD |
|  |  | Normal | TDLD10-200 | 70 % | TBD | pos1 | Yes | TBD |
| 2 |  | Normal | TDLA10-650 | 70 % | TBD | pos1 | [No] | TBD |
|  |  | Normal | [TDLA10-650] | 70 % | TBD | pos1 | Yes | TBD |
|  |  | Normal | TDLD10-200 | 70 % | TBD | pos1 | Yes | TBD |

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.

### 8.2.2 Performance requirements for PUSCH with transform precoding enabled

#### 8.2.2.1 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 clause 8.1.2.

#### 8.2.2.2 Minimum Requirement

For *BS type 1-O*, the minimum requirement is in TS 38.104 [2], clause 11.2.1.2.

For *BS type 2-O*, the minimum requirement is in TS 38.104 [2], clause 11.2.2.2.

#### 8.2.2.3 Test Purpose

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

#### 8.2.2.4 Method of test

##### 8.2.2.4.1 Initial Conditions

Test environment: Normal, see clause B.2.

RF channels to be tested for single carrier: M, see clause 4.9.1.

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

##### 8.2.2.4.2 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 8.2.2.4.2-1.

Table 8.2.2.4.2-1: Test parameters for testing PUSCH

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | BS type 1-O | BS type 2-O |
| Transform precoding | | Enabled | |
| 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  480kHz SCS:14D2S4U,S1=12D:2G0U,S2=0D:6G:8U |
| 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 | |
|  | DM-RS sequence generation | *NID*0=0, group hopping and sequence hopping are disabled | |
| Time | PUSCH mapping type | A, B | B |
| domain | Start symbol | 0 | 0 |
| resource assignment | Allocation length | 14 | 10 |
| Frequency domain resource assignment | RB assignment | 15 kHz SCS: 25 PRBs in the middle of the test bandwidth  30 kHz SCS: 24 PRBs in the middle of the test bandwidth | 30 PRBs in the middle of the test bandwidth |
|  | Frequency hopping | Disabled | |
| Code block group based PUSCH transmission | | Disabled | |
| PT-RS | | Not configured | |
| 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 clause 8.2.2.5.1 and 8.2.2.5.2 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 8.2.2.4.2-2.

Table 8.2.2.4.2-2: AWGN power level at the BS input

|  |  |  |  |
| --- | --- | --- | --- |
| BS type | Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| *BS type 1-O* (Note 4) | 15 | 5 | -86.5 - ΔOTAREFSENS dBm / 4.5 MHz |
|  | 30 | 10 | -83.6 - ΔOTAREFSENS dBm / 8.64 MHz |
| *BS type 2-O* (Note 5) | 60 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 47.52MHz |
| 120 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 46.08 MHz |
| 480 | 400 | TBD |
| NOTE 1: ΔOTAREFSENS as declared in D.53 in table 4.6-1 and clause 7.1.  NOTE 2: ΔFR2\_REFSENS = -3 dB as described in clause 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.  NOTE 4: The AWGN power level contains an AWGN offset of 16dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 16dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level.  NOTE 5: The AWGN power level contains an AWGN offset of 15dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 15dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level. | | | |

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

#### 8.2.2.5 Test Requirement

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

The throughput measured according to clause 8.2.2.4.2 shall not be below the limits for the SNR levels specified in table 8.2.2.5.1-1 to table 8.2.2.5.1-4.

Table 8.2.2.5.1-1: Test requirements for PUSCH with 70% of maximum throughput, Type A, 5 MHz channel bandwidth, 15 kHz SCS in FR2-1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and 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-A3-31 | pos1 | -1.8 |

Table 8.2.2.5.1-2: Test requirements for PUSCH with 70% of maximum throughput, Type A, 10 MHz channel bandwidth, 30 kHz SCS in FR2-1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and 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-A3-32 | pos1 | -1.9 |

Table 8.2.2.5.1-3: Test requirements for PUSCH with 70% of maximum throughput, Type B, 5 MHz channel bandwidth, 15 kHz SCS in FR2-1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and 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-A3-31 | pos1 | -1.7 |

Table 8.2.2.5.1-4: Test requirements for PUSCH with 70% of maximum throughput, Type B, 10 MHz channel bandwidth, 30 kHz SCS in FR2-1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and 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-A3-32 | pos1 | -2.1 |

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

The throughput measured according to clause 8.2.2.4.2 shall not be below the limits for the SNR levels specified in table 8.2.2.5.2-1 to table 8.2.2.5.2-2.

Table 8.2.2.5.2-1: Test requirements for PUSCH with 70% of maximum throughput, Type B, 50 MHz channel bandwidth, 60 kHz SCS in FR2-1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix  (annex J) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLA30-300 Low | 70 % | G-FR2-A3-11 | Pos0 | -1.2 |
|  |  |  |  |  | G-FR2-A3-23 | pos1 | -1.3 |

Table 8.2.2.5.2-2: Test requirements for PUSCH with 70% of maximum throughput, Type B, 50 MHz channel bandwidth, 120 kHz SCS in FR2-1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix  (annex J) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLA30-300 Low | 70 % | G-FR2-A3-12 | Pos0 | -1.2 |
|  |  |  |  |  | G-FR2-A3-24 | pos1 | -1.3 |

Table 8.2.2.5.2-1: Test requirements for PUSCH with 70% of maximum throughput, Type B, 100 MHz channel bandwidth, 120 kHz SCS in FR2-2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix  (annex J) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLA30-650 Low | 70 % | TBD | pos1 | TBD |

Table 8.2.2.5.2-2: Test requirements for PUSCH with 70% of maximum throughput, Type B, 400 MHz channel bandwidth, 480 kHz SCS in FR2-2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix  (annex J) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLA10-650 Low | 70 % | TBD | pos1 | TBD |