**3GPP TSG-RAN4 Meeting #113 *R4-2418937***

**Orlando, USA, 18th - 22nd, November, 2024**

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| *CR-Form-v12.3* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.181** | **CR** | **0051** | **rev** | **1** | **Current version:** | **18.3.0** |  |
|  | | | | | | | | |
| *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:*** | CR on performance requirements for PUSCH in TS 38.181 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Samsung, Nokia | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_NTN\_enh-Perf | | | | |  | ***Date:*** | | | 2024-11-06 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **F** |  | | | | | ***Release:*** | | | Rel-18 |
|  | *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-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)  Rel-20 (Release 20)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | The performance part of Rel-18 NTN enhanced WI was completed in RAN4#111 meeting, the big CR has been implemented into the spec.  -The current requirement was captured with [].  -The refered clause number in minimum requirement is not ok and align with core spec 108  - The format of test requirement clause is not aligned with other channel, where two sub-sections are inlcuded to differentiate SAN type 1-O and SAN type 2-O | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | * Add new sections under test requirement section for SAN type 1-O and 2-O, and update the related table index * Remove [] for requirement * Remove [] for Propagation conditions and correlation matrix * Correct the clause number in mimimum requirement section | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | The OTA performacne requirement can not be verified well | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 11.2 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **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:*** | | Revison of R4-2418937 with merging R4-2417557 | | | | | | | | |

<Start of Change 1>

### 8.2.5 Performance requirements for PUSCH with DMRS bundling

#### 8.2.5.1 Definition and applicability

The performance requirement of PUSCH with DMRS bundling 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 SAN is based on the test applicability rules defined in clause 8.1.2.9.

#### 8.2.5.2 Minimum Requirement

The minimum requirement is in TS 38.108 [2] clause 8.2.5.

#### 8.2.5.3 Test Purpose

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

#### 8.2.5.4 Method of test

##### 8.2.5.4.1 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.

##### 8.2.5.4.2 Procedure

1) Connect the SAN tester generating the wanted signal, multipath fading simulators and AWGN generators to all SAN TAB connectors for diversity reception via a combining network as shown in annex D.6 for *SAN type 1-H*.

2) Adjust the AWGN generator, according to the channel bandwidth, defined in table 8.2.5.4.2-1.

Table 8.2.5.4.2-1: AWGN power level at the SAN input

|  |  |  |
| --- | --- | --- |
| Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| 15kHz | 5 | -86.5 dBm / 4.5MHz |
| 30kHz | 10 | -83.6 dBm / 8.64MHz |
| NOTE: 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. | | |

3) The characteristics of the wanted signal shall be configured according to the corresponding UL reference measurement channel defined in annex A and the test parameters in table 8.2.5.4.2-2.

Table 8.2.5.4.2-2: Test parameters for testing PUSCH with DMRS bundling

|  |  |  |
| --- | --- | --- |
| Parameter | | Value |
| Transform precoding | | Disabled |
| HARQ | Maximum number of HARQ transmissions | 4 |
| RV sequence (Note 1) | 0,0,0,0 |
| DM-RS | DM-RS configuration type | 1 |
| DM-RS duration | single-symbol DM-RS |
| Additional DM-RS position | pos1 |
| Number of DM-RS CDM group(s) without data | 2 |
| Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB |
| DM-RS port(s) | {0} |
| DM-RS sequence generation | NID0=0, nSCID =0 |
| Time domain resource assignment | PUSCH mapping type | A, B |
| Start symbol | 0 |
| Allocation length | 14 |
| PUSCH aggregation factor | n4 for 15kHz SCS  n8 for 30kHz SCS |
| pusch-TimeDomainWindowLength | | 4 for 15kHz SCS  8 for 30kHz SCS |
| Frequency domain resource assignment | RB assignment | 6 RBs in the middle of the channel bandwidth |
| Frequency hopping | Disabled |
| Code block group based PUSCH transmission | | Disabled |
| NOTE 1: The effective RV sequence is {0, 2, 3, 1} with slot aggregation. | | |

4) The multipath fading emulators shall be configured according to the corresponding channel model defined in annex G.2.

5) Adjust the equipment so that required SNR specified in table 8.2.5.5-1 to table 8.2.5.5-4 is achieved at the SAN input.

6) For each of the reference channels in table 8.2.5.5-1 to table 8.2.5.5-4 applicable for the base station, measure the throughput.

#### 8.2.5.5 Test Requirement

The throughput measured according to clause 8.2.5.4.2 shall not be below the limits for the SNR levels specified in table 8.2.5.5-1 to table 8.2.5.5-4.

Table 8.2.5.5-1: Test requirements for PUSCH with 70% of maximum throughput, Type A, 5 MHz channel bandwidth, FR1-NTN, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex G) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-7 | pos1 | -0.1 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-7 | pos1 | -3.6 |

Table 8.2.5.5-2: Test requirements for PUSCH with 70% of maximum throughput, Type A, 10 MHz channel bandwidth, FR1-NTN, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex G) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-8 | pos1 | -2.9 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-8 | pos1 | -6.1 |

Table 8.2.5.5-3: Test requirements for PUSCH with 70% of maximum throughput, Type B, 5 MHz channel bandwidth, FR1-NTN, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex G) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-7 | pos1 | -0.0 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-7 | pos1 | -3.5 |

Table 8.2.5.5-4: Test requirements for PUSCH with 70% of maximum throughput, Type B, 10 MHz channel bandwidth, FR1-NTN, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex G) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-8 | pos1 | -2.8 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-8 | pos1 | -6.1 |

<End of Change 1>

<Start of Change 2>

## 11.2 OTA performance requirements for PUSCH

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

#### 11.2.1.1 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 SAN is based on the test applicability rules defined in clause 11.1.3.

#### 11.2.1.2 Minimum Requirement

For *SAN type 1-O*, the minimum requirement is in TS 38.108 [2] clause 11.2.1.1.

For *SAN type 2-O*, the minimum requirement is in TS 38.108 [2] clause 11.2.2.1.

#### 11.2.1.3 Test Purpose

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

#### 11.2.1.4 Method of test

##### 11.2.1.4.1 Initial Conditions

Test environment: Normal, see annex B.2.

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

Direction to be tested: OTA REFSENS *receiver target reference direction* (see D.44 in table 4.6-1).

##### 11.2.1.4.2 Procedure

1) Place the SAN with its manufacturer declared coordinate system reference point in the same place as calibrated point in the test system, as shown in annex D.7.

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

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

4) Connect the SAN 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 D.7. 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 11.2.1.4.2-1.

Table 11.2.1.4.2-1: Test parameters for testing PUSCH

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Value** | |
| Transform precoding | | SAN type 1-O | SAN type 2-O |
| 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 | |
| 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 resource assignment | PUSCH mapping type | A, B | B |
| Start symbol | 0 | |
| Allocation length | 14 | 10 |
| Frequency domain resource assignment | RB assignment | Full applicable test bandwidth | |
| Frequency hopping | Disabled | |
| Code block group based PUSCH transmission | | Disabled | |
| Frequency domain resource assignment | RB assignment | N.A. | Disabled |
|  | Frequency hopping | N.A. | Disabled |

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

7) Adjust the test signal mean power so the calibrated radiated SNR value at the SAN receiver is as specified in clause 11.2.1.5 and clause 11.2.1.6for *SAN type 1-O* and *SAN type 2-O* respectively, and that the SNR at the SAN 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 11.2.1.4.2-2.

Table 11.2.1.4.2-2: AWGN power level at the SAN input

|  |  |  |  |
| --- | --- | --- | --- |
| SAN type | Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| 1-O  (Note 2) | 15 | 5 | -86.5 - ΔOTAREFSENS dBm / 4.5 MHz |
| 30 | 10 | -83.6 - ΔOTAREFSENS dBm / 8.64 MHz |
| 2-O (Note 5) | 120 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 46.08 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.43 in table 4.6-1 and clause 10.1  [NOTE 2: 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 3: ΔFR2\_REFSENS = -3 dB as described in clause 10.1, since the OTA REFSENS reference direction (as declared in D.43 in table 4.6-1) is used for testing.  NOTE 4: EISREFSENS\_50M as declared in D.xx in table 4.6-1.  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 SAN, measure the throughput.

#### 11.2.1.5 Test Requirement

##### 11.2.1.5.1 Test Requirement for *SAN type 1-O*

The throughput measured according to clause 11.2.1.4.2 shall not be below the limits for the SNR levels specified in table 11.2.1.5.1-1 to 11.2.1.5.1-4.

Table 11.2.1.5.1-1: Test requirements for PUSCH with 70% of maximum throughput, Type A, 5 MHz channel bandwidth, 15 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-1 | pos1 | 3.8 |
| Normal | NTN-TDLC5-200 Low | 70 % | G-FR1-NTN-A3-1 | pos1 | 2.2 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-1 | pos1 | -0.1 |
| Normal | NTN-TDLC5-200 Low | 70% | G-FR1-NTN-A3-1 | pos1 | -0.6 |

Table 11.2.1.5.1-2: Test requirements for PUSCH with 70% of maximum throughput, Type A, 10 MHz channel bandwidth, 30 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-2 | pos1 | 3.5 |
| Normal | NTN-TDLC5-200 Low | 70 % | G-FR1-NTN-A3-2 | pos1 | 2.0 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-2 | pos1 | -0.4 |
| Normal | NTN-TDLC5-200 Low | 70% | G-FR1-NTN-A3-2 | pos1 | -0.8 |

Table 11.2.1.5.1-3: Test requirements for PUSCH with 70% of maximum throughput, Type B, 5 MHz channel bandwidth, 15 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-1 | pos1 | 3.9 |
| Normal | NTN-TDLC5-200 Low | 70 % | G-FR1-NTN-A3-1 | pos1 | 2.2 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-1 | pos1 | 0.0 |
| Normal | NTN-TDLC5-200 Low | 70% | G-FR1-NTN-A3-1 | pos1 | -0.6 |

Table 11.2.1.5.1-4: Test requirements for PUSCH with 70% of maximum throughput, Type B, 10 MHz channel bandwidth, 30 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-2 | pos1 | 3.5 |
| Normal | NTN-TDLC5-200 Low | 70 % | G-FR1-NTN-A3-2 | pos1 | 1.9 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-2 | pos1 | -0.4 |
| Normal | NTN-TDLC5-200 Low | 70% | G-FR1-NTN-A3-2 | pos1 | -0.8 |

##### 11.2.1.5.2 Test Requirement for *SAN type 2-O*

The throughput measured according to clause 11.2.1.4.2 shall not be below the limits for the SNR levels specified in table 11.2.1.5.2-1.

Table 11.2.1.5.2-1: Test requirements for PUSCH with 70% of maximum throughput, 50 MHz Channel Bandwidth, 120 kHz SCS in FR2-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLC5-1200 Low | 70 % | G-FR2-NTN-A5-1 | pos1 | 0.6 |
| Normal | NTN-TDLC5-1200 Low | 70 % | G-FR2-NTN-A6-1 | pos1 | 9.5 |
| 2 | Normal | NTN-TDLC5-1200 Low | 70 % | G-FR2-NTN-A5-1 | pos1 | -2.8 |
| Normal | NTN-TDLC5-1200 Low | 70% | G-FR2-NTN-A6-1 | pos1 | 6.1 |

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

#### 11.2.2.1 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 SAN is based on the test applicability rules defined in clause 11.1.3.

#### 11.2.2.2 Minimum Requirement

For *SAN type 1-O*, the minimum requirement is in TS 38.108 [2] clause 11.2.1.2.

For *SAN type 2-O*, the minimum requirement is in TS 38.108 [2] clause 11.2.2.2.

#### 11.2.2.3 Test Purpose

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

#### 11.2.2.4 Method of test

##### 11.2.2.4.1 Initial Conditions

Test environment: Normal, see annex B.2.

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

Direction to be tested: OTA REFSENS *receiver target reference direction* (see D.44 in table 4.6-1).

##### 11.2.2.4.2 Procedure

1) Place the SAN with its manufacturer declared coordinate system reference point in the same place as calibrated point in the test system, as shown in annex D.7.

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

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

4) Connect the SAN 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 D.7. 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 11.2.2.4.2-1.

Table 11.2.2.4.2-1: Test parameters for testing PUSCH

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Value | |
| SAN type 1-O | SAN type 2-O |
| Transform precoding | | Enabled | |
| 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 | |
| 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, group hopping and sequence hopping are disabled | |
| Time domain resource assignment | PUSCH mapping type | A, B | B |
| Start symbol | 0 | |
| Allocation length | 14 | 10 |
| Frequency domain resource assignment | RB assignment | Full applicable test bandwidth | 30 PRBs in the middle of the test bandwidth |
| Frequency hopping | Disabled | |
| Code block group based PUSCH transmission | | Disabled | |
| PTRS configuration | Frequency density (*KPT-RS*) | N.A. | Disabled |
| Time density (*LPT-RS*) | N.A. | Disabled |

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

7) Adjust the test signal mean power so the calibrated radiated SNR value at the SAN receiver is as specified in clause 11.2.2.5 and clause 11.2.2.6 for *SAN type 1-O* and *SAN type 1-O* respectively, and that the SNR at the SAN 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 11.2.2.4.2-2.

Table 11.2.2.4.2-2: AWGN power level at the SAN input

|  |  |  |  |
| --- | --- | --- | --- |
| SAN type | Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| *1-O*  (Note 2) | 15 | 5 | -86.5 - ΔOTAREFSENS dBm / 4.5 MHz |
| 30 | 10 | -83.6 - ΔOTAREFSENS dBm / 8.64 MHz |
| *2-O*  (Note 5) | 120 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 46.08 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.43 in table 4.6-1 and clause 10.1.  [NOTE 2: 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 3: ΔFR2\_REFSENS = -3 dB as described in clause 10.1, since the OTA REFSENS reference direction (as declared in D.43 in table 4.6-1) is used for testing.  NOTE 4: EISREFSENS\_50M as declared in D.xx in table 4.6-1.  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 SAN, measure the throughput.

#### 11.2.2.5 Test Requirement

##### 11.2.2.5.1 Test Requirement for *SAN type 1-O*

The throughput measured according to clause 11.2.2.4.2 shall not be below the limits for the SNR levels specified in table 11.2.2.5.1-1 to 11.2.2.5.1-4.

Table 11.2.2.5.1-1: Test requirements for PUSCH with 70% of maximum throughput, PUSCH mapping Type A, 5 MHz channel bandwidth, 15 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-3 | pos1 | 4.3 |
| Normal | NTN-TDLC5-200 Low | 70 % | G-FR1-NTN-A3-3 | pos1 | 2.2 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-3 | pos1 | 0.1 |
| Normal | NTN-TDLC5-200 Low | 70% | G-FR1-NTN-A3-3 | pos1 | -0.6 |

Table 11.2.2.5.1-2: Test requirements for PUSCH with 70% of maximum throughput, PUSCH mapping Type A, 10 MHz channel bandwidth, 30 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-4 | pos1 | 4.1 |
| Normal | NTN-TDLC5-200 Low | 70 % | G-FR1-NTN-A3-4 | pos1 | 1.9 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-4 | pos1 | -0.1 |
| Normal | NTN-TDLC5-200 Low | 70% | G-FR1-NTN-A3-4 | pos1 | -0.8 |

Table 11.2.2.5.1-3: Test requirements for PUSCH with 70% of maximum throughput, PUSCH mapping Type B, 5 MHz channel bandwidth, 15 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-3 | pos1 | 4.3 |
| Normal | NTN-TDLC5-200 Low | 70 % | G-FR1-NTN-A3-3 | pos1 | 2.2 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-3 | pos1 | 0.1 |
| Normal | NTN-TDLC5-200 Low | 70% | G-FR1-NTN-A3-3 | pos1 | -0.6 |

Table 11.2.2.5.1-4: Test requirements for PUSCH with 70% of maximum throughput, PUSCH mapping Type B, 10 MHz channel bandwidth, 30 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-4 | pos1 | 4.1 |
| Normal | NTN-TDLC5-200 Low | 70 % | G-FR1-NTN-A3-4 | pos1 | 1.9 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-4 | pos1 | -0.1 |
| Normal | NTN-TDLC5-200 Low | 70% | G-FR1-NTN-A3-4 | pos1 | -0.8 |

##### 11.2.2.5.2 Test Requirement for *SAN type 2-O*

The throughput measured according to clause 11.2.2.4.2 shall not be below the limits for the SNR levels specified in table 11.2.2.5.2-1.

Table 11.2.2.5.2-1: Test requirements for PUSCH with 70% of maximum throughput, PUSCH mapping Type B, 50 MHz channel bandwidth, 120 kHz SCS in FR2-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLC5-1200 Low | 70 % | G-FR2-NTN-A5-2 | pos1 | 0.7 |
| 2 | Normal | NTN-TDLC5-1200 Low | 70 % | G-FR2-NTN-A5-2 | pos1 | -2.6 |

### 11.2.3 Performance requirements for UL timing adjustment

#### 11.2.3.1 Definition and applicability

The performance requirement of UL timing adjustment is determined by a minimum required throughput measured for the moving UE at given SNR. The performance requirements assume HARQ retransmissions.

In the tests for UL timing adjustment, two signals are configured, one being transmitted by a moving UE and the other being transmitted by a stationary UE. The transmission of SRS from UE is optional. FRC parameters in Table A.3-3 are applied for both UEs. The received power for both UEs is the same. The resource blocks allocated for both UEs are consecutive.

Which specific test(s) are applicable to SAN is based on the test applicability rules defined in clause 11.1.3.

#### 11.2.3.2 Minimum Requirement

For *SAN type 1-O*, the minimum requirement is in TS 38.108 [2] clause 11.2.1.3.

#### 11.2.3.3 Test Purpose

The test shall verify the receiver's ability to achieve throughput measured for the moving UE at given SNR under moving propagation conditions.

#### 11.2.3.4 Method of test

##### 11.2.3.4.1 Initial Conditions

Test environment: Normal, see annex B.2.

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

Direction to be tested: OTA REFSENS *receiver target reference direction* (see D.44 in table 4.6-1).

##### 11.2.3.4.2 Procedure

1) Place the SAN with its manufacturer declared coordinate system reference point in the same place as calibrated point in the test system, as shown in annex D.7.

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

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

4) Connect the SAN 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 D.7. 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 11.2.3.4.2-1.

Table 11.2.3.4.2-1 Test parameters for testing UL timing adjustment for *SAN type 1-O*

|  |  |  |
| --- | --- | --- |
| **Parameter** | | **Value** |
| Transform precoding | | Disabled |
| 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 | 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 for moving UE  NID0=1, nSCID =1 for stationary UE |
| Time domain resource assignment | PUSCH mapping type | A, B |
| Start symbol | 0 |
| Allocation length | 14 |
| Frequency domain resource  assignment | RB assignment | 12 RB for each UE |
| Starting PRB index | Moving UE: 0 Stationary UE: 12 |
| Frequency hopping | Disabled |
| SRS resource allocation | Slots in which sounding RS is transmitted (Note 1) | slot #1 in radio frames |
| SRS resource allocation | CSRS = 5, BSRS =0, for 20 RB |
| Code block group based PUSCH transmission | | Disabled |
| NOTE 1. The transmission of SRS is optional. The transmission comb is configured as KTC = 2. The SRS periodic is configured as TSRS = 10 for 15kHz SCS and 20 for 30kHz SCS respectively. | | |

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

7) Adjust the test signal mean power so the calibrated radiated SNR value at the SAN receiver is as specified in clause 11.2.3.5 and that the SNR at the SAN 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 11.2.3.4.2-2.

Table 11.2.3.4.2-2: AWGN power level at the SAN input

|  |  |  |
| --- | --- | --- |
| Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| 15 | 5 | -86.5dBm - ΔOTAREFSENS dBm / 4.5MHz |
| 30 | 10 | -83.6 dBm - ΔOTAREFSENS dBm / 8.64MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.43 in table 4.6-1 and clause 10.1.  [NOTE 2: 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.] | | |

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

#### 11.2.3.5 Test Requirement

##### 11.2.3.5.1 Test Requirement for *SAN type 1-O*

The throughput measured according to clause 11.2.3.4.2 shall not be below the limits for the SNR levels specified in table 11.2.3.5.1-1 to 11.2.3.5.1-4.

Table 11.2.3.5.1-1: Test requirements for UL timing adjustment with 70% of maximum throughput, PUSCH mapping Type A, 5 MHz channel bandwidth, 15 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | SNR  (dB) |
| 1 | 1 | Normal | Scenario X | 70 % | G-FR1-NTN-A3-5 | pos1 | 4.7 |
| 2 | Normal | Scenario X | 70 % | G-FR1-NTN-A3-5 | pos1 | 0.3 |

Table 11.2.3.5.1-2: Test requirements for UL timing adjustment with 70% of maximum throughput, PUSCH mapping Type A, 10 MHz channel bandwidth, 30 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | SNR  (dB) |
| 1 | 1 | Normal | Scenario X | 70 % | G-FR1-NTN-A3-6 | pos1 | 4.2 |
| 2 | Normal | Scenario X | 70 % | G-FR1-NTN-A3-6 | pos1 | 0.1 |

Table 11.2.3.5.1-3: Test requirements for UL timing adjustment with 70% of maximum throughput, PUSCH mapping Type B, 5 MHz channel bandwidth, 15 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | SNR  (dB) |
| 1 | 1 | Normal | Scenario X | 70 % | G-FR1-NTN-A3-5 | pos1 | 4.8 |
| 2 | Normal | Scenario X | 70 % | G-FR1-NTN-A3-5 | pos1 | 0.3 |

Table 11.2.3.5.1-4: Test requirements for UL timing adjustment with 70% of maximum throughput, PUSCH mapping Type B, 10 MHz channel bandwidth, 30 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **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** | **SNR**  **(dB)** |
| 1 | 1 | Normal | Scenario X | 70 % | G-FR1-NTN-A3-6 | pos1 | 4.2 |
| 2 | Normal | Scenario X | 70 % | G-FR1-NTN-A3-6 | pos1 | 0.2 |

### 11.2.4 Performance requirements for PUSCH repetition Type A

#### 11.2.4.1 Definition and applicability

The performance requirement of PUSCH with slot aggregation factor configured is determined by a maximum target BLER for a given SNR. The required BLER is defined as the probability of incorrectly decoding the PUSCH information when the PUSCH information is sent for the FRCs listed in annex A. The performance requirements assume HARQ re-transmissions.

Which specific test(s) are applicable to SAN is based on the test applicability rules defined in clause 11.1.3.

#### 11.2.4.2 Minimum Requirement

For *SAN type 1-O*, the minimum requirement is in TS 38.108 [2] clause 11.2.1.4.

For *SAN type 2-O*, the minimum requirement is in TS 38. 108 [2] clause 11.2.2.3.

#### 11.2.4.3 Test Purpose

The test shall verify the receiver's ability to achieve 1% BLER with PUSCH repetition Type A under multipath fading propagation conditions for a given SNR.

#### 11.2.4.4 Method of test

##### 11.2.4.4.1 Initial Conditions

Test environment: Normal, see annex B.2.

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

Direction to be tested: OTA REFSENS *receiver target reference direction* (see D.44 in table 4.6-1).

##### 11.2.4.4.2 Procedure

1) Place the SAN with its manufacturer declared coordinate system reference point in the same place as calibrated point in the test system, as shown in annex D.7.

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

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

4) Connect the SAN 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 D.7. 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 11.2.4.4.2-1.

Table 11.2.4.4.2-1: Test parameters for testing PUSCH repetition Type A

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Value | |
| SAN Type 1-O | SAN Type 2-O |
| Transform precoding | | Disabled | |
| HARQ | Maximum number of HARQ transmissions | 4 | |
| RV sequence | 0, 3, 0, 3 [Note 1] | |
| DM-RS | DM-RS configuration type | 1 | |
| DM-RS duration | single-symbol DM-RS | |
| Additional DM-RS position | pos1 | |
| Number of DM-RS CDM group(s) without data | 2 | |
| Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB | |
| DM-RS port | {0} | |
| DM-RS sequence generation | NID0=0, nSCID =0 | |
| Time domain  resource  assignment | PUSCH mapping type | A, B | B |
| Start symbol | 0 | |
| Allocation length | 14 | 10 |
| PUSCH aggregation factor | n2 | |
| Frequency domain resource assignment | RB assignment | Full applicable test bandwidth | |
| Frequency hopping | Disabled | |
| Code block group based PUSCH transmission | | Disabled | |
| PTRS configuration | Frequency density (*KPT-RS*) | N.A. | Disabled |
| Time density (*LPT-RS*) | N.A. | Disabled |
| Note 1: The effective RV sequence is {0, 2, 3, 1} with slot aggregation. | | | |

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

7) Adjust the test signal mean power so the calibrated radiated SNR value at the SAN receiver is as specified in clause 11.2.4.5 and clause 11.2.4.6 for *SAN type 1-O* and *SAN type 2-O* respectively, and that the SNR at the SAN 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 11.2.4.4.2-2.

Table 11.2.4.4.2-2: AWGN power level at the SAN input

|  |  |  |  |
| --- | --- | --- | --- |
| SAN type | Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| *1-O* (NOTE 2) | 15 | 5 | -86.5 - ΔOTAREFSENS dBm / 4.5 MHz |
| 30 | 10 | -83.6 - ΔOTAREFSENS dBm / 8.64 MHz |
| *2-O* (NOTE 5) | 120 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 46.08 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.43 in table 4.6-1 and clause 10.1.  [NOTE 2: 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 3: ΔFR2\_REFSENS = -3 dB as described in clause 10.1, since the OTA REFSENS reference direction (as declared in D.43 in table 4.6-1) is used for testing.  NOTE 4: EISREFSENS\_50M as declared in D.xx in table 4.6-1.  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 SAN, measure the throughput.

#### 11.2.4.5 Test Requirement

##### 11.2.4.5.1 Test Requirement for *SAN type 1-O*

The BLER measured according to clause 11.2.4.4.2 shall not be above the limits for the SNR levels specified in table 11.2.4.5.1-1 to 11.2.4.5.1-4.

Table 11.2.4.5.1-1: Test requirements for PUSCH repetition TypeA, PUSCH mapping Type A, 5 MHz channel bandwidth, 15 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (Annex G) | Target BLER | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 1% (Note 1) | G-FR1-NTN-A3A-1 | pos1 | -4.5 |
| 2 | Normal | NTN-TDLA100-200 Low | 1% (Note 1) | G-FR1-NTN-A3A-1 | pos1 | -7.9 |
| Note 1: BLER is defined as residual BLER; i.e., ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block. | | | | | | | |

Table 11.2.4.5.1-2: Test requirements for PUSCH, PUSCH mapping Type A, 10 MHz channel bandwidth, 30 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (Annex G) | Target BLER | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 1% (Note 1) | G-FR1-NTN-A3A-2 | pos1 | -4.5 |
| 2 | Normal | NTN-TDLA100-200 Low | 1% (Note 1) | G-FR1-NTN-A3A-2 | pos1 | -7.9 |
| Note 1: BLER is defined as residual BLER; i.e., ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block. | | | | | | | |

Table 11.2.4.5.1-3: Test requirements for PUSCH, PUSCH mapping Type B, 5 MHz channel bandwidth, 15 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (Annex G) | Target BLER | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 1% (Note 1) | G-FR1-NTN-A3A-1 | pos1 | -4.5 |
| 2 | Normal | NTN-TDLA100-200 Low | 1% (Note 1) | G-FR1-NTN-A3A-1 | pos1 | -7.9 |
| Note 1: BLER is defined as residual BLER; i.e., ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block. | | | | | | | |

Table 11.2.4.5.1-4: Test requirements for PUSCH, PUSCH mapping Type B, 10 MHz channel bandwidth, 30 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (Annex G) | Target BLER | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 1% (Note 1) | G-FR1-NTN-A3A-2 | pos1 | -4.5 |
| 2 | Normal | NTN-TDLA100-200 Low | 1% (Note 1) | G-FR1-NTN-A3A-2 | pos1 | -7.9 |
| Note 1: BLER is defined as residual BLER; i.e., ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block. | | | | | | | |

##### 11.2.4.5.2 Test Requirement for *SAN type 2-O*

The BLER measured according to clause 11.2.4.4.2 shall not be above the limits for the SNR levels specified in table 11.2.4.5.2-1.

Table 11.2.4.5.2-1: Test requirements for PUSCH repetition TypeA, PUSCH mapping Type B, 50 MHz channel bandwidth, 120 kHz SCS in FR2-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (Annex G) | Target BLER | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLC5-1200 Low | 1% (Note 1) | G-FR2-NTN-A3A-1 | pos1 | -8.0 |
| 2 | Normal | NTN-TDLC5-1200 Low | 1% (Note 1) | G-FR2-NTN-A3A-1 | pos1 | -11.4 |
| Note 1: BLER is defined as residual BLER; i.e., ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block. | | | | | | | |

### 11.2.5 Performance requirements for PUSCH with DM-RS bundling

#### 11.2.5.1 Definition and applicability

The performance requirement of PUSCH with DM-RS bundling 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 SAN is based on the test applicability rules defined in clause 11.1.3.

#### 11.2.5.2 Minimum Requirement

For *SAN type 1-O*, the minimum requirement is in TS 38.108 [2] clause 11.2.1.5.

#### 11.2.5.3 Test purpose

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

#### 11.2.5.4 Method of test

##### 11.2.5.4.1 Initial conditions

Test environment: Normal, see annex [B.2].

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

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

##### 11.2.5.4.2 Procedure

1) Place the SAN with its manufacturer declared coordinate system reference point in the same place as calibrated point in the test system, as shown in annex [D.7].

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

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

4) Connect the SAN 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 11.2.5.4.2-1.

Table 11.2.5.4.2-1: Test parameters for testing PUSCH

|  |  |  |
| --- | --- | --- |
| Parameter | | Value |
| Transform precoding | | Disabled |
| HARQ | Maximum number of HARQ transmissions | 4 |
| RV sequence (Note 1) | 0,0,0,0 |
| DM-RS | DM-RS configuration type | 1 |
| DM-RS duration | single-symbol DM-RS |
| Additional DM-RS position | pos1 |
| Number of DM-RS CDM group(s) without data | 2 |
| Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB |
| DM-RS port(s) | {0} |
| DM-RS sequence generation | NID0=0, nSCID =0 |
| Time domain resource assignment | PUSCH mapping type | A, B |
| Start symbol | 0 |
| Allocation length | 14 |
| PUSCH aggregation factor | n4 for 15kHz SCS  n8 for 30kHz SCS |
| pusch-TimeDomainWindowLength | | 4 for 15kHz SCS  8 for 30kHz SCS |
| Frequency domain resource assignment | RB assignment | 6 RBs in the middle of the channel bandwidth |
| Frequency hopping | Disabled |
| Code block group based PUSCH transmission | | Disabled |
| SAN type | | 1-O |
| NOTE 1: The effective RV sequence is {0, 2, 3, 1} with slot aggregation. | | |

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 SAN receiver is as specified in clause 11.2.5.5.1 for *SAN type 1-O*, and that the SNR at the SAN 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 11.2.5.4.2-2.

Table 11.2.5.4.2-2: AWGN power level at the SAN input

|  |  |  |  |
| --- | --- | --- | --- |
| SAN Type | Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| 1-O (NOTE 2) | 15 | 5 | -86.5 - ΔOTAREFSENS dBm / 4.5 MHz |
|  | 30 | 10 | -83.6 - ΔOTAREFSENS dBm / 8.64 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.53 in table 4.6-1 and clause 7.1.  NOTE 2: 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 SAN, measure the throughput.

#### 11.2.5.5 Test Requirement

##### 11.2.5.5.1 Test requirement for *SAN type 1-O*

The throughput measured according to clause 11.2.5.4.2 shall not be below the limits for the SNR levels specified in table 11.2.5.5.1-1 ~ 11.2.5.5.1.4.

Table 11.2.5.5.1-1: Test requirements for PUSCH with 70% of maximum throughput, Type A, 5 MHz channel bandwidth, FR1-NTN, 15 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 G) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-7 | pos1 | -0.1 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-7 | pos1 | -3.6 |

Table 11.2.5.5.1-2: Test requirements for PUSCH with 70% of maximum throughput, Type A, 10 MHz channel bandwidth, FR1-NTN, 30 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 G) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-8 | pos1 | -2.9 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-8 | pos1 | -6.1 |

Table 11.2.5.5.1-3: Test requirements for PUSCH with 70% of maximum throughput, Type B, 5 MHz channel bandwidth, FR1-NTN, 15 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 G) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-7 | pos1 | -0.0 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-7 | pos1 | -3.5 |

Table 11.2.5.5.1-4: Test requirements for PUSCH with 70% of maximum throughput, Type B, 10 MHz channel bandwidth, FR1-NTN, 30 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 G) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-8 | pos1 | -2.8 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-8 | pos1 | -6.1 |

<End of Change 2>