**3GPP TSG-RAN4 Meeting # 113 *R4-2419258***

**Orlando, US, November 18th – 22th 2024**

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| *CR-Form-v12.3* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.181** | **CR** |  | **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 for 38.181 on FR2-NTN PUCCH demodulation requirements | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Ericsson | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_NTN\_enh-Perf | | | | |  | ***Date:*** | | | 2024-11-18 |
|  |  | | | |  | |  | | |  |
| ***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 requirement values of FR2-NTN PUCCH still with [ ] and format 4 has TBD in the latest specification. The new simulation results are delivered for format 1, 3 and 4 and the corresponding SNR values could be updated accordingly. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | * Remove [ ] from SNR values. * New SNR values for FR2-NTN PUCCH format 1 and 3. * Replace TBD by SNR values for FR2-NTN PUCCH format 4. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | The FR2-NTN PUCCH demodulation requirements are still with [ ]. Format 1 and 3 requirment values are not aligned with the latest simulation results. The FR2-NTN PUCCH format 4 demodulation requirements are missing. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 11.3 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **x** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  | **x** | Test specifications | | | | TS | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | | Revised from R4-2419258. | | | | | | | | |

################## Start of Change #1 ######################

## 11.3 OTA performance requirements for PUCCH

### 11.3.1 Performance requirements for PUCCH format 0

#### 11.3.1.1 Definition and applicability

The performance requirement of single user PUCCH format 0 for ACK missed detection is determined by the two parameters: probability of false detection of the ACK and the probability of detection of ACK. The performance is measured by the required SNR at probability of detection equal to 0.99. The probability of false detection of the ACK shall be 0.01 or less.

The probability of false detection of the ACK is defined as a conditional probability of erroneous detection of the ACK when input is only noise.

The probability of detection of ACK is defined as conditional probability of detection of the ACK when the signal is present.

The transient period as specified in TS 38.101-5 [12] clause 6.3.3 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the CC center, i.e. intra-slot frequency hopping is enabled.

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

#### 11.3.1.2 Minimum Requirement

For *SAN type 1-O*, the minimum requirements are in TS 38.108 [2] clause 11.3.1.1 and 11.3.1.2.

For *SAN type 2-O*, the minimum requirements are in TS 38.108 [2] clause [11.3.2.1] and [11.3.2.2].

#### 11.3.1.3 Test purpose

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

#### 11.3.1.4 Method of test

##### 11.3.1.4.1 Initial conditions

Test environment: Normal, see Annex B.2.

RF channels to be tested: 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).

##### 11.3.1.4.2 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 TS 38.211 [8] and according to additional test parameters listed in table 11.3.1.4.2-1.

**Table 11.3.1.4.2-1: Test parameters**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **SAN type 1-O** | **SAN type 2-O** |
| number of UCI information bits | 1 | |
| Number of PRBS | 1 | |
| First PRB prior to frequency hopping | 0 | |
| Intra-slot frequency hopping | Enabled | |
| First PRB after frequency hopping | N/A | |
| Group and sequence hopping | neither | |
| Hopping ID | 0 | |
| Initial cyclic shift | 0 | |
| First symbol | 12 for 2 symbols | |

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

7) Adjust the test signal mean power so the calibrated radiated SNR value at the SAN receiver is as specified in clause 11.3.1.5.1 and 11.3.1.5.2 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 quoted in table 11.3.1.4.2-2.

Table 11.3.1.4.2-2: AWGN power level at the SAN input

|  |  |  |  |
| --- | --- | --- | --- |
| SAN type | Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| SAN type 1-O (Note 2) | 15 | 5 | -86.5 - ΔOTAREFSENS dBm / 4.5 MHz |
| 30 | 10 | -83.6 - ΔOTAREFSENS dBm / 8.64 MHz |
| SAN type 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.54 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) The signal generator sends a test pattern with the pattern outlined in figure 11.3.1.4.2-1. The following statistics are kept: the number of ACKs detected in the idle periods and the number of missed ACKs.



Figure 11.3.1.4.2-1: Test signal pattern for single user PUCCH format 0 demodulation tests

#### 11.3.1.5 Test Requirement

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

The fraction of falsely detected ACKs shall be less than 1% and the fraction of correctly detected ACKs shall be larger than 99% for the SNR listed in table 11.3.1.5.1-1 and in table 11.3.1.5.1-2.

Table 11.3.1.5.1-1: Required SNR for PUCCH format 0, 15 kHz SCS and 5MHz channel bandwidth

|  |  |  |  |
| --- | --- | --- | --- |
| Number of  TX antennas | Number of demodulation branches | Propagation conditions and  correlation matrix (Annex G) | SNR (dB) |
| 1 | 1 | NTN-TDLA100-200 Low | 9.5 |
| 2 | NTN-TDLA100-200 Low | 3.9 |

Table 11.3.1.5.1-2: Required SNR for PUCCH format 0, 30 kHz SCS and 10MHz channel bandwidth

|  |  |  |  |
| --- | --- | --- | --- |
| Number of  TX antennas | Number of demodulation branches | Propagation conditions and  correlation matrix (Annex G) | SNR (dB) |
| 1 | 1 | NTN-TDLA100-200 Low | 11.7 |
| 2 | NTN-TDLA100-200 Low | 5.4 |

##### 11.3.1.5.2 Test requirement for *SAN type 2-O*

The fraction of falsely detected ACKs shall be less than 1% and the fraction of correctly detected ACKs shall be larger than 99% for the SNR listed in table 11.3.1.5.2-1.

Table 11.3.1.5.2-1: Required SNR for PUCCH format 0, 120 kHz SCS and 50MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of  TX antennas | Number of demodulation branches | Propagation conditions and  correlation matrix (Annex G) | Number of OFDM symbols | SNR (dB) |
| 1 | 1 | NTN-TDLC5-1200 Low | 2 | 6.9 |
| 2 | NTN-TDLC5-1200 Low | 2 | 1.9 |

### 11.3.2 Performance requirements for PUCCH format 1

#### 11.3.2.1 NACK to ACK detection

##### 11.3.2.1.1 Definition and applicability

The performance requirement of PUCCH format 1 for NACK to ACK detection is determined by the two parameters: probability of false detection of the ACK and the NACK to ACK detection probability. The performance is measured by the required SNR at probability of the NACK to ACK detection equal to 0.1% or less. The probability of false detection of the ACK shall be 0.01 or less.

The probability of false detection of the ACK is defined as a conditional probability of erroneous detection of the ACK at particular bit position when input is only noise. Each false bit detection is counted as one error.

The NACK to ACK detection probability is the probability of detecting an ACK bit when a NACK bit was sent on particular bit position. Each NACK bit erroneously detected as ACK bit is counted as one error. Erroneously detected NACK bits in the definition do not contain the NACK bits which are mapped from DTX, i.e., NACK bits received when DTX is sent should not be considered.

The transient period as specified in TS 38.101-5 [12] clause 6.3.3 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the CC center, i.e., intra-slot frequency hopping is enabled.

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

##### 11.3.2.1.2 Minimum Requirement

For SAN type 1-O, the minimum requirement is in TS 38.108 [2], clause 11.3.1.3.

For SAN type 2-O, the minimum requirement is in TS 38.108 [2], clause [11.3.2.3].

##### 11.3.2.1.3 Test purpose

The test shall verify the receiver's ability not to falsely detect NACK bits as ACK bits under multipath fading propagation conditions for a given SNR.

##### 11.3.2.1.4 Method of test

###### 11.3.2.1.4.1 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).

###### 11.3.2.1.4.2 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 TS 38.211 [8], and according to additional test parameters listed in table 11.3.2.1.4.2-1.

**Table 11.3.2.1.4.2-1: Test parameters**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Test** | |
| **SAN type 1-O** | **SAN type 2-O** |
| Number of information bits | 2 | |
| Number of PRBs | 1 | |
| Number of symbols | 14 | |
| First PRB prior to frequency hopping | 0 | |
| Intra-slot frequency hopping | enabled | |
| First PRB after frequency hopping | The largest PRB index - (nrofPRBs - 1) | |
| Group and sequence hopping | neither | |
| Hopping ID | 0 | |
| Initial cyclic shift | 0 | |
| First symbol | 0 | |
| Index of orthogonal cover code (*timeDomainOCC*) | 0 | |

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

7) Adjust the test signal mean power so the calibrated radiated SNR value at the SAN receiver is as specified in clause 11.3.2.1.5.1 and 11.3.2.1.5.2 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 11.3.2.1.4.2-2.

Table 11.3.2.1.4.2-2: AWGN power level at the SAN input

|  |  |  |  |
| --- | --- | --- | --- |
| SAN type | Subcarrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| SAN type 1-O (Note 2) | 15 kHz | 5 | -86.5 - ΔOTAREFSENS dBm / 4.5 MHz |
| 30 kHz | 10 | -83.6 – ΔOTAREFSENS dBm / 8.64 MHz |
| SAN type 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.54 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) The signal generator sends random codeword from applicable codebook, in regular time periods. The following statistics are kept: the number of ACK bits detected in the idle periods and the number of NACK bits detected as ACK.

##### 11.3.2.1.5 Test Requirement

11.3.2.1.5.1 Test Requirement for *SAN type 1-O*

The fraction of falsely detected ACK bits shall be less than 1 % and the fraction of NACK bits falsely detected as ACK shall be less than 0.1 % for the SNR listed in tables 11.3.2.1.5.1-1 and table 11.3.2.1.5.1-2.

Table 11.3.2.1.5.1-1: Required SNR for PUCCH format 1 with 15 kHz SCS 5MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of  TX antennas | Number of demodulation branches | Cyclis Prefix | Propagation conditions and  correlation matrix (Annex X) | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 2.8 |
| 2 | Normal | NTN-TDLA100-200 Low | -3.5 |

Table 11.3.2.1.5.1-2: Required SNR for PUCCH format 1 with 30 kHz SCS 10MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of  TX antennas | Number of demodulation branches | Cyclis Prefix | Propagation conditions and  correlation matrix (Annex X) | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 3.6 |
| 2 | Normal | NTN-TDLA100-200 Low | -2.9 |

11.3.2.1.5.2 Test Requirement for *SAN type 2-O*

The fraction of falsely detected ACK bits shall be less than 1 % and the fraction of NACK bits falsely detected as ACK shall be less than 0.1 % for the SNR listed in tables 11.3.2.1.5.2-1.

Table 11.3.2.1.5.2-1: Required SNR for PUCCH format 1 with 120 kHz SCS 50MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of  TX antennas | Number of demodulation branches | Cyclis Prefix | Propagation conditions and  correlation matrix (Annex G) | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLC5-1200 Low | 0.4 |
| 2 | Normal | NTN-TDLC5-1200 Low | -4.7 |

#### 11.3.2.2 ACK missed detection

##### 11.3.2.2.1 Definition and applicability

The performance requirement of PUCCH format 1 for ACK missed detection is determined by the two parameters: probability of false detection of the ACK and the probability of detection of ACK. The performance is measured by the required SNR at probability of detection equal to 0.99. The probability of false detection of the ACK shall be 0.01 or less.

The probability of false detection of the ACK is defined as a conditional probability of erroneous detection of the ACK when input is only noise.

The probability of detection of ACK is defined as conditional probability of detection of the ACK when the signal is present.

The transient period as specified in TS 38.101-5 [12] clause 6.3.3 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the CC center, i.e., intra-slot frequency hopping is enabled.

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

##### 11.3.2.2.2 Minimum Requirement

For SAN type 1-O, the minimum requirement is in TS 38.108 [2], clause 11.3.1.3.

For SAN type 2-O, the minimum requirement is in TS 38.108 [2], clause [11.3.2.3].

##### 11.3.2.2.3 Test purpose

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

##### 11.3.2.2.4 Method of test

###### 11.3.2.2.4.1 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).

###### 11.3.2.2.4.2 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 TS 38.211 [8], and according to additional test parameters listed in table 11.3.2.2.4.2-1.

**Table 11.3.2.2.4.2-1: Test Parameters**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Value** | |
| **SAN type 1-O** | **SAN type 2-O** |
| Number of information bits | 2 | |
| Number of PRBs | 1 | |
| Number of symbols | 14 | |
| First PRB prior to frequency hopping | 0 | |
| Intra-slot frequency hopping | enabled | |
| First PRB after frequency hopping | The largest PRB index – (nrofPRBS – 1) | |
| Group and sequence hopping | neither | |
| Hopping ID | 0 | |
| Initial cyclic shift | 0 | |
| First symbol | 0 | |
| Index of orthogonal cover code (*timeDomainOCC*) | 0 | |

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

7) Adjust the test signal mean power so the calibrated radiated SNR value at the SAN receiver is as specified in clause 11.3.2.2.5.1 and 11.3.2.2.5.2 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 11.3.2.2.4.2-2.

Table 11.3.2.2.4.2-2: AWGN power level at the SAN input

|  |  |  |  |
| --- | --- | --- | --- |
| SAN type | Subcarrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| SAN type 1-O (Note 2) | 15 kHz | 5 | -86.5 – ΔOTAREFSENS dBm / 4.5 MHz |
| 30 kHz | 10 | -83.6 – ΔOTAREFSENS dBm / 8.64 MHz |
| SAN type 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.54 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) The signal generator sends random codewords from applicable codebook, in regular time periods. The following statistics are kept: the number of ACK bits falsely detected in the idle periods and the number of missed ACK bits. Each falsely detected ACK bit in the idle periods is accounted as one error for the statistics of false ACK detection, and each missed ACK bit is accounted as one error for the statistics of missed ACK detection.

Note that the procedure described in this clause for ACK missed detection has the same condition as that described in clause 11.3.2.1.4.2 for NACK to ACK detection. Both statistics are measured in the same testing.

##### 11.3.2.2.5 Test Requirement

11.3.2.2.5.1 Test Requirement for SAN type 1-O

The fraction of falsely detected ACK bits shall be less than 1% and the fraction of correctly detected ACK bits shall be larger than 99% for the SNR listed in tables 11.3.2.2.5-1 and table 11.3.2.2.5-2.

Table 11.3.2.2.5.1-1: Required SNR for PUCCH format 1 with 15 kHz SCS 5MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of  TX antennas | Number of demodulation branches | Cyclic Prefix | Propagation conditions and  correlation matrix (Annex G) | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 2.1 |
| 2 | Normal | NTN-TDLA100-200 Low | -4.0 |

Table 11.3.2.2.5.1-2: Required SNR for PUCCH format 1 with 30 kHz SCS 10MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of  TX antennas | Number of demodulation branches | Cyclic Prefix | Propagation conditions and  correlation matrix (Annex G) | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 3.7 |
| 2 | Normal | NTN-TDLA100-200 Low | -2.8 |

11.3.2.2.5.2 Test Requirement for SAN type 2-O

The fraction of falsely detected ACK bits shall be less than 1% and the fraction of correctly detected ACK bits shall be larger than 99% for the SNR listed in tables 11.3.2.2.5.2-1.

Table 11.3.2.2.5.2-1: Required SNR for PUCCH format 1 with 120 kHz SCS 50MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of  TX antennas | Number of demodulation branches | Cyclis Prefix | Propagation conditions and  correlation matrix (Annex G) | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLC5-1200 Low | -0.8 |
| 2 | Normal | NTN-TDLC5-1200 Low | -5.3 |

### 11.3.3 Performance requirements for PUCCH format 2

#### 11.3.3.1 ACK missed detection performance requirements

##### 11.3.3.1.1 Definition and applicability

The performance requirement of PUCCH format 2 for ACK missed detection is determined by the two parameters: probability of false detection of the ACK and the probability of detection of ACK on the wanted signal. The performance is measured by the required SNR at probability of detection equal to 0.99. The probability of false detection of the ACK shall be 0.01 or less.

The probability of false detection of the ACK is defined as a probability of erroneous detection of the ACK when input is only noise.

The probability of detection of ACK is defined as probability of detection of the ACK when the signal is present.

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

The transient period as specified in TS 38.101-5 [12] clause 6.3.3 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the CC center, i.e., intra-slot frequency hopping is enabled.

##### 11.3.3.1.2 Minimum Requirement

For *SAN type 1-O*, the minimum requirement is in TS 38.108 [2] clause 11.3.1.4.

For *SAN type 2-O*, the minimum requirement is in TS 38.108 [2] clause [11.3.2.4].

##### 11.3.3.1.3 Test Purpose

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

##### 11.3.3.1.4 Method of test

###### 11.3.3.1.4.1 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).

###### 11.3.3.1.4.2 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 one polarization of the test antenna(s).

5) The characteristics of the wanted signal shall be configured according to TS 38.211 [8], and according to additional test parameters listed in table 11.3.3.1.4.2-1.

**Table 11.3.3.1.4.2-1: Test parameters**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Value** | |
| **SAN type 1-O** | **SAN type 2-O** |
| Modulation order | QPSK | |
| First PRB prior to frequency hopping | 0 | |
| Intra-slot frequency hopping | N/A | |
| First PRB after frequency hopping | The largest PRB index - (Number of PRBs-1) | |
| Number of PRBs | 4 | |
| Number of symbols | 1 | |
| The number of UCI information bits | 4 | |
| First symbol | 13 | |
| DM-RS sequence generation | *NID*0=0 | |

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

7) Adjust the test signal mean power so the calibrated radiated SNR value at the SAN receiver is as specified in clause 11.3.3.1.5.1 and 11.3.3.1.5.2 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 11.3.3.1.4.2-2.

Table 11.3.3.1.4.2-2: AWGN power level at the SAN input

|  |  |  |  |
| --- | --- | --- | --- |
| SAN type | Sub-carrier spacing  (kHz) | Channel bandwidth  (MHz) | AWGN power level |
| SAN type 1-O (Note 2) | 15 kHz | 5 | -86.5 - ΔOTAREFSENS dBm / 4.5 MHz |
| 30 kHz | 10 | -83.6 - ΔOTAREFSENS dBm / 8.64 MHz |
| SAN type 2-O (Note 5) | 120 kHz | 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.54 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) The signal generator sends a test pattern with pattern outlined in figure 11.3.3.1.4.2-1. The following statistics are kept: the number of ACK bits detected in the idle periods and the number of missed ACKs.



Figure 11.3.3.1.4.2-1: Test signal pattern for PUCCH format 2 demodulation tests

##### 11.3.3.1.5 Test requirement

11.3.3.1.5.1 Requirements for SAN type 1-O

The fraction of falsely detected ACKs shall be less than 1% and the fraction of correctly detected ACKs shall be larger than 99% for the SNR listed in table 11.3.3.1.5.1-1 and table 11.3.3.1.5.1-2.

Table 11.3.3.1.5.1-1: Required SNR for PUCCH format 2 with 15 kHz SCS 5MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of  TX antennas | Number of demodulation branches | Cyclic Prefix | Propagation conditions and  correlation matrix (Annex G) | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 15.2 |
| 2 | Normal | NTN-TDLA100-200 Low | 5.3 |

Table 11.3.3.1.5.1-2: Required SNR for PUCCH format 2 with 30 kHz SCS 10MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of  TX antennas | Number of demodulation branches | Cyclic Prefix | Propagation conditions and  correlation matrix (Annex G) | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 12.6 |
| 2 | Normal | NTN-TDLA100-200 Low | 5.0 |

11.3.3.1.5.2 Requirements for SAN type 2-O

The fraction of falsely detected ACKs shall be less than 1% and the fraction of correctly detected ACKs shall be larger than 99% for the SNR listed in table 11.3.3.1.5.2-1.

Table 11.3.3.1.5.2-1: Required SNR for PUCCH format 2 with 120 kHz SCS 50MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of  TX antennas | Number of demodulation branches | Cyclis Prefix | Propagation conditions and  correlation matrix (Annex G) | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLC5-1200 Low | 5.6 |
| 2 | Normal | NTN-TDLC5-1200 Low | 0.9 |

#### 11.3.3.2 UCI BLER performance requirements

##### 11.3.3.2.1 Definition and applicability

The UCI block error probability is defined as the probability of incorrectly decoding the UCI information when the UCI information is sent. The UCI information does not contain CSI part 1 and part 2.

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

The transient period as specified in TS 38.101-5 [12] clause 6.3.3 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the CC center, i.e., intra-slot frequency hopping is enabled.

##### 11.3.3.2.2 Minimum Requirement

For *SAN type 1-O*, the minimum requirement is in TS 38.108 [2] clause 11.3.1.4.

For *SAN type 2-O*, the minimum requirement is in TS 38.108 [2] clause [11.3.2.4].

##### 11.3.3.2.3 Test Purpose

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

##### 11.3.3.2.4 Method of test

###### 11.3.3.2.4.1 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).

###### 11.3.3.2.4.2 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 branches signals should be transmitted on each polarization of the test antenna(s).

5) The characteristics of the wanted signal shall be configured according to TS 38.211 [8], and according to additional test parameters listed in table 11.3.3.2.4.2-1.

Table 11.3.3.2.4.2-1: Test parameters

|  |  |  |
| --- | --- | --- |
| Parameter | Value | |
| SAN type 1-O | SAN type 2-O |
| Modulation order | QPSK | |
| First PRB prior to frequency hopping | 0 | |
| Intra-slot frequency hopping | enabled | |
| First PRB after frequency hopping | The largest PRB index - (Number of PRBs-1) | |
| Number of PRBs | 9 | |
| Number of symbols | 2 | |
| The number of UCI information bits | 22 | |
| First symbol | 12 | |
| DM-RS sequence generation | *NID*0=0 | |

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

7) Adjust the test signal mean power so the calibrated radiated SNR value at the SAN receiver is as specified in clause 11.3.3.2.5.1 and 11.3.3.2.5.2 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 11.3.3.2.4.2-2.

Table 11.3.3.2.4.2-2: AWGN power level at the SAN input

|  |  |  |  |
| --- | --- | --- | --- |
| SAN type | Sub-carrier spacing  (kHz) | Channel bandwidth  (MHz) | AWGN power level |
| SAN type 1-O (Note 2) | 15 kHz | 5 | -86.5 - ΔOTAREFSENS dBm / 4.5 MHz |
| 30 kHz | 10 | -83.6 - ΔOTAREFSENS dBm / 8.64 MHz |
| SAN type 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.54 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) The signal generator sends a test pattern with the pattern outlined in figure 11.3.3.2.4.2-1. The following statistics are kept: the number of incorrectly decoded UCI.



Figure 11.3.3.2.4.2-1: Test signal pattern for PUCCH format 2 demodulation tests

##### 11.3.3.2.5 Test requirement

11.3.3.2.5.1 Requirements for SAN type 1-O

The fraction of incorrectly decoded UCI shall be less than 1% for the SNR listed in table 11.3.3.2.5.1-1 and table 11.3.3.2.5.1-2.

Table 11.3.3.2.5.1-1: Required SNR for PUCCH format 2 with 15 kHz SCS 5MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of  TX antennas | Number of demodulation branches | Cyclic Prefix | Propagation conditions and  correlation matrix (Annex G) | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 6.9 |
| 2 | Normal | NTN-TDLA100-200 Low | 1.4 |

Table 11.3.3.2.5.1-2: Required SNR for PUCCH format 2 with 30 kHz SCS 10MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of  TX antennas | Number of demodulation branches | Cyclis Prefix | Propagation conditions and  correlation matrix (Annex G) | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 7.0 |
| 2 | Normal | NTN-TDLA100-200 Low | 1.1 |

11.3.3.2.5.2 Requirements for SAN type 2-O

The fraction of incorrectly decoded UCI shall be less than 1% for the SNR listed in table 11.3.3.2.5.2-1.

Table 11.3.3.2.5.2-1: Required SNR for PUCCH format 2 with 120 kHz SCS 50MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of  TX antennas | Number of demodulation branches | Cyclis Prefix | Propagation conditions and  correlation matrix (Annex G) | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLC5-1200 Low | 4.8 |
| 2 | Normal | NTN-TDLC5-1200 Low | -1.0 |

### 11.3.4 Performance requirements for PUCCH format 3

#### 11.3.4.1 Definition and applicability

The performance is measured by the required SNR at UCI block error probability not exceeding 1%.

The UCI block error probability is defined as the conditional probability of incorrectly decoding the UCI information when the UCI information is sent. The UCI information does not contain CSI part 1 and part 2.

The transient period as specified in TS 38.101-5 [12] clause 6.3.3 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the CC center, i.e. intra-slot frequency hopping is enabled.

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

#### 11.3.4.2 Minimum requirement

For *SAN type 1-O*, the minimum requirement is in TS 38.108 [2], clause 11.3.1.5.

For *SAN type 2-O*, the minimum requirement is in TS 38.108 [2], clause [11.3.2.5].

#### 11.3.4.3 Test purpose

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

#### 11.3.4.4 Method of test

##### 11.3.4.4.1 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).

##### 11.3.4.4.2 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 TS 38.211 [8], and according to additional test parameters listed in table 11.3.4.4.2-1.

Table 11.3.4.4.2-1: Test parameters

|  |  |  |
| --- | --- | --- |
| Parameter | Test | |
| **SAN type 1-O** | **SAN type 2-O** |
| Modulation order | QPSK | |
| First PRB prior to frequency hopping | 0 | |
| Intra-slot frequency hopping | enabled | |
| First PRB after frequency hopping | The largest PRB index – (Number of PRBs – 1) | |
| Group and sequence hopping | neither | |
| Hopping ID | 0 | |
| Number of PRBs | 1 | |
| Number of symbols | 14 | |
| The number of UCI information bits | 16 | |
| First symbol | 0 | |

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

7) Adjust the test signal mean power so the calibrated radiated SNR value at the SAN receiver is as specified in clause 11.3.4.5.1 and 11.3.4.5.2 for *SAN type 1-O* and *SAN type 2-O* respectively, and 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 11.3.4.4.2-2.

Table 11.3.4.4.2-2: AWGN power level at the SAN input

|  |  |  |  |
| --- | --- | --- | --- |
| SAN type | Subcarrier spacing  (kHz) | Channel bandwidth (MHz) | AWGN power level |
| SAN type 1-O (Note 2) | 15 | 5 | -86.5 - ΔOTAREFSENS dBm / 4.5MHz |
| 30 | 10 | -83.6 - ΔOTAREFSENS dBm / 8.64MHz |
| SAN type 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.54 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. | | | |

#### 11.3.4.5 Test requirement

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

The fraction of incorrectly decoded UCI shall be less than 1% for the SNR listed in table 11.3.4.5.1-1 and table 11.3.4.5.1-2.

Table 11.3.4.5.1-1: Required SNR for PUCCH format 3 with 15 kHz SCS 5MHz channel bandwidth

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of  TX antennas | Number of demodulation branches | Cyclic Prefix | Propagation conditions and  correlation matrix (Annex G) | Additional DM-RS configuration | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | No additional DM-RS | 7.2 |
| Additional DM-RS | 7.0 |
| 2 | Normal | NTN-TDLA100-200 Low | No additional DM-RS | 0.9 |
| Additional DM-RS | 0.6 |

Table 11.3.4.5.1-2: Required SNR for PUCCH format 3 with 30 kHz SCS 10MHz channel bandwidth

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of  TX antennas | Number of demodulation branches | Cyclic Prefix | Propagation conditions and  correlation matrix (Annex G) | Additional DM-RS configuration | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | No additional DM-RS | 9.8 |
| Additional DM-RS | 9.2 |
| 2 | Normal | NTN-TDLA100-200 Low | No additional DM-RS | 2.2 |
| Additional DM-RS | 1.9 |

##### 11.3.4.5.2 Test requirement for *SAN type 2-O*

The fraction of incorrectly decoded UCI shall be less than 1% for the SNR listed in table 11.3.4.5.2-1.

Table 11.3.4.5.2-1: Required SNR for PUCCH format 3 with 120 kHz SCS 50MHz channel bandwidth

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of  TX antennas | Number of demodulation branches | Cyclis Prefix | Propagation conditions and  correlation matrix (Annex G) | Additioan DM-RS configuration | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLC5-1200 Low | No additional DM-RS | 2.9 |
| Additional DM-RS | 2.3 |
| 2 | Normal | NTN-TDLC5-1200 Low | No additional DM-RS | -1.3 |
| Additional DM-RS | -1.9 |

### 11.3.5 Performance requirements for PUCCH format 4

#### 11.3.5.1 Definition and applicability

The performance is measured by the required SNR at UCI block error probability not exceeding 1%.

The UCI block error probability is defined as the conditional probability of incorrectly decoding the UCI information when the UCI information is sent. The UCI information does not contain CSI part 1 and part 2.

The transient period as specified in TS 38.101-5 [12] clause 6.3.3 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the CC center, i.e., intra-slot frequency hopping is enabled.

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

#### 11.3.5.2 Minimum requirement

For *SAN type 1-O*, the minimum requirement is in TS 38.108 [2], clause 11.3.1.6.

For *SAN type 2-O*, the minimum requirement is in TS 38.108 [2], clause [11.3.2.6].

#### 11.3.5.3 Test purpose

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

#### 11.3.5.4 Method of test

##### 11.3.5.4.1 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.44 in table 4.6-1).

##### 11.3.5.4.2 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 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 TS 38.211 [8], and according to additional test parameters listed in table 11.3.4.4.2-1.

Table 11.3.5.4.2-1: Test parameters

|  |  |  |
| --- | --- | --- |
| Parameter | Value | |
| SAN type 1-O | SAN type 2-O |
| Modulation order | QPSK | |
| First PRB prior to frequency hopping | 0 | |
| Number of PRBS | 1 | |
| Intra-slot frequency hopping | enabled | |
| First PRB after frequency hopping | The largest PRB index - (Number of PRBS - 1) | |
| Group and sequence hopping | neither | |
| Hopping ID | 0 | |
| Number of symbols | 14 | |
| The number of UCI information bits | 22 | |
| First symbol | 0 | |
| Length of the orthogonal cover code | n2 | |
| Index of the orthogonal cover code | n0 | |

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

7) Adjust the test signal mean power so the calibrated radiated SNR value at the SAN receiver is as specified in clause 11.3.5.5.1 and 11.3.5.5.2 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 11.3.5.4.2-2.

Table 11.3.5.4.2-2: AWGN power level at the SAN input

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

Table 11.3.5.4.2-2: AWGN power level at the SAN input

|  |  |  |  |
| --- | --- | --- | --- |
| SAN type | Subcarrier spacing  (kHz) | Channel bandwidth (MHz) | AWGN power level |
| SAN type 1-O (Note 2) | 15 | 5 | -86.5 - ΔOTAREFSENS dBm / 4.5MHz |
| 30 | 10 | -83.6 - ΔOTAREFSENS dBm / 8.64MHz |
| SAN type 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.54 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. | | | |

#### 11.3.5.5 Test requirement

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

The fraction of incorrectly decoded UCI shall be less than 1% for the SNR listed in table 11.3.5.5.1-1 and table 11.3.5.5.1-2.

Table 11.3.5.5.1-1: Required SNR for PUCCH format 4 with 15 kHz SCS 5MHz channel bandwidth

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of  TX antennas | Number of demodulation branches | Cyclic Prefix | Propagation conditions and  correlation matrix (Annex G) | Additional DM-RS configuration | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | No additional DM-RS | 9.5 |
| Additional DM-RS | 9.2 |
| 2 | Normal | NTN-TDLA100-200 Low | No additional DM-RS | 3.1 |
| Additional DM-RS | 2.8 |

Table 11.3.5.5.1-2: Required SNR for PUCCH format 4 with 30 kHz SCS 10MHz channel bandwidth

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of  TX antennas | Number of demodulation branches | Cyclic Prefix | Propagation conditions and  correlation matrix (Annex G) | Additional DM-RS configuration | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | No additional DM-RS | 11.1 |
| Additional DM-RS | 11.1 |
| 2 | Normal | NTN-TDLA100-200 Low | No additional DM-RS | 4.1 |
| Additional DM-RS | 3.9 |

##### 11.3.5.5.2 Test requirement for *SAN type 2-O*

The fraction of incorrectly decoded UCI shall be less than 1% for the SNR listed in table 11.3.5.5.2-1.

Table 11.3.5.5.2-1: Required SNR for PUCCH format 4 with 120 kHz SCS 50MHz channel bandwidth

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of  TX antennas | Number of demodulation branches | Cyclis Prefix | Propagation conditions and  correlation matrix (Annex G) | Additioan DM-RS configuration | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLC5-1200 Low | No additional DM-RS | 4.7 |
| Additional DM-RS | 6.4 |
| 2 | Normal | NTN-TDLC5-1200 Low | No additional DM-RS | 0.4 |
| Additional DM-RS | 0.0 |

################## End of Change #1 ######################