**3GPP TSG- Meeting # *R4-2115709***

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

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| ***Title:*** | draftCR to TS 38.176-2 IAB-DU performance requirements and parts of DU and MT appendix | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** |  | | | | | | | | | |
| ***Source to TSG:*** |  | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** |  | | | | |  | ***Date:*** | | |  |
|  |  | | | |  | |  | | |  |
| ***Category:*** |  |  | | | | | ***Release:*** | | |  |
|  | *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-15 (Release 15) Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | Provide corrections to the first published version of the TS sections on IAB-DU perefomance requirements and parts of DU and MT appedix as per work split. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | 1. Editorial changes in IAB-DU performance requirments 2. Removal of 5MHz cahnnel bendwidth requirements 3. Updates in IAB-MT and IAB-DU test setup figures 4. Update of text in NOTE 2 to test setup figures 5. Removal of square brackets in test tolerances 6. Addition of missing section on Physical signals, channels mapping and precoding | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | It will be inconsistencies in the specification 38.176-2 | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 8.1, E.3, J.3 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | | **X** |  | Other core specifications | | | | 38.174 | | |
| ***affected:*** | | **X** |  | Test specifications | | | | 38.176-1 | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | | Agenda item 6.1.2.6.1 - General | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | | Revision of R4-2112021 | | | | | | | | |

**<<start of change>>**

### 8.1.2 Performance requirements for PUSCH

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

##### 8.1.2.1.1 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 IAB-DU is based on the test applicability rules defined in clause 8.1.1.3.2.

##### 8.1.2.1.2 Minimum Requirement

For *BS type 1-O*, the minimum requirement is in TS 38.174 [2], clause 11.1.2.1.1.

For *BS type 2-O*, the minimum requirement is in TS 38.174 [2], clause 11.1.2.2.1

##### 8.1.2.1.3 Test purpose

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

##### 8.1.2.1.4 Method of test

8.1.2.1.4.1 Initial conditions

Test environment: Normal, see annex B.2.

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

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

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

8.1.2.1.4.2 Procedure

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

2) Align the manufacturer declared coordinate system orientation of the IAB-DU with the test system.

3) Set the IAB-DU in the declared direction to be tested.

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

5) The characteristics of the wanted signal shall be configured according to the corresponding UL reference measurement channel defined in annex A, and according to additional test parameters listed in table 8.1.2.1.4.2-1.

Table 8.1.2.1.4.2-1: Test parameters for testing PUSCH

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

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

7) Adjust the test signal mean power so the calibrated radiated SNR value at the IAB-DU receiver is as specified in clause 8.1.2.1.5.1 and 8.1.2.1.5.2 for *IAB type 1-O* and *IAB type 2-O* respectively, and that the SNR at the IAB-DU receiver is not impacted by the noise floor.

The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level in table 8.1.2.1.4.2-2.

Table 8.1.2.1.4.2-2: AWGN power level at the IAB-DU input

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| *IAB type 1-O* | 15 |  |  |
|  |  |  |  |
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|  | | | |

8) For reference channels applicable to the IAB-DU, measure the throughput.

##### 8.1.2.1.5 Test Requirement

8.1.2.1.5.1 Test requirement for *IAB type 1-O*

The throughput measured according to clause 8.1.2.1.4.2 shall not be below the limits for the SNR levels specified in table 8.1.2.1.5.1-1 to table 8.1.2.1.5.1-14 for 1Tx and for 2Tx two layer spatial multiplexing transmission.

Table 8.1.2.1.5.1-1: Void



Table 8.1.2.1.5.1-2: Test requirements for PUSCH with 70% of maximum throughput, Type A, 10 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix (annex J)** | **FRC (annex A)** | **Additional DM-RS position** | **SNR**  **(dB)** |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-2 | pos1 | -1.9 |
|  |  | TDLC300-100 Low | D-FR1-A.2.3-2 | pos1 | 10.8 |
|  |  | TDLA30-10 Low | D-FR1-A.2.4-2 | pos1 | 12.8 |
| 2 | 2 | TDLB100-400 Low | D-FR1-A.2.1-9 | pos1 | 2.5 |
|  |  | TDLC300-100 Low | D-FR1-A.2.3-9 | pos1 | 19.1 |

Table 8.1.2.1.5.1-3: Test requirements for PUSCH with 70% of maximum throughput, Type A, 20 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix (annex J)** | **FRC (annex A)** | **Additional DM-RS position** | **SNR**  **(dB)** |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-3 | pos1 | -1.5 |
|  |  | TDLC300-100 Low | D-FR1-A.2.3-3 | pos1 | 10.6 |
|  |  | TDLA30-10 Low | D-FR1-A.2.4-3 | pos1 | 13.0 |
| 2 | 2 | TDLB100-400 Low | D-FR1-A2.1-10 | pos1 | 2.9 |
|  |  | TDLC300-100 Low | D-FR1-A.2.3-10 | pos1 | 19.1 |

Table 8.1.2.1.5.1-4: Test requirements for PUSCH with 70% of maximum throughput, Type A, 10 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix (annex J)** | **FRC (annex A)** | **Additional DM-RS position** | **SNR**  **(dB)** |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-4 | pos1 | -1.7 |
|  |  | TDLC300-100 Low | D-FR1-A.2.3-4 | pos1 | 10.8 |
|  |  | TDLA30-10 Low | D-FR1-A.2.4-4 | pos1 | 13.4 |
| 2 | 2 | TDLB100-400 Low | D-FR1-A.2.1-11 | pos1 | 2.1 |
|  |  | TDLC300-100 Low | D-FR1-A.2.3-11 | pos1 | 19.2 |

Table 8.1.2.1.5.1-5: Test requirements for PUSCH with 70% of maximum throughput, Type A, 20 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix (annex J)** | **FRC (annex A)** | **Additional DM-RS position** | **SNR**  **(dB)** |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-5 | pos1 | -2.3 |
|  |  | TDLC300-100 Low | D-FR1-A.2.3-5 | pos1 | 10.8 |
|  |  | TDLA30-10 Low | D-FR1-A.2.4-5 | pos1 | 13.1 |
| 2 | 2 | TDLB100-400 Low | D-FR1-A.2.1-12 | pos1 | 2.1 |
|  |  | TDLC300-100 Low | D-FR1-A.2.3-12 | pos1 | 18.9 |

Table 8.1.2.1.5.1-6: Test requirements for PUSCH with 70% of maximum throughput, Type A, 40 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix (annex J)** | **FRC (annex A)** | **Additional DM-RS position** | **SNR**  **(dB)** |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-6 | pos1 | -1.9 |
|  |  | TDLC300-100 Low | D-FR1-A.2.3-6 | pos1 | 10.6 |
|  |  | TDLA30-10 Low | D-FR1-A.2.4-6 | pos1 | 13.0 |
| 2 | 2 | TDLB100-400 Low | D-FR1-A.2.1-13 | pos1 | 2.1 |
|  |  | TDLC300-100 Low | D-FR1-A.2.3-13 | pos1 | 20.3 |

Table 8.1.2.1.5.1-7: Test requirements for PUSCH with 70% of maximum throughput, Type A, 100 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix (annex J)** | **FRC (annex A)** | **Additional DM-RS position** | **SNR**  **(dB)** |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-7 | pos1 | -2.2 |
|  |  | TDLC300-100 Low | D-FR1-A.2.3-7 | pos1 | 10.8 |
|  |  | TDLA30-10 Low | D-FR1-A.2.4-7 | pos1 | 13.6 |
| 2 | 2 | TDLB100-400 Low | D-FR1-A.2.1-14 | pos1 | 2.2 |
|  |  | TDLC300-100 Low | D-FR1-A.2.3-14 | pos1 | 20.0 |

Table 8.1.2.1.5.1-8: Void



Table 8.1.2.1.5.1-9: Test requirements for PUSCH with 70% of maximum throughput, Type B, 10 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix (annex J)** | **FRC (annex A)** | **Additional DM-RS position** | **SNR**  **(dB)** |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-2 | pos1 | -1.7 |
|  |  | TDLC300-100 Low | D-FR1-A.2.3-2 | pos1 | 11.1 |
|  |  | TDLA30-10 Low | D-FR1-A.2.4-2 | pos1 | 13.2 |
| 2 | 2 | TDLB100-400 Low | D-FR1-A.2.1-9 | pos1 | 2.8 |
|  |  | TDLC300-100 Low | D-FR1-A.2.3-9 | pos1 | 19.5 |

Table 8.1.2.1.5.1-10: Test requirements for PUSCH with 70% of maximum throughput, Type B, 20 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix (annex J)** | **FRC (annex A)** | **Additional DM-RS position** | **SNR**  **(dB)** |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-3 | pos1 | -1.5 |
|  |  | TDLC300-100 Low | D-FR1-A.2.3-3 | pos1 | 11.0 |
|  |  | TDLA30-10 Low | D-FR1-A.2.4-3 | pos1 | 12.9 |
| 2 | 2 | TDLB100-400 Low | D-FR1-A2.1-10 | pos1 | 2.4 |
|  |  | TDLC300-100 Low | D-FR1-A.2.3-10 | pos1 | 18.9 |

Table 8.1.2.1.5.1-11: Test requirements for PUSCH with 70% of maximum throughput, Type B, 10 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix (annex J)** | **FRC (annex A)** | **Additional DM-RS position** | **SNR**  **(dB)** |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-4 | pos1 | -1.8 |
|  |  | TDLC300-100 Low | D-FR1-A.2.3-4 | pos1 | 10.7 |
|  |  | TDLA30-10 Low | D-FR1-A.2.4-4 | pos1 | 13.1 |
| 2 | 2 | TDLB100-400 Low | D-FR1-A.2.1-11 | pos1 | 1.9 |
|  |  | TDLC300-100 Low | D-FR1-A.2.3-11 | pos1 | 19.3 |

Table 8.1.2.1.5.1-12: Test requirements for PUSCH with 70% of maximum throughput, Type B, 20 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix (annex J)** | **FRC (annex A)** | **Additional DM-RS position** | **SNR**  **(dB)** |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-5 | pos1 | -2.3 |
|  |  | TDLC300-100 Low | D-FR1-A.2.3-5 | pos1 | 10.7 |
|  |  | TDLA30-10 Low | D-FR1-A.2.4-5 | pos1 | 13.1 |
| 2 | 2 | TDLB100-400 Low | D-FR1-A.2.1-12 | pos1 | 2.1 |
|  |  | TDLC300-100 Low | D-FR1-A.2.3-12 | pos1 | 19.0 |

Table 8.1.2.1.5.1-13: Test requirements for PUSCH with 70% of maximum throughput, Type B, 40 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix (annex J)** | **FRC (annex A)** | **Additional DM-RS position** | **SNR**  **(dB)** |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-6 | pos1 | -1.9 |
|  |  | TDLC300-100 Low | D-FR1-A.2.3-6 | pos1 | 10.6 |
|  |  | TDLA30-10 Low | D-FR1-A.2.4-6 | pos1 | 13.1 |
| 2 | 2 | TDLB100-400 Low | D-FR1-A.2.1-13 | pos1 | 2.5 |
|  |  | TDLC300-100 Low | D-FR1-A.2.3-13 | pos1 | 19.5 |

Table 8.1.2.1.5.1-14: Test requirements for PUSCH with 70% of maximum throughput, Type B, 100 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix (annex J)** | **FRC (annex A)** | **Additional DM-RS position** | **SNR**  **(dB)** |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-7 | pos1 | -1.9 |
|  |  | TDLC300-100 Low | D-FR1-A.2.3-7 | pos1 | 10.7 |
|  |  | TDLA30-10 Low | D-FR1-A.2.4-7 | pos1 | 13.7 |
| 2 | 2 | TDLB100-400 Low | D-FR1-A.2.1-14 | pos1 | 2.4 |
|  |  | TDLC300-100 Low | D-FR1-A.2.3-14 | pos1 | 20.1 |

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

8.1.2.1.5.2 Test requirement for *IAB type 2-O*

The throughput measured according to clause 8.1.2.1.4.2 shall not be below the limits for the SNR levels specified in table 8.1.2.1.5.2-1 to 8.1.2.1.5.2-7.

Table 8.1.2.1.5.2-1: Test requirements for PUSCH with 70% of maximum throughput, 50 MHz Channel Bandwidth, 60 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix (annex J)** | **FRC (annex A)** | **Additional DM-RS position** | **PT-RS** | **SNR**  **(dB)** |
| 1 | 2 | TDLA30-300 Low | D-FR2-A.2.1-1 | pos0 | No | -1.4 |
|  |  |  | D-FR2-A.2.1-13 | pos1 | No | -1.6 |
|  |  | TDLA30-300 Low | D-FR2-A.2.3-1 | pos0 | Yes | 12.6 |
|  |  |  |  |  | No | 12.1 |
|  |  |  | D-FR2-A.2.3-11 | pos1 | Yes | 11.3 |
|  |  |  |  |  | No | 11.3 |
|  |  | TDLA30-75 Low | D-FR2-A.2.4-1 | pos0 | Yes | 14.3 |
|  |  |  |  |  | No | 13.7 |
|  |  |  | D-FR2-A.2.4-6 | pos1 | Yes | 14.0 |
|  |  |  |  |  | No | 13.5 |
| 2 |  | TDLA30-300 Low | D-FR2-A.2.1-6 | pos0 | No | 2.3 |
|  |  |  | D-FR2-A.2.1-18 | pos1 | No | 2.0 |
|  |  | TDLA30-300 Low | D-FR2-A.2.2-1 | pos0 | Yes | 16.0 |
|  |  |  |  |  | No | 15.1 |
|  |  |  | D-FR2-A.2.2-6 | pos1 | Yes | 14.6 |
|  |  |  |  |  | No | 13.8 |

Table 8.1.2.1.5.2-2: Test requirements for PUSCH with 70% of maximum throughput, 100 MHz Channel Bandwidth, 60 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix (annex J)** | **FRC (annex A)** | **Additional DM-RS position** | **PT-RS** | **SNR**  **(dB)** |
| 1 | 2 | TDLA30-300 Low | D-FR2-A.2.1-2 | pos0 | No | -1.5 |
|  |  |  | D-FR2-A.2.1-14 | pos1 | No | -1.8 |
|  |  | TDLA30-300 Low | D-FR2-A.2.3-2 | pos0 | Yes | 12.8 |
|  |  |  |  |  | No | 11.8 |
|  |  |  | D-FR2-A.2.3-12 | pos1 | Yes | 11.8 |
|  |  |  |  |  | No | 11.2 |
|  |  | TDLA30-75 Low | D-FR2-A.2.4-2 | pos0 | Yes | 14.8 |
|  |  |  |  |  | No | 13.9 |
|  |  |  | D-FR2-A.2.4-7 | pos1 | Yes | 14.3 |
|  |  |  |  |  | No | 13.7 |
| 2 |  | TDLA30-300 Low | D-FR2-A.2.1-7 | pos0 | No | 2.3 |
|  |  |  | D-FR2-A.2.1-19 | pos1 | No | 2.0 |
|  |  | TDLA30-300 Low | D-FR2-A.2.2-2 | pos0 | Yes | 16.8 |
|  |  |  |  |  | No | 15.7 |
|  |  |  | D-FR2-A.2.2-7 | pos1 | Yes | 14.6 |
|  |  |  |  |  | No | 13.9 |

Table 8.1.2.1.5.2-3: Test requirements for PUSCH with 70% of maximum throughput, 50 MHz Channel Bandwidth, 120 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix (annex J)** | **FRC (annex A)** | **Additional DM-RS position** | **PT-RS** | **SNR**  **(dB)** |
| 1 | 2 | TDLA30-300 Low | D-FR2-A.2.1-3 | pos0 | No | -1.2 |
|  |  |  | D-FR2-A.2.1-15 | pos1 | No | -1.5 |
|  |  | TDLA30-300 Low | D-FR2-A.2.3-3 | pos0 | Yes | 12.2 |
|  |  |  |  |  | No | 11.5 |
|  |  |  | D-FR2-A.2.3-13 | pos1 | Yes | 11.5 |
|  |  |  |  |  | No | 11.1 |
|  |  | TDLA30-75 Low | D-FR2-A.2.4-3 | pos0 | Yes | 14.3 |
|  |  |  |  |  | No | 13.7 |
|  |  |  | D-FR2-A.2.4-8 | pos1 | Yes | 13.8 |
|  |  |  |  |  | No | 13.6 |
| 2 |  | TDLA30-300 Low | D-FR2-A.2.1-8 | pos0 | No | 2.2 |
|  |  |  | D-FR2-A.2.1-20 | pos1 | No | 2.1 |
|  |  | TDLA30-300 Low | D-FR2-A.2.2-3 | pos0 | Yes | 15.0 |
|  |  |  |  |  | No | 14.4 |
|  |  |  | D-FR2-A.2.2-8 | Pos1 | Yes | 14.7 |
|  |  |  |  |  | No | 13.9 |

Table 8.1.2.1.5.2-4: Test requirements for PUSCH with 70% of maximum throughput, 100 MHz Channel Bandwidth, 120 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix (annex J)** | **FRC (annex A)** | **Additional DM-RS position** | **PT-RS** | **SNR**  **(dB)** |
| 1 | 2 | TDLA30-300 Low | D-FR2-A.2.1-4 | pos0 | No | -1.8 |
|  |  |  | D-FR2-A.2.1-16 | pos1 | No | -1.9 |
|  |  | TDLA30-300 Low | D-FR2-A.2.3-4 | pos0 | Yes | 12.5 |
|  |  |  |  |  | No | 11.1 |
|  |  |  | D-FR2-A.2.3-14 | pos1 | Yes | 11.7 |
|  |  |  |  |  | No | 11.1 |
|  |  | TDLA30-75 Low | D-FR2-A.2.4-4 | pos0 | Yes | 14.1 |
|  |  |  |  |  | No | 13.5 |
|  |  |  | D-FR2-A.2.4-9 | pos1 | Yes | 14.0 |
|  |  |  |  |  | No | 13.4 |
| 2 |  | TDLA30-300 Low | D-FR2-A.2.1-9 | pos0 | No | 2.2 |
|  |  |  | D-FR2-A.2.1-21 | pos1 | No | 2.0 |
|  |  | TDLA30-300 Low | D-FR2-A.2.2-4 | pos0 | Yes | 14.7 |
|  |  |  |  |  | No | 14.0 |
|  |  |  | D-FR2-A.2.2-9 | pos1 | Yes | 14.3 |
|  |  |  |  |  | No | 13.7 |

Table 8.1.2.1.5.2-5: Test requirements for PUSCH with 70% of maximum throughput, 200 MHz Channel Bandwidth, 120 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix (annex J)** | **FRC (annex A)** | **Additional DM-RS position** | **PT-RS** | **SNR**  **(dB)** |
| 1 | 2 | TDLA30-300 Low | D-FR2-A.2.1-5 | pos0 | No | -1.5 |
|  |  |  | D-FR2-A.2.1-17 | pos1 | No | -1.8 |
|  |  | TDLA30-300 Low | D-FR2-A.2.3-5 | pos0 | Yes | 11.9 |
|  |  |  |  |  | No | 11.5 |
|  |  |  | D-FR2-A.2.3-15 | pos1 | Yes | 11.8 |
|  |  |  |  |  | No | 11.3 |
|  |  | TDLA30-75 Low | D-FR2-A.2.4-5 | pos0 | Yes | 14.7 |
|  |  |  |  |  | No | 14.0 |
|  |  |  | D-FR2-A.2.4-10 | pos1 | Yes | 14.3 |
|  |  |  |  |  | No | 13.9 |
| 2 |  | TDLA30-300 Low | D-FR2-A.2.1-10 | pos0 | No | 2.2 |
|  |  |  | D-FR2-A.2.1-22 | pos1 | No | 1.9 |
|  |  | TDLA30-300 Low | D-FR2-A.2.2-5 | pos0 | Yes | 14.8 |
|  |  |  |  |  | No | 14.1 |
|  |  |  | D-FR2-A.2.2-10 | pos1 | Yes | 14.4 |
|  |  |  |  |  | No | 13.8 |

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

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

##### 8.1.2.2.1 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 IAB-DU is based on the test applicability rules defined in clause 8.1.1.3.2.

##### 8.1.2.2.2 Minimum Requirement

For *IAB type 1-O*, the minimum requirement is in TS 38.174 [2], clause 11.1.2.1.2.

For *IAB type 2-O*, the minimum requirement is in TS 38.174 [2], clause 11.1.2.2.2.

##### 8.1.2.2.3 Test Purpose

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

##### 8.1.2.2.4 Method of test

8.1.2.2.4.1 Initial Conditions

Test environment: Normal, see clause B.2.

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

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

8.1.2.2.4.2 Procedure

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

2) Align the manufacturer declared coordinate system orientation of the IAB-DU with the test system.

3) Set the IAB-DU in the declared direction to be tested.

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

5) The characteristics of the wanted signal shall be configured according to the corresponding UL reference measurement channel defined in annex A, and according to additional test parameters listed in table 8.1.2.2.4.2-1.

Table 8.1.2.2.4.2-1: Test parameters for testing PUSCH

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | ***IAB type 1-O*** | ***IAB type 2-O*** |
| Transform precoding | | Enabled | |
| Cyclic prefix | | Normal | |
| Default TDD UL-DL pattern (Note) | | 15 kHz SCS:  3D1S1U, S=10D:2G:2U  30 kHz SCS:  7D1S2U, S=6D:4G:4U | 60 kHz and 120kHz SCS:  3D1S1U, S=10D:2G:2U |
| HARQ | Maximum number of HARQ transmissions | 4 | |
|  | RV sequence | 0, 2, 3, 1 | |
| DM-RS | DM-RS configuration type | 1 | |
|  | DM-RS duration | single-symbol DM-RS | |
|  | Additional DM-RS position | pos1 | pos0, pos1 |
|  | Number of DM-RS CDM group(s) without data | 2 | |
|  | Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB | |
|  | DM-RS port(s) | 0 | |
|  | DM-RS sequence generation | *NID*0=0, group hopping and sequence hopping are disabled | |
| Time | PUSCH mapping type | A, B | B |
| domain | Start symbol | 0 | 0 |
| resource assignment | Allocation length | 14 | 10 |
| Frequency domain resource assignment | RB assignment | 15 kHz SCS: 25 PRBs in the middle of the test bandwidth  30 kHz SCS: 24 PRBs in the middle of the test bandwidth | 30 PRBs in the middle of the test bandwidth |
|  | Frequency hopping | Disabled | |
| Code block group based PUSCH transmission | | Disabled | |
| PT-RS | | Not configured | |
| NOTE: The same requirements are applicable to TDD with different UL-DL patterns for *IAB type 1-O*, and *IAB type 2-O*. | | | |

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

7) Adjust the test signal mean power so the calibrated radiated SNR value at the IAB-DU receiver is as specified in clause 8.1.2.2.5.1 and 8.1.2.2.5.2 for *IAB type 1-O* and *IAB type 2-O* respectively, and that the SNR at the IAB-DU receiver is not impacted by the noise floor.

The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level in table 8.1.2.2.4.2-2.

Table 8.1.2.2.4.2-2: AWGN power level at the BS input

|  |  |  |  |
| --- | --- | --- | --- |
| **IAB-DU type** | **Sub-carrier spacing (kHz)** | **Channel bandwidth (MHz)** | **AWGN power level** |
| *IAB type 1-O* | 15 | 5 | -86.5 - ΔOTAREFSENS dBm / 4.5 MHz |
|  | 30 | 10 | -83.6 - ΔOTAREFSENS dBm / 8.64 MHz |
| *IAB type 2-O* | 60 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 47.52MHz |
|  | 120 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 46.08 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.53 in table 4.6-1 and clause 7.1.  NOTE 2: ΔFR2\_REFSENS = -3 dB as described in clause 7.1, since the OTA REFSENS reference direction (as declared in D.54 in table 4.6-1) is used for testing.  NOTE 3: EISREFSENS\_50M as declared in D.28 in table 4.6-1. | | | |

8) For reference channels applicable to the IAB-DU, measure the throughput.

##### 8.1.2.2.5 Test Requirement

8.1.2.2.5.1 Test requirement for *IAB type 1-O*

The throughput measured according to clause 8.1.2.2.4.2 shall not be below the limits for the SNR levels specified in table 8.1.2.2.5.1-1 to table 8.1.2.2.5.1-4.

Table 8.1.2.2.5.1-1: Test requirements for PUSCH with 70% of maximum throughput, Type A, 5 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix (annex J)** | **FRC (annex A)** | **Additional DM-RS position** | **SNR**  **(dB)** |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-15 | pos1 | -1.8 |

Table 8.1.2.2.5.1-2: Test requirements for PUSCH with 70% of maximum throughput, Type A, 10 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix (annex J)** | **FRC (annex A)** | **Additional DM-RS position** | **SNR**  **(dB)** |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-16 | pos1 | -1.9 |

Table 8.1.2.2.5.1-3: Test requirements for PUSCH with 70% of maximum throughput, Type B, 5 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix (annex J)** | **FRC (annex A)** | **Additional DM-RS position** | **SNR**  **(dB)** |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-15 | pos1 | -1.7 |

Table 8.1.2.2.5.1-4: Test requirements for PUSCH with 70% of maximum throughput, Type B, 10 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix (annex J)** | **FRC (annex A)** | **Additional DM-RS position** | **SNR**  **(dB)** |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-16 | pos1 | -2.1 |

8.1.2.2.5.2 Test requirement for *IAB type 2-O*

The throughput measured according to clause 8.1.2.2.4.2 shall not be below the limits for the SNR levels specified in table 8.1.2.2.5.2-1 to table 8.1.2.2.5.2-2.

Table 8.1.2.2.5.2-1: Test requirements for PUSCH with 70% of maximum throughput, Type B, 50 MHz channel bandwidth, 60 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix**  **(annex J)** | **FRC (annex A)** | **Additional DM-RS position** | **SNR**  **(dB)** |
| 1 | 2 | TDLA30-300 Low | D-FR2-A.2.1-11 | Pos0 | -1.2 |
|  |  |  | D-FR2-A.2.1-23 | pos1 | -1.3 |

Table 8.1.2.2.5.2-2: Test requirements for PUSCH with 70% of maximum throughput, Type B, 50 MHz channel bandwidth, 120 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix**  **(annex J)** | **FRC (annex A)** | **Additional DM-RS position** | **SNR**  **(dB)** |
| 1 | 2 | TDLA30-300 Low | D-FR2-A.2.1-12 | Pos0 | -1.2 |
|  |  |  | D-FR2-A.2.1-24 | pos1 | -1.3 |

#### 8.1.2.3 Performance requirements for UCI multiplexed on PUSCH

##### 8.1.2.3.1 Definition and applicability

The performance requirement of UCI multiplexed on PUSCH is determined by two parameters: block error probability (BLER) of CSI part 1 and block error probability of CSI part 2. The performance is measured by the required SNR at block error probability of CSI part 1 not exceeding 0.1 %, and the required SNR at block error probability of CSI part 2 not exceeding 1 %.

The CSI part 1 BLER is defined as the probability of incorrectly decoding the CSI part 1 information when the CSI part 1 information is sent.

The CSI part 2 BLER is defined as the probability of incorrectly decoding the CSI part 2 information when the CSI part2 information is sent.

In the test of UCI multiplexed on PUSCH, the UCI information only contains CSI part 1 and CSI part 2 information, there is no HACK/ACK information transmitted.

The number of UCI information bit payload per slot is defined for two cases as follows:

- 7 bits: 5 bits in CSI part 1, 2 bits in CSI part 2

- 40 bits: 20 bits in CSI part 1, 20 bits in CSI part 2

The 7 bits UCI information case is further defined with the bitmap [c0 c1 c2 c3 c4] = [0 1 0 1 0] for CSI part 1 information, where c0 is mapping to the RI information, and with the bitmap [c0 c1] = [1 0] for CSI part 2 information.

The 40 bits UCI information case is assumed random information bit selection.

In both tests, PUSCH data, CSI part 1 and CSI part 2 are transmitted simultaneously.

Which specific test(s) is applicable to IAB-DU is based on the test applicability rule defined in clause 8.1.1.3.2.

##### 8.1.2.3.2 Minimum Requirement

For *IAB type 1-O*, the minimum requirement is in TS 38.174 [2] clause 11.1.2.1.3.

For *IAB type 2-O*, the minimum requirement is in TS 38.174 [2] clause 11.1.2.2.3.

##### 8.1.2.3.3 Test Purpose

The test shall verify the receiver's ability to detect UCI with CSI part 1 and CSI part 2 bits multiplexed on PUSCH under multipath fading propagation conditions for a given SNR.

##### 8.1.2.3.4 Method of test

8.1.2.3.4.1 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).

8.1.2.3.4.2 Procedure

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

2) Align the manufacturer declared coordinate system orientation of the IAB-DU with the test system.

3) Set the IAB-DU in the declared direction to be tested.

4) Connect the IAB-DU 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 to the corresponding UL reference measurement channel defined in annex A, and according to additional test parameters listed in table 8.1.2.3.4.2-1. The UCI information bit payload per slot is equal to 7bits with CSI part 1 5bits, CSI part 2 2bits, and the UCI information bit payload per slot is equal to 40 bits with CSI part 1 20bits, CSI part 2 20 bits.

Table: 8.1.2.3.4.2-1 Test parameters for testing UCI multiplexed on PUSCH

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | | ***IAB type 1-O*** | ***IAB type 2-O*** | |
| Transform precoding | | Disabled | | |
| Cyclic prefix | | Normal | | |
| Default TDD UL-DL pattern (Note) | | 30 kHz SCS:  7D1S2U, S=6D:4G:4U | 120 kHz SCS:  3D1S1U, S=10D:2G:2U | |
| HARQ | Maximum number of HARQ transmissions | 1 | | |
|  | RV sequence | 0 | | |
| DM-RS | DM-RS configuration type | 1 | | |
|  | DM-RS duration | Single-symbol DM-RS | | |
|  | Additional DM-RS position | pos1 | pos0,pos1 | |
|  | Number of DM-RS CDM group(s) without data | 2 | | |
|  | Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB | | |
|  | DM-RS port(s) | {0} | {0} | |
|  | DM-RS sequence generation | NID0=0, nSCID =0 | | |
| Time domain | PUSCH mapping type | A,B | B | |
| resource | Start symbol | 0 | | |
| assignment | Allocation length | 14 | 10 | |
| Frequency | RB assignment | Full applicable test bandwidth | | |
| domain resource assignment | Frequency hopping | Disabled | | |
| Code block group based PUSCH transmission | | Disabled | | |
| PT-RS | PT-RS | Disabled | | Enabled |
| configuration | Frequency density (*KPT-RS*) | N.A. | | 2 |
|  | Time density (*LPT-RS*) | N.A. | | 1 |
| UCI | Number of CSI part1 and CSI part2 information bit payload | {5, 2}, {20,20} | | |
|  | scaling | 1 | | |
|  | betaOffsetACK-Index1 | 11 | | |
|  | betaOffsetCSI-Part1-Index1 and betaOffsetCSI-Part1-Index2 | 13 | | |
|  | betaOffsetCSI-Part2-Index1 and betaOffsetCSI-Part2-Index2 | 13 | | |
|  | UCI partition for frequency hopping | Disabled | | |
| NOTE: The same requirements are applicable to TDD with different UL-DL patterns for *IAB type 1-O* and IAB *type 2-O.* | | | | |

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

7) Adjust the test signal mean power so the calibrated radiated SNR value at the IAB-DU receiver is as specified in clause 8.1.2.3.5.1 and 8.1.2.3.5.2 for *IAB type 1-O* and *IAB type 2-O* respectively, and that the SNR at the BS receiver is not impacted by the noise floor.

The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level in table 8.1.2.3.4.2-2.

Table 8.1.2.3.4.2-2: AWGN power level at the BS input

|  |  |  |  |
| --- | --- | --- | --- |
| **IAB-DU type** | **Sub-carrier spacing (kHz)** | **Channel bandwidth (MHz)** | **AWGN power level** |
| *IAB type 1-O* | 30 | 10 | -83.6 - ΔOTAREFSENS dBm / 8.64 MHz |
| *IAB type 2-O* | 120 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 46.08 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.53 in table 4.6-1 and clause 7.1.  NOTE 2: ΔFR2\_REFSENS = -3 dB as declared in clause 7.1, since the OTA REFSENS reference direction (as declared in D.54 in table 4.6-1) is used for testing.  NOTE 3: EISREFSENS\_50M as declared in D.28 in table 4.6-1. | | | |

8) The signal generator sends a test pattern where UCI with CSI part 1 and CSI part 2 information can be multiplexed on PUSCH. The following statistics are kept: the number of incorrectly decoded CSI part 1 information transmitted, the number of incorrectly decoded CSI part 2 information transmitted during UCI multiplexed on PUSCH transmission.

##### 8.1.2.3.5 Test Requirement

8.1.2.3.5.1 Test requirement for *IAB type 1-O*

The fraction of incorrectly decoded UCI with CSI part 1 according to clause 8.1.2.3.4.2 shall be less than 0.1 % for the SNR listed in table 8.1.2.3.5.1-1 and table 8.1.2.3.5.1-2. The fraction of incorrectly decoded UCI with CSI part 2 according to clause 8.1.2.3.4.2 shall be less than 1 % for the SNR listed in table 8.1.2.3.5.1-3 and table 8.1.2.3.5.1-4.

Table 8.1.2.3.5.1-1: Test requirements for UCI multiplexed on PUSCH, Type A, CSI part 1, 10 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix (Annex J)** | **UCI bits**  **(CSI part 1, CSI part 2)** | **Additional DM-RS position** | **FRC**  **(Annex A)** | **SNR (dB)** |
| 1 | 2 | TDLC300-100 Low | 7 (5, 2) | pos1 | D-FR1-A.2.3-4 | 6.0 |
|  | 2 | TDLC300-100 Low | 40 (20,20) | pos1 | D-FR1-A.2.3-4 | 4.9 |

Table 8.1.2.3.5.1-2: Test requirements for UCI multiplexed on PUSCH, Type B, CSI part 1, 10MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix (Annex J)** | **UCI bits**  **(CSI part 1, CSI part 2)** | **Additional DM-RS position** | **FRC**  **(Annex A)** | **SNR (dB)** |
| 1 | 2 | TDLC300-100 Low | 7 (5, 2) | pos1 | D-FR1-A.2.3-4 | 6.4 |
|  | 2 | TDLC300-100 Low | 40 (20,20) | pos1 | D-FR1-A.2.3-4 | 4.7 |

Table 8.1.2.3.5.1-3: Test requirements for UCI multiplexed on PUSCH, Type A, CSI part 2, 10MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix (Annex J)** | **UCI bits**  **(CSI part 1, CSI part 2)** | **Additional DM-RS position** | **FRC**  **(Annex A)** | **SNR (dB)** |
| 1 | 2 | TDLC300-100 Low | 7 (5, 2) | pos1 | D-FR1-A.2.3-4 | 0.4 |
|  | 2 | TDLC300-100 Low | 40 (20,20) | pos1 | D-FR1-A.2.3-4 | 3.0 |

Table 8.1.2.3.5.1-4: Test requirements for UCI multiplexed on PUSCH, Type B, CSI part 2, 10MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix (Annex J)** | **UCI bits**  **(CSI part 1, CSI part 2)** | **Additional DM-RS position** | **FRC**  **(Annex A)** | **SNR (dB)** |
| 1 | 2 | TDLC300-100 Low | 7 (5, 2) | pos1 | D-FR1-A.2.3-4 | 0.9 |
|  | 2 | TDLC300-100 Low | 40 (20,20) | pos1 | D-FR1-A.2.3-4 | 3.2 |

8.1.2.3.5.2 Test requirement for *IAB type 2-O*

The fraction of incorrectly decoded UCI with CSI part 1 measured according to clause 8.1.2.3.4.2 shall be less than 0.1 % for the SNR listed in table 8.1.2.3.5.2-1 and table 8.1.2.3.5.2-2. The fraction of incorrectly decoded UCI with CSI part 2 measured according to clause 8.1.2.3.4.2 shall be less than 1 % for the SNR listed in table 8.1.2.3.5.2-3 and table 8.1.2.3.5.2-4.

Table 8.1.2.3.5.2-1: Test requirements for UCI multiplexed on PUSCH, Type B, with PT-RS, CSI part 1, 50 MHz channel bandwidth, 120 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix (Annex J)** | **UCI bits**  **(CSI part 1, CSI part 2)** | **Additional DM-RS position** | **FRC**  **(Annex A)** | **SNR (dB)** |
| 1 | 2 | TDLA30-300 Low | 7 (5, 2) | pos0 | D-FR2-A.2.3-3 | 7.8 |
|  | 2 | TDLA30-300 Low | 40 (20,20) | pos0 | D-FR2-A.2.3-3 | 6.4 |
|  | 2 | TDLA30-300 Low | 7 (5, 2) | pos1 | D-FR2-A.2.3-13 | 8.4 |
|  | 2 | TDLA30-300 Low | 40 (20,20) | pos1 | D-FR2-A.2.3-13 | 6.5 |

Table 8.1.2.3.5.2-2: Test requirements for UCI multiplexed on PUSCH, Type B, without PT-RS, CSI part 1, 50MHz channel bandwidth, 120 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix (Annex J)** | **UCI bits**  **(CSI part 1, CSI part 2)** | **Additional DM-RS position** | **FRC**  **(Annex A)** | **SNR (dB)** |
| 1 | 2 | TDLA30-300 Low | 7 (5, 2) | pos0 | D-FR2-A.2.3-3 | 7.7 |
|  | 2 | TDLA30-300 Low | 40 (20,20) | pos0 | D-FR2-A.2.3-3 | 6.4 |
|  | 2 | TDLA30-300 Low | 7 (5, 2) | pos1 | D-FR2-A.2.3-13 | 7.9 |
|  | 2 | TDLA30-300 Low | 40 (20,20) | pos1 | D-FR2-A.2.3-13 | 6.1 |

Table 8.1.2.3.5.2-3: Test requirements for UCI multiplexed on PUSCH, Type B, with PT-RS, CSI part 2, 50 MHz channel bandwidth, 120 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix (Annex J)** | **UCI bits**  **(CSI part 1, CSI part 2)** | **Additional DM-RS position** | **FRC**  **(Annex A)** | **SNR (dB)** |
| 1 | 2 | TDLA30-300 Low | 7 (5, 2) | pos0 | D-FR2-A.2.3-3 | 1.7 |
|  | 2 | TDLA30-300 Low | 40 (20,20) | pos0 | D-FR2-A.2.3-3 | 4.6 |
|  | 2 | TDLA30-300 Low | 7 (5, 2) | pos1 | D-FR2-A.2.3-13 | 1.9 |
|  | 2 | TDLA30-300 Low | 40 (20,20) | pos1 | D-FR2-A.2.3-13 | 4.6 |

Table 8.1.2.3.5.2-4: Test requirements for UCI multiplexed on PUSCH, Type B, Without PT-RS, CSI part 2, 50MHz channel bandwidth, 120 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation branches** | **Propagation conditions and correlation matrix (Annex J)** | **UCI bits**  **(CSI part 1, CSI part 2)** | **Additional DM-RS position** | **FRC**  **(Annex A)** | **SNR (dB)** |
| 1 | 2 | TDLA30-300 Low | 7 (5, 2) | pos0 | D-FR2-A.2.3-3 | 1.7 |
|  | 2 | TDLA30-300 Low | 40 (20,20) | pos0 | D-FR2-A.2.3-3 | 4.5 |
|  | 2 | TDLA30-300 Low | 7 (5, 2) | pos1 | D-FR2-A.2.3-13 | 1.8 |
|  | 2 | TDLA30-300 Low | 40 (20,20) | pos1 | D-FR2-A.2.3-13 | 4.3 |

### 8.1.3 Performance requirements for PUСCH

#### 8.1.3.1 Performance requirements for PUCCH format 0

##### 8.1.3.1.1 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 38.101-1 [16] clause 6.3.3.1 and TS 38.101-2 [17] clause 6.3.3.1 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 IAB-DU is based on the test applicability rules defined in clause 8.1.1.3.3.

##### 8.1.3.1.2 Minimum Requirement

For *IAB type 1-O*, the minimum requirements are in TS 38.174 [2] clause 11.3.1.1 and 11.1.3.1.2.

For *IAB type 2-O*, the minimum requirements are in TS 38.174 [2] clause 11.3.2.1 and 11.1.3.2.2.

##### 8.1.3.1.3 Test Purpose

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

##### 8.1.3.1.4 Method of test

8.1.3.1.4.1 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.54 in table 4.6-1).

8.1.3.1.4.2 Procedure

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

2) Align the manufacturer declared coordinate system orientation of the IAB-DU with the test system.

3) Set the IAB-DU in the declared direction to be tested.

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

5) The characteristics of the wanted signal shall be configured according to TS 38.211 [7] and according to additional test parameters listed in table 8.1.3.1.4.2-1.

Table 8.1.3.1.4.2-1: Test parameters

|  |  |  |
| --- | --- | --- |
| **Parameter** | ***IAB type 1-O*** | ***IAB type 2-O*** |
| number of UCI information bits | 1 | 1 |
| Number of PRBs | 1 | 1 |
| First PRB prior to frequency hopping | 0 | 0 |
| Intra-slot frequency hopping | N/A for 1 symbol  Enabled for 2 symbols | N/A for 1 symbol  Enabled for 2 symbols |
| First PRB after frequency hopping | The largest PRB index – (number of PRBs – 1) | The largest PRB index – (number of PRBs – 1) |
| Group and sequence hopping | neither | neither |
| Hopping ID | 0 | 0 |
| Initial cyclic shift | 0 | 0 |
| First symbol | 13 for 1 symbol  12 for 2 symbols | 13 for 1 symbol  12 for 2 symbols |
| Cyclic prefix | normal | |

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

7) Adjust the test signal mean power so the calibrated radiated SNR value at the IAB-DU receiver is as specified in clause 8.1.3.1.5.1 and 8.1.3.1.5.2 for *IAB type 1-O* and *IAB type 2-O* respectively, and that the SNR at the IAB-DU 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 8.1.3.1.4.2-2.

Table 8.1.3.1.4.2-2: AWGN power level at the IAB-DU input

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| *IAB type 1-O* | 15 |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
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|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  | | | |

8) The signal generator sends a test pattern with the pattern outlined in figure 8.1.3.1.4.2-1. The following statistics are kept: the number of ACKs detected in the idle periods and the number of missed ACKs.

****

Figure 8.1.3.1.4.2-1: Test signal pattern for single user PUCCH format 0 demodulation tests

##### 8.1.3.1.5 Test Requirement

8.1.3.1.5.1 Test requirement for *IAB 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 8.1.3.1.5.1-1 and in table 8.1.3.1.5.1-2.

Table 8.1.3.1.5.1-1: Test requirements for PUCCH format 0 and 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Number** | **Number of** | **Propagation conditions and** | **Number of** | **Channel bandwidth / SNR (dB)** | | | |
| **of TX antennas** | **demodulation branches** | **correlation matrix (annex J)** | **OFDM symbols** | **10 MHz** | | **20 MHz** | |
| 1 | 2 | TDLC300-100 Low | 1 | 9.4 | | 9.9 | |
|  |  |  | 2 | 4.3 | | 3.9 | |

Table 8.1.3.1.5.1-2: Test requirements for PUCCH format 0 and 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Number** | **Number of** | **Propagation conditions** | **Number** | **Channel bandwidth / SNR (dB)** | | | |
| **of TX antennas** | **demodulation branches** | **and correlation matrix (annex J)** | **of OFDM symbols** | **10 MHz** | **20 MHz** | **40 MHz** | **100 MHz** |
| 1 | 2 | TDLC300-100 Low | 1 | 10.4 | 10.4 | 10.1 | 9.8 |
|  |  |  | 2 | 4.8 | 4.2 | 4.4 | 4.1 |

8.1.3.1.5.2 Test requirement for *IAB 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 8.1.3.1.5.2-1 and in table 8.1.3.1.5.2-2.

Table 8.1.3.1.5.2-1: Test requirements for PUCCH format 0 and 60 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of TX** | **Number of demodulation** | **Propagation conditions and correlation matrix (annex J)** | **Number of OFDM** | **Channel bandwidth / SNR (dB)** | |
| **antennas** | **branches** |  | **symbols** | **50 MHz** | **100 MHz** |
| 1 | 2 | TDLA30-300 Low | 1 | 9.9 | 9.6 |
|  |  |  | 2 | 4.8 | 4.6 |

Table 8.1.3.1.5.2-2: Test requirements for PUCCH format 0 and 120 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Number of TX** | **Number of demodulation** | **Propagation conditions and correlation matrix (annex J)** | **Number of OFDM** | **Channel bandwidth / SNR (dB)** | | |
| **antennas** | **branches** |  | **symbols** | **50 MHz** | **100 MHz** | **200 MHz** |
| 1 | 2 | TDLA30-300 Low | 1 | 10.1 | 9.8 | 10.3 |
|  |  |  | 2 | 4.7 | 4.4 | 4.6 |

#### 8.1.3.2 Performance requirements for PUCCH format 1

##### 8.1.3.2.1 NACK to ACK detection

8.1.3.2.1.1 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 an 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 38.101-1 [16] and TS 38.101-2 [17] clause 6.3.3.1 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 IAB-DU is based on the test applicability rules defined in clause 8.1.1.3.3.

8.1.3.2.1.2 Minimum Requirement

For BS type 1-O, the minimum requirement is in TS 38.174 [2], clause 11.1.3.1.3.

For BS type 2-O, the minimum requirement is in TS 38.174 [2], clause 11.1.3.2.3.

8.1.3.2.1.3 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.

8.1.3.2.1.4 Method of test

8.1.3.2.1.4.1 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.54 in table 4.6-1).

8.1.3.2.1.4.2 Procedure

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

2) Align the manufacturer declared coordinate system orientation of the IAB-DU with the test system.

3) Set the IAB-DU in the declared direction to be tested.

4) Connect the IAB-DU 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 TS 38.211 [7], and according to additional test parameters listed in table 8.1.3.2.1.4.2-1.

Table 8.1.3.2.1.4.2-1: Test parameters

|  |  |
| --- | --- |
| **Parameter** | **Test** |
| 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 |
| Cyclic prefix | normal |

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 IAB-DU receiver is as specified in clause 8.1.3.2.1.5.1 and 8.1.3.2.1.5.2 for *IAB type 1-O* and *IAB type 2-O* respectively, and that the SNR at the IAB-DU receiver is not impacted by the noise floor.

The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level in table 8.1.3.2.1.4.2-2.

Table 8.1.3.2.1.4.2-2: AWGN power level at the BS input

|  |  |  |  |
| --- | --- | --- | --- |
| **IAB type** | **Subcarrier spacing (kHz)** | **Channel bandwidth (MHz)** | **AWGN power level** |
| *IAB type 1-O* | 15 kHz | 10 | -80.3 – ΔOTAREFSENS dBm / 9.36 MHz |
|  |  | 20 | -77.2 – ΔOTAREFSENS dBm / 19.08 MHz |
|  | 30 kHz | 10 | -80.6 – ΔOTAREFSENS dBm / 8.64 MHz |
|  |  | 20 | -77.4 – ΔOTAREFSENS dBm / 18.36 MHz |
|  |  | 40 | -74.2 – ΔOTAREFSENS dBm / 38.16 MHz |
|  |  | 100 | -70.1 – ΔOTAREFSENS dBm / 98.28 MHz |
| *IAB type 2-O* | 60 kHz | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 47.52 MHz |
|  |  | 100 | EISREFSENS\_50M + ΔFR2\_REFSENS + 18 dBm / 95.04 MHz |
|  |  | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 46.08 MHz |
|  |  | 100 | EISREFSENS\_50M + ΔFR2\_REFSENS + 18 dBm / 95.04 MHz |
|  |  | 200 | EISREFSENS\_50M + ΔFR2\_REFSENS + 21 dBm / 190.08 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.53 in table 4.6-1 and clause 7.1.  NOTE 2: ΔFR2\_REFSENS = -3 dB as described in clause 7.1, since the OTA REFSENS reference direction (as declared in D.54 in table 4.6-1) is used for testing.  NOTE 3: EISREFSENS\_50M as declared in D.28 in table 4.6-1. | | | |

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.

8.1.3.2.1.5 Test Requirement

8.1.3.2.1.5.1 Test requirement for *IAB 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 8.1.3.2.1.5.1-1 and table 8.1.3.2.1.5.1-2.

Table 8.1.3.2.1.5.1-1: Required SNR for PUCCH format 1 with 15 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Number of TX** | **Number of Demodulation** | **Propagation conditions and** | **Channel bandwidth / SNR (dB)** | | | |
| **antennas** | **Branches** | **correlation matrix (annex J)** | **10 MHz** | | **20 MHz** | |
| 1 | 2 | TDLC300-100 Low | -3.0 | | -3.0 | |

Table 8.1.3.2.1.5.1-2: Required SNR for PUCCH format 1 with 30 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Number of TX** | **Number of Demodulation** | **Propagation conditions and** | **Channel bandwidth / SNR (dB)** | | | |
| **antennas** | **Branches** | **correlation matrix (annex J)** | **10 MHz** | **20 MHz** | **40 MHz** | **100 MHz** |
| 1 | 2 | TDLC300-100 Low | -2.2 | -2.7 | -3.3 | -2.9 |

8.1.3.2.1.5.2 Test requirement for *IAB 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 8.1.3.2.1.5.2-1 and table 8.1.3.2.1.5.2-2.

Table 8.1.3.2.1.5.2-1: Required SNR for PUCCH format 1 with 60 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Number of TX** | **Number of Demodulation** | **Propagation conditions and** | **Channel bandwidth / SNR (dB)** | |
| **antennas** | **Branches** | **correlation matrix (annex J)** | **50 MHz** | **100 MHz** |
| 1 | 2 | TDLA30-300 Low | -0.6 | -3.6 |

Table 8.1.3.2.1.5.2-2: Required SNR for PUCCH format 1 with 120 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of TX** | **Number of Demodulation** | **Propagation conditions and** | **Channel bandwidth / SNR (dB)** | | |
| **antennas** | **Branches** | **correlation matrix (annex J)** | **50 MHz** | **100 MHz** | **200 MHz** |
| 1 | 2 | TDLA30-300 Low | -3.3 | -3.3 | -2.4 |

##### 8.1.3.2.2 ACK missed detection

8.1.3.2.2.1 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 38.101-1 [16] and TS 38.101-2 [17] clause 6.3.3.1 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 IAB DU is based on the test applicability rules defined in clause 8.1.1.3.3.

8.1.3.2.2.2 Minimum Requirement

For *IAB type 1-O*, the minimum requirement is in TS 38.174 [7], clause 11.1.3.1.3.

For *IAB type 2-O*, the minimum requirement is in TS 38.174 [7], clause 11.1.3.2.3.

8.1.3.2.2.3 Test Purpose

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

8.1.3.2.2.4 Method of test

8.1.3.2.2.4.1 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.54 in table 4.6-1).

8.1.3.2.2.4.2 Procedure

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

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

3) Set the IAB DU in the declared direction to be tested.

4) Connect the IAB DU 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 TS 38.211 [7], and according to additional test parameters listed in table 8.1.3.2.2.4.2-1.

Table 8.1.3.2.2.4.2-1: Test Parameters

|  |  |
| --- | --- |
| **Parameter** | **Test** |
| 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 |
| Cyclic prefix | normal |

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

7) Adjust the test signal mean power so the calibrated radiated SNR value at the IAB DU receiver is as specified in clause 8.1.3.2.2.5.1 and 8.1.3.2.2.5.2 for *IAB type 1-O* and *IAB type 2-O* respectively, and that the SNR at the IAB DU receiver is not impacted by the noise floor.

The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level in table 8.1.3.2.2.4.2-2.

Table 8.1.3.2.2.4.2-2: AWGN power level at the BS input

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| *IAB type 1-O* | 15 kHz |  |  |
|  |  |  |  |
|  |  |  |  |
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|  |  |  |  |
|  | | | |

8) The tester 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 8.1.3.2.1.4.2 for NACK to ACK detection. Both statistics are measured in the same testing.

8.1.3.2.2.5 Test Requirement

8.1.3.2.2.5.1 Test requirement for *IAB 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 8.1.3.2.2.5-1 and table 8.1.3.2.2.5-2.

Table 8.1.3.2.2.5.1-1: Required SNR for PUCCH format 1 with 15 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | | | |
|  |  |  |  | |  | |
|  |  |  |  | |  | |

Table 8.1.3.2.2.5.1-2: Required SNR for PUCCH format 1 with 30 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Number of TX** | **Number of Demodulation** | **Propagation conditions and** | **Channel bandwidth / SNR (dB)** | | | |
| **antennas** | **Branches** | **correlation matrix (annex J)** | **10 MHz** | **20 MHz** | **40 MHz** | **100 MHz** |
| 1 | 2 | TDLC300-100 Low | -3.3 | -3.8 | -3.8 | -3.6 |

8.1.3.2.2.5.2 Test requirement for *IAB 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 8.1.3.2.2.5.2-1 and table 8.1.3.2.2.5.2-2.

Table 8.1.3.2.2.5.2-1: Required SNR for PUCCH format 1 with 60 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Number of TX** | **Number of Demodulation** | **Propagation conditions and** | **Channel bandwidth / SNR (dB)** | |
| **antennas** | **Branches** | **correlation matrix (annex J)** | **50 MHz** | **100 MHz** |
| 1 | 2 | TDLA30-300 Low | -3.3 | -3.6 |

Table 8.1.3.2.2.5.2-2: Required SNR for PUCCH format 1 with 120 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of TX** | **Number of Demodulation** | **Propagation conditions and** | **Channel bandwidth / SNR (dB)** | | |
| **antennas** | **Branches** | **correlation matrix (annex J)** | **50 MHz** | **100 MHz** | **200 MHz** |
| 1 | 2 | TDLA30-300 Low | -4.1 | -4.0 | -4.0 |

#### 8.1.3.3 Performance requirements for PUCCH format 2

##### 8.1.3.3.1 ACK missed detection performance requirements

8.1.3.3.1.1 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 IAB DU is based on the test applicability rules defined in clause 8.1.1.3.

The transient period as specified in TS 38.101-1 [16] and TS 38.101-2 [17] clause 6.3.3.1 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.

8.1.3.3.1.2 Minimum Requirement

For *IAB type 1-O*, the minimum requirement is in TS 38.174 [2] clause 11.1.3.1.4.

For *IAB type 2-O*, the minimum requirement is in TS 38.174 [2] clause 11.1.3.2.4.

8.1.3.3.1.3 Test Purpose

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

8.1.3.3.1.4 Method of test

8.1.3.3.1.4.1 Initial Conditions

Test environment: Normal, see clause B.2.

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

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

8.1.3.3.1.4.2 Procedure

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

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

3) Set the IAB DU in the declared direction to be tested.

4) Connect the IAB DU 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 one polarization of the test antenna(s).

5) The characteristics of the wanted signal shall be configured according to TS 38.211 [7], and according to additional test parameters listed in table 8.1.3.3.1.4.2-1.

Table 8.1.3.3.1.4.2-1: Test parameters

|  |  |
| --- | --- |
| **Parameter** | **Value** |
| 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 |
| Cyclic prefix | normal |

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 IAB DU receiver is as specified in clause 8.1.3.3.1.5.1 and 8.1.3.3.1.5.2 for *IAB type 1-O* and *IAB type 2-O* respectively, and that the SNR at the IAB DU receiver is not impacted by the noise floor.

The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level in table 8.1.3.3.1.4.2-2.

Table 8.1.3.3.1.4.2-2: AWGN power level at the BS input

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| *IAB type 1-O* | 15 kHz |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  | | | |

8) The tester sends a test pattern with pattern outlined in figure 8.1.3.3.1.4.2-1. The following statistics are kept: the number of ACK bits detected in the idle periods and the number of missed ACKs.

****

Figure 8.1.3.3.1.4.2-1: Test signal pattern for PUCCH format 2 demodulation tests

8.1.3.3.1.5 Test Requirement

8.1.3.3.1.5.1 Test requirement for *IAB 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 8.1.3.3.1.5.1-1 and table 8.1.3.3.1.5.1-2.

Table 8.1.3.3.1.5.1-1: Required SNR for PUCCH format 2 with 15 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | | | |
|  |  |  |  | |  | |
|  |  |  |  | |  | |

Table 8.1.3.3.1.5.1-2: Required SNR for PUCCH format 2 with 30 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Number of** | **Number of** | **Propagation** | **Channel bandwidth/ SNR (dB)** | | | |
| **TX antennas** | **demodulation branches** | **conditions and correlation matrix (annex J)** | **10MHz** | **20MHz** | **40MHz** | **100MHz** |
| 1 | 2 | TDLC300-100 Low | 6.1 | 6.2 | 6.1 | 6.3 |

8.1.3.3.1.5.2 Test requirement for *IAB 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 8.1.3.3.1.5.2-1 and table 8.1.3.3.1.5.2.-2.

Table 8.1.3.3.1.5.2-1: Required SNR for PUCCH format 2 with 60 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Number of** | **Number of** | **Propagation** | **Channel bandwidth / SNR (dB)** | |
| **TX antennas** | **demodulation branches** | **conditions and correlation matrix (annex J)** | **50 MHz** | **100 MHz** |
| 1 | 2 | TDLA30-300 Low | 7.3 | 7.8 |

Table 8.1.3.3.1.5.2-2: Required SNR for PUCCH format 2 with 120 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of** | **Number of** | **Propagation** | **Channel bandwidth / SNR (dB)** | | |
| **TX antennas** | **demodulation branches** | **conditions and correlation matrix (annex J)** | **50 MHz** | **100 MHz** | **200 MHz** |
| 1 | 2 | TDLA30-300 Low | 7.2 | 6.9 | 7.2 |

##### 8.1.3.3.2 UCI BLER performance requirements

8.1.3.3.2.1 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 2.

Which specific test(s) are applicable to IAB DU is based on the test applicability rules defined in clause 8.1.2.

The transient period as specified in TS 38.101-1 [16] and TS 38.101-2 [17] clause 6.3.3.1 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.

8.1.3.3.2.2 Minimum Requirement

For *IAB type 1-O*, the minimum requirement is in TS 38.174 [2] clause 11.1.3.1.4.

For *IAB type 2-O*, the minimum requirement is in TS 38.174 [2] clause 11.1.3.2.4.

8.1.3.3.2.3 Test Purpose

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

8.1.3.3.2.4 Method of test

8.1.3.3.2.4.1 Initial Conditions

Test environment: Normal, see clause B.2.

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

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

8.1.3.3.2.4.2 Procedure

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

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

3) Set the IAB DU in the declared direction to be tested.

4) Connect the IAB DU 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 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 [7], and according to additional test parameters listed in table 8.1.3.3.2.4.2-1.

Table 8.1.3.3.2.4.2-1: Test parameters

|  |  |
| --- | --- |
| **Parameter** | **Value** |
| 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 |
| Cyclic prefix | normal |

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 IAB DU receiver is as specified in clause 8.1.3.3.2.5.1 and 8.1.3.3.2.5.2 for *IAB type 1-O* and *IAB type 2-O* respectively, and that the SNR at the IAB DU receiver is not impacted by the noise floor.

The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level in table 8.3.3.2.4.2-2.

Table 8.1.3.3.2.4.2-2: AWGN power level at the BS input

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| *IAB type 1-O* | 15 kHz |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
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|  |  |  |  |
|  | | | |

8) The tester sends a test pattern with the pattern outlined in figure 8.1.3.3.2.4.2-1. The following statistics are kept: the number of incorrectly decoded UCI.

****

Figure 8.1.3.3.2.4.2-1: Test signal pattern for PUCCH format 2 demodulation tests

8.1.3.3.2.5 Test Requirement

8.1.3.3.2.5.1 Test requirement for *IAB type 1-O*

The fraction of incorrectly decoded UCI is shall be less than 1% for the SNR listed in table 8.1.3.3.2.5.1-1 and table 8.1.3.3.2.5.1-2.

Table 8.1.3.3.2.5.1-1: Required SNR for PUCCH format 2 with 15 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | | | |
|  |  |  |  | |  | |
|  |  |  |  | |  | |

Table 8.1.3.3.2.5.1-2: Required SNR for PUCCH format 2 with 30 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Number of** | **Number of** | **Propagation** | **Channel bandwidth/ SNR (dB)** | | | |
| **TX antennas** | **demodulation branches** | **conditions and correlation matrix (annex J)** | **10MHz** | **20MHz** | **40MHz** | **100MHz** |
| 1 | 2 | TDLC300-100 Low | 1.1 | 1.7 | 1.0 | 0.9 |

8.1.3.3.2.5.2 Test requirement for *IAB type 2-O*

The fraction of incorrectly decoded UCI is shall be less than 1% for the SNR listed in table 8.1.3.3.2.5.2-1 and table 8.1.3.3.2.5.2-2.

Table 8.1.3.3.2.5.2-1: Required SNR for PUCCH format 2 with 60 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Number of** | **Number of** | **Propagation** | **Channel bandwidth / SNR (dB)** | |
| **TX antennas** | **demodulation branches** | **conditions and correlation matrix (annex J)** | **50 MHz** | **100 MHz** |
| 1 | 2 | TDLA30-300 Low | 3.2 | 1.7 |

Table 8.1.3.3.2.5.2-2: Required SNR for PUCCH format 2 with 120 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of** | **Number of** | **Propagation** | **Channel bandwidth / SNR (dB)** | | |
| **TX antennas** | **demodulation branches** | **conditions and correlation matrix (annex J)** | **50 MHz** | **100 MHz** | **200 MHz** |
| 1 | 2 | TDLA30-300 Low | 1.8 | 1.8 | 1.7 |

#### 8.1.3.4 Performance requirements for PUCCH format 3

##### 8.1.3.4.1 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 2.

The transient period as specified in TS 38.101-1 [16] clause 6.3.3.1 and TS 38.101-2 [17] clause 6.3.3.1 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 IAB DU is based on the test applicability rules defined in clause 8.1.1.3.

##### 8.1.3.4.2 Minimum Requirement

For *IAB type 1-O*, the minimum requirement is in TS 38.174 [7], clause 11.1.3.1.5.

For *IAB type 2-O*, the minimum requirement is in TS 38.174 [7], clause 11.1.3.2.5.

##### 8.1.3.4.3 Test Purpose

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

##### 8.1.3.4.4 Method of test

8.1.3.4.4.1 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.54 in table 4.6-1).

8.1.3.4.4.2 Procedure

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

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

3) Set the IAB DU in the declared direction to be tested.

4) Connect the IAB DU 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 TS 38.211 [7], and according to additional test parameters listed in table 8.1.3.4.4.2-1.

Table 8.1.3.4.4.2-1: Test parameters

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Test 1** | **Test 2** |
| Modulation order | QPSK | |
| Cyclic prefix | normal | |
| 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 | 3 |
| Number of symbols | 14 | 4 |
| The number of UCI information bits | 16 | 16 |
| First symbol | 0 | 0 |

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 IAB-DU receiver is as specified in clause 8.1.3.4.5.1 and 8.1.3.4.5.2 for *IAB type 1-O* and *IAB type 2-O* respectively, and the SNR at the IAB-DU receiver is not impacted by the noise floor.

The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level in table 8.1.3.4.4.2-2.

Table 8.1.3.4.4.2-2: AWGN power level at the BS input

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| *IAB type 1-O* | 15 |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  | | | |

##### 8.1.3.4.5 Test Requirement

8.1.3.4.5.1 Test requirement for *IAB type 1-O*

The fraction of incorrectly decoded UCI is shall be less than 1% for the SNR listed in table 8.1.3.4.5.1-1 and table 8.1.3.4.5.1-2.

Table 8.1.3.4.5.1-1: Required SNR for PUCCH format 3 with 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  | | |
|  |  |  |  |  |  | |  |
|  |  |  |  |  |  | |  |
|  |  |  |  |  |  | |  |
|  |  |  |  |  |  | |  |

Table 8.1.3.4.5.1-2: Required SNR for PUCCH format 3 with 30 kHz SCS

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test Number** | **Number of TX** | **Number of** | **Propagation conditions** | **Additional DM-RS** | **Channel bandwidth / SNR (dB)** | | | |
|  | **antennas** | **demodulation branches** | **and correlation matrix (annex J)** | **configuration** | **10 MHz** | **20 MHz** | **40 MHz** | **100 MHz** |
| 1 | 1 | 2 | TDLC300-100 Low | No additional DM-RS | 1.5 | 1.2 | 1.2 | 1.5 |
|  |  |  |  | Additional DM-RS | 1.1 | 0.9 | 0.6 | 0.7 |
| 2 | 1 | 2 | TDLC300-100 Low | No additional DM-RS | 2.4 | 2.6 | 2.6 | 2.1 |

8.1.3.4.5.2 Test requirement for *IAB type 2-O*

The fraction of incorrectly decoded UCI is shall be less than 1% for the SNR listed in table 8.1.3.4.5.2-1 and table 8.1.3.4.5.2-2.

Table 8.1.3.4.5.2-1: Required SNR for PUCCH format 3 with 60 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Test Number** | **Number of TX** | **Number of** | **Propagation conditions** | **Additional DM-RS** | **Channel bandwidth / SNR (dB)** | |
|  | **antennas** | **demodulation branches** | **and correlation matrix (annex J)** | **configuration** | **50 MHz** | **100 MHz** |
| 1 | 1 | 2 | TDLA30-300 Low | No additional DM-RS | 2.2 | 1.3 |
|  |  |  |  | Additional DM-RS | 1.9 | 1.5 |
| 2 | 1 | 2 | TDLA30-300 Low | No additional DM-RS | 3.6 | 3.0 |

Table 8.1.3.4.5.2-2: Required SNR for PUCCH format 3 with 120 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Test** | **Number** | **Number of** | **Propagation** | **Additional** | **Channel bandwidth / SNR (dB)** | | |
| **Number** | **of TX antennas** | **demodulation branches** | **conditions and correlation matrix (annex J)** | **DM-RS configuration** | **50 MHz** | **100 MHz** | **200 MHz** |
| 1 | 1 | 2 | TDLA30-300 Low | No additional DM-RS | 2.0 | 1.3 | 1.3 |
|  |  |  |  | Additional DM-RS | 1.9 | 2.0 | 1.5 |
| 2 | 1 | 2 | TDLA30-300 Low | No additional DM-RS | 1.7 | 3.5 | 2.0 |

#### 8.1.3.5 Performance requirements for PUCCH format 4

##### 8.1.3.5.1 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 2.

The transient period as specified in TS 38.101-1 [16] and TS 38.101-2 [17] clause 6.3.3.1 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 BS is based on the test applicability rules defined in clause 8.1.1.3.3.

##### 8.1.3.5.2 Minimum Requirement

For *IAB type 1-O*, the minimum requirement is in TS 38.174 [2], clause 11.1.3.1.6.

For *IAB type 2-O*, the minimum requirement is in TS 38.174 [2], clause 11.1.3.2.6.

##### 8.1.3.5.3 Test Purpose

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

##### 8.1.3.5.4 Method of test

8.1.3.5.4.1 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.54 in table 4.6-1).

8.1.3.5.4.2 Procedure

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

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

3) Set the IAB DU in the declared direction to be tested.

4) Connect the IAB DU 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 TS 38.211 [7], and according to additional test parameters listed in table 8.1.3.4.4.2-1.

Table 8.1.3.5.4.2-1: Test parameters

|  |  |
| --- | --- |
| **Parameter** | **Value** |
| Modulation order | QPSK |
| Cyclic prefix | normal |
| 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 J.

7) Adjust the test signal mean power so the calibrated radiated SNR value at the IAB DU receiver is as specified in clause 8.1.3.5.5.1 and 8.1.3.5.5.2 for *IAB type 1-O* and *IAB type 2-O* respectively, and that the SNR at the IAB DU receiver is not impacted by the noise floor.

The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level in table 8.1.3.5.4.2-2.

Table 8.1.3.5.4.2-2: AWGN power level at the BS input

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| *IAB type 1-O* | 15 |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
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|  |  |  |  |
|  | | | |

##### 8.1.3.5.5 Test Requirement

8.1.3.5.5.1 Test requirement for *IAB type 1-O*

The fraction of incorrectly decoded UCI is shall be less than 1% for the SNR listed in table 8.1.3.5.5.1-1 and table 8.1.3.5.5.1-2.

Table 8.1.3.5.5.1-1: Required SNR for PUCCH format 4 with 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | | | |
|  |  |  |  |  | |  | |
|  |  |  |  |  | |  | |
|  |  |  |  |  | |  | |

Table 8.1.3.5.5.1-2: Required SNR for PUCCH format 4 with 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Number of** | **Number of** | **Propagation** | **Additional** | **Channel bandwidth / SNR (dB)** | | | |
| **TX antennas** | **demodulation branches** | **conditions and correlation matrix (annex J)** | **DM‑RS configuration** | **10**  **MHz** | **20 MHz** | **40 MHz** | **100 MHz** |
| 1 | 2 | TDLC300-100 Low | No additional DM-RS | 3.7 | 3.4 | 3.7 | 3.4 |
|  |  |  | Additional DM‑RS | 3.4 | 2.9 | 3.7 | 2.8 |

8.1.3.5.5.2 Test requirement for *IAB type 2-O*

The fraction of incorrectly decoded UCI is shall be less than 1% for the SNR listed in table 8.1.3.5.5.2-1 and table 8.1.3.5.5.2-2.

Table 8.1.3.5.5.2-1: Required SNR for PUCCH format 4 with 60 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation** | **Propagation conditions and** | **Additional DM‑RS configuration** | **Channel bandwidth / SNR (dB)** | |
|  | **branches** | **correlation matrix (annex J)** |  | **50 MHz** | **100 MHz** |
| 1 | 2 | TDLA30-300 Low | No additional DM-RS | 3.6 | 3.3 |
|  |  |  | Additional DM-RS | 3.7 | 4.1 |

Table 8.1.3.5.5.2-2: Required SNR for PUCCH format 4 with 120 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Number of TX** | **Number of demodulation** | **Propagation conditions and** | **Additional DM‑RS configuration** | **Channel bandwidth / SNR (dB)** | | |
| **antennas** | **branches** | **correlation matrix (annex J)** |  | **50 MHz** | **100 MHz** | **200MHz** |
| 1 | 2 | TDLA30-300 Low | No additional DM-RS | 3.4 | 3.4 | 4.1 |
|  |  |  | Additional DM-RS | 4.2 | 4.4 | 3.8 |

#### 8.1.3.6 Performance requirements for multi-slot PUCCH

##### 8.1.3.6.1 Performance requirements for multi-slot PUCCH format 1

8.1.3.6.1.1 NACK to ACK detection

8.1.3.6.1.1.1 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 an 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.

Which specific test(s) are applicable to IAB DU is based on the test applicability rules defined in clause 8.1.1.3.3.

8.1.3.6.1.1.2 Minimum Requirement

For *IAB type 1-O*, the minimum requirement is in TS 38.174 [2], clause 11.1.3.1.7.

8.1.3.6.1.1.3 Test Purpose

8.1.3.6.1.1.4 Method of test

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.

8.1.3.6.1.1.4.1 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* (D.54).

8.1.3.6.1.1.4.2 Procedure

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

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

3) Set the IAB DU in the declared direction to be tested.

4) Connect the IAB DU 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 TS 38.211 [7], and according to additional test parameters listed in table 8.1.3.6.1.1.4.2-1.

Table 8.1.3.6.1.1.4.2-1: Test Parameters for multi-slot PUCCH format 1

|  |  |
| --- | --- |
| **Parameter** | **Test** |
| Number of information bits | 2 |
| Number of PRBs | 1 |
| Number of symbols | 14 |
| First PRB prior to frequency hopping | 0 |
| Intra-slot frequency hopping | disabled |
| Inter-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 |
| Number of slots for PUCCH repetition | 2 |
| Cyclic prefix | normal |

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 IAB DU receiver is as specified in clause 8.1.3.6.1.1.5.1 for *IAB type 1-O*, and that the SNR at the IAB DU receiver is not impacted by the noise floor.

The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level in table 8.1.3.6.1.1.4.2-2.

Table 8.1.3.6.1.1.4.2-2: AWGN power level at the BS input

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| *IAB type 1-O* | 15 kHz |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  | | | |

8) The tester 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.

8.1.3.6.1.1.5 Test Requirement

8.1.3.6.1.1.5.1 Test requirement for *IAB 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 table 8.1.3.6.1.1.5.1-1.

Table 8.1.3.6.1.1.5.1-1: Required SNR for multi-slot PUCCH format 1 with 30 kHz SCS

|  |  |  |  |
| --- | --- | --- | --- |
| **Number of TX** | **Number of RX** | **Propagation conditions and correlation matrix** | **Channel bandwidth (MHz) / SNR (dB)** |
| **antennas** | **antennas** | **(Annex J)** | **40 MHz** |
| 1 | 2 | TDLC-300-100 Low | -5.7 |

8.1.3.6.1.2 ACK missed detection

8.1.3.6.1.2.1 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.

8.1.3.6.1.2.2 Minimum Requirement

For *IAB type 1-O*, the minimum requirement is in TS 38.174 [2], clause 11.1.3.1.7.

8.1.3.6.1.2.3 Test Purpose

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

8.1.3.6.1.2.4 Method of test

8.1.3.6.1.2.4.1 Initial Conditions

Test environment: Normal; see annex B.2.

RF channels to be tested for single carrier (SC): M; see clause 4.9.1

Direction to be tested: OTA REFSENS *receiver target reference direction* (D.54).

8.1.3.6.1.2.4.2 Procedure

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

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

3) Set the IAB DU in the declared direction to be tested.

4) Connect the IAB DU 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 TS 38.211 [7], and according to additional test parameters listed in table 8.1.3.6.1.2.4.2-1.

Table 8.1.3.6.1.2.4.2-1: Test Parameters for multi-slot PUCCH format 1

|  |  |
| --- | --- |
| **Parameter** | **Test** |
| Number of information bits | 2 |
| Number of PRBs | 1 |
| Number of symbols | 14 |
| First PRB prior to frequency hopping | 0 |
| Intra-slot frequency hopping | disabled |
| Inter-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 |
| Number of slots for PUCCH repetition | 2 |
| Cyclic prefix | normal |

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 IAB DU receiver is as specified in clause 8.1.3.6.1.2.5.1 for *IAB type 1-O*, and that the SNR at the IAB DU receiver is not impacted by the noise floor.

The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level in table 8.1.3.6.1.2.4.2-2.

Table 8.1.3.6.1.2.4.2-2: AWGN power level at the BS input

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| *IAB type 1-O* | 15 kHz |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  | | | |

8) The tester sends a test pattern with the pattern outlined in figure 8.1.3.6.1.2.4.2-1. The following statistics are kept: the number of ACKs detected in the idle periods and the number of missed ACKs.

****

Figure 8.1.3.6.1.2.4.2-1: Test signal pattern for PUCCH format 1 demodulation tests

8.1.3.6.1.2.5 Test Requirement

8.1.3.6.1.2.5.1 Test requirement for *IAB 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 table 8.1.3.6.1.2.5.1-1.

Table 8.1.3.6.1.2.5.1-1: Required SNR for multi-slot PUCCH format 1 with 30 kHz SCS

|  |  |  |  |
| --- | --- | --- | --- |
| **Number of TX** | **Number of RX** | **Propagation conditions and correlation matrix** | **Channel bandwidth (MHz) / SNR (dB)** |
| **antennas** | **antennas** | **(Annex G)** | **40 MHz** |
| 1 | 2 | TDLC-300-100 Low | -7.0 |

### 8.1.4 Performance requirements for PRACH

#### 8.1.4.1 PRACH false alarm probability and missed detection

##### 8.1.4.1.1 Definition and applicability

The performance requirement of PRACH for preamble detection is determined by the two parameters: total probability of false detection of the preamble (Pfa) and the probability of detection of preamble (Pd). The performance is measured by the required SNR at probability of detection, Pd of 99%. Pfa shall be 0.1% or less.

Pfa is defined as a conditional total probability of erroneous detection of the preamble (i.e. erroneous detection from any detector) when input is only noise.

Pd is defined as conditional probability of detection of the preamble when the signal is present. The erroneous detection consists of several error cases – detecting only different preamble(s) than the one that was sent, not detecting any preamble at all, or detecting the correct preamble but with the out-of-bounds timing estimation value. For AWGN, TDLC300-100 and TDLA30-300, a timing estimation error occurs if the estimation error of the timing of the strongest path is larger than the time error tolerance values given in table 8.1.4.1.1-1.

Table 8.1.4.1.1-1: Time error tolerance for AWGN, TDLC300-100 and TDLA30-300

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **PRACH** | **PRACH SCS** | **Time error tolerance** | | |
| **preamble** | **(kHz)** | **AWGN** | **TDLC300-100** | **TDLA30-300** |
| 0 | 1.25 | 1.04 us | 2.55 us | N/A |
| A1, A2, A3, B4, C0, C2 | 15 | 0.52 us | 2.03 us | N/A |
|  | 30 | 0.26 us | 1.77 us | N/A |
|  | 60 (FR2) | 0.13 us | N/A | 0.28 us |
|  | 120 | 0.07 us | N/A | 0.22 us |

The test preambles for normal mode are listed in table A.2.5-1 and A.2.5-2.

Which specific test(s) are applicable to BS is based on the test applicability rules defined in clause 8.1.1.3.4.

##### 8.1.4.1.2 Minimum requirement

For *IAB type 1-O*, the minimum requirement is in TS 38.174 [2] clause 11.1.4.1.1 and 11.1.4.1.2.

For *IAB type 2-O*, the minimum requirement is in TS 38.174 [2] clause 11.1.4.2.1 and 11.1.4.2.2.

##### 8.1.4.1.3 Test purpose

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

##### 8.1.4.1.4 Method of test

8.1.4.1.4.1 Initial conditions

Test environment: Normal, see clause B.2.

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

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

8.1.4.1.4.2 Procedure

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

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

3) Set the IAB DU in the declared direction to be tested.

4) Connect the IAB DU 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 the test parameter *msg1-FrequencyStart* is set to 0.

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

7) Adjust the AWGN generator, according to the SCS and channel bandwidth. The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level in table 8.1.4.1.4.2-1.

Table 8.1.4.1.4.2-1: AWGN power level at the BS input

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| *IAB type 1-O* | 15 |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  | | | |

8) Adjust the frequency offset of the test signal according to table 8.1.4.1.5.1-1 or 8.1.4.1.5.1-2 or 8.1.4.1.5.1-3 or 8.1.4.1.6.1-1 or 8.1.4.1.6.1-2 or 8.1.4.1.6.1-3 or 8.1.4.1.6.1-4 or 8.1.4.1.5.2-1 or 8.1.4.1.5.2-2.

9) Adjust the equipment so that the SNR specified in table 8.1.4.1.5.1-1 or 8.1.4.1.5.1-2 or 8.1.4.1.5.1-3 or 8.1.4.1.6.1-1 or 8.1.4.1.6.1-2 or 8.1.4.1.6.1-3 or 8.1.4.1.6.1-4 or 8.1.4.1.5.2-1 or 8.1.4.1.5.2-2 is achieved at the BS input during the PRACH preambles.

10) The test signal generator sends a preamble and the receiver tries to detect the preamble. This pattern is repeated as illustrated in figure 8.1.4.1.4.2-1. The preambles are sent with certain timing offsets as described below. The following statistics are kept: the number of preambles detected in the idle period and the number of missed preambles.

****

Figure 8.1.4.1.4.2-1: PRACH preamble test pattern

The timing offset base value for PRACH preamble format 0 is set to 50% of Ncs. This offset is increased within the loop, by adding in each step a value of 0.1us, until the end of the tested range, which is 0.9us. Then the loop is being reset and the timing offset is set again to 50% of Ncs. The timing offset scheme for PRACH preamble format 0 is presented in Figure 8.1.4.1.4.2-2.

****

Figure 8.1.4.1.4.2-2: Timing offset scheme for PRACH preamble format 0

The timing offset base value for PRACH preamble format A1, A2, A3, B4, C0 and C2 is set to 0. This offset is increased within the loop, by adding in each step a value of 0.1us, until the end of the tested range, which is 0.8us. Then the loop is being reset and the timing offset is set again to 0. The timing offset scheme for PRACH preamble format A1, A2, A3, B4, C0 and C2 is presented in Figure 8.1.4.1.4.2-3.

****

Figure 8.1.4.1.4.2-3: Timing offset scheme for PRACH preamble format A1, A2, A3, B4, C0 and C2

##### 8.1.4.1.5 Test requirement for Normal Mode

8.1.4.1.5.1 Test requirement for *IAB type 1-O*

Pfa shall not exceed 0.1%. Pd shall not be below 99% for the SNRs in tables 8.1.4.1.5.1-1 to 8.1.4.1.5.1-3.

Table 8.1.4.1.5.1-1: PRACH missed detection test requirements for Normal Mode, 1.25 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Number of TX** | **Number of demodulation** | **Propagation conditions and** | **Frequency offset** | **SNR (dB)** |
| **antennas** | **branches** | **correlation matrix (annex J)** |  | **Burst format 0** |
| 1 | 2 | AWGN | 0 | -14.2 |
|  |  | TDLC300-100 Low | 400 Hz | -6.0 |

Table 8.1.4.1.5.1-2: PRACH missed detection test requirements for Normal Mode, 15 kHz SCS

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Number** | **Number of** | **Propagation** | **Frequency** | **SNR (dB)** | | | | | |
| **of TX antennas** | **demodulation branches** | **conditions and correlation matrix (annex J)** | **offset** | **Burst format A1** | **Burst format A2** | **Burst format A3** | **Burst format B4** | **Burst format C0** | **Burst format C2** |
| 1 | 2 | AWGN | 0 | -9.0 | -12.3 | -13.9 | -16.5 | -6.0 | -12.2 |
|  |  | TDLC300-100 Low | 400 Hz | -1.5 | -4.2 | -6.0 | -8.2 | 1.4 | -4.3 |

Table 8.1.4.1.5.1-3: PRACH missed detection test requirements for Normal Mode, 30 kHz SCS

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Number** | **Number of** | **Propagation** | **Frequency** | **SNR (dB)** | | | | | |
| **of TX antennas** | **demodulation branches** | **conditions and correlation matrix (annex J)** | **offset** | **Burst format A1** | **Burst format A2** | **Burst format A3** | **Burst format B4** | **Burst format C0** | **Burst format C2** |
| 1 | 2 | AWGN | 0 | -8.8 | -11.7 | -13.5 | -16.2 | -5.8 | -11.6 |
|  |  | TDLC300-100 Low | 400 Hz | -2.2 | -5.1 | -6.8 | -9.3 | 0.7 | -5.0 |

8.1.4.1.5.2 Test requirement for *IAB type 2-O*

Pfa shall not exceed 0.1%. Pd shall not be below 99% for the SNRs in tables 8.1.4.1.5.2-1 to 8.1.4.1.5.2-2.

Table 8.1.4.1.5.2-1: PRACH missed detection test requirements for Normal Mode, 60 kHz SCS

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Number** | **Number of** | **Propagation** | **Frequency** | **SNR (dB)** | | | | | |
| **of TX antennas** | **demodulation branches** | **conditions and correlation matrix (annex J)** | **offset** | **Burst format A1** | **Burst format A2** | **Burst format A3** | **Burst format B4** | **Burst format C0** | **Burst format C2** |
| 1 | 2 | AWGN | 0 | -8.6 | -11.6 | -13.2 | -15.5 | -5.7 | -11.5 |
|  |  | TDLA30-300 Low | 4000 Hz | -1.0 | -3.2 | -4.2 | -6.3 | 1.7 | -3.3 |

Table 8.1.4.1.5.2-2: PRACH missed detection test requirements for Normal Mode, 120 kHz SCS

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Number** | **Number of** | **Propagation** | **Frequency** | **SNR (dB)** | | | | | |
| **of TX antennas** | **demodulation branches** | **conditions and correlation matrix (annex J)** | **offset** | **Burst format A1** | **Burst format A2** | **Burst format A3** | **Burst format B4** | **Burst format C0** | **Burst format C2** |
| 1 | 2 | AWGN | 0 | -8.4 | -11.2 | -13.0 | -15.5 | -5.5 | -11.1 |
|  |  | TDLA30-300 Low | 4000 Hz | -1.1 | -3.8 | -5.2 | -6.9 | 1.8 | -3.6 |

**<<End of change>>**

**<<start of change>>**

Annex C (informative):   
Test tolerances and derivation of test requirements

The test requirements explicitly defined in the present document have been calculated by relaxing the minimum requirements of the core specification TS 38.174 [2] using the test tolerances (TT) defined here. When the TT value is zero, the test requirement will be the same as the minimum requirement. When the TT value is non-zero, the test requirements will differ from the minimum requirements, and the formula used for this relaxation is given in the following tables.

The TTOTA values are derived from OTA Test System uncertainties, regulatory requirements and criticality to system performance. As a result, the TTOTA values may sometimes be set to zero.

The TTOTA values should not be modified for any reason e.g. to take account of commonly known OTA Test System errors (such as mismatch, cable loss, etc.).

Note that a formula for applying TTOTA values is provided for all OTA tests, even those with a test tolerance of zero. This is necessary in the case where the OTA Test System uncertainty is greater than that allowed in clause 4.1.2. In this event, the excess error shall be subtracted from the defined TTOTA value in order to generate the correct tightened test requirements as defined in this annex.

# C.3 Measurement of performance requirements

## C.3.1 IAB-DU Test Tolerances

Table C.3.1-1: Derivation of test requirements (FR1 and FR2 performance tests)

|  |  |  |  |
| --- | --- | --- | --- |
| Test | Minimum Requirement in TS 38.174 [2] | Test Tolerance (TTOTA) | Test requirement in the present document |
| Performance requirements for PUSCH with transform precoding disabled | SNRs as specified | 0.6 dB | Formula: SNR + TTOTA  T-put limit unchanged |
| Performance requirements for PUSCH with transform precoding enabled | SNRs as specified | 0.6 dB | Formula: SNR + TTOTA  T-put limit unchanged |
| Performance requirements for UCI multiplexed on PUSCH | SNRs as specified | 0.6 dB | Formula: SNR + TTOTA  BLER limit unchanged |
| Performance requirements for PUCCH format 0 | SNRs as specified | 0.6 dB | Formula: SNR + TTOTA  False ACK limit unchanged  Correct ACK limit unchanged |
| Performance requirements for PUCCH format 1 | SNRs as specified | 0.6 dB | Formula: SNR + TTOTA  False ACK limit unchanged  False NACK limit unchanged  Correct ACK limit unchanged |
| Performance requirements for PUCCH format 2 | SNRs as specified | 0.6 dB | Formula: SNR + TTOTA  False ACK limit unchanged  Correct ACK limit unchanged  UCI BLER limit unchanged |
| Performance requirements for PUCCH format 3 | SNRs as specified | 0.6 dB | Formula: SNR + TTOTA  UCI BLER limit unchanged |
| Performance requirements for PUCCH format 4 | SNRs as specified | 0.6 dB | Formula: SNR + TTOTA  UCI BLER limit unchanged |
| Performance requirements for multi-slot PUCCH | SNRs as specified | 0.6 dB | Formula: SNR + TTOTA  False ACK limit unchanged  False NACK limit unchanged  Correct ACK limit unchanged |
| PRACH false alarm probability and missed detection | SNRs as specified | 0.3 dB | Formula: SNR + TTOTA  PRACH False detection limit unchanged  PRACH detection limit unchanged |
| NOTE: TT values are applicable for normal condition unless otherwise stated. | | | |

## C.3.2 IAB-MT Test Tolerances

### C.3.2.1 Demodulation Performance

Table C.3.2.1-1: Derivation of Test Requirements (FR1 demodulation performance tests)

|  |  |  |  |
| --- | --- | --- | --- |
| Test | Minimum Requirement in TS 38.174 [2] | Test Tolerance (TT) | Test requirement in the present document |
| Performance requirements for PDSCH | SNRs as specified | 0.9 dB for > 10 Hz doppler  1.0 dB for 10Hz doppler | Formula: SNR + TT  T-put limit unchanged |
| Performance requirements for PDCCH with 1 Tx antenna performance | SNRs as specified | 1.0 dB | Formula: SNR + TT  T-put limit unchanged |
| Performance requirements for PDCCH with 2 Tx antenna performance | SNRs as specified | 0.9 dB | Formula: SNR + TT  T-put limit unchanged |

Table C.3.2.1-2: Derivation of Test Requirements (FR2 demodulation performance tests)

|  |  |  |  |
| --- | --- | --- | --- |
| Test | Minimum Requirement in TS 38.174 [2] | Test Tolerance (TT) | Test requirement in the present document |
| Performance requirements for PDSCH | SNRs as specified | 2Tx, Rank 1:  1.8 dB  2Tx, Rank 2:  1.7 dB for doppler < 100Hz  1.6 dB otherwise | Formula: SNR + TT  T-put limit unchanged |
| Performance requirements for PDCCH with 1 Tx antenna | SNRs as specified | 1Tx, rank1:  1.7 dB | Formula: SNR + TT  T-put limit unchanged |
| Performance requirements for PDCCH with 2 Tx antenna | SNRs as specified | 2Tx, rank1:  1.8 dB | Formula: SNR + TT  T-put limit unchanged |

### C.3.2.2 Channel State Information Reporting

Table C.3.2.2-1: Derivation of Test Requirements (FR1 and FR2 CSI reporting tests)

|  |  |  |  |
| --- | --- | --- | --- |
| Test | Minimum Requirement in TS 38.174 [2] | Test Tolerance (TT) | Test requirement in the present document |
| CQI reporting | SNRs as specified  Limits as in the Test Procedure | No test tolerances applied | SNR unchanged |
| PMI reporting | SNRs as specified  ** as specified | SNR 0 dB  *0.01* | SNR unchanged  ** -TT |
| RI reporting | SNRs as specified  ** or ** as specified | SNR 0 dB  *0.01*  *0.01* | SNR unchanged  ** -TT or ** -TT |

**<<end of change>>**

Annex E (informative):   
OTA measurement system set-up

Editor’s comment: Text above kept without changes.

**<<start of change>>**

# E.3 Measurement set-up IAB-MT and IAB-DU performance requirements

## E.3.1 PUSCH and PUCCH single antenna port in multipath fading

Figure E.3.1-1: Functional set-up for PUSCH and PUCCH single antenna port performance requirements in multipath fading

The OTA chamber shown in Figure E.3.1-1 is intended to be generic and can be replaced with any suitable OTA chamber (e.g. far field anechoic chamber, CATR, etc.).

NOTE 1: The feedback could be done as an RF feedback, either using NR channels or using other means, or as a digital feedback. The HARQ Feedback should be error free.

NOTE 2: In tests performed with signal generators, a synchronization signal may be provided between the IAB node and the signal generator, or a common (e.g., GNSS) source may be provided to both IAB node and the signal generator, to enable correct timing of the wanted signal. The method of synchronization with the TE is left to test implementation.

NOTE 3: It is left up to implementation how L1/L2 is configured for testing.

## E.3.2 2 antenna port PUSCH, PDCCH, PDSCH in multi-path fading

Figure E.3.2-1: Functional set-up for PUSCH, PDCCH, PDSCH performance requirements with Rx diversity (2 Rx case shown)

The OTA chamber shown in Figure E.3.2-1 is intended to be generic and can be replaced with any suitable OTA chamber (e.g. far field anechoic chamber, CATR, etc.).

NOTE 1: The feedback could be done as an RF feedback, either using NR channels or using other means, or as a digital feedback. The HARQ Feedback should be error free.

NOTE 2: In tests performed with signal generators, a synchronization signal may be provided between the IAB node and the signal generator, or a common (e.g., GNSS) source may be provided to both IAB node and the signal generator, to enable correct timing of the wanted signal. The method of synchronization with the TE is left to test implementation.

NOTE 3: It is left up to implementation how L1/L2 is configured for testing.

## E.3.3 PUSCH, PRACH, CSI in static AWGN

Figure E.3.3-1: Functional set-up for PUSCH, PRACH, CSI reporting performance requirements in static AWGN channel with Rx diversity (2 Rx case shown)

The OTA chamber shown in Figure E.3.3-1 is intended to be generic and can be replaced with any suitable OTA chamber (e.g. far field anechoic chamber, CATR, etc.).

NOTE 1: The feedback could be done as an RF feedback, either using NR channels or using other means, or as a digital feedback. The HARQ Feedback should be error free.

NOTE 2: In tests performed with signal generators, a synchronization signal may be provided between the IAB node and the signal generator, or a common (e.g., GNSS) source may be provided to both IAB node and the signal generator, to enable correct timing of the wanted signal. The method of synchronization with the TE is left to test implementation.

NOTE 3: It is left up to implementation how L1/L2 is configured for testing.

**<<End of change>>**

**<<start of change>>**

# J.3 Physical signals, channels mapping and precoding

## J.3.1 General

Unless otherwise stated, the transmission on antenna port(s) is defined by using a precoder matrix  of size , where is the number of physical transmit antenna elements configured per test , is the number of ports for a reference signal or physical channel configured per test, and is the first port for that reference signal or physical channel as defined in clauses 7.3 and 7.4 in TS 38.211 [9]. This precoder takes as an input a block of signals for antenna port(s) , , , with  being the number of modulation symbols per antenna port including the reference signal symbols, and generates a block of signals the elements of which are to be mapped onto the frequency-time index pair as per the test configuration but transmitted on different physical antenna elements:



For Clause 6 and 8, the transmission of PDCCH and PDCCH DMRS on antenna port is defined by using a precoder matrix  of size 2x1. This precoder takes as an input a block of signals for antenna port(s) , and generates a block of signals the elements of which are to be mapped onto the frequency-time index pair as per the test configuration but transmitted on different physical antenna elements:



The precoder matrix is specific to the test case configuration  is defined in Clause 5.2.2.2 of TS 38.214 [24].

The transmission on PT-RS antenna port is associated (using same precoder) with the lowest indexed DM-RS antenna port among the DM-RS antenna ports assigned for the PDSCH.

The physical antenna elements are identified by indices, where  is the number of physical antenna elements configured per test.

Modulation symbols with (i.e. PSS, SSS, PBCH and DM-RS for PBCH) are directly mapped to first physical antenna element.



Modulation symbols  for CSI-RS resources which configured for tracking with one port are directly mapped to first physical antenna element.

Modulation symbols  for CSI-RS resources which configured for beam refinement with one port are directly mapped to first physical antenna element.

Modulation symbols  for NZP CSI-RS which configured for CSI acquisition with  are mapped to the physical antenna index  where is the number of NZP CSI-RS ports configured per test.

**<<end of change>>**