**3GPP TSG-RAN WG4 Meeting #99-e R4-2108604**

**Electronic Meeting, 19th - 27th May, 2021**

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| *CR-Form-v12.1* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.174** | **CR** | **0016** | **rev** | **1** | **Current version:** | **16.2.0** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network | **x** | Core Network |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | | | | | | | | |
| ***Title:*** | Big CR on IAB-MT demodulation in TS 38.174 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Huawei, HiSilicon | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_IAB-Perf | | | | |  | ***Date:*** | | | 2021-06-03 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-16 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-15 (Release 15) Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | Provide big CR for NR IAB as per work split. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | For introducing IAB performance requirements, Update clauses 8, 11, Annex A.2, Annex A.3, Annex G, Annex H. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | There will be inconsistence between the specification 38.174 and RAN 4 agreements. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 8, 11, Annex A.2, Annex A.3, Annex G, Annex H | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **x** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | | **X** |  | Test specifications | | | | TS 38.176-1, TS 38.176-2 | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | | R4-2110539 | | | | | | | | |

*<START OF THE CHANGE 1>*

# 8 Conducted performance requirements

## 8.1 IAB-DU performance requirements

### 8.1.1 General

Conducted performance requirements specify the ability of the IAB type 1-H to correctly demodulate signals in various conditions and configurations. Conducted performance requirements are specified at the TAB connector(s).

Conducted performance requirements for the IAB-DU are specified for the fixed reference channels defined in annex A and the propagation conditions in annex TBA. The requirements only apply to those FRCs that are supported by the IAB-DU.

Unless stated otherwise, performance requirements apply for a single carrier only. Performance requirements for an IAB-DU supporting carrier aggregation are defined in terms of single carrier requirements.

The SNR used in this clause is specified based on a single carrier and defined as:

SNR = S / N

Where:

S is the total signal energy in the slot on a single TAB connector.

N is the noise energy in a bandwidth corresponding to the transmission bandwidth over the duration of a slot on a single TAB connector.

### 8.1.2 Performance requirements for PUSCH

#### 8.1.2.1 Requirements for PUSCH with transform precoding disabled

##### 8.1.2.1.1 General

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 retransmissions.

Table: 8.1.2.1.1-1 Test parameters for testing PUSCH

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

##### 8.1.2.1. Minimum requirements

The throughput shall be equal to or larger than 70% of the maximum throughput for the FRCs stated in tables 8.1.2.1.2-1 to 8.1.2.1.2-14 at the given SNR for 1Tx or for 2Tx two-layer spatial multiplexing transmission. FRCs are defined in annex A.

Table 8.1.2.1.2-1: Minimum 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 TBA) | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-1 | pos1 | -2.3 |
| TDLC300-100 Low | D-FR1-A.2.3-1 | pos1 | 10.1 |
| TDLA30-10 Low | D-FR1-A.2.4-1 | pos1 | 12.3 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-1 | pos1 | -5.8 |
| TDLC300-100 Low | D-FR1-A.2.3-1 | pos1 | 6.2 |
| TDLA30-10 Low | D-FR1-A.2.4-1 | pos1 | 8.8 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-1 | pos1 | -8.7 |
| TDLC300-100 Low | D-FR1-A.2.3-1 | pos1 | 3.0 |
| TDLA30-10 Low | D-FR1-A.2.4-1 | pos1 | 5.6 |
| 2 | 2 | TDLB100-400 Low | D-FR1-A.2.1-8 | pos1 | 1.0 |
| TDLC300-100 Low | D-FR1-A.2.3-8 | pos1 | 18.2 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-8 | pos1 | -2.3 |
| TDLC300-100 Low | D-FR1-A.2.3-8 | pos1 | 11.0 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-8 | pos1 | -5.3 |
| TDLC300-100 Low | D-FR1-A.2.3-8 | pos1 | 6.8 |

Table 8.1.2.1.2-2: Minimum 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 TBA) | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-2 | pos1 | -2.5 |
| TDLC300-100 Low | D-FR1-A.2.3-2 | pos1 | 10.2 |
| TDLA30-10 Low | D-FR1-A.2.4-2 | pos1 | 12.2 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-2 | pos1 | -6.0 |
| TDLC300-100 Low | D-FR1-A.2.3-2 | pos1 | 6.3 |
| TDLA30-10 Low | D-FR1-A.2.4-2 | pos1 | 8.6 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-2 | pos1 | -8.7 |
| TDLC300-100 Low | D-FR1-A.2.3-2 | pos1 | 3.1 |
| TDLA30-10 Low | D-FR1-A.2.4-2 | pos1 | 5.5 |
| 2 | 2 | TDLB100-400 Low | D-FR1-A.2.1-9 | pos1 | 1.7 |
| TDLC300-100 Low | D-FR1-A.2.3-9 | pos1 | 18.3 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-9 | pos1 | -2.0 |
| TDLC300-100 Low | D-FR1-A.2.3-9 | pos1 | 11.2 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-9 | pos1 | -5.5 |
| TDLC300-100 Low | D-FR1-A.2.3-9 | pos1 | 6.8 |

Table 8.1.2.1.2-3: Minimum 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 TBA) | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-3 | pos1 | -2.1 |
| TDLC300-100 Low | D-FR1-A.2.3-3 | pos1 | 10.0 |
| TDLA30-10 Low | D-FR1-A.2.4-3 | pos1 | 12.4 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-3 | pos1 | -5.5 |
| TDLC300-100 Low | D-FR1-A.2.3-3 | pos1 | 6.2 |
| TDLA30-10 Low | D-FR1-A.2.4-3 | pos1 | 8.6 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-3 | pos1 | -8.5 |
| TDLC300-100 Low | D-FR1-A.2.3-3 | pos1 | 3.0 |
| TDLA30-10 Low | D-FR1-A.2.4-3 | pos1 | 5.5 |
| 2 | 2 | TDLB100-400 Low | D-FR1-A2.1-10 | pos1 | 2.1 |
| TDLC300-100 Low | D-FR1-A.2.3-10 | pos1 | 18.3 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-10 | pos1 | -1.8 |
| TDLC300-100 Low | D-FR1-A.2.3-10 | pos1 | 11.1 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-10 | pos1 | -5.3 |
| TDLC300-100 Low | D-FR1-A.2.3-10 | pos1 | 6.9 |

Table 8.1.2.1.2-4: Minimum 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 TBA) | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-4 | pos1 | -2.3 |
| TDLC300-100 Low | D-FR1-A.2.3-4 | pos1 | 10.2 |
| TDLA30-10 Low | D-FR1-A.2.4-4 | pos1 | 12.8 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-4 | pos1 | -5.6 |
| TDLC300-100 Low | D-FR1-A.2.3-4 | pos1 | 6.4 |
| TDLA30-10 Low | D-FR1-A.2.4-4 | pos1 | 8.6 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-4 | pos1 | -8.6 |
| TDLC300-100 Low | D-FR1-A.2.3-4 | pos1 | 3.3 |
| TDLA30-10 Low | D-FR1-A.2.4-4 | pos1 | 5.5 |
| 2 | 2 | TDLB100-400 Low | D-FR1-A.2.1-11 | pos1 | 1.3 |
| TDLC300-100 Low | D-FR1-A.2.3-11 | pos1 | 18.4 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-11 | pos1 | -2.2 |
| TDLC300-100 Low | D-FR1-A.2.3-11 | pos1 | 11.2 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-11 | pos1 | -5.2 |
| TDLC300-100 Low | D-FR1-A.2.3-11 | pos1 | 7.0 |

Table 8.1.2.1.2-5: Minimum 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 TBA) | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-5 | pos1 | -2.9 |
| TDLC300-100 Low | D-FR1-A.2.3-5 | pos1 | 10.2 |
| TDLA30-10 Low | D-FR1-A.2.4-5 | pos1 | 12.5 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-5 | pos1 | -6.0 |
| TDLC300-100 Low | D-FR1-A.2.3-5 | pos1 | 6.4 |
| TDLA30-10 Low | D-FR1-A.2.4-5 | pos1 | 8.6 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-5 | pos1 | -8.8 |
| TDLC300-100 Low | D-FR1-A.2.3-5 | pos1 | 3.2 |
| TDLA30-10 Low | D-FR1-A.2.4-5 | pos1 | 5.5 |
| 2 | 2 | TDLB100-400 Low | D-FR1-A.2.1-12 | pos1 | 1.3 |
| TDLC300-100 Low | D-FR1-A.2.3-12 | pos1 | 18.1 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-12 | pos1 | -2.2 |
| TDLC300-100 Low | D-FR1-A.2.3-12 | pos1 | 11.3 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-12 | pos1 | -5.3 |
| TDLC300-100 Low | D-FR1-A.2.3-12 | pos1 | 6.9 |

Table 8.1.2.1.2-6: Minimum 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 TBA) | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-6 | pos1 | -2.5 |
| TDLC300-100 Low | D-FR1-A.2.3-6 | pos1 | 10.0 |
| TDLA30-10 Low | D-FR1-A.2.4-6 | pos1 | 12.4 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-6 | pos1 | -5.8 |
| TDLC300-100 Low | D-FR1-A.2.3-6 | pos1 | 6.3 |
| TDLA30-10 Low | D-FR1-A.2.4-6 | pos1 | 8.5 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-6 | pos1 | -8.7 |
| TDLC300-100 Low | D-FR1-A.2.3-6 | pos1 | 3.1 |
| TDLA30-10 Low | D-FR1-A.2.4-6 | pos1 | 5.4 |
| 2 | 2 | TDLB100-400 Low | D-FR1-A.2.1-13 | pos1 | 1.3 |
| TDLC300-100 Low | D-FR1-A.2.3-13 | pos1 | 19.5 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-13 | pos1 | -2.3 |
| TDLC300-100 Low | D-FR1-A.2.3-13 | pos1 | 11.3 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-13 | pos1 | -5.2 |
| TDLC300-100 Low | D-FR1-A.2.3-13 | pos1 | 6.9 |

Table 8.1.2.1.2-7: Minimum 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 TBA) | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-7 | pos1 | -2.8 |
| TDLC300-100 Low | D-FR1-A.2.3-7 | pos1 | 10.2 |
| TDLA30-10 Low | D-FR1-A.2.4-7 | pos1 | 13.0 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-7 | pos1 | -5.8 |
| TDLC300-100 Low | D-FR1-A.2.3-7 | pos1 | 6.5 |
| TDLA30-10 Low | D-FR1-A.2.4-7 | pos1 | 9.0 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-7 | pos1 | -8.7 |
| TDLC300-100 Low | D-FR1-A.2.3-7 | pos1 | 3.2 |
| TDLA30-10 Low | D-FR1-A.2.4-7 | pos1 | 5.8 |
| 2 | 2 | TDLB100-400 Low | D-FR1-A.2.1-14 | pos1 | 1.4 |
| TDLC300-100 Low | D-FR1-A.2.3-14 | pos1 | 19.2 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-14 | pos1 | -2.2 |
| TDLC300-100 Low | D-FR1-A.2.3-14 | pos1 | 11.6 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-14 | pos1 | -5.2 |
| TDLC300-100 Low | D-FR1-A.2.3-14 | pos1 | 7.1 |

Table 8.1.2.1.2-8: Minimum 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 TBA) | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-1 | pos1 | -2.3 |
| TDLC300-100 Low | D-FR1-A.2.3-1 | pos1 | 10.2 |
| TDLA30-10 Low | D-FR1-A.2.4-1 | pos1 | 12.5 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-1 | pos1 | -5.7 |
| TDLC300-100 Low | D-FR1-A.2.3-1 | pos1 | 6.3 |
| TDLA30-10 Low | D-FR1-A.2.4-1 | pos1 | 8.9 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-1 | pos1 | -8.7 |
| TDLC300-100 Low | D-FR1-A.2.3-1 | pos1 | 3.0 |
| TDLA30-10 Low | D-FR1-A.2.4-1 | pos1 | 5.7 |
| 2 | 2 | TDLB100-400 Low | D-FR1-A.2.1-8 | pos1 | 1.5 |
| TDLC300-100 Low | D-FR1-A.2.3-8 | pos1 | 18.3 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-8 | pos1 | -2.3 |
| TDLC300-100 Low | D-FR1-A.2.3-8 | pos1 | 11.1 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-8 | pos1 | -5.4 |
| TDLC300-100 Low | D-FR1-A.2.3-8 | pos1 | 6.8 |

Table 8.1.2.1.2-9: Minimum 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 TBA) | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-2 | pos1 | -2.3 |
| TDLC300-100 Low | D-FR1-A.2.3-2 | pos1 | 10.5 |
| TDLA30-10 Low | D-FR1-A.2.4-2 | pos1 | 12.6 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-2 | pos1 | -5.7 |
| TDLC300-100 Low | D-FR1-A.2.3-2 | pos1 | 6.5 |
| TDLA30-10 Low | D-FR1-A.2.4-2 | pos1 | 8.9 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-2 | pos1 | -9.0 |
| TDLC300-100 Low | D-FR1-A.2.3-2 | pos1 | 3.2 |
| TDLA30-10 Low | D-FR1-A.2.4-2 | pos1 | 5.8 |
| 2 | 2 | TDLB100-400 Low | D-FR1-A.2.1-9 | pos1 | 2.0 |
| TDLC300-100 Low | D-FR1-A.2.3-9 | pos1 | 18.7 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-9 | pos1 | -2.3 |
| TDLC300-100 Low | D-FR1-A.2.3-9 | pos1 | 11.3 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-9 | pos1 | -5.2 |
| TDLC300-100 Low | D-FR1-A.2.3-9 | pos1 | 7.0 |

Table 8.1.2.1.2-10: Minimum 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 TBA) | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-3 | pos1 | -2.1 |
| TDLC300-100 Low | D-FR1-A.2.3-3 | pos1 | 10.4 |
| TDLA30-10 Low | D-FR1-A.2.4-3 | pos1 | 12.3 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-3 | pos1 | -5.7 |
| TDLC300-100 Low | D-FR1-A.2.3-3 | pos1 | 6.3 |
| TDLA30-10 Low | D-FR1-A.2.4-3 | pos1 | 8.8 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-3 | pos1 | -8.5 |
| TDLC300-100 Low | D-FR1-A.2.3-3 | pos1 | 3.1 |
| TDLA30-10 Low | D-FR1-A.2.4-3 | pos1 | 5.7 |
| 2 | 2 | TDLB100-400 Low | D-FR1-A2.1-10 | pos1 | 1.6 |
| TDLC300-100 Low | D-FR1-A.2.3-10 | pos1 | 18.1 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-10 | pos1 | -2.0 |
| TDLC300-100 Low | D-FR1-A.2.3-10 | pos1 | 11.2 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-10 | pos1 | -5.3 |
| TDLC300-100 Low | D-FR1-A.2.3-10 | pos1 | 6.9 |

Table 8.1.2.1.2-11: Minimum 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 TBA) | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-4 | pos1 | -2.4 |
| TDLC300-100 Low | D-FR1-A.2.3-4 | pos1 | 10.1 |
| TDLA30-10 Low | D-FR1-A.2.4-4 | pos1 | 12.5 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-4 | pos1 | -5.7 |
| TDLC300-100 Low | D-FR1-A.2.3-4 | pos1 | 6.4 |
| TDLA30-10 Low | D-FR1-A.2.4-4 | pos1 | 8.6 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-4 | pos1 | -8.8 |
| TDLC300-100 Low | D-FR1-A.2.3-4 | pos1 | 3.2 |
| TDLA30-10 Low | D-FR1-A.2.4-4 | pos1 | 5.6 |
| 2 | 2 | TDLB100-400 Low | D-FR1-A.2.1-11 | pos1 | 1.1 |
| TDLC300-100 Low | D-FR1-A.2.3-11 | pos1 | 18.5 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-11 | pos1 | -2.5 |
| TDLC300-100 Low | D-FR1-A.2.3-11 | pos1 | 11.3 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-11 | pos1 | -5.6 |
| TDLC300-100 Low | D-FR1-A.2.3-11 | pos1 | 7.0 |

Table 8.1.2.1.2-12: Minimum 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 TBA) | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-5 | pos1 | -2.9 |
| TDLC300-100 Low | D-FR1-A.2.3-5 | pos1 | 10.1 |
| TDLA30-10 Low | D-FR1-A.2.4-5 | pos1 | 12.5 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-5 | pos1 | -6.0 |
| TDLC300-100 Low | D-FR1-A.2.3-5 | pos1 | 6.3 |
| TDLA30-10 Low | D-FR1-A.2.4-5 | pos1 | 8.6 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-5 | pos1 | -9.0 |
| TDLC300-100 Low | D-FR1-A.2.3-5 | pos1 | 3.1 |
| TDLA30-10 Low | D-FR1-A.2.4-5 | pos1 | 5.6 |
| 2 | 2 | TDLB100-400 Low | D-FR1-A.2.1-12 | pos1 | 1.3 |
| TDLC300-100 Low | D-FR1-A.2.3-12 | pos1 | 18.2 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-12 | pos1 | -2.3 |
| TDLC300-100 Low | D-FR1-A.2.3-12 | pos1 | 11.2 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-12 | pos1 | -5.4 |
| TDLC300-100 Low | D-FR1-A.2.3-12 | pos1 | 7.0 |

Table 8.1.2.1.2-13: Minimum 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 TBA) | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-6 | pos1 | -2.5 |
| TDLC300-100 Low | D-FR1-A.2.3-6 | pos1 | 10.0 |
| TDLA30-10 Low | D-FR1-A.2.4-6 | pos1 | 12.5 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-6 | pos1 | -5.8 |
| TDLC300-100 Low | D-FR1-A.2.3-6 | pos1 | 6.2 |
| TDLA30-10 Low | D-FR1-A.2.4-6 | pos1 | 8.7 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-6 | pos1 | -8.8 |
| TDLC300-100 Low | D-FR1-A.2.3-6 | pos1 | 3.0 |
| TDLA30-10 Low | D-FR1-A.2.4-6 | pos1 | 5.5 |
| 2 | 2 | TDLB100-400 Low | D-FR1-A.2.1-13 | pos1 | 1.7 |
| TDLC300-100 Low | D-FR1-A.2.3-13 | pos1 | 18.7 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-13 | pos1 | -2.1 |
| TDLC300-100 Low | D-FR1-A.2.3-13 | pos1 | 11.2 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-13 | pos1 | -5.2 |
| TDLC300-100 Low | D-FR1-A.2.3-13 | pos1 | 6.9 |

Table 8.1.2.1.2-14: Minimum 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 TBA) | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-7 | pos1 | -2.5 |
| TDLC300-100 Low | D-FR1-A.2.3-7 | pos1 | 10.1 |
| TDLA30-10 Low | D-FR1-A.2.4-7 | pos1 | 13.1 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-7 | pos1 | -5.8 |
| TDLC300-100 Low | D-FR1-A.2.3-7 | pos1 | 6.3 |
| TDLA30-10 Low | D-FR1-A.2.4-7 | pos1 | 9.2 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-7 | pos1 | -8.7 |
| TDLC300-100 Low | D-FR1-A.2.3-7 | pos1 | 3.1 |
| TDLA30-10 Low | D-FR1-A.2.4-7 | pos1 | 5.9 |
| 2 | 2 | TDLB100-400 Low | D-FR1-A.2.1-14 | pos1 | 1.6 |
| TDLC300-100 Low | D-FR1-A.2.3-14 | pos1 | 19.3 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-14 | pos1 | -2.2 |
| TDLC300-100 Low | D-FR1-A.2.3-14 | pos1 | 11.6 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-14 | pos1 | -5.3 |
| TDLC300-100 Low | D-FR1-A.2.3-14 | pos1 | 7.1 |

#### 8.1.2.2 Requirements for PUSCH with transform precoding enabled

##### 8.1.2.2.1 General

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 retransmissions.

Table 8.1.2.2.1-1: Test parameters for testing PUSCH

|  |  |  |
| --- | --- | --- |
| Parameter | | Value |
| Transform precoding | | Enabled |
| Cyclic Prefix | | Normal |
| Default TDD UL-DL pattern (Note 1) | | 15 kHz SCS:  3D1S1U, S=10D:2G:2U  30 kHz SCS:  7D1S2U, S=6D:4G:4U |
| HARQ | Maximum number of HARQ transmissions | 4 |
| RV sequence | 0, 2, 3, 1 |
| DM-RS | DM-RS configuration type | 1 |
| DM-RS duration | single-symbol DM-RS |
| Additional DM-RS position | pos1 |
| Number of DM-RS CDM group(s) without data | 2 |
| Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB |
| DM-RS port(s) | 0 |
| DM-RS sequence generation | NID0=0, group hopping and sequence hopping are disabled |
| Time domain resource assignment | PUSCH mapping type | A, B |
| Start symbol | 0 |
| Allocation length | 14 |
| 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 |
| Frequency hopping | Disabled |
| Code block group based PUSCH transmission | | Disabled |
| NOTE 1: The same requirements are applicable to FDD and TDD with different UL-DL patterns. | | |

##### 8.1.2.2.2 Minimum requirements

The throughput shall be equal to or larger than 70% of the maximum throughput for the FRCs stated in tables 8.1.2.2.2-1 to 8.1.2.2.2-4 at the given SNR. FRCs are defined in annex A.

Table 8.1.2.2.2-1: Minimum 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 TBA) | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-15 | pos1 | -2.4 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-15 | pos1 | -5.7 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-15 | pos1 | -8.5 |

Table 8.1.2.2.2-2: Minimum 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 TBA) | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-16 | pos1 | -2.5 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-16 | pos1 | -5.7 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-16 | pos1 | -8.4 |

Table 8.1.2.2.2-3: Minimum 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 TBA) | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-15 | pos1 | -2.3 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-15 | pos1 | -5.8 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-15 | pos1 | -8.6 |

Table 8.1.2.2.2-4: Minimum 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 TBA) | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-16 | pos1 | -2.7 |
| 4 | TDLB100-400 Low | D-FR1-A.2.1-16 | pos1 | -6.0 |
| 8 | TDLB100-400 Low | D-FR1-A.2.1-16 | pos1 | -8.8 |

#### 8.1.2.3 Requirements for UCI multiplexed on PUSCH

##### 8.1.2.3.1 General

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

The CSI part 1 block error probability (BLER) is defined as the probability of incorrectly decoding the CSI part 1 information when the CSI part 1 information is sent as follow:

where:

- #(false CSI part 1) denotes the number of incorrectly decoded CSI part 1 information transmitted occasions

- #(CSI part 1) denotes the number of CSI part 1 information transmitted occasions.

The CSI part 2 block error probability is defined as the probability of incorrectly decoding the CSI part 2 information when the CSI part 2 information is sent as follows:

where:

- #(false CSI part 2) denotes the number of incorrectly decoded CSI part 2 information transmitted occasions

- #(CSI part 2) denotes the number of CSI part 2 information transmitted occasions.

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

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

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

The 7bits UCI 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 part2 information.

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

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

Table 8.1.2.3.1-1: Test parameters for testing UCI on PUSCH

|  |  |  |
| --- | --- | --- |
| Parameter | | Value |
| Transform precoding | | Disabled |
| Default TDD UL-DL pattern (Note 1) | | 30 kHz SCS:  7D1S2U, S=6D:4G:4U |
| Cyclic Prefix | | Normal |
| 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 |
| Number of DM-RS CDM group(s) without data | 2 |
| Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB |
| DM-RS port(s) | {0} |
| DM-RS sequence generation | NID0=0, nSCID=0 |
| Time domain resource assignment | PUSCH mapping type | A,B |
| Start symbol | 0 |
| Allocation length | 14 |
| Frequency domain resource assignment | RB assignment | Full applicable test bandwidth |
| Frequency hopping | Disabled |
| Code block group based PUSCH transmission | | Disabled |
| UCI | Number of CSI part 1 and CSI part 2 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 1: The same requirements are applicable to FDD and TDD with different UL-DL patterns. | | |

##### 8.1.2.3.2 Minimum requirements

The CSI part 1 block error probability shall not exceed 0.1% at the SNR in table 8.2.2.3.2-1 and table 8.2.2.3.2-2.The CSI part 2 block error probability shall not exceed 1% at the SNR given in table 8.2.2.3.2-3 and table 8.2.2.3.2-4.

Table 8.1.2.3.2-1: Minimum 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 TBA) | 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 | 5.4 |
| 2 | TDLC300-100 Low | 40(20,20) | pos1 | D-FR1-A.2.3-4 | 4.3 |

Table 8.1.2.3.2-2: Minimum requirements for UCI multiplexed on PUSCH, Type B, CSI part 1, 10 MHz Channel Bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of Demodulation Branches | Propagation conditions and correlation matrix (Annex TBA) | 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 | 5.8 |
| 2 | TDLC300-100 Low | 40(20,20) | pos1 | D-FR1-A.2.3-4 | 4.1 |

Table 8.1.2.3.2-3: Minimum requirements for UCI multiplexed on PUSCH, Type A, CSI part 2, 10 MHz Channel Bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of Demodulation Branches | Propagation conditions and correlation matrix (Annex TBA) | 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 | -0.2 |
| 2 | TDLC300-100 Low | 40(20,20) | pos1 | D-FR1-A.2.3-4 | 2.4 |

Table 8.1.2.3.2-4: Minimum requirements for UCI multiplexed on PUSCH, Type B, CSI part 2, 10 MHz Channel Bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of Demodulation Branches | Propagation conditions and correlation matrix (Annex TBA) | 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 | 0.3 |
| 2 | TDLC300-100 Low | 40(20,20) | pos1 | D-FR1-A.2.3-4 | 2.6 |

### 8.1.3 Performance requirements for PUCCH

#### 8.1.3.1 DTX to ACK probability

##### 8.1.3.1.1 General

The DTX to ACK probability, i.e. the probability that ACK is detected when nothing was sent:

where:

- #(false ACK bits) denotes the number of detected ACK bits.

- #(ACK/NACK bits) denotes the number of encoded bits per slot

- #(PUCCH DTX) denotes the number of DTX occasions

##### 8.1.3.1.2 Minimum requirement

The DTX to ACK probability shall not exceed 1% for all PUCCH formats carrying ACK/NACK bits:

#### 8.1.3.2 Performance requirements for PUCCH format 0

##### 8.1.3.2.1 General

The ACK missed detection probability is the probability of not detecting an ACK when an ACK was sent.

Table 8.1.3.2.1-1: Test Parameters

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

[The transient period as specified in TS 38.101-1 [3] clause 6.3.3.1 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the CC centre, i.e. intra-slot frequency hopping is enabled.]

##### 8.1.3.2.2 Minimum requirement

The ACK missed detection probability shall not exceed 1% at the SNR given in table 8.1.3.2.2-1 and in table 8.1.3.2.2-2.

Table 8.1.3.2.2-1: Minimum requirements for PUCCH format 0 and 15 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Propagation conditions and correlation matrix (Annex TBA) | Number of OFDM symbols | Channel bandwidth / SNR (dB) | | |
| 5 MHz | 10 MHz | 20 MHz |
| 1 | 2 | TDLC300-100 Low | 1 | 9.4 | 8.8 | 9.3 |
| 2 | 2.8 | 3.7 | 3.3 |
| 1 | 4 | TDLC300-100 Low | 1 | 3.0 | 2.9 | 3.2 |
| 2 | -1.0 | -0.5 | -0.8 |
| 1 | 8 | TDLC300-100 Low | 1 | -1.1 | -1.1 | -1.1 |
| 2 | -4.1 | -3.9 | -4.0 |

Table 8.2.3.2.2-2: Minimum requirements for PUCCH format 0 and 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Propagation conditions and correlation matrix (Annex TBA) | Number of OFDM symbols | Channel bandwidth / SNR (dB) | | | |
| 10 MHz | 20 MHz | 40 MHz | 100 MHz |
| 1 | 2 | TDLC300-100 Low | 1 | 9.8 | 9.8 | 9.5 | 9.2 |
| 2 | 4.2 | 3.6 | 3.8 | 3.5 |
| 1 | 4 | TDLC300-100 Low | 1 | 3.4 | 3.4 | 3.0 | 3.3 |
| 2 | -0.3 | -0.4 | -0.5 | -0.8 |
| 1 | 8 | TDLC300-100 Low | 1 | -1.0 | -1.0 | -1.1 | -1.0 |
| 2 | -3.7 | -3.8 | -4.0 | -3.9 |

#### 8.1.3.3 Performance requirements for PUCCH format 1

##### 8.1.3.3.1 NACK to ACK requirements

8.1.3.3.1.1 General

The NACK to ACK detection probability is the probability that an ACK bit is falsely detected when an NACK bit was sent on the particular bit position, where the NACK to ACK detection probability is defined as follows:

**,

where:

- denotes the total number of NACK bits transmitted

- denotes the number of NACK bits decoded as ACK bits at the receiver, i.e. the number of received ACK bits

- 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.

Random codeword selection is assumed.

Table 8.1.3.3.1.1-1: Test Parameters

|  |  |
| --- | --- |
| Parameter | Test |
| Cyclic prefix | Normal |
| 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 |

[The transient period as specified in TS 38.101-1 [3] clause 6.3.3.1 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the CC centre, i.e. intra-slot frequency hopping is enabled.]

8.1.3.3.1.2 Minimum requirements

The NACK to ACK probability shall not exceed 0.1% at the SNR given in table 8.1.3.3.1.2-1 and table 8.1.3.3.1.2-2.

Table 8.1.3.3.1.2-1: Minimum requirements for PUCCH format 1 with 15 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of Demodulation Branches | Propagation conditions and correlation matrix (Annex TBA) | Channel bandwidth / SNR (dB) | | |
| 5 MHz | 10 MHz | 20 MHz |
| 1 | 2 | TDLC-300-100 Low | -3.8 | -3.6 | -3.6 |
| 4 | TDLC-300-100 Low | -8.4 | -7.6 | -8.4 |
| 8 | TDLC-300-100 Low | -11.8 | -11.4 | -11.4 |

Table 8.1.3.3.1.2-2: Minimum requirements for PUCCH format 1 with 30 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of Demodulation Branches | Propagation conditions and correlation matrix (Annex TBA) | Channel bandwidth / SNR (dB) | | | |
| 10 MHz | 20 MHz | 40 MHz | 100 MHz |
| 1 | 2 | TDLC-300-100 Low | -2.8 | -3.3 | -3.9 | -3.5 |
| 4 | TDLC-300-100 Low | -8.1 | -8.3 | -7.5 | -8.0 |
| 8 | TDLC-300-100 Low | -11.5 | -11.2 | -11.6 | -11.3 |

##### 8.1.3.3.2 ACK missed detection requirements

8.1.3.3.2.1 General

The ACK missed detection probability is the probability of not detecting an ACK when an ACK was sent. The test parameters in table 8.3.3.1.1-1 are configured.

[The transient period as specified in TS 38.101-1 [3] clause 6.3.3.1 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the centre, i.e. intra-slot frequency hopping is enabled.]

8.1.3.3.2.2 Minimum requirements

The ACK missed detection probability shall not exceed 1% at the SNR given in table 8.1.3.3.2.2-1 and in table 8.1.3.3.2.2-2.

Table 8.1.3.3.2.2-1: Minimum requirements for PUCCH format 1 with 15 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of Demodulation Branches | Propagation conditions and correlation matrix (Annex TBA) | Channel bandwidth / SNR (dB) | | |
| 5 MHz | 10 MHz | 20 MHz |
| 1 | 2 | TDLC-300-100 Low | -5.0 | -4.4 | -5.0 |
| 4 | TDLC-300-100 Low | -8.6 | -8.2 | -8.5 |
| 8 | TDLC-300-100 Low | -11.6 | -11.5 | -11.5 |

Table 8.1.3.3.2.2-2: Minimum requirements for PUCCH format 1 with 30 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of Demodulation Branches | Propagation conditions and correlation matrix (Annex TBA) | Channel bandwidth / SNR (dB) | | | |
| 10 MHz | 20 MHz | 40 MHz | 100 MHz |
| 1 | 2 | TDLC-300-100 Low | -3.9 | -4.4 | -4.4 | -4.2 |
| 4 | TDLC-300-100 Low | -8.0 | -8.1 | -8.4 | -8.3 |
| 8 | TDLC-300-100 Low | -11.4 | -11.4 | -11.4 | -11.4 |

#### 8.1.3.4 Performance requirements for PUCCH format 2

##### 8.1.3.4.1 NACK to ACK requirements

8.1.3.4.1.1 General

The ACK missed detection probability is the probability of not detecting an ACK when an ACK was sent.

The ACK missed detection requirement only applies to the PUCCH format 2 with 4 UCI bits.

Table 8.1.3.4.1.1-1: Test Parameters

|  |  |
| --- | --- |
| Parameter | Value |
| Cyclic Prefix | Normal |
| Modulation order | QSPK |
| 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 |

[The transient period as specified in TS 38.101-1 [3] 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.]

8.1.3.4.1.2 Minimum requirements

The ACK missed detection probability shall not exceed 1% at the SNR given in table 8.1.3.4.1.2-1 and table 8.1.3.4.1.2-2 for 4UCI bits.

Table 8.1.3.4.1.2-1: Minimum requirements for PUCCH format 2 with 15 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of Demodulation Branches | Propagation conditions and correlation matrix (Annex TBA) | Channel bandwidth / SNR (dB) | | |
| 5 MHz | 10 MHz | 20 MHz |
| 1 | 2 | TDLC300-100 Low | 5.8 | 5.6 | 5.9 |
| 4 | TDLC300-100 Low | 0.4 | 0.5 | 0.3 |
| 8 | TDLC300-100 Low | -3.5 | -3.5 | -3.5 |

Table 8.1.3.4.1.2-2: Minimum requirements for PUCCH format 2 with 30 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of Demodulation Branches | Propagation conditions and correlation matrix (Annex TBA) | Channel bandwidth / SNR (dB) | | | |
| 10 MHz | 20 MHz | 40 MHz | 100 MHz |
| 1 | 2 | TDLC300-100 Low | 5.5 | 5.6 | 5.5 | 5.7 |
| 4 | TDLC300-100 Low | 0.3 | 0.2 | 0.3 | 0.4 |
| 8 | TDLC300-100 Low | -3.6 | -3.6 | -3.5 | -3.3 |

##### 8.1.3.4.2 UCI BLER performance requirements

8.1.3.4.2.1 General

The UCI block error probability (BLER) 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.

[The transient period as specified in TS 38.101-1 [3] clause 6.3.3.1 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the CC centre, i.e. intra-slot frequency hopping is enabled.]

The UCI block error probability performance requirement only applies to the PUCCH format 2 with 22 UCI bits.

Table 8.1.3.4.2.1-1: Test Parameters

|  |  |
| --- | --- |
| Parameter | Value |
| Cyclic Prefix | Normal |
| Modulation order | QSPK |
| First PRB prior to frequency hopping | 0 |
| Intra-slot frequency hopping | enabled |
| Frist 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 |

8.1.3.4.2.2 Minimum requirement

The UCI block error probability shall not exceed 1% at the SNR given in table 8.2.3.4.2.2-1 and table 8.1.3.4.2.2-2 for 22 UCI bits.

Table 8.1.3.4.2.2-1: Minimum requirements for PUCCH format 2 with 15 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of TX antennas | Number of Demodulation Branches | Channel bandwidth / SNR (dB) | | |
| 5 MHz | 10 MHz | 20 MHz |
| 1 | 2 | 0.2 | 0.8 | 1.2 |
| 4 | -3.6 | -3.2 | -3.2 |
| 8 | -6.8 | -6.7 | -6.8 |

Table 8.1.3.4.2.2-2: Minimum requirements for PUCCH format 2 with 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of Demodulation Branches | Cyclic Prefix | Propagation conditions and correlation matrix (Annex TBA) | Channel bandwidth / SNR (dB) | | | |
| 10 MHz | 20 MHz | 40 MHz | 100 MHz |
| 1 | 2 | Normal | TDLC300-100 Low | 0.5 | 1.1 | 0.4 | 0.3 |
| 4 | Normal | TDLC300-100 Low | -3.3 | -2.9 | -3.3 | -3.4 |
| 8 | Normal | TDLC300-100 Low | -5.8 | -5.8 | -6.7 | -5.9 |

#### 8.1.3.5 Performance requirements for PUCCH format 3

##### 8.1.3.5.1 General

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 [3] clause 6.3.3.1 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the centre, i.e. intra-slot frequency hopping is enabled.]

Table 8.1.3.5.1-1: Test Parameters

|  |  |  |
| --- | --- | --- |
| Parameter | Test 1 | Test 2 |
| Cyclic Prefix | Normal | |
| Modulation order | QPSK | |
| First PRB prior to frequency hopping | 0 | |
| Intra-slot frequency hopping | enabled | |
| First PRB after frequency hopping | The largest PRB index – (Number of PRBs – 1) | |
| Group and sequence hopping | neither | |
| Hopping ID | 0 | |
| Number of PRBs | 1 | 3 |
| Number of symbols | 14 | 4 |
| The number of UCI information bits | 16 | 16 |
| First symbol | 0 | 0 |

##### 8.1.3.5.2 Minimum requirements

The UCI block error probability shall not exceed 1% at the SNR given in Table 8.2.3.5.2-1 and Table 8.2.3.5.2-2.

Table 8.2.3.5.2-1: Minimum requirements for PUCCH format 3 with 15 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Test Number | Number of TX antennas | Number of Demodulation Branches | Additional DM-RS configuration | Channel bandwidth / SNR (dB) | | |
| 5 MHz | 10 MHz | 20 MHz |
| 1 | 1 | 2 | No additional DM-RS | 0.2 | 1.1 | 0.3 |
| Additional DM-RS | -0.1 | 0.5 | -0.1 |
| 4 | No additional DM-RS | -3.8 | -3.3 | -3.8 |
| Additional DM-RS | -4.3 | -4.0 | -4.0 |
| 8 | No additional DM-RS | -7.0 | -6.7 | -6.9 |
| Additional DM-RS | -7.7 | -7.5 | -7.7 |
| 2 | 1 | 2 | No additional DM-RS | 1.4 | 2.2 | 2.0 |
| 4 | No additional DM-RS | -3.1 | -2.5 | -2.5 |
| 8 | No additional DM-RS | -6.5 | -6.0 | -6.2 |

Table 8.1.3.5.2-2: Minimum requirements for PUCCH format 3 with 30 kHz SCS

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test Number | Number of TX antennas | Number of Demodulation Branches | Cyclic Prefix | Propagation conditions and correlation matrix (Annex TBA) | Additional DM-RS configuration | Channel bandwidth / SNR (dB) | | | |
| 10 MHz | 20 MHz | 40 MHz | 100 MHz |
| 1 | 1 | 2 | Normal | TDLC300-100 Low | No additional DM-RS | 0.9 | 0.6 | 0.6 | 0.9 |
| Additional DM-RS | 0.5 | 0.3 | 0.0 | 0.1 |
| 4 | Normal | TDLC300-100 Low | No additional DM-RS | -3.1 | -3.4 | -3.2 | -3.5 |
| Additional DM-RS | -3.7 | -4.1 | -4.0 | -4.2 |
| 8 | Normal | TDLC300-100 Low | No additional DM-RS | -6.6 | -6.7 | -6.8 | -6.8 |
| Additional DM-RS | -7.5 | -7.6 | -7.6 | -7.7 |
| 2 | 1 | 2 | Normal | TDLC300-100 Low | No additional DM-RS | 1.8 | 2.0 | 2.0 | 1.5 |
| 4 | Normal | TDLC300-100 Low | No additional DM-RS | -2.9 | -3.0 | -2.4 | -3.0 |
| 8 | Normal | TDLC300-100 Low | No additional DM-RS | -6.4 | -6.0 | -6.4 | -6.2 |

#### 8.1.3.6 Performance requirements for PUCCH format 4

##### 8.1.3.6.1 General

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 [3] clause 6.3.3.1 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the centre, i.e. intra-slot frequency hopping is enabled.]

Table 8.1.3.6.1-1: Test parameters

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

##### 8.1.3.6.2 Minimum requirement

The UCI block error probability shall not exceed 1% at the SNR given in Table 8.2.3.6.2-1 and Table 8.2.3.6.2-2.

Table 8.1.3.6.2-1: Required SNR for PUCCH format 4 with 15 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of Demodulation Branches | Propagation conditions and correlation matrix (Annex TBA) | Additional DM-RS configuration | Channel bandwidth / SNR (dB) | | |
| 5 MHz | 10 MHz | 20 MHz |
| 1 | 2 | TDLC300-100 Low | No additional DM-RS | 1.8 | 2.6 | 2.2 |
| Additional DM-RS | 1.6 | 2.4 | 1.8 |
| 4 | TDLC300-100 Low | No additional DM-RS | -2.3 | -1.9 | -2.2 |
| Additional DM-RS | -2.9 | -2.6 | -2.7 |
| 8 | TDLC300-100 Low | No additional DM-RS | -5.9 | -5.7 | -5.8 |
| Additional DM-RS | -6.6 | -6.4 | -6.3 |

Table 8.1.3.6.2-2: Required SNR for PUCCH format 4 with 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of Demodulation Branches | Propagation conditions and correlation matrix (Annex TBA) | Additional DM-RS configuration | Channel bandwidth / SNR (dB) | | | |
| 10 MHz | 20 MHz | 40 MHz | 100 MHz |
| 1 | 2 | TDLC300-100 Low | No additional DM-RS | 3.1 | 2.8 | 3.1 | 2.8 |
| Additional DM-RS | 2.8 | 2.3 | 3.1 | 2.2 |
| 4 | TDLC300-100 Low | No additional DM-RS | -1.7 | -1.9 | -1.7 | -2.1 |
| Additional DM-RS | -2.0 | -2.5 | -2.5 | -2.4 |
| 8 | TDLC300-100 Low | No additional DM-RS | -5.6 | -5.5 | -5.5 | -5.5 |
| Additional DM-RS | -6.2 | -6.1 | -6.4 | -6.2 |

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

##### 8.1.3.7.1 General

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

8.1.3.7.2.1 ACK to NACK requirements

8.1.3.7.2.1.1 General

The NACK to ACK detection probability is the probability that an ACK bit is falsely detected when an NACK bit was sent on the particular bit position, where the NACK to ACK detection probability is defined as follows:

**,

where:

- denotes the total number of NACK bits transmitted

- denotes the number of NACK bits decoded as ACK bits at the receiver, i.e. the number of received ACK bits

- 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.

Random codeword selection is assumed.

Table 8.1.3.7.2.1.1-1: Test Parameters for multi-slot PUCCH format 1

|  |  |
| --- | --- |
| Parameter | Test |
| Cyclic Prefix | Normal |
| 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 |

8.1.3.7.2.1.2 Minimum requirements

The multi-slot NACK to ACK probability shall not exceed 0.1% at the SNR given in table 8.2.3.7.2.1.2-1.

Table 8.1.3.7.2.1.2-1: Minimum requirements for multi-slot PUCCH format 1 with 30kHz SCS

|  |  |  |  |
| --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Propagation conditions and correlation matrix (Annex TBA) | Channel bandwidth / SNR (dB) |
| 40 MHz |
| 1 | 2 | TDLC-300-100 Low | -6.3 |

8.1.3.7.2.2 ACK missed detection requirements

8.1.3.7.2.2.1 General

The ACK missed detection probability is the probability of not detecting an ACK when an ACK was sent. The test parameters in table 8.2.3.7.2.1.1-1 are configured.

8.1.3.7.2.2.2 Minimum requirements

The multi-slot ACK missed detection probability shall not exceed 1% at the SNR given in table 8.2.3.7.2.2.2-1.

Table 8.1.3.7.2.2.2-1: Minimum requirements for multi-slot PUCCH format 1 with 30kHz SCS

|  |  |  |  |
| --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Propagation conditions and correlation matrix (Annex TBA) | Channel bandwidth / SNR (dB) |
| 40 MHz |
| 1 | 2 | TDLC-300-100 Low | -7.6 |

### 8.1.4 Performance requirements for PRACH

#### 8.1.4.1 PRACH false alarm probability

##### 8.1.4.1.1 General

The false alarm requirement is valid for any number of receive antennas, for any channel bandwidth.

The false alarm probability is the conditional total probability of erroneous detection of the preamble (i.e. erroneous detection from any detector) when input is only noise.

##### 8.1.4.1.2 Minimum requirement

The false alarm probability shall be less than or equal to 0.1%.

#### 8.1.4.2 PRACH detection requirements

##### 8.1.4.2.1 General

The probability of detection is the conditional probability of correct detection of the preamble when the signal is present. There are several error cases – detecting different preamble than the one that was sent, not detecting a preamble at all or correct preamble detection but with the wrong timing estimation. A timing estimation error occurs if the estimation error of the timing of the strongest path is larger than the time error tolerance given in Table 8.1.4.2.1-1.

Table 8.1.4.2.1-1: Time error tolerance

|  |  |  |
| --- | --- | --- |
| PRACH preamble | PRACH SCS (kHz) | Time error tolerance |
| 0 | 1.25 | 2.55 us |
| A1, A2, A3, B4, C0, C2 | 15 | 2.03 us |
| 30 | 1.77 us |

The test preambles for normal mode are listed in table A.2.5-1 and the test parameter *msg1-FrequencyStart* is set to 0.

##### 8.1.4.2.2 Minimum requirements for normal mode

The probability of detection shall be equal to or exceed 99% for the SNR levels listed in Tables 8.1.4.2.2-1 to 8.1.4.2.2-3.

Table 8.1.4.2.2-1: PRACH missed detection requirements for Normal Mode, 1.25 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Propagation conditions and correlation matrix (Annex TBA) | Frequency offset | SNR (dB) |
| Burst format 0 |
| 1 | 2 | TDLC300-100 Low | 400 Hz | -6.6 |
| 4 | TDLC300-100 Low | 400 Hz | -11.9 |
| 8 | TDLC300-100 Low | 400 Hz | -15.8 |

Table 8.1.4.2.2-2: PRACH missed detection requirements for Normal Mode, 15 kHz SCS

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of Demodulation Branches | Propagation conditions and correlation matrix (Annex TBA) | Frequency offset | SNR (dB) | | | | | |
| Burst format A1 | Burst format A2 | Burst format A3 | Burst format B4 | Burst format C0 | Burst format C2 |
| 1 | 2 | TDLC300-100 Low | 400 Hz | -2.1 | -4.8 | -6.6 | -8.8 | 0.8 | -4.9 |
| 4 | TDLC300-100 Low | 400 Hz | -7.3 | -10.3 | -11.7 | -13.8 | -4.3 | -10.2 |
| 8 | TDLC300-100 Low | 400 Hz | -11.0 | -13.9 | -15.2 | -17.3 | -8.1 | -13.9 |

Table 8.1.4.2.2-3: PRACH missed detection requirements for Normal Mode, 30 kHz SCS

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of Demodulation Branches | Propagation conditions and correlation matrix (Annex TBA) | Frequency offset | SNR (dB) | | | | | |
| Burst format A1 | Burst format A2 | Burst format A3 | Burst format B4 | Burst format C0 | Burst format C2 |
| 1 | 2 | TDLC300-100 Low | 400 Hz | -2.8 | -5.7 | -7.4 | -9.9 | 0.1 | -5.6 |
| 4 | TDLC300-100 Low | 400 Hz | -7.2 | -10.4 | -12.0 | -14.5 | -4.5 | -10.4 |
| 8 | TDLC300-100 Low | 400 Hz | -10.7 | -13.7 | -15.1 | -17.6 | -7.8 | -13.7 |

## 8.2 IAB-MT requirements

### 8.2.1 General

Conducted performance requirements specify the ability of the *IAB-MT type 1-H* to correctly demodulate signals in various conditions and configurations. Conducted performance requirements are specified at the *TAB connector(s)* (for *IAB-MT type 1-H*).

Conducted performance requirements for the IAB-MT are specified for the fixed reference channels defined in annex A and the propagation conditions in annex TBA. The requirements only apply to those FRCs that are supported by the IAB-MT.

The SNR used in this clause is specified based on a single carrier and defined as:

SNR = S / N

Where:

S is the total signal energy in the slot on a single *TAB connector* (for *IAB-MT type 1-H*).

N is the noise energy in a bandwidth corresponding to the transmission bandwidth over the duration of a slot on a single TAB connector (for *IAB-MT type 1-H*).

### 8.2.2 Demodulation performance requirements

#### 8.2.2.1 Performance requirements for PDSCH

##### 8.2.2.1.1 General

The performance requirement of PDSCH 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 retransmissions.

Table: 8.2.2.1.1-1 Test parameters for testing PDSCH

|  |  |  |
| --- | --- | --- |
| Parameter | | Value |
| Cyclic prefix | | Normal |
| Default TDD UL-DL pattern (Note 1) | | 7D1S2U, S=6D:4G:4U |
| 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 |
| DM-RS position (*l0*) | 2 |
| Additional DM-RS position | pos1 |
| Number of DM-RS CDM group(s) without data | 1 for Rank 1 and Rank 2 tests 2 for Rank 3 and Rank 4 tests |
| DM-RS port(s) | {1000} for Rank 1 tests {1000-1001} for Rank 2 tests {1000-1002} for Rank 3 tests {1000-1003} for Rank 4 tests |
| DM-RS sequence generation | NID0=0 |
| Time domain resource assignment | PDSCH mapping type | A |
| Start symbol | 2 |
| Allocation length | 12 |
| Frequency domain resource assignment | RB assignment | Full applicable test bandwidth |
| PT-RS configuration | | Not configured |
| PRB bundling size | | 2 |
| VRB-to-PRB mapping type | | Not interleaved |
| PDSCH & PDSCH DMRS Precoding configuration | | Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i1, i2 combination, and with PRB bundling granularity |
| Note 1: The same requirements are applicable to TDD with different UL-DL patterns. | | |

##### 8.2.2.1.2 Minimum requirements

The throughput shall be equal to or larger than the fraction of maximum throughput for the FRCs stated in tables 8.2.2.1.2-1 to 8.2.2.1.2-4 at the given SNR with the test parameters stated in Table 8.2.2.1.1-1.

Table 8.2.2.1.2-1: Minimum requirements for PDSCH Type A with Rank 1

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Test number | FRC (Annex A) | Bandwidth (MHz) / Subcarrier spacing (kHz) | Propagation conditions (Annex TBA) | Antenna configuration | Fraction of maximum throughput (%) | SNR  (dB) |
| 1-1 | M-FR1-A.3.3-1 | 40/30 | TDLA30-10 | 2x4, ULA Low | 70 | 21.6 |
| 1-2 | M-FR1-A.3.1-1 | 40/30 | TDLA30-10 | 2x4, ULA Low | 30 | [-1.1] |

Table 8.2.2.1.2-2: Minimum requirements for PDSCH Type A with Rank 2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Test number | FRC (Annex A) | Bandwidth (MHz) / Subcarrier spacing (kHz) | Propagation conditions (Annex TBA) | Antenna configuration | Fraction of maximum throughput (%) | SNR  (dB) |
| 2-1 | M-FR1-A.3.2-1 | 40/30 | TDLA30-10 | 2x4, ULA Low | 70 | 13.6 |

Table 8.2.2.1.2-3: Minimum requirements for PDSCH Type A with Rank 3

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Test number | FRC (Annex A) | Bandwidth (MHz) / Subcarrier spacing (kHz) | Propagation conditions (Annex TBA) | Antenna configuration | Fraction of maximum throughput (%) | SNR  (dB) |
| 3-1 | M-FR1-A.3.1-2 | 40/30 | TDLA30-10 | 4x4, ULA Low | 70 | [11.4] |

Table 8.2.2.1.2-4: Minimum requirements for PDSCH Type A with Rank 4

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Test number | FRC (Annex A) | Bandwidth (MHz) / Subcarrier spacing (kHz) | Propagation conditions (Annex TBA) | Antenna configuration | Fraction of maximum throughput (%) | SNR  (dB) |
| 4-1 | M-FR1-A.3.1-3 | 40/30 | TDLA30-10 | 4x4, ULA Low | 70 | 15.4 |

#### 8.2.2.2 Performance requirements for PDCCH

##### 8.2.2.2.1 General

The receiver characteristics of the PDCCH are determined by the probability of miss-detection of the Downlink Scheduling Grant (Pm-dsg).

Table: 8.2.2.2.1-1 Test parameters for testing PDCCH

|  |  |
| --- | --- |
| Parameter | Value |
| Cyclic prefix | Normal |
| Default TDD UL-DL pattern (Note 1) | 7D1S2U, S=6D:4G:4U |
| DM-RS sequence generation | NID=0 |
| Frequency domain resource allocation for CORESET | Start from RB = 0 with contiguous RB allocation |
| CCE to REG mapping type | Interleaved |
| Interleaver size | 3 |
| REG bundle size | 2 for test with 1Tx 6 for test with 2Tx |
| Shift Index | 0 |
| Slots for PDCCH monitoring | Each slot |
| Number of PDCCH candidates for the tested aggregation level | 1 |
| PDCCH Precoding configuration | Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i1, i2 combination with REG bundling granularity for number of Tx larger than 1 |
| Note 1: The same requirements are applicable to TDD with different UL-DL patterns. | |

##### 8.2.2.2.2 Minimum requirements

The Pm-dsg shall be equal to or smaller than 1%, for the cases stated in Table 8.2.2.2.2-1 at the given SNR with the test parameters stated in Table 8.2.2.2.1-1.

Table 8.2.2.2.2-1: Minimum requirements for PDCCH

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test number | Bandwidth (MHz) / Subcarrier spacing (kHz) | CORESET RB | CORESET duration | Aggregation level | FRC (Annex A) | Propagation conditions (Annex TBA) | Antenna configuration | Pm-dsg (%) | SNR  (dB) |
| 1 | 40/30 | 102 | 1 | 2 | M-FR1-A.3.4-1 | TDLA30-10 | 1x4, ULA Low | 1 | 2.1 |
| 2 | 40/30 | 102 | 1 | 4 | M-FR1-A.3.4-1 | TDLA30-10 | 1x4, ULA Low | 1 | [0.7] |
| 3 | 40/30 | 90 | 1 | 8 | M-FR1-A.3.4-1 | TDLA30-10 | 2x4, ULA Low | 1 | [-4.1] |

### 8.2.3 CSI reporting requirements

#### 8.2.3.1 General

This clause includes conducted requirements for the reporting of channel state information (CSI).

##### 8.2.3.1.1 Common test parameters

Parameters specified in Table 8.2.3.1-1 are applied for all test cases in clause 8.2.3 unless otherwise stated.

Table 8.2.3.1-1: Test parameters for CSI test cases

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | | | | Unit | Value |
| PDSCH transmission scheme | | | |  | Transmission scheme 1 |
| Duplex mode | | | |  | TDD |
| Actual carrier configuration | Offset between Point A and the lowest usable subcarrier on this carrier (Note 2) | | | RBs | 0 |
| Subcarrier spacing | | | kHz | 15 or 30 |
| DL BWP configuration #1 | Cyclic prefix | | |  | Normal |
| RB offset | | | RBs | 0 |
| Number of contiguous PRB | | | PRBs | Maximum transmission bandwidth configuration as specified in clause TBA for tested channel bandwidth and subcarrier spacing |
| Active DL BWP index | | | |  | 1 |
| Cross carrier scheduling | | | |  | Not configured |
| PDSCH configuration | | Mapping type | |  | Type A |
| *k0* | |  | 0 |
| Starting symbol (S) | |  | 2 |
| Length (L) | |  | 12 |
| PDSCH aggregation factor | |  | 1 |
| PRB bundling type | |  | Static |
| PRB bundling size | |  | 2 |
| Resource allocation type | |  | type 0 |
| VRB-to-PRB mapping type | |  | Non-interleaved |
| VRB-to-PRB mapping interleaver bundle size | |  | N/A |
| PDSCH DMRS configuration | | DMRS Type | |  | Type 1 |
| Number of additional DMRS | |  | 1 |
| Maximum number of OFDM symbols for DL front loaded DMRS | |  | 1 |
| DMRS ports indexes | |  | {1000} for Rank1  {1000,1001} for Rank2  {1000,1001,1002} for Rank3  {1000,1001,1002,1003} for Rank4 |
| Number of PDSCH DMRS CDM group(s) without data | |  | 2 |
| PTRS configuration | | | Frequency density (*KPT-RS*) |  | N/A |
| Time density (*LPT-RS*) |  | N/A |
| NZP CSI-RS for CSI acquisition | | | Frequency Occupation |  | Start PRB 0  Number of PRB = BWP size |
| QCL info |  | TCI state #1 |
| Number of HARQ Processes | | | |  | 8 |
| HARQ ACK/NACK bundling | | | |  | Multiplexed |
| Redundancy version coding sequence | | | |  | {0,2,3,1} |
| K1 value (PDSCH-to-HARQ-timing-indicator) | | | |  | For FR1.30-1:  8 if mod(i,10) = 0 6 if mod(i,10) = 2 5 if mod(i,10) = 3 5 if mod(i,10) = 4 4 if mod(i,10) = 5 3 if mod(i,10) = 6  Where i is slot index per radio frame with 0~19 |
| Symbols for unused REs | | | |  | OP.1 TDD as defined in Annex TBA |
| Physical signals, channels mapping and precoding | | | |  | As specified in Annex TBA |
| Note 1: PDSCH is not scheduled on slots containing CSI-RS or slots which are not full DL.  Note 2: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-1 [3] for tested channel bandwidth and subcarrier spacing. | | | | | |

#### 8.2.3.2 Reporting of Channel Quality Indicator (CQI)

##### 8.2.3.2.1 General

The reporting accuracy of the channel quality indicator (CQI) under frequency non-selective conditions is determined by the reporting variance and the BLER performance using the transport format indicated by the reported CQI median. The purpose is to verify that the reported CQI values are in accordance with the CQI definition given in TS 38.214 [11]. To account for sensitivity of the input SNR the reporting definition is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

Table 8.2.3.2.1-1: Test parameters for testing CQI reporting

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | | Unit | Test 1 | | Test 2 | |
| Bandwidth | | MHz | 40 | | | |
| Subcarrier spacing | | kHz | 30 | | | |
| Default TDD UL-DL pattern (Note 1) | |  | 7D1S2U, S=6D:4G:4U | | | |
| SNR | | dB | 5 | 6 | 11 | 12 |
| Propagation channel | |  | AWGN | | | |
| Antenna configuration | |  | 2x4 | | | |
| Beamforming Model | |  | As specified in Annex TBA | | | |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type |  | Periodic | | | |
| Number of CSI-RS ports (*X*) |  | 2 | | | |
| CDM Type |  | FD-CDM2 | | | |
| Density (ρ) |  | 1 | | | |
| First subcarrier index in the PRB used for CSI-RS (k0, k1) |  | Row 3,(6,-) | | | |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | 13 | | | |
| NZP CSI-RS-timeConfig  periodicity and offset | slot | 10/1 | | | |
| ReportConfigType | |  | Periodic | | | |
| CQI-table | |  | Table 2 | | | |
| reportQuantity | |  | cri-RI-PMI-CQI | | | |
| cqi-FormatIndicator | |  | Wideband | | | |
| pmi-FormatIndicator | |  | Wideband | | | |
| Sub-band Size | | RB | 16 | | | |
| Csi-ReportingBand | |  | 1111111 | | | |
| CSI-Report periodicity and offset | | slot | 10/9 | | | |
| Codebook configuration | Codebook Type |  | typeI-SinglePanel | | | |
| Codebook Mode |  | 1 | | | |
| (CodebookConfig-N1, CodebookConfig-N2) |  | Not configured | | | |
| CodebookSubsetRestriction |  | 010000 | | | |
| RI Restriction |  | N/A | | | |
| Maximum number of HARQ transmission | |  | 1 | | | |
| Measurement channel | |  | M-FR1-A.3.5-2 | | | |
| Note 1: The same requirements are applicable for TDD with different UL-DL pattern.  Note 2: SSB, TRS, CSI-RS, and/or other unspecified test parameters with respect to TS 38.101-4 [TBA] are left up to test implementation, if transmitted or needed. | | | | | | |

##### 8.2.3.2.2 Minimum requirements

For the parameters specified in Table 8.2.3.2.1-1, and using the downlink physical channels specified in Annex TBA, the minimum requirements are specified by the following:

a) The reported CQI value according to the reference channel shall be in the range of ±1 of the reported median more than 90% of the time.

b) If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 0.1.

#### 8.2.3.3 Reporting of Precoding Matrix Indicator (PMI)

##### 8.2.3.3.1 General

The minimum performance requirements of PMI reporting are defined based on the precoding gain, expressed as the relative increase in throughput when the transmitter is configured according to the UE reported PMI compared to the case when the transmitter is using random precoding, respectively. When the transmitter uses random precoding, for each PDSCH allocation a precoder is randomly generated with equal propability of each applicable i1 and i2 combination and applied to the PDSCH. A fixed transport format (FRC) is configured for all requirements.

The requirements for transmission mode 1 with higher layer parameter *codebookType* set to 'typeI-SinglePanel' are specified in terms of the ratio:



In the definition of *γ*, for 4TX, 8TX PMI requirements, is 90 % of the maximum throughput obtained at  using the precoders configured according to the UE reports, and is the throughput measured at with random precoding.

Table 8.2.3.3.1-1: Test parameters for testing PMI reporting

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Test 1** | **Test 2** |
| Bandwidth | | MHz | 40 | |
| Subcarrier spacing | | kHz | 30 | |
| TDD DL-UL configuration (Note 1) | |  | 7D1S2U, S=6D:4G:4U | |
| Propagation channel | |  | TDLA30-5 | |
| Antenna configuration | |  | High XP 4 x 4  (N1,N2) = (2,1) | High XP 8 x 4  (N1,N2) = (4,1) |
| Beamforming Model | |  | As specified in Annex TBA | |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type |  | Aperiodic | |
| Number of CSI-RS ports (*X*) |  | 4 | 8 |
| CDM Type |  | FD-CDM2 | CDM4 (FD2, TD2) |
| Density (ρ) |  | 1 | |
| First subcarrier index in the PRB used for CSI-RS (k0, k1) |  | Row 4, (0,-) | Row 8, (4,6) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (13,-) | (5,-) |
| CSI-RS  interval and offset | slot | Not configured | |
| ReportConfigType | |  | Aperiodic | |
| CQI-table | |  | Table 1 | |
| reportQuantity | |  | cri-RI-PMI-CQI | |
| cqi-FormatIndicator | |  | Wideband | |
| pmi-FormatIndicator | |  | Wideband | |
| Sub-band Size | | RB | 16 | |
| csi-ReportingBand | |  | 1111111 | |
| CSI-Report interval and offset | | slot | Not configured | |
| Aperiodic Report Slot Offset | |  | 8 | |
| CSI request | |  | 1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0 | |
| CSI-AperiodicTriggerStateList | |  | One State with one Associated Report Configuration  Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM | |
| Codebook configuration | Codebook Type |  | typeI-SinglePanel | |
| Codebook Mode |  | 1 | |
| (CodebookConfig-N1, CodebookConfig-N2) |  | (2,1) | (4,1) |
| (CodebookConfig-O1, CodebookConfig-O2) |  | (4,1) | |
| CodebookSubsetRestriction |  | 11111111 | 0x FFFF |
| RI Restriction |  | 00000001 | 00000010 |
| CQI/RI/PMI delay | | ms | 5.5 | 6.5 |
| Maximum number of HARQ transmission | |  | 4 | |
| Measurement channel | |  | M-FR1-A.3.5-5 | M-FR1-A.3.5-6 |
| Note 1: The same requirements are applicable for TDD with different UL-DL pattern.  Note 2: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable i1, i2 combination.  Note 3: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-4) for test 1 and not later than slot#(n-6) for test 2, this reported PMI cannot be applied at the gNB downlink before slot#(n+4) for test 1 and before slot#(n+6) for test 2.  Note 4: Randomization of the principle beam direction shall be used as specified in TBA  Note 5: SSB, TRS, CSI-RS, and/or other unspecified test parameters with respect to TS 38.101-4 [TBA] are left up to test implementation, if transmitted or needed. | | | | |

##### 8.2.3.3.2 Minimum requirements

For the parameters specified in Table 8.2.3.2.1-1 and using the downlink physical channels specified in Annex TBA, the minimum requirements are specified in Table 8.2.3.2.2-1:

Table 8.2.3.2.2-1: Minimum requirement for PMI reporting

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Test 1** | **Test 2** |
| ** | 1.3 | 1.5 |

#### 8.2.3.4 Reporting of Rank Indicator (RI)

##### 8.2.3.4.1 General

The purpose of this test is to verify that the reported rank indicator accurately represents the channel rank. The accuracy of RI reporting is determined by the relative increase of the throughput obtained when transmitting based on the reported rank compared to the case for which a fixed rank is used for transmission.

Table 8.2.3.4.1-1: Test parameters for testing RI reporting

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Test 1** | **Test 2** | **Test 3** | **Test 4** |
| Bandwidth | | | MHz | 40 | | | |
| Subcarrier spacing | | | kHz | 30 | | | |
| Default TDD UL-DL pattern (Note 1) | | |  | 7D1S2U, S=6D:4G:4U | | | |
| SNR | | | dB | -2 | 16 | 16 | 22 |
| Propagation channel | | |  | TDLA30-5 | | | |
| Antenna configuration | | |  | ULA Low 2x4 | ULA Low 2x4 | ULA High 2x4 | ULA Low 4x4 |
| Beamforming Model | | |  | As defined in Annex TBA | | | |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type | |  | Periodic | | | |
| Number of CSI-RS ports (*X*) | |  | 2 | 2 | 2 | 4 |
| CDM Type | |  | FD-CDM2 | | | |
| Density (ρ) | |  | 1 | | | |
| First subcarrier index in the PRB used for CSI-RS (k0, k1) | |  | Row 3 (6,-) | Row 3 (6,-) | Row 3 (6,-) | Row 4 (0,-) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) | |  | (13, -) | | | |
| NZP CSI-RS-timeConfig  periodicity and offset | | slot | 10/1 | | | |
| ReportConfigType | | |  | Periodic | | | |
| CQI-table | | |  | Table 2 | | | |
| reportQuantity | | |  | cri-RI-PMI-CQI | | | |
| cqi-FormatIndicator | | |  | Wideband | | | |
| pmi-FormatIndicator | | |  | Wideband | | | |
| Sub-band Size | | | RB | 16 | | | |
| csi-ReportingBand | | |  | 1111111 | | | |
| CSI-Report periodicity and offset | | | slot | 10/9 | | | |
| Codebook configuration | | Codebook Type |  | typeI-SinglePanel | | | |
| Codebook Mode |  | 1 | | | |
| (CodebookConfig-N1, CodebookConfig-N2) |  | N/A | N/A | N/A | (2,1) |
| CodebookSubsetRestriction |  | 010000 for fixed rank 2,  010011 for following rank | 000011 for fixed rank 1,  010011 for following rank | 000011 for fixed rank 1,  010011 for following rank | 11111111 |
| RI Restriction |  | N/A | N/A | N/A | 00000010 for fixed Rank 2 and 00001111 for follow RI |
| CQI/RI/PMI delay | | | ms | 9.5 | | | |
| Maximum number of HARQ transmission | | |  | 1 | | | |
| RI Configuration | | |  | Fixed RI = 2 and follow RI | Fixed RI = 1 and follow RI | Fixed RI = 1 and follow RI | Fixed RI = 2 and follow RI |
| Note 1: The same requirements are applicable for TDD with different UL-DL pattern.  Note 2: SSB, TRS, CSI-RS, and/or other unspecified test parameters with respect to TS 38.101-4 [TBA] are left up to test implementation, if transmitted or needed.  Note 3: Measurements channels are specified in Table A.3.5-1. M-FR1-A.3.5-1 is used for Rank 1 case. M-FR1-A.3.5-2 is used for Rank 2 case. M-FR1-A.3.5-3 is used for Rank 3 case. M-FR1-A.3.5-4 is used for Rank 4 case. | | | | | | | |

##### 8.2.3.4.2 Minimum requirements

The minimum performance requirement in Table 8.2.3.4.2-1is defined as

a) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be ≥ ;

b) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 2 shall be ≥ ;

For the parameters specified in Table 8.2.3.3.1-1 and using the downlink physical channels specified in Annex TBA, the minimum requirements are specified in Table 8.2.3.4.2-1.

Table 8.2.3.4.2-1: Minimum requirement for RI reporting

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Test 1** | **Test 2** | **Test 3** | **Test 4** |
| **1 | N/A | 1.05 | 0.9 | N/A |
| **2 | 0.9 | N/A | N/A | 0.9 |

*<END OF THE CHANGE 1>*

*<START OF THE CHANGE 2>*

# 11 Radiated performance requirements

## 11.1 IAB-DU performance requirements

### 11.1.1 General

Radiated performance requirements specify the ability of the *IAB-DU type 1-O* or *IAB-DU type 2-O* to correctly demodulate radiated signals in various conditions and configurations. Radiated performance requirements are specified at the RIB.

Radiated performance requirements for the IAB-DU are specified for the fixed reference channels defined in annex A and the propagation conditions in annex TBA. The requirements only apply to those FRCs that are supported by the IAB-DU.

The radiated performance requirements for *IAB-DU type 1-O* and for *IAB-DU type 2-O* are limited to two OTA *demodulation branches* as described in clause 11.1.2. Conformance requirements can only be tested for 1 or 2 *demodulation branches* depending on the number of polarizations supported by the IAB-DU, with the required SNR applied separately per polarization.

NOTE 1: The IAB-DU can support more than 2 *demodulation branches*, however OTA conformance testing can only be performed for 1 or 2 *demodulation branches*.

Unless stated otherwise, radiated performance requirements apply for a single carrier only. Radiated performance requirements for a IAB-DU supporting CA are defined in terms of single carrier requirements.

In tests performed with signal generators a synchronization signal may be provided from the IAB-DU to the signal generator, to enable correct timing of the wanted signal.

Whenever the "RX antennas" term is used for the radiated performance requirements description, it shall refer to the *demodulation branches* (i.e. not physical antennas of the antenna array).

The SNR used in this clause is specified based on a single carrier and defined as:

SNR = S / N

Where:

S is the total signal energy in a slot on a RIB.

N is the noise energy in a bandwidth corresponding to the *transmission bandwidth* over the duration of a slot on a RIB.

### 11.1.2 OTA demodulation branches

Radiated performance requirements are only specified for up to 2 *demodulation branches*.

If the *IAB-DU type 1-O*, or the *IAB-DU type 2-O* uses polarization diversity and has the ability to maintain isolation between the signals for each of the *demodulation branches*, then radiated performance requirements can be tested for up to two *demodulation branches* (i.e. 1RX or 2RX test setups). When tested for two *demodulation branches*, each demodulation branch maps to one polarization.

If the *IAB-DU type 1-O*,or the *IAB-DU type 2-O* does not use polarization diversity then radiated performance requirements can only be tested for a single *demodulation branch* (i.e. 1RX test setup).

### 11.1.2 Performance requirements for PUSCH

#### 11.1.2.1 Performance requirements for *IAB type 1-O*

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

Apply the requirements defined in clause 8.1.2.1 for 2Rx.

##### 11.1.2.1.2 Performance requirmements for PUSCH with transform precoding enabled

Apply the requirements defined in clause 8.1.2.2 for 2Rx.

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

Apply the requirements defined in clause 8.1.2.3 for 2Rx.

#### 11.1.2.2 Performance requirements for IAB type 2-O

##### 11.1.2.2.1 Performance requirmements for PUSCH with transform precoding disabled

11.1.2.2.1.1 General

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 the maximum throughput for the FRCs listed in annex A. The performance requirements assume HARQ retransmissions.

Table 11.1.2.2.1.1-1: Test parameters for PUSCH testing

|  |  |  |
| --- | --- | --- |
| Parameter | | Value |
| Transform precoding | | Disabled |
| Default TDD UL-DL pattern (Note 1) | | 60 kHz and 120kHz SCS:  3D1S1U, S=10D:2G:2U |
| Cyclic prefix | | Normal |
| 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 symbols | 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 | NID=0, nSCID =0 |
| Time domain resource | PUSCH mapping type | B |
| Start symbol index | 0 |
| Allocation length | 10 |
| Frequency domain resource | RB assignment | Full applicable test bandwidth |
| Frequency hopping | Disabled |
| TPMI index for 2Tx two-layer spatial multiplexing transmission | | 0 |
| Code block group based PUSCH transmission | | Disabled |
| PT-RS configuration | Frequency density (*KPT-RS*) | 2, Disabled |
| Time density (*LPT-RS*) | 1, Disabled |
| Note 1: The same requirements are applicable to TDD with different UL-DL patterns. | | |

11.1.2.2.1.2 Minimum requirements

The throughput shall be equal to or larger than the 70% of maximum throughput stated in the tables 11.1.2.2.1.2-1 to 11.1.2.2.1.2-5 at the given SNR for 1Tx and for 2Tx two-layer spatial multiplexing transmission.

Table 11.1.2.2.1.2-1: Minimum requirements for PUSCH, 50 MHz channel bandwidth, 60 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (Annex TBA) | FRC (Annex A) | Additional DM-RS position | PT-RS | SNR  (dB) | |
| 1 | 2 | TDLA30-300 Low | D-FR2-A.2.1-1 | pos0 | No | -2.0 | |
| D-FR2-A.2.1-13 | pos1 | No | -2.2 | |
| D-FR2-A.2.3-1 | pos0 | Yes | | 12.0 |
| No | | 11.5 |
| D-FR2-A.2.3-11 | pos1 | Yes | | 10.7 |
| No | | 10.7 |
| TDLA30-75 Low | D-FR2-A.2.4-1 | pos0 | Yes | | 13.7 |
| No | | 13.1 |
| D-FR2-A.2.4-6 | pos1 | Yes | | 13.4 |
| No | | 12.9 |
| 2 | TDLA30-300 Low | D-FR2-A.2.1-6 | pos0 | No | 1.5 | |
| D-FR2-A.2.1-18 | pos1 | No | 1.2 | |
| D-FR2-A.2.2-1 | pos0 | Yes | | 15.2 |
| No | | 14.3 |
| D-FR2-A.2.2-6 | pos1 | Yes | | 13.8 |
| No | | 13.0 |

Table 11.1.2.2.1.2-2: Minimum requirements for PUSCH, 100 MHz channel bandwidth, 60 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (Annex TBA) | FRC (Annex A) | Additional DM-RS position | PT-RS | SNR  (dB) | |
| 1 | 2 | TDLA30-300 Low | D-FR2-A.2.1-2 | pos0 | No | -2.1 | |
| D-FR2-A.2.1-14 | pos1 | No | -2.4 | |
| D-FR2-A.2.3-2 | pos0 | Yes | | 12.2 |
| No | | 11.2 |
| D-FR2-A.2.3-12 | pos1 | Yes | | 11.2 |
| No | | 10.6 |
| TDLA30-75 Low | D-FR2-A.2.4-2 | pos0 | Yes | | 14.2 |
| No | | 13.3 |
| D-FR2-A.2.4-7 | pos1 | Yes | | 13.7 |
| No | | 13.1 |
| 2 | TDLA30-300 Low | D-FR2-A.2.1-7 | pos0 | No | 1.5 | |
| D-FR2-A.2.1-19 | pos1 | No | 1.2 | |
| D-FR2-A.2.2-2 | pos0 | Yes | | 16.0 |
| No | | 14.9 |
| D-FR2-A.2.2-7 | pos1 | Yes | | 13.8 |
| No | | 13.1 |

Table 11.1.2.2.1.2-3: Minimum requirements for PUSCH, 50 MHz channel bandwidth, 120 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (Annex TBA) | FRC (Annex A) | Additional DM-RS position | PT-RS | SNR  (dB) | |
| 1 | 2 | TDLA30-300 Low | D-FR2-A.2.1-3 | pos0 | No | -1.8 | |
| D-FR2-A.2.1-15 | pos1 | No | -2.1 | |
| D-FR2-A.2.3-3 | pos0 | Yes | | 11.6 |
| No | | 10.9 |
| D-FR2-A.2.3-13 | pos1 | Yes | | 10.9 |
| No | | 10.5 |
| TDLA30-75 Low | D-FR2-A.2.4-3 | pos0 | Yes | | 13.7 |
| No | | 13.1 |
| D-FR2-A.2.4-8 | pos1 | Yes | | 13.2 |
| No | | 13.0 |
| 2 | TDLA30-300 Low | D-FR2-A.2.1-8 | pos0 | No | 1.4 | |
| D-FR2-A.2.1-20 | pos1 | No | 1.3 | |
| D-FR2-A.2.2-3 | pos0 | Yes | | 14.2 |
| No | | 13.6 |
| D-FR2-A.2.2-8 | pos1 | Yes | | 13.9 |

Table 11.1.2.2.1.2-4: Minimum requirements for PUSCH, 100 MHz channel bandwidth, 120 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (Annex TBA) | FRC (Annex A) | Additional DM-RS position | PT-RS | SNR  (dB) | |
| 1 | 2 | TDLA30-300 Low | D-FR2-A.2.1-4 | pos0 | No | -2.4 | |
| D-FR2-A.2.1-16 | pos1 | No | -2.5 | |
| D-FR2-A.2.3-4 | pos0 | Yes | | 11.9 |
| No | | 10.5 |
| D-FR2-A.2.3-14 | pos1 | Yes | | 11.1 |
| No | | 10.5 |
| TDLA30-75 Low | D-FR2-A.2.4-4 | pos0 | Yes | | 13.5 |
| No | | 12.9 |
| D-FR2-A.2.4-9 | pos1 | Yes | | 13.4 |
| No | | 12.8 |
| 2 | TDLA30-300 Low | D-FR2-A.2.1-9 | pos0 | No | 1.4 | |
| D-FR2-A.2.1-21 | pos1 | No | 1.2 | |
| D-FR2-A.2.2-4 | pos0 | Yes | | 13.9 |
| No | | 13.2 |
| D-FR2-A.2.2-9 | pos1 | Yes | | 13.5 |

Table 11.1.2.2.1.2-5: Minimum requirements for PUSCH, 200 MHz channel bandwidth, 120 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (Annex TBA) | FRC (Annex A) | Additional DM-RS position | PT-RS | SNR  (dB) | |
| 1 | 2 | TDLA30-300 Low | D-FR2-A.2.1-5 | pos0 | No | -2.1 | |
| D-FR2-A.2.1-17 | pos1 | No | -2.4 | |
| D-FR2-A.2.3-5 | pos0 | Yes | | 11.3 |
| No | | 10.9 |
| D-FR2-A.2.3-15 | pos1 | Yes | | 11.2 |
| No | | 10.7 |
| TDLA30-75 Low | D-FR2-A.2.4-5 | pos0 | Yes | | 14.1 |
| No | | 13.4 |
| D-FR2-A.2.4-10 | pos1 | Yes | | 13.7 |
| No | | 13.3 |
| 2 | TDLA30-300 Low | D-FR2-A.2.1-10 | pos0 | No | 1.4 | |
| D-FR2-A.2.1-22 | pos1 | No | 1.1 | |
| D-FR2-A.2.2-5 | pos0 | Yes | | 14.0 |
| No | | 13.3 |
| D-FR2-A.2.2-10 | pos1 | Yes | | 13.6 |

##### 11.1.2.2.2 Performance requirmements for PUSCH with transform precoding enabled

11.1.2.2.2.1 General

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 the maximum throughput for the FRCs listed in Annex A. The performance requirements assume HARQ retransmissions.

Table 11.1.2.2.2.1-1: Test parameters for PUSCH testing

|  |  |  |
| --- | --- | --- |
| Parameter | | Value |
| Transform precoding | | Enabled |
| Default TDD UL-DL pattern (Note 1) | | 60 kHz and 120kHz SCS:  3D1S1U, S=10D:2G:2U |
| Cyclic prefix | | Normal |
| 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 | 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 | NID0=0, group hopping and sequence hopping are disabled |
| Time domain resource assignment | PUSCH mapping type | B |
| Start symbol | 0 |
| Allocation length | 10 |
| Frequency domain resource assignment | RB assignment | 30 PRBs in the middle of the test bandwidth |
| Frequency hopping | Disabled |
| Code block group based PUSCH transmission | | Disabled |
| PT-RS | | Not configured |
| Note 1: The same requirements are applicable to TDD with different UL-DL patterns. | | |

11.1.2.2.2.2 Minimum requirements

The throughput shall be equal to or larger than the 70% of maximum throughput stated in the tables 11.1.2.2.2.2-1 to 11.1.2.2.2.2-2 at the given SNR.

Table 11.1.2.2.2.2-1: Minimum requirements for PUSCH, Type B, 50 MHz Channel Bandwidth, 60 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (Annex TBA) | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | TDLA30-300 Low | D-FR2-A.2.1-11 | pos0 | -1.8 |
| D-FR2-A.2.1-23 | pos1 | -1.9 |

Table 11.1.2.2.2.2-2: Minimum requirements for PUSCH, Type B, 50 MHz Channel Bandwidth, 120 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (Annex TBA) | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | TDLA30-300 Low | D-FR2-A.2.1-12 | pos0 | -1.8 |
| D-FR2-A.2.1-24 | pos1 | -1.9 |

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

11.1.2.2.3.1 General

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

The CSI part 1 block error probability is defined as the probability of incorrectly decoded the CSI part 1 information when the CSI part 1 information is sent as follow:

where:

- #(false CSI part 1) denotes the number of incorrectly decoded CSI part 1 information transmitted occasions

- #(CSI part 1) denotes the number of CSI part 1information transmitted occasions.

The CSI part 2 block error probability (BLER) is defined as the probability of incorrectly decoded the CSI part 2 information when the CSI part 2 information is sent as follows:

where:

- #(false CSI part 2) denotes the number of incorrectly decoded CSI part 2 information transmitted occasions

- #(CSI part 2) denotes the number of CSI part 2 information transmitted occasions.

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

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

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

The 7bits UCI 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 part2 information.

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

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

Table 11.1.2.2.3.1-1: Test parameters for UCI multiplexed on PUSCH testing

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Value | |
| Transform precoding | | Disabled | |
| Default TDD UL-DL pattern (Note 1) | | 120 kHz SCS:  3D1S1U, S=10D:2G:2U | |
| Cyclic prefix | | Normal | |
| 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 | 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 | *NID0*=0,*nSCID*=0 | |
| Time domain resource assignment | PUSCH mapping type | B | |
| Start symbol | 0 | |
| Allocation length | 10 | |
| Frequency domain resource assignment | RB assignment | Full applicable test bandwidth | |
| Frequency hopping | Disabled | |
| Code block group based PUSCH transmission | | Disabled | |
| PT-RS configuration | PT-RS | Disabled | Enabled |
| Frequency density (*KPT-RS*) | N/A: | 2 |
| Time density (*LPT-RS*) | N/A | 1 |
| UCI | Number of CSI part 1 and CSI part 2 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 1: The same requirements are applicable to TDD with different UL-DL patterns. | | | |

11.1.2.2.3.2 Minimum requirements

The CSI part 1 block error probability shall not exceed 0.1% at the SNR given in table 11.1.2.2.3.2-1 and table 11.1.2.2.3.2-2. The CSI part 2 block error probability shall not exceed 1% at the SNR given in table 11.1.2.2.3.2-3 and table 11.1.2.2.3.2-4.

Table 11.1.2.2.3.2-1: Minimum 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 TBA) | 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 | 7.2 |
| 2 | TDLA30-300 Low | 40(20,20) | pos0 | D-FR2-A.2.3-3 | 5.8 |
| 2 | TDLA30-300 Low | 7(5,2) | pos1 | D-FR2-A.2.3-13 | 7.8 |
| 2 | TDLA30-300 Low | 40(20,20) | pos1 | D-FR2-A.2.3-13 | 5.9 |

Table 11.1.2.2.3.2-2: Minimum requirements for UCI multiplexed on PUSCH, Type B, Without PTRS, CSI part 1, 50 MHz Channel Bandwidth, 120 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (Annex TBA) | 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 | 7.1 |
| 2 | TDLA30-300 Low | 40(20,20) | pos0 | D-FR2-A.2.3-3 | 5.8 |
| 2 | TDLA30-300 Low | 7(5,2) | pos1 | D-FR2-A.2.3-13 | 7.3 |
| 2 | TDLA30-300 Low | 40(20,20) | pos1 | D-FR2-A.2.3-13 | 5.5 |

Table 11.1.2.2.3.2-3: Minimum requirements for UCI multiplexed on PUSCH, Type B, With PTRS, CSI part 2, 50 MHz Channel Bandwidth, 120 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (Annex TBA) | 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 | 1.1 |
| 2 | TDLA30-300 Low | 40(20,20) | pos0 | D-FR2-A.2.3-3 | 4.0 |
| 2 | TDLA30-300 Low | 7(5,2) | pos1 | D-FR2-A.2.3-13 | 1.3 |
| 2 | TDLA30-300 Low | 40(20,20) | pos1 | D-FR2-A.2.3-13 | 4.0 |

Table 11.1.2.2.3.2-4: Minimum requirements for UCI multiplexed on PUSCH, Type B, Without PTRS, CSI part 2, 50 MHz Channel Bandwidth, 120 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (Annex TBA) | 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 | 1.1 |
| 2 | TDLA30-300 Low | 40(20,20) | pos0 | D-FR2-A.2.3-3 | 3.9 |
| 2 | TDLA30-300 Low | 7(5,2) | pos1 | D-FR2-A.2.3-13 | 1.2 |
| 2 | TDLA30-300 Low | 40(20,20) | pos1 | D-FR2-A.2.3-13 | 3.7 |

### 11.1.3 Performance requirements for PUCCH

#### 11.1.3.1 Performance requirements for *IAB type 1-O*

##### 11.1.3.1.1 DTX to ACK probability

Apply the requirements defined in clause 8.1.3.1

##### 11.1.3.1.2 Performance requirements for PUCCH format 0

Apply the requirements defined in clause 8.1.3.2 for 2 Rx.

##### 11.1.3.1.3 Performance requirements for PUCCH format 1

Apply the requirements defined in clause 8.1.3.3 for 2Rx.

##### 11.1.3.1.4 Performance requirements for PUCCH format 2

Apply the requirements defined in clause 8.1.3.4 for 2Rx.

##### 11.1.3.1.5 Performance requirements for PUCCH format 3

Apply the requirements defined in clause 8.1.3.5 for 2Rx.

##### 11.1.3.1.6 Performance requirements for PUCCH format 4

Apply the requirements defined in clause 8.1.3.6 for 2Rx.

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

Apply the requirements defined in clause 8.1.3.7 for 2Rx.

#### 11.1.3.2 Performance requirements for *IAB type 2-O*

##### 11.1.3.2.1 DTX to ACK probability

Apply the requirements defined in clause 8.1.3.1.

##### 11.1.3.2.2 Performance requirements for PUCCH format 0

11.1.3.2.2.1 General

The ACK missed detection probability is the probability of not detecting an ACK when an ACK was sent.

Table 11.1.3.2.2.1-1: Test parameters for PUCCH format 0 testing

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

The transient period as specified in TBA and TBA clause is not taken into account for performance requirement testing, where the RB hopping is symmetric to the CC centre, i.e. intra-slot frequency hopping is enabled.

11.1.3.2.2.2 Minimum requirements

The ACK missed detection probability shall not exceed 1% at the SNR given in table 11.1.3.2.2.2-1 and in table 11.1.3.2.2.2-2.

Table 11.1.3.2.2.2-1: Minimum requirements for PUCCH format 0 and 60 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (Annex TBA) | Number of OFDM symbols | Channel bandwidth / SNR (dB) | |
| 50 MHz | 100 MHz |
| 1 | 2 | TDLA30-300 Low | 1 | 9.3 | 9.0 |
| 2 | 4.2 | 4.0 |

Table 11.1.3.2.2.2-2: Minimum requirements for PUCCH format 0 and 120 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (Annex TBA) | Number of OFDM symbols | Channel bandwidth / SNR (dB) | | |
| 50 MHz | 100 MHz | 200 MHz |
| 1 | 2 | TDLA30-300 Low | 1 | 9.5 | 9.2 | 9.7 |
| 2 | 4.1 | 3.8 | 4.0 |

##### 11.1.3.2.3 Performance requirements for PUCCH format 1

11.1.3.2.3.1 NACK to ACK requirements

11.1.3.2.3.1.1 General

The NACK to ACK detection probability is the probability that an ACK bit is falsely detected when an NACK bit was sent on the particular bit position, where the NACK to ACK detection probability is defined as follows:



where:

-  denotes the total number of NACK bits transmitted

-  denotes the number of NACK bits decoded as ACK bits at the receiver, i.e. the number of received ACK bits

- 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.

Random codeword selection is assumed.

Table 11.1.3.2.3.1.1-1: Test Parameters for PUCCH format 1 testing

|  |  |
| --- | --- |
| Parameter | Test |
| Cyclic prefix | Normal |
| 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 |

The transient period as specified in TS 38.101-1 [3] and TS 38.101-2 [4] clause 6.3.3.1 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the CC centre, i.e. intra-slot frequency hopping is enabled.

11.1.3.2.3.1.2 Minimum requirements

The NACK to ACK probability shall not exceed 0.1% at the SNR given in Table 11.1.3.2.3.1.2-1 and Table 11.1.3.2.3.1.2‑2.

Table 11.1.3.2.3.1.2-1: Minimum requirements for PUCCH format 1 with 60 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of TX antennas | Number of Demodulation Branches | Propagation conditions and correlation matrix (Annex TBA) | Channel bandwidth / SNR (dB) | |
| 50 MHz | 100 MHz |
| 1 | 2 | TDLA30-300 Low | -1.2 | -4.2 |

Table 11.1.3.2.3.1.2-2: Minimum requirements for PUCCH format 1 with 120 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of Demodulation Branches | Propagation conditions and correlation matrix (Annex TBA) | Channel bandwidth / SNR (dB) | | |
| 50 MHz | 100 MHz | 200 MHz |
| 1 | 2 | TDLA30-300 Low | -3.9 | -3.9 | -3.0 |

11.1.3.2.3.2 ACK missed detection requirements

11.1.3.2.3.2.1 General

The ACK missed detection probability is the probability of not detecting an ACK when an ACK was sent. The test parameters in Table 11.1.3.2.3.1.1-1 are configured.

The transient period as specified in TBA and TBA is not taken into account for performance requirement testing, where the RB hopping is symmetric to the CC centre, i.e. intra-slot frequency hopping is enabled.

11.1.3.2.3.2.2 Minimum requirements

The ACK missed detection probability shall not exceed 1% at the SNR given in Table 11.1.3.2.3.2.2-1 and in Table 11.1.3.2.3.2.2-2.

Table 11.1.3.2.3.2.2-1: Minimum requirements for PUCCH format 1 with 60 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of TX antennas | Number of Demodulation Branches | Propagation conditions and correlation matrix (Annex TBA) | Channel bandwidth / SNR (dB) | |
| 50 MHz | 100 MHz |
| 1 | 2 | TDLA30-300 Low | -3.9 | -4.2 |

Table 11.1.3.2.3.2.2-2: Minimum requirements for PUCCH format 1 with 120 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of Demodulation Branches | Propagation conditions and correlation matrix (Annex TBA) | Channel bandwidth / SNR (dB) | | |
| 50 MHz | 100 MHz | 200 MHz |
| 1 | 2 | TDLA30-300 Low | -4.7 | -4.6 | -4.6 |

##### 11.1.3.2.4 Performance requirements for PUCCH format 2

11.1.3.2.4.1 ACK missed detection requirements

11.1.3.2.4.1.1 General

The ACK missed detection probability is the probability of not detecting an ACK when an ACK was sent.

The ACK missed detection requirement only applies to the PUCCH format 2 with 4 UCI bits.

Table 11.1.3.2.4.1.1-1: Test Parameters for PUCCH format 2 testing

|  |  |
| --- | --- |
| Parameter | Value |
| Cyclic prefix | Normal |
| Modulation order | QSPK |
| 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 |

The transient period as specified in TBA and TBA 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.

The ACK missed detection probability shall not exceed 1% at the SNR given in table 11.1.3.2.4.1.2-1 and table 11.1.3.2.4.1.2-2 for 4 UCI bits.

Table 11.1.3.2.4.1.2-1: Minimum requirements for PUCCH format 2 with 60 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (Annex TBA) | Channel bandwidth / SNR (dB) | |
| 50 MHz | 100 MHz |
| 1 | 2 | TDLA30-300 Low | 6.7 | 7.2 |

Table 11.1.3.2.4.1.2-2: Minimum requirements for PUCCH format 2 with 120 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (Annex TBA) | Channel bandwidth / SNR (dB) | | |
| 50 MHz | 100 MHz | 200 MHz |
| 1 | 2 | TDLA30-300 Low | 6.6 | 6.3 | 6.6 |

11.1.3.2.4.2 UCI BLER performance requirements

11.1.3.2.4.2.1 General

The UCI block error probability (BLER) is defined as the probability of incorrectly decoded UCI information when the UCI information is sent. The UCI information does not contain CSI part 2.

The transient period as specified in TBA and TBA clause 6.3.3.1 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the CC centre, i.e. intra-slot frequency hopping is enabled.

The UCI performance only applies to the PUCCH format 2 with 22 UCI bits.

Table 11.1.3.2.4.2.1-1: Test Parameters for UCI BLER testing

|  |  |
| --- | --- |
| Parameter | Value |
| Cyclic prefix | Normal |
| Modulation order | QSPK |
| 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 | NID0=0 |

11.1.3.2.4.2.2 Minimum requirements

The UCI block error probability shall not exceed 1% at the SNR given in table 11.1.3.2.4.2.2-1 and table 11.1.3.2.4.2.2-2 for 22 UCI bits.

Table 11.1.3.2.4.2.2-1: Minimum requirements for PUCCH format 2 with 60 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (Annex TBA) | Channel bandwidth / SNR (dB) | |
| 50 MHz | 100 MHz |
| 1 | 2 | TDLA30-300 Low | 2.6 | 1.1 |

Table 11.1.3.2.4.2.2-2: Minimum requirements for PUCCH format 2 with 120 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (Annex TBA) | Channel bandwidth / SNR (dB) | | |
| 50 MHz | 100 MHz | 200 MHz |
| 1 | 2 | TDLA30-300 Low | 1.2 | 1.2 | 1.1 |

##### 11.1.3.2.5 Performance requirements for PUCCH format 3

11.1.3.2.5.1 General

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 38.101-2 [4] clause 6.3.3.1 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the CC centre, i.e. intra-slot frequency hopping is enabled.

Table 11.1.3.2.5.1-1: Test parameters for PUCCH format 3 testing

|  |  |  |
| --- | --- | --- |
| Parameter | Test 1 | Test 2 |
| Cyclic prefix | Normal | |
| Modulation order | QPSK | |
| First PRB prior to frequency hopping | 0 | |
| Intra-slot frequency hopping | enabled | |
| First PRB after frequency hopping | The largest PRB index – (Number of PRBs – 1) | |
| Group and sequence hopping | neither | |
| Hopping ID | 0 | |
| Number of PRBs | 1 | 3 |
| Number of symbols | 14 | 4 |
| The number of UCI information bits | 16 | 16 |
| First symbol | 0 | 0 |

11.1.3.2.5.2 Minimum requirements

The UCI block error probability shall not exceed 1% at the SNR given in Table 11.1.3.2.5.2-1 and Table 11.1.3.2.5.2-2.

Table 11.1.3.2.5.2-1: Required SNR for PUCCH format 3 with 60 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Test Number | Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (Annex TBA) | Additional DM‑RS configuration | Channel Bandwidth / SNR (dB) | |
| 50 MHz | 100 MHz |
| 1 | 1 | 2 | TDLA30-300 Low | No additional DM-RS | 1.6 | 0.7 |
| Additional DM-RS | 1.3 | 0.9 |
| 2 | 1 | 2 | TDLA30-300 Low | No additional DM-RS | 3.0 | 2.4 |

Table 11.1.3.2.5.2-2: Required SNR for PUCCH format 3 with 120kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test Number | Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (Annex TBA) | Additional DM‑RS configuration | Channel Bandwidth / SNR (dB) | | |
| 50 MHz | 100 MHz | 200 MHz |
| 1 | 1 | 2 | TDLA30-300 Low | No additional DM-RS | 1.4 | 0.7 | 0.7 |
| Additional DM-RS | 1.3 | 1.4 | 0.9 |
| 2 | 1 | 2 | TDLA30-300 Low | No additional DM-RS | 1.1 | 2.9 | 1.4 |

##### 11.1.3.2.6 Performance requirements for PUCCH format 4

11.1.3.2.6.1 General

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 decoded UCI information when the UCI information is sent. The UCI information does not contain CSI part 2.

The transient period as specified in TBA is not taken into account for performance requirement testing, where the RB hopping is symmetric to the CC centre, i.e. intra-slot frequency hopping is enabled.

Table 11.1.3.2.6.1-1: Test parameters for PUCCH format 4 testing

|  |  |
| --- | --- |
| Parameter | Value |
| Cyclic prefix | Normal |
| Modulation | QPSK |
| First PRB prior to frequency hoppingstartingPRB | 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 |

11.1.3.2.6.2 Minimum requirements

The UCI block error probability shall not exceed 1% at the SNR given in Table 11.1.3.2.6.2-1 and Table 11.1.3.2.6.2-2.

Table 11.1.3.2.6.2-1: Minimum requirements for PUCCH format 4 with 60 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (Annex TBA) | Additional DM-RS configuration | Channel Bandwidth / SNR (dB) | |
| 50 MHz | 100 MHz |
| 1 | 2 | TDLA30-300 Low | No additional DM-RS | 3.0 | 2.7 |
| Additional DM-RS | 3.1 | 3.5 |

Table 11.1.3.2.6.2-2: Minimum requirements for PUCCH format 4 with 120 kHz SCS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (Annex TBA) | Additional DM-RS configuration | Channel Bandwidth / SNR (dB) | | |
| 50 MHz | 100 MHz | 200MHz |
| 1 | 2 | TDLA30-300 Low | No additional DM-RS | 2.8 | 2.8 | 3.5 |
| Additional DM-RS | 3.6 | 3.8 | 3.2 |

### 11.1.4 Performance requirements for PRACH

#### 11.1.4.1 Performance requirements for *IAB type 1-O*

##### 11.1.4.1.1 PRACH False alarm probability

Apply the requirements defined in clause 8.1.4.1 for 2Rx.

##### 11.1.4.1.2 PRACH detection requirements

Apply the requirements defined in clause 8.1.4.2 for 2Rx.

#### 11.1.4.2 Performance requirements for *IAB type 2-O*

##### 11.1.4.2.1 PRACH false alarm probability

11.1.4.2.1.1 General

The false alarm requirement is valid for any number of receive antennas, for any channel bandwidth.

The false alarm probability is the conditional total probability of erroneous detection of the preamble (i.e. erroneous detection from any detector) when input is only noise.

11.1.4.2.1.2 Minimum requirement

The false alarm probability shall be less than or equal to 0.1%.

##### 11.1.4.2.2 PRACH missed detection requirements

11.1.4.2.2.1 General

The probability of detection is the conditional probability of correct detection of the preamble when the signal is present. There are several error cases – detecting different preamble than the one that was sent, not detecting a preamble at all or correct preamble detection but with the wrong timing estimation. For AWGN 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 given in Table 11.1.4.2.2.1-1.

Table 11.1.4.2.2.1-1: Time error tolerance for AWGN and TDLA30-300

|  |  |  |  |
| --- | --- | --- | --- |
| PRACH preamble | PRACH SCS (kHz) | Time error tolerance | |
| AWGN | TDLA30-300 |
| A1, A2, A3, B4, C0, C2 | 60 | 0.13 us | 0.28 us |
| 120 | 0.07 us | 0.22 us |

The test preambles for normal mode are listed in table A.2.5-2 and the test parameter *msg1-FrequencyStart* is set to 0.

11.1.4.2.2.2 Minimum requirements

The probability of detection shall be equal to or exceed 99% for the SNR levels listed in Tables 11.1.4.2.2.2-1 to 11.1.4.2.2.2-2.

Table 11.1.4.2.2.2-1: PRACH missed detection requirements for Normal Mode, 60 kHz SCS

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (Annex TBA) | Frequency offset | SNR (dB) | | | | | |
| Burst format A1 | Burst format A2 | Burst format A3 | Burst format B4 | Burst format C0 | Burst format C2 |
| 1 | 2 | AWGN | 0 | -8.9 | -11.9 | -13.5 | -15.8 | -6.0 | -11.8 |
| TDLA30-300 Low | 4000 Hz | -1.6 | -3.8 | -4.8 | -6.9 | 1.1 | -3.9 |

Table 11.1.4.2.2.2-2: PRACH missed detection requirements for Normal Mode, 120 kHz SCS

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (Annex TBA) | Frequency offset | SNR (dB) | | | | | |
| Burst format A1 | Burst format A2 | Burst format A3 | Burst format B4 | Burst format C0 | Burst format C2 |
| 1 | 2 | AWGN | 0 | -8.7 | -11.5 | -13.3 | -15.8 | -5.8 | -11.4 |
| TDLA30-300 Low | 4000 Hz | -1.7 | -4.4 | -5.8 | -7.5 | 1.2 | -4.2 |

## 11.2 IAB-MT performance requirements

### 11.2.1 General

Radiated performance requirements specify the ability of the *IAB-MT type 1-O* or the *IAB-MT type 2-O* to correctly demodulate radiated signals in various conditions and configurations. Radiated performance requirements are specified at the RIB.

Radiated performance requirements for the IAB-MT are specified for the fixed reference channels defined in annex A and the propagation conditions in annex TBA. The requirements only apply to those FRCs that are supported by the IAB-MT.

The radiated performance requirements for the *IAB-MT type 1-O* and for the *IAB-MT type 2-O* are limited to two OTA *demodulation branches* as described in clause 11.2.2. Conformance requirements can only be tested for 1 or 2 *demodulation branches* depending on the number of polarizations supported by the IAB-MT, with the required SNR applied separately per polarization.

NOTE 1: The IAB-MT can support more than 2 *demodulation branches*, however OTA conformance testing can only be performed for 1 or 2 *demodulation branches*.

Unless stated otherwise, radiated performance requirements apply for a single carrier only.

Whenever the "RX antennas" term is used for the radiated performance requirements description, it shall refer to the *demodulation branches* (i.e. not physical antennas of the antenna array).

The SNR used in this clause is specified based on a single carrier and defined as:

SNR = S / N

Where:

S is the total signal energy in a slot on a RIB.

N is the noise energy in a bandwidth corresponding to the *transmission bandwidth* over the duration of a slot on a RIB

Radiated performance requirements are only specified for up to 2 *demodulation branches*.

### 11.2.2 OTA demodulation branches

If the *IAB-MT type 1-O*, or the *IAB-MT type 2-O* uses polarization diversity and has the ability to maintain isolation between the signals for each of the *demodulation branches*, then radiated performance requirements can be tested for up to two *demodulation branches* (i.e. 1RX or 2RX test setups). When tested for two *demodulation branches*, each demodulation branch maps to one polarization.

If the *IAB-MT type 1-O*,or the *IAB-MT type 2-O* does not use polarization diversity then radiated performance requirements can only be tested for a single *demodulation branch* (i.e. 1RX test setup).

### 11.2.2 Demodulation performance requirements

#### 11.2.2.1 Performance requireements for IAB type 1-O

##### 11.2.2.1.1 Performance requirements for PDSCH

11.2.2.1.1.1 General

The performance requirement of PDSCH 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 retransmissions.

Table: 11.2.2.1.1.1-1 Test parameters for PDSCH testing

|  |  |  |
| --- | --- | --- |
| Parameter | | Value |
| Cyclic prefix | | Normal |
| Default TDD UL-DL pattern (Note 1) | | 7D1S2U, S=6D:4G:4U |
| 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 |
| DM-RS position (*l0*) | 2 |
| Additional DM-RS position | pos1 |
| Number of DM-RS CDM group(s) without data | 1 for Rank 1 and Rank 2 tests 2 for Rank 3 and Rank 4 tests |
| DM-RS port(s) | {1000} for Rank 1 tests {1000-1001} for Rank 2 tests {1000-1002} for Rank 3 tests {1000-1003} for Rank 4 tests |
| DM-RS sequence generation | NID0=0 |
| Time domain resource assignment | PDSCH mapping type | A |
| Start symbol | 2 |
| Allocation length | 12 |
| Frequency domain resource assignment | RB assignment | Full applicable test bandwidth |
| PT-RS configuration | | Not configured |
| PRB bundling size | | 2 |
| VRB-to-PRB mapping type | | Not interleaved |
| PDSCH & PDSCH DMRS Precoding configuration | | Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i1, i2 combination, and with PRB bundling granularity |
| Note 1: The same requirements are applicable to TDD with different UL-DL patterns.  Note 2: SSB, TRS, CSI-RS, and/or other unspecified test parameters with respect to TS 38.101-4 [TBA] are left up to test implementation, if transmitted or needed. | | |

11.2.2.1.1.2 Minimum requirements

The throughput shall be equal to or larger than the fraction of maximum throughput for the FRCs stated in tables 11.2.2.1.1.2-1 and 11.2.2.1.1.2-2 at the given SNR with the test parameters stated in Table 11.2.2.1.1.1-1.

Table 11.2.2.1.1.2-1: Minimum requirements for PDSCH with Rank 1, 40 MHz Channel Bandwidth, 30 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (Annex TBA) | FRC (Annex A) | Fraction of maximum throughput (%) | SNR  (dB) |
| 2 | 2 | TDLA30-10, ULA Low | M-FR1-A.3.3-1 | 70 | 25.3 |
| TDLA30-10, ULA Low | M-FR1-A.3.1-1 | 30 | 2.2 |

Table 11.2.2.1.1.2-2: Minimum requirements for PDSCH with Rank 2, 40 MHz Channel Bandwidth, 30 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (Annex TBA) | FRC (Annex A) | Fraction of maximum throughput (%) | SNR  (dB) |
| 2 | 2 | TDLA30-10, ULA Low | M-FR1-A.3.2-1 | 70 | 19.8 |

##### 11.2.2.1.2 Performance requirements for PDCCH

11.2.2.1.2.1 General

The receiver characteristics of the PDCCH are determined by the probability of miss-detection of the Downlink Scheduling Grant (Pm-dsg).

Table: 11.2.2.1.2.1-1 Test parameters for PDCCH testing

|  |  |
| --- | --- |
| Parameter | Value |
| Cyclic prefix | Normal |
| Default TDD UL-DL pattern (Note 1) | 7D1S2U, S=6D:4G:4U |
| DM-RS sequence generation | NID=0 |
| Frequency domain resource allocation for CORESET | Start from RB = 0 with contiguous RB allocation |
| CCE to REG mapping type | Interleaved |
| Interleaver size | 3 |
| REG bundle size | 6 for test with aggregation level 8 2 for others |
| Shift Index | 0 |
| Slots for PDCCH monitoring | Each slot |
| Number of PDCCH candidates for the tested aggregation level | 1 |
| PDCCH Precoding configuration | Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i1, i2 combination with REG bundling granularity for number of Tx larger than 1 |
| Note 1: The same requirements are applicable to TDD with different UL-DL patterns.  Note 2: SSB, TRS, CSI-RS, and/or other unspecified test parameters with respect to TS 38.101-4 [TBA] are left up to test implementation, if transmitted or needed. | |

11.2.2.1.2.2 Minimum requirements

The Pm-dsg shall be equal to or smaller than 1%, for the cases stated in Table 11.2.2.1.2.2-1 at the given SNR with the test parameters stated in Table 11.2.2.1.2.1-1.

Table 11.2.2.1.2.2-1: Minimum requirements for PDCCH, 40 MHz Channel Bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Antenna configuration | CORESET RB | CORESET duration | Aggregation level | FRC (Annex A) | Propagation conditions and correlation matrix (Annex TBA) | Pm-dsg (%) | SNR  (dB) |
| 1x2 | 102 | 1 | 2 | M-FR1-A.3.4-1 | TDLA30-10, Low | 1 | 7.0 |
| 1x2 | 102 | 1 | 4 | M-FR1-A.3.4-1 | TDLA30-10, Low | 1 | 4.9 |
| 2x2 | 90 | 1 | 8 | M-FR1-A.3.4-1 | TDLA30-10, Low | 1 | -0.7 |

#### 11.2.2.2 Performance requirements for IAB type 2-O

##### 11.2.2.2.1 Performance requirements for PDSCH

11.2.2.2.1.1 General

The performance requirement of PDSCH 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 retransmissions.

Table: 11.2.2.2.1.1-1 Test parameters for PDSCH testing

|  |  |  |
| --- | --- | --- |
| Parameter | | Value |
| Cyclic prefix | | Normal |
| Default TDD UL-DL pattern (Note 1) | | 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 |
| DM-RS position (*l0*) | 2 |
| Additional DM-RS position | pos1 |
| Number of DM-RS CDM group(s) without data | 1 |
| DM-RS port(s) | {1000} for Rank 1 tests {1000-1001} for Rank 2 tests |
| DM-RS sequence generation | NID0=0 |
| Time domain resource assignment | PDSCH mapping type | A |
| Start symbol | 1 |
| Allocation length | 13 |
| Frequency domain resource assignment | RB assignment | Full applicable test bandwidth |
| PT-RS configuration | Frequency density (*KPT-RS*) | 2 |
| Time density (*LPT-RS*) | 1 |
| PRB bundling size | | 2 |
| VRB-to-PRB mapping type | | Not interleaved |
| PDSCH & PDSCH DMRS Precoding configuration | | Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i1, i2 combination, and with PRB bundling granularity |
| Note 1: The same requirements are applicable to TDD with different UL-DL patterns.  Note 2: SSB, TRS, CSI-RS, and/or other unspecified test parameters with respect to TS 38.101-4 [TBA] are left up to test implementation, if transmitted or needed. | | |

11.2.2.2.1.2 Minimum requirements

The throughput shall be equal to or larger than the fraction of maximum throughput for the FRCs stated in table 11.2.2.2.1.2-1, 11.2.2.2.1.2-2 and 11.2.2.2.1.2-3 at the given SNR with the test parameters stated in Table 11.2.2.2.1.1-1.

Table 11.2.2.2.1.2-1: Minimum requirements for PDSCH with Rank 1, 100 MHz Channel Bandwidth, 120 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (Annex TBA) | FRC (Annex A) | Fraction of maximum throughput (%) | SNR  (dB) |
| 2 | 2 | TDLA30-75, ULA Low | M-FR2-A.3.1-2 | 30 | 2.3 |
| 2 | 2 | TDLA30-75, ULA Low | M-FR2-A.3.2-1 | 70 | 11.7 |

Table 11.2.2.2.1.2-2: Minimum requirements for PDSCH with Rank 2, 50 MHz Channel Bandwidth, 60 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (Annex TBA) | FRC (Annex A) | Fraction of maximum throughput (%) | SNR  (dB) |
| 2 | 2 | TDLA30-75, ULA Low | M-FR2-A.3.1-1 | 70 | 14.3 |

Table 11.2.2.2.1.2-3: Minimum requirements for PDSCH with Rank 2, 100 MHz Channel Bandwidth, 120 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (Annex TBA) | FRC (Annex A) | Fraction of maximum throughput (%) | SNR  (dB) |
| 2 | 2 | TDLA30-75, ULA Low | M-FR2-A.3.1-3 | 70 | 14.2 |
| 2 | 2 | TDLA30-75, ULA Low | M-FR2-A.3.2-2 | 70 | 18.6 |

##### 11.2.2.2.2 Performance requirements for PDCCH

11.2.2.2.2.1 General

The receiver characteristics of the PDCCH are determined by the probability of miss-detection of the Downlink Scheduling Grant (Pm-dsg).

Table: 11.2.2.2.2.1-1 Test parameters for testing PDCCH

|  |  |
| --- | --- |
| Parameter | Value |
| Cyclic prefix | Normal |
| Default TDD UL-DL pattern (Note 1) | 3D1S1U, S=10D:2G:2U |
| DM-RS sequence generation | NID=0 |
| Frequency domain resource allocation for CORESET | Start from RB = 0 with contiguous RB allocation |
| CCE to REG mapping type | Interleaved |
| Interleaver size | 2 for test with Aggregation level 4 3 for others |
| REG bundle size | 6 for test with Aggregation level 4 2 for others |
| Shift Index | 0 |
| Slots for PDCCH monitoring | Each slot |
| Number of PDCCH candidates for the tested aggregation level | 1 |
| PDCCH Precoding configuration | Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i1, i2 combination with REG bundling granularity for number of Tx larger than 1 |
| Note 1: The same requirements are applicable to TDD with different UL-DL patterns.  Note 2: SSB, TRS, CSI-RS, and/or other unspecified test parameters with respect to TS 38.101-4 [TBA] are left up to test implementation, if transmitted or needed. | |

11.2.2.2.2.2 Minimum requirements

The Pm-dsg shall be equal to or smaller than 1%, for the cases stated in Table 11.2.2.2.2.2-1 at the given SNR with the test parameters stated in Table 11.2.2.2.2.1-1.

Table 11.2.2.2.2.2-1: Minimum requirements for PDCCH, 100 MHz Channel Bandwidth, 120 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Antenna configuration | CORESET RB | CORESET duration | Aggregation level | FRC (Annex A) | Propagation conditions and correlation matrix (Annex TBA) | Pm-dsg (%) | SNR  (dB) |
| 1x2 | 60 | 1 | 2 | M-FR2-A.3.4-1 | TDLA30-75, ULA Low | 1 | 6.4 |
| 1x2 | 60 | 1 | 4 | M-FR2-A.3.4-2 | TDLA30-75, ULA Low | 1 | 2.9 |
| 2x2 | 60 | 1 | 8 | M-FR2-A.3.4-3 | TDLA30-75, ULA Low | 1 | 0.1 |

### 11.2.3 CSI reporting requirements

#### 11.2.3.1 Performance requirements for IAB type 1-O

##### 11.2.3.1.1 Reporting of Channel Quality Indicator (CQI)

Apply the requirements defined in clause 8.2.3.2 for 2Rx.

##### 11.2.3.1.2 Reporting of Precoding Matrix Indicator (PMI)

Apply the requirements defined in clause 8.2.3.3 for 2Rx.

##### 11.2.3.1.3 Reporting of Rank Indicator (RI)

Apply the requirements defined in clause 8.2.3.4 for 2Rx.

#### 11.2.3.2 Performance requirements for IAB type 2-O

##### 11.2.3.2.1 General

This clause includes radiated requirements for the reporting of channel state information (CSI).

11.2.3.2.1.1 Applicability of requirements

Editor’s Note: Text and sections on applicability will be added here once wording is agreed.

11.2.3.2.1.2 Common test parameters

Parameters specified in Table 11.2.3.2.1.2-1 are applied for all test cases in this clause unless otherwise stated.

Table 11.2.3.2.1.2-1: Test parameters for CSI test cases

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | | Unit | Value |
| PDSCH transmission scheme | | |  | Transmission scheme 1 |
| Duplex Mode | | |  | TDD |
| PTRS *epre-Ratio* | | |  | 0 |
| Actual carrier configuration | | Offset between Point A and the lowest usable subcarrier on this carrier (Note 3) | RBs | 0 |
| Subcarrier spacing | kHz | 120 |
| DL BWP configuration #1 | | Cyclic prefix |  | Normal |
| RB offset | RBs | 0 |
| Number of contiguous PRB | PRBs | Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-2 [4] for tested channel bandwidth and subcarrier spacing |
| Active DL BWP index | | |  | 1 |
| PDSCH configuration | Mapping type | |  | Type A |
| *k0* | |  | 0 |
| Starting symbol (S) | |  | 2 |
| Length (L) | |  | 12 |
| PDSCH aggregation factor | |  | 1 |
| PRB bundling type | |  | Static |
| PRB bundling size | |  | 2 |
| Resource allocation type | |  | Type 0 |
| RBG size | |  | Config2 |
| VRB-to-PRB mapping type | |  | Non-interleaved |
| VRB-to-PRB mapping interleaver bundle size | |  | N/A |
| PDSCH DMRS configuration | DMRS Type | |  | Type 1 |
| Number of additional DMRS | |  | 1 |
| DMRS ports indexes | |  | {1000} for Rank1  {1000,1001} for Rank2 |
| Maximum number of OFDM symbols for DL front loaded DMRS | |  | 1 |
| Number of PDSCH DMRS CDM group(s) without data | |  | 2 |
| PTRS configuration | Frequency density (*KPT-RS*) | |  | 2 |
| Time density (*LPT-RS*) | |  | 1 |
| Resource Element Offset | |  | 2 |
| NZP CSI-RS for CSI acquisition | | Frequency Occupation |  | Start PRB 0  Number of PRB = BWP size |
| Number of HARQ Processes | | |  | 8 |
| HARQ ACK/NACK bundling | | |  | Multiplexed |
| Redundancy version coding sequence | | |  | {0,2,3,1} |
| Physical signals, channels mapping and precoding | | |  | As specified in Annex TBA |
| Note 1: PDSCH is scheduled only on full DL slots without CSI-RS resource and TRS allocated.  Note 2: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-2 [4] for tested channel bandwidth and subcarrier spacing. | | | | |

##### 11.2.3.2.2 Reporting of Channel Quality Indicator (CQI)

11.2.3.2.2.1 General

The reporting accuracy of the channel quality indicator (CQI) under frequency non-selective conditions is determined by the reporting variance and the BLER performance using the transport format indicated by the reported CQI median. The purpose is to verify that the reported CQI values are in accordance with the CQI definition given in TS 38.214 [11]. To account for sensitivity of the input SNR the reporting definition is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

Table 11.2.3.2.2.1-1: Test parameters

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Test 1** | | **Test 2** | |
| Bandwidth | | | MHz | 100 | | | |
| Subcarrier spacing | | | kHz | 120 | | | |
| Duplex Mode | | |  | TDD | | | |
| Default TDD UL-DL pattern (Note 1) | | |  | 3D1S1U | | | |
| Special Slot Configuration | | |  | 10D+2G+2U | | | |
| SNRBB | | | dB | 8 | 9 | 14 | 15 |
| Propagation channel | | |  | AWGN | | | |
| Antenna configuration | | |  | 2×2 with static channel specified in Annex TBA | | | |
| Beamforming Model | | |  | As specified in Annex TBA | | | |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type | |  | *Periodic* | | | |
| Number of CSI-RS ports (*X*) | |  | 2 | | | |
| CDM Type | |  | *fd-CDM2* | | | |
| Density (ρ) | |  | 1 | | | |
| First subcarrier index in the PRB used for CSI-RS (k0, k1 ) | |  | 6 | | | |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) | |  | 13 | | | |
| NZP CSI-RS-timeConfig  periodicity and offset | | slot | 8/1 | | | |
| ReportConfigType | | |  | *Periodic* | | | |
| CQI-table | | |  | Table 1 | | | |
| reportQuantity | | |  | *cri-RI-PMI-CQI* | | | |
| cqi-FormatIndicator | | |  | *Wideband* | | | |
| pmi-FormatIndicator | | |  | *Wideband* | | | |
| Sub-band Size | | | RB | 8 | | | |
| csi-ReportingBand | | |  | 111111111 | | | |
| CSI-Report periodicity and offset | | | slot | 8/3 | | | |
| Codebook configuration | | Codebook Type |  | *typeI-SinglePanel* | | | |
| Codebook Mode |  | 1 | | | |
| (CodebookConfig-N1,CodebookConfig-N2) |  | *Not configured* | | | |
| CodebookSubsetRestriction |  | 010000 | | | |
| RI Restriction |  | N/A | | | |
| Maximum number of HARQ transmission | | |  | 1 | | | |
| Measurement channel | | |  | M-FR2-A.3.5-2 | | | |
| Note 1: The same requirements are applicable to with different UL-DL patterns.  Note 2: SSB, TRS, CSI-RS, and/or other unspecified test parameters with respect to TS 38.101-4 [TBA] are left up to test implementation, if transmitted or needed. | | | | | | | |

11.2.3.2.2.2 Minimum requirements

For the parameters specified in Table 11.2.3.2.1.1-1, and using the downlink physical channels specified in Annex TBA, the minimum requirements are specified by the following:

a) The reported CQI value according to the reference channel shall be in the range of ±1 of the reported median more than 90% of the time.

b) If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 0.1.

##### 11.2.3.2.3 Reporting of Precoding Matrix Indicator (PMI)

11.2.3.2.3.1 General

The minimum performance requirements of PMI reporting are defined based on the precoding gain, expressed as the relative increase in throughput when the transmitter is configured according to the UE reports compared to the case when the transmitter is using random precoding, respectively. When the transmitter uses random precoding, for each PDSCH allocation a precoder is randomly generated and applied to the PDSCH. A fixed transport format (FRC) is configured for all requirements.

The requirements for transmission mode 1 with 2TX and higher layer parameter *codebookType* set to 'typeI-SinglePanel' are specified in terms of the ratio



In the definition of *γ*, for 2TX PMI requirements, is 90 % of the maximum throughput obtained at  using the precoders configured according to the UE reports, and is the throughput measured at with random precoding.

Table 11.2.3.2.3.1-1: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Test 1** |
| Bandwidth | | MHz | 100 |
| Subcarrier spacing | | kHz | 120 |
| Default TDD UL-DL pattern (Note 1) | |  | 3D1S1U |
| Special Slot Configuration | |  | 10D+2G+2U |
| Propagation channel | |  | TDLA30-35 |
| Antenna configuration | |  | 2 x 2 ULA Low |
| Beamforming Model | |  | As specified in Annex TBA |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type |  | Periodic |
| Number of CSI-RS ports (*X*) |  | 2 |
| CDM Type |  | FD-CDM2 |
| Density (ρ) |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0, k1 ) |  | Row 3, (6,-) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (13,-) |
| CSI-RS  interval and offset | slot | 8/1 |
| ReportConfigType | |  | Periodic |
| CQI-table | |  | Table 1 |
| reportQuantity | |  | cri-RI-PMI-CQI |
| cqi-FormatIndicator | |  | Wideband |
| pmi-FormatIndicator | |  | Wideband |
| Sub-band Size | | RB | 8 |
| csi-ReportingBand | |  | 111111111 |
| CSI-Report interval and offset | | slot | 8/3 |
| Codebook configuration | Codebook Type |  | typeI-SinglePanel |
| Codebook Mode |  | 1 |
| (CodebookConfig-N1,CodebookConfig-N2) |  | N/A |
| CodebookSubsetRestriction |  | 001111 |
| RI Restriction |  | N/A |
| CQI/RI/PMI delay | | ms | 1.75 |
| Maximum number of HARQ transmission | |  | 4 |
| Measurement channel | |  | M-FR2-A.3.5-3 |
| Note 1: The same requirements are applicable for TDD with different UL-DL pattern.  Note 2: For random precoder selection, the precoder shall be updated in each slot (0.125 ms granularity).  Note 3: If the UE reports in an available uplink reporting instance at slot #n based on PMI estimation at a downlink slot not later than slot#(n-4), this reported PMI cannot be applied at the gNB downlink before slot#(n+4).  Note 4: Randomization of the principle beam direction shall be used as specified in Annex TBA.  Note 5: SSB, TRS, CSI-RS and/or other unspecified test parameters with respect to TS 38.101-4 [TBA] are left up to test implementation, if transmitted or needed. | | | |

11.2.3.2.3.2 Minimum requirements

For the parameters specified in Table 11.2.3.2.3.1-1, and using the downlink physical channels specified in Annex TBA, the minimum requirements are specified in Table 11.2.3.2.3.2-1.

Table 11.2.3.2.3.2-1: Minimum requirement

|  |  |
| --- | --- |
| **Parameter** | **Test 1** |
| ** | 1.05 |

##### 11.2.3.2.4 Reporting of Rank Indicator (RI)

11.2.3.2.4.1 General

The purpose of this test is to verify that the reported rank indicator accurately represents the channel rank. The accuracy of RI reporting is determined by the relative increase of the throughput obtained when transmitting based on the reported rank compared to the case for which a fixed rank is used for transmission.

The minimum performance requirement in Table 11.2.3.2.4.2-1 is defined as

a) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be ≥ ;

b) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 2 shall be ≥ ;

Table 11.2.3.2.4.1-1: Test parameters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Test 1** | **Test 2** | **Test 3** |
| Bandwidth | | | MHz | 100 | 100 | 100 |
| Subcarrier spacing | | | kHz | 120 | 120 | 120 |
| Duplex Mode | | |  | TDD | TDD | TDD |
| Default TDD UL-DL pattern (Note 1) | | |  | 3D1S1U | 3D1S1U | 3D1S1U |
| Special Slot Configuration | | |  | 10D+2G+2U | 10D+2G+2U | 10D+2G+2U |
| SNR | | | dB | 0 | 16 | 16 |
| Propagation channel | | |  | TDLA30-35 | TDLA30-35 | TDLA30-35 |
| Antenna configuration | | |  | ULA Low 2x2 | ULA Low 2x2 | XP High 2x2 |
| Beamforming Model | | |  | As defined in Annex TBA | As defined in Annex TBA | As defined in Annex TBA |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type | |  | Periodic | Periodic | Periodic |
| Number of CSI-RS ports (*X*) | |  | 2 | 2 | 2 |
| CDM Type | |  | FD-CDM2 | FD-CDM2 | FD-CDM2 |
| Density (ρ) | |  | 1 | 1 | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0, k1 ) | |  | Row 3 (6,-) | Row 3 (6,-) | Row 3 (6,-) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) | |  | (13,-) | (13,-) | (13,-) |
| NZP CSI-RS-timeConfig  interval and offset | | slot | 8/1 | 8/1 | 8/1 |
| ReportConfigType | | |  | Periodic | Periodic | Periodic |
| CQI-table | | |  | Table 1 | Table 1 | Table 1 |
| reportQuantity | | |  | cri-RI-PMI-CQI | cri-RI-PMI-CQI | cri-RI-PMI-CQI |
| cqi-FormatIndicator | | |  | Wideband | Wideband | Wideband |
| pmi-FormatIndicator | | |  | Wideband | Wideband | Wideband |
| Sub-band Size | | | RB | 8 | 8 | 8 |
| csi-ReportingBand | | |  | 111111111 | 111111111 | 111111111 |
| CSI-Report interval and offset | | | slot | 8/3 | 8/3 | 8/3 |
| Codebook configuration | | Codebook Type |  | typeI-SinglePanel | typeI-SinglePanel | typeI-SinglePanel |
| Codebook Mode |  | 1 | 1 | 1 |
| (CodebookConfig-N1,CodebookConfig-N2) |  | N/A | N/A | N/A |
| CodebookSubsetRestriction |  | 010000 for fixed rank 2,  010011 for following rank | 000011 for fixed rank 1,  010011 for following rank | 000011 for fixed rank 1,  010011 for following rank |
| RI Restriction |  | N/A | N/A | N/A |
| CQI/RI/PMI delay | | | ms | 1.375 | 1.375 | 1.375 |
| Maximum number of HARQ transmission | | |  | 1 | 1 | 1 |
| RI Configuration | | |  | Fixed RI = 2 and follow RI | Fixed RI = 1 and follow RI | Fixed RI = 1 and follow RI |
| Note 1: The same requirements are applicable to with different UL-DL patterns.  Note 2: SSB, TRS, CSI-RS and/or other unspecified test parameters with respect to TS 38.101-4 are left up to test implementation, if transmitted or needed.  Note 3: Measurements channels are specified in Table A.3.5-2. M-FR2-A.3.5-1 is used for Rank 1 case. M-FR2-A.3.5-2 is used for Rank 2 case. | | | | | | |

11.2.3.2.4.2 Minimum requirements

For the parameters specified in Table 11.2.3.2.4.1-1, and using the downlink physical channels specified in Annex TBA, the minimum requirements are specified in Table 11.2.3.2.4.2-1.

Table 11.2.3.2.4.2-1: Minimum requirement

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Test 1** | **Test 2** | **Test 3** |
| **1 | N/A | 1.05 | 1.05 |
| **2 | 1.0 | N/A | N/A |

*<END OF THE CHANGE 2>*

*<START OF THE CHANGE 3>*

## A.2 IAB-DU Fixed Reference Channels

### A.2.1 Fixed Reference Channels for PUSCH performance requirements (QPSK, R=193/1024)

The parameters for the reference measurement channels are specified in table A.2.1-1 to table A.2.1-3 for FR1 PUSCH performance requirements:

- FRC parameters are specified in table A.2.1-1 for FR1 PUSCH with transform precoding disabled, Additional DM-RS position = pos1 and 1 transmission layer.

- FRC parameters are specified in table A.2.1-2 for FR1 PUSCH with transform precoding disabled, Additional DM-RS position = pos1 and 2 transmission layers.

- FRC parameters are specified in table A.2.1-3 for FR1 PUSCH with transform precoding enabled, Additional DM-RS position = pos1 and 1 transmission layer.

The parameters for the reference measurement channels are specified in table A.2.1-4 to table A.2.1-9 for FR2 PUSCH performance requirements:

- FRC parameters are specified in table A.2.1-4 for FR2 PUSCH with transform precoding disabled, Additional DM-RS position = pos0 and 1 transmission layer.

- FRC parameters are specified in table A.2.1-5 for FR2 PUSCH with transform precoding disabled, Additional DM-RS position = pos0 and 2 transmission layers.

- FRC parameters are specified in table A.2.1-6 for FR2 PUSCH with transform precoding enabled, Additional DM-RS position = pos0 and 1 transmission layer.

- FRC parameters are specified in table A.2.1-7 for FR2 PUSCH with transform precoding disabled, Additional DM-RS position = pos1 and 1 transmission layer.

- FRC parameters are specified in table A.2.1-8 for FR2 PUSCH with transform precoding disabled, Additional DM-RS position = pos1 and 2 transmission layers.

- FRC parameters are specified in table A.2.1-9 for FR2 PUSCH with transform precoding enabled, Additional DM-RS position = pos1 and 1 transmission layer.

Table A.2.1-1: FRC parameters for FR1 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos1* and 1 transmission layer (QPSK, R=193/1024)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Reference channel | D-FR1-A.2.1-1 | D-FR1-A.2.1-2 | D-FR1-A.2.1-3 | D-FR1-A.2.1-4 | D-FR1-A.2.1-5 | D-FR1-A.2.1-6 | D-FR1-A.2.1-7 |
| Subcarrier spacing [kHz] | 15 | 15 | 15 | 30 | 30 | 30 | 30 |
| Allocated resource blocks | 25 | 52 | 106 | 24 | 51 | 106 | 273 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Modulation | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK |
| Code rate | 193/1024 | 193/1024 | 193/1024 | 193/1024 | 193/1024 | 193/1024 | 193/1024 |
| Payload size (bits) | 1352 | 2856 | 5768 | 1320 | 2792 | 5768 | 14856 |
| Transport block CRC (bits) | 16 | 16 | 24 | 16 | 16 | 24 | 24 |
| Code block CRC size (bits) | - | - | 24 | - | - | 24 | 24 |
| Number of code blocks - C | 1 | 1 | 2 | 1 | 1 | 2 | 4 |
| Code block size including CRC (bits) (Note 2) | 1368 | 2872 | 2920 | 1336 | 2808 | 2920 | 3744 |
| Total number of bits per slot | 7200 | 14976 | 30528 | 6912 | 14688 | 30528 | 78624 |
| Total symbols per slot | 3600 | 7488 | 15264 | 3456 | 7344 | 15264 | 39312 |
| NOTE 1: *DM-RS configuration type*  = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos1*, *l0*= 2 and *l* =11 for PUSCH mapping type A, *l0*= 0 and *l* =10 for PUSCH mapping type B as per table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [9]. | | | | | | | |

Table A.2.1-2: FRC parameters for FR1 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos1* and 2 transmission layers (QPSK, R=193/1024)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Reference channel | D-FR1-A.2.1-8 | D-FR1-A.2.1-9 | D-FR1-A.2.1-10 | D-FR1-A.2.1-11 | D-FR1-A.2.1-12 | D-FR1-A.2.1-13 | D-FR1-A.2.1-14 |
| Subcarrier spacing [kHz] | 15 | 15 | 15 | 30 | 30 | 30 | 30 |
| Allocated resource blocks | 25 | 52 | 106 | 24 | 51 | 106 | 273 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Modulation | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK |
| Code Rate | 193/1024 | 193/1024 | 193/1024 | 193/1024 | 193/1024 | 193/1024 | 193/1024 |
| Payload size (bits) | 2728 | 5640 | 11528 | 2600 | 5512 | 11528 | 29736 |
| Transport block CRC (bits) | 16 | 24 | 24 | 16 | 24 | 24 | 24 |
| Code block CRC size (bits) | - | 24 | 24 | - | 24 | 24 | 24 |
| Number of code blocks - C | 1 | 2 | 4 | 1 | 2 | 4 | 8 |
| Code block size including CRC (bits) (Note 2) | 2744 | 2856 | 2912 | 2616 | 2792 | 2912 | 3744 |
| Total number of bits per slot | 14400 | 29952 | 61056 | 13824 | 29376 | 61056 | 157248 |
| Total symbols per slot | 7200 | 14976 | 30528 | 6912 | 14688 | 30528 | 78624 |
| NOTE 1: *DM-RS configuration type*  = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos1*, *l0*= 2 and *l*=11 for PUSCH mapping type A, *l0* = 0 and *l* =10 for PUSCH mapping type B as per table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [9]. | | | | | | | |

Table A.2.1-3: FRC parameters for FR1 PUSCH performance requirements, transform precoding enabled, *Additional DM-RS position = pos1* and 1 transmission layer (QPSK, R=193/1024)

|  |  |  |
| --- | --- | --- |
| Reference channel | D-FR1-A.2.1-15 | D-FR1-A.2.1-16 |
| Subcarrier spacing [kHz] | 15 | 30 |
| Allocated resource blocks | 25 | 24 |
| DFT-s-OFDM Symbols per slot (Note 1) | 12 | 12 |
| Modulation | QPSK | QPSK |
| Code Rate | 193/1024 | 193/1024 |
| Payload size (bits) | 1352 | 1320 |
| Transport block CRC (bits) | 16 | 16 |
| Code block CRC size (bits) | - | - |
| Number of code blocks - C | 1 | 1 |
| Code block size including CRC (bits) (Note 2) | 1368 | 1336 |
| Total number of bits per slot | 7200 | 6912 |
| Total symbols per slot | 3600 | 3456 |
| NOTE 1: *DM-RS configuration type*  = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos1*, *l0*= 2 and *l*=11 for PUSCH mapping type A, *l0*= 0 and *l* =10 for PUSCH mapping type B as per Table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [9]. | | |

Table A.2.1-4: FRC parameters for FR2 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos0* and 1 transmission layer (QPSK, R=193/1024)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Reference channel | D-FR2-A.2.1-1 | D-FR2-A.2.1-2 | D-FR2-A.2.1-3 | D-FR2-A.2.1-4 | D-FR2-A.2.1-5 |
| Subcarrier spacing [kHz] | 60 | 60 | 120 | 120 | 120 |
| Allocated resource blocks | 66 | 132 | 32 | 66 | 132 |
| CP-OFDM Symbols per slot (Note 1) | 9 | 9 | 9 | 9 | 9 |
| Modulation | QPSK | QPSK | QPSK | QPSK | QPSK |
| Code Rate | 193/1024 | 193/1024 | 193/1024 | 193/1024 | 193/1024 |
| Payload size (bits) | 2664 | 5384 | 1320 | 2664 | 5384 |
| Transport block CRC (bits) | 16 | 24 | 16 | 16 | 24 |
| Code block CRC size (bits) | - | 24 | - | - | 24 |
| Number of code blocks - C | 1 | 2 | 1 | 1 | 2 |
| Code block size including CRC (bits) (Note 2) | 2680 | 2728 | 1336 | 2680 | 2728 |
| Total number of bits per slot | 14256 | 28512 | 6912 | 14256 | 28512 |
| Total symbols per slot | 7128 | 14256 | 3456 | 7128 | 14256 |
| NOTE 1: *DM-RS configuration type*  = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos0* with *l0*= 0 as per Table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [9]. | | | | | |

Table A.2.1-5: FRC parameters for FR2 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos0* and 2 transmission layers (QPSK, R=193/1024)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Reference channel | D-FR2-A.2.1-6 | D-FR2-A.2.1-7 | D-FR2-A.2.1-8 | D-FR2-A.2.1-9 | D-FR2-A.2.1-10 |
| Subcarrier spacing [kHz] | 60 | 60 | 120 | 120 | 120 |
| Allocated resource blocks | 66 | 132 | 32 | 66 | 132 |
| CP-OFDM Symbols per slot (Note 1) | 9 | 9 | 9 | 9 | 9 |
| Modulation | QPSK | QPSK | QPSK | QPSK | QPSK |
| Code Rate | 193/1024 | 193/1024 | 193/1024 | 193/1024 | 193/1024 |
| Payload size (bits) | 5384 | 10752 | 2600 | 5384 | 10752 |
| Transport block CRC (bits) | 24 | 24 | 16 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | - | 24 | 24 |
| Number of code blocks - C | 2 | 3 | 1 | 2 | 3 |
| Code block size including CRC (bits) (Note 2) | 2728 | 3616 | 2616 | 2728 | 3616 |
| Total number of bits per slot | 28512 | 57024 | 13824 | 28512 | 57024 |
| Total symbols per slot | 14256 | 28512 | 6912 | 14256 | 28512 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos0* with *l0*= 0 as per Table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [9]. | | | | | |

Table A.2.1-6: FRC parameters for FR2 PUSCH performance requirements, transform precoding enabled, *Additional DM-RS position = pos0* and 1 transmission layer (QPSK, R=193/1024)

|  |  |  |
| --- | --- | --- |
| Reference channel | D-FR2-A.2.1-11 | D-FR2-A.2.1-12 |
| Subcarrier spacing [kHz] | 60 | 120 |
| Allocated resource blocks | 30 | 30 |
| DFT-s-OFDM Symbols per slot (Note 1) | 9 | 9 |
| Modulation | QPSK | QPSK |
| Code Rate | 193/1024 | 193/1024 |
| Payload size (bits) | 1224 | 1224 |
| Transport block CRC (bits) | 16 | 16 |
| Code block CRC size (bits) | - | - |
| Number of code blocks - C | 1 | 1 |
| Code block size including CRC (bits) (Note 2) | 1240 | 1240 |
| Total number of bits per slot | 6480 | 6480 |
| Total symbols per slot | 3240 | 3240 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos0* with *l0*= 0 as per Table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [9]. | | |

Table A.2.1-7: FRC parameters for FR2 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos1* and 1 transmission layer (QPSK, R=193/1024)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Reference channel | D-FR2-A.2.1-13 | D-FR2-A.2.1-14 | D-FR2-A.2.1-15 | D-FR2-A.2.1-16 | D-FR2-A.2.1-17 |
| Subcarrier spacing [kHz] | 60 | 60 | 120 | 120 | 120 |
| Allocated resource blocks | 66 | 132 | 32 | 66 | 132 |
| CP-OFDM Symbols per slot (Note 1) | 8 | 8 | 8 | 8 | 8 |
| Modulation | QPSK | QPSK | QPSK | QPSK | QPSK |
| Code Rate | 193/1024 | 193/1024 | 193/1024 | 193/1024 | 193/1024 |
| Payload size (bits) | 2408 | 4744 | 1160 | 2408 | 4744 |
| Transport block CRC (bits) | 16 | 24 | 16 | 16 | 24 |
| Code block CRC size (bits) | - | 24 | - | - | 24 |
| Number of code blocks - C | 1 | 2 | 1 | 1 | 2 |
| Code block size including CRC (bits) (Note 2) | 2424 | 2408 | 1176 | 2424 | 2408 |
| Total number of bits per slot | 12672 | 25344 | 6144 | 12672 | 25344 |
| Total symbols per slot | 6336 | 12672 | 3072 | 6336 | 12672 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos1* with *l0*= 0 and *l* =8 as per Table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [9]. | | | | | |

Table A.2.1-8: FRC parameters for FR2 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos1* and 2 transmission layers (QPSK, R=193/1024)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Reference channel | D-FR2-A.2.1-18 | D-FR2-A.2.1-19 | D-FR2-A.2.1-20 | D-FR2-A.2.1-21 | D-FR2-A.2.1-22 |
| Subcarrier spacing [kHz] | 60 | 60 | 120 | 120 | 120 |
| Allocated resource blocks | 66 | 132 | 32 | 66 | 132 |
| CP-OFDM Symbols per slot (Note 1) | 8 | 8 | 8 | 8 | 8 |
| Modulation | QPSK | QPSK | QPSK | QPSK | QPSK |
| Code Rate | 193/1024 | 193/1024 | 193/1024 | 193/1024 | 193/1024 |
| Payload size (bits) | 4744 | 9480 | 2408 | 4744 | 9480 |
| Transport block CRC (bits) | 24 | 24 | 16 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | - | 24 | 24 |
| Number of code blocks - C | 2 | 3 | 1 | 2 | 3 |
| Code block size including CRC (bits) (Note 2) | 2408 | 3192 | 2424 | 2408 | 3192 |
| Total number of bits per slot | 25344 | 50688 | 12288 | 25344 | 50688 |
| Total symbols per slot | 12672 | 25344 | 6144 | 12672 | 25344 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos1* with *l0*= 0 and *l* =8 as per Table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [9]. | | | | | |

Table A.2.1-9: FRC parameters for FR2 PUSCH performance requirements, transform precoding enabled, *Additional DM-RS position = pos1* and 1 transmission layer (QPSK, R=193/1024)

|  |  |  |
| --- | --- | --- |
| Reference channel | D-FR2-A.2.1-23 | D-FR2-A.2.1-24 |
| Subcarrier spacing [kHz] | 60 | 120 |
| Allocated resource blocks | 30 | 30 |
| DFT-s-OFDM Symbols per slot (Note 1) | 8 | 8 |
| Modulation | QPSK | QPSK |
| Code Rate | 193/1024 | 193/1024 |
| Payload size (bits) | 1128 | 1128 |
| Transport block CRC (bits) | 16 | 16 |
| Code block CRC size (bits) | - | - |
| Number of code blocks - C | 1 | 1 |
| Code block size including CRC (bits) (Note 2) | 1144 | 1144 |
| Total number of bits per slot | 5760 | 5760 |
| Total symbols per slot | 2880 | 2880 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos1* with *l0*= 0 and *l* =8 as per Table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [9]. | | |

### A.2.2 Fixed Reference Channels for PUSCH performance requirements (16QAM, R=434/1024)

The parameters for the reference measurement channels are specified in table A.2.2-1 for FR2 PUSCH performance requirements with transform precoding disabled, additional DM-RS position = pos0 and 2 transmission layers.

The parameters for the reference measurement channels are specified in table A.2.2-2 for FR2 PUSCH performance requirements with transform precoding disabled, additional DM-RS position = pos1 and 2 transmission layers.

Table A.2.2-1: FRC parameters for FR2 PUSCH performance requirements, transform precoding disabled, Additional DM-RS position = pos0 and 2 transmission layers (16QAM, R=434/1024)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Reference channel | D-FR2-A.2.2-1 | D-FR2-A.2.2-2 | D-FR2-A.2.2-3 | D-FR2-A.2.2-4 | D-FR2-A.2.2-5 |
| Subcarrier spacing [kHz] | 60 | 60 | 120 | 120 | 120 |
| Allocated resource blocks | 66 | 132 | 32 | 66 | 132 |
| CP-OFDM Symbols per slot (Note 1) | 9 | 9 | 9 | 9 | 9 |
| Modulation | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Code Rate | 434/1024 | 434/1024 | 434/1024 | 434/1024 | 434/1024 |
| Payload size (bits) | 24072 | 48168 | 11784 | 24072 | 48168 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 | 24 | 24 |
| Number of code blocks - C | 3 | 6 | 2 | 3 | 6 |
| Code block size including CRC (bits) (Note 2) | 8056 | 8056 | 5928 | 8056 | 8056 |
| Total number of bits per slot | 57024 | 114048 | 27648 | 57024 | 114048 |
| Total symbols per slot | 14256 | 28512 | 6912 | 14256 | 28512 |
| NOTE 1: *DM-RS configuration type*  = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos0* with *l0*= 0 as per Table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [9]. | | | | | |

Table A.2.2-2: FRC parameters for FR2 PUSCH performance requirements, transform precoding disabled, Additional DM-RS position = pos1 and 2 transmission layers (16QAM, R=434/1024)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Reference channel | D-FR2-A.2.2-6 | D-FR2-A.2.2-7 | D-FR2-A.2.2-8 | D-FR2-A.2.2-9 | D-FR2-A.2.2-10 |
| Subcarrier spacing [kHz] | 60 | 60 | 120 | 120 | 120 |
| Allocated resource blocks | 66 | 132 | 32 | 66 | 132 |
| CP-OFDM Symbols per slot (Note 1) | 8 | 8 | 8 | 8 | 8 |
| Modulation | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Code Rate | 434/1024 | 434/1024 | 434/1024 | 434/1024 | 434/1024 |
| Payload size (bits) | 21504 | 43032 | 10504 | 21504 | 43032 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 | 24 | 24 |
| Number of code blocks - C | 3 | 6 | 2 | 3 | 6 |
| Code block size including CRC (bits) (Note 2) | 7200 | 7200 | 5288 | 7200 | 7200 |
| Total number of bits per slot | 50688 | 101376 | 24576 | 50688 | 101376 |
| Total symbols per slot | 12672 | 25344 | 6144 | 12672 | 25344 |
| NOTE 1: *DM-RS configuration type*  = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos1* with *l0* = 0 and *l* = 8 as per Table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [9]. | | | | | |

### A.2.3 Fixed Reference Channels for PUSCH performance requirements (16QAM, R=658/1024)

The parameters for the reference measurement channels are specified in table A.2.3-1 and table A.2.3-2 for FR1 PUSCH performance requirements:

- FRC parameters are specified in table A.2.3-1 for FR1 PUSCH with transform precoding disabled, *Additional DM-RS position = pos1* and 1 transmission layer.

- FRC parameters are specified in table A.2.3-2 for FR1 PUSCH with transform precoding disabled, *Additional DM-RS position = pos1* and 2 transmission layers.

The parameters for the reference measurement channels are specified in table A.2.3-3 to table A.2.3-6 for FR2 PUSCH performance requirements:

- FRC parameters are specified in table A.2.3-3 for FR2 PUSCH with transform precoding disabled, *Additional DM-RS position = pos0* and 1 transmission layer.

- FRC parameters are specified in table A.2.3-4 for FR2 PUSCH with transform precoding disabled, *Additional DM-RS position = pos0* and 2 transmission layers.

- FRC parameters are specified in table A.2.3-5 for FR2 PUSCH with transform precoding disabled, *Additional DM-RS position = pos1* and 1 transmission layer.

- FRC parameters are specified in table A.2.3-6 for FR2 PUSCH with transform precoding disabled, *Additional DM-RS position = pos1* and 2 transmission layers.

Table A.2.3-1: FRC parameters for FR1 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos1* and 1 transmission layer (16QAM, R=658/1024)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Reference channel | D-FR1-A.2.3-1 | D-FR1-A.2.3-2 | D-FR1-A.2.3-3 | D-FR1-A.2.3-4 | D-FR1-A.2.3-5 | D-FR1-A.2.3-6 | D-FR1-A.2.3-7 |
| Subcarrier spacing [kHz] | 15 | 15 | 15 | 30 | 30 | 30 | 30 |
| Allocated resource blocks | 25 | 52 | 106 | 24 | 51 | 106 | 273 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Modulation | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Code Rate | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 |
| Payload size (bits) | 9224 | 19464 | 38936 | 8968 | 18960 | 38936 | 100392 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of code blocks - C | 2 | 3 | 5 | 2 | 3 | 5 | 12 |
| Code block size including CRC (bits) (Note 2) | 4648 | 6520 | 7816 | 4520 | 6352 | 7816 | 8392 |
| Total number of bits per slot | 14400 | 29952 | 61056 | 13824 | 29376 | 61056 | 157248 |
| Total symbols per slot | 3600 | 7488 | 15264 | 3456 | 7344 | 15264 | 39312 |
| NOTE 1: *DM-RS configuration type*  = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos1*, *l0*= 2 and *l*=11 for PUSCH mapping type A, *l0*= 0 and *l* =10 for PUSCH mapping type B as per table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [9]. | | | | | | | |

Table A.2.3-2: FRC parameters for FR1 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos1* and 2 transmission layers (16QAM, R=658/1024)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Reference channel | D-FR1-A.2.3-8 | D-FR1-A.2.3-9 | D-FR1-A.2.3-10 | D-FR1-A.2.3-11 | D-FR1-A.2.3-12 | D-FR1-A.2.3-13 | D-FR1-A.2.3-14 |
| Subcarrier spacing [kHz] | 15 | 15 | 15 | 30 | 30 | 30 | 30 |
| Allocated resource blocks | 25 | 52 | 106 | 24 | 51 | 106 | 273 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Modulation | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Code Rate | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 |
| Payload size (bits) | 18432 | 38936 | 77896 | 17928 | 37896 | 77896 | 200808 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of code blocks - C | 3 | 5 | 10 | 3 | 5 | 10 | 24 |
| Code block size including CRC (bits) (Note 2) | 6176 | 7816 | 7816 | 6008 | 7608 | 7816 | 8392 |
| Total number of bits per slot | 28800 | 59904 | 122112 | 27648 | 58752 | 122112 | 314496 |
| Total symbols per slot | 7200 | 14976 | 30528 | 6912 | 14688 | 30528 | 78624 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos1*, *l0*= 2 and *l*=11 for PUSCH mapping type A, *l0*= 0 and *l* =10 for PUSCH mapping type B as per table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [9]. | | | | | | | |

Table A.2.3-3: FRC parameters for FR2 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos0* and 1 transmission layer (16QAM, R=658/1024)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Reference channel | D-FR2-A.2.3-1 | D-FR2-A.2.3-2 | D-FR2-A.2.3-3 | D-FR2-A.2.3-4 | D-FR2-A.2.3-5 |
| Subcarrier spacing [kHz] | 60 | 60 | 120 | 120 | 120 |
| Allocated resource blocks | 66 | 132 | 32 | 66 | 132 |
| CP-OFDM Symbols per slot (Note 1) | 9 | 9 | 9 | 9 | 9 |
| Modulation | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Code Rate | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 |
| Payload size (bits) | 18432 | 36896 | 8968 | 18432 | 36896 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 | 24 | 24 |
| Number of code blocks - C | 3 | 5 | 2 | 3 | 5 |
| Code block size including CRC (bits) (Note 2) | 6176 | 7408 | 4520 | 6176 | 7408 |
| Total number of bits per slot | 28512 | 57024 | 13824 | 28512 | 57024 |
| Total symbols per slot | 7128 | 14256 | 3456 | 7128 | 14256 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos0* with *l0*= 0 as per Table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [9]. | | | | | |

Table A.2.3-4: FRC parameters for FR2 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos0* and 2 transmission layers (16QAM, R=658/1024)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Reference channel | D-FR2-A.2.3-6 | D-FR2-A.2.3-7 | D-FR2-A.2.3-8 | D-FR2-A.2.3-9 | D-FR2-A.2.3-10 |
| Subcarrier spacing [kHz] | 60 | 60 | 120 | 120 | 120 |
| Allocated resource blocks | 66 | 132 | 32 | 66 | 132 |
| CP-OFDM Symbols per slot (Note 1) | 9 | 9 | 9 | 9 | 9 |
| Modulation | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Code Rate | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 |
| Payload size (bits) | 36896 | 73776 | 17928 | 36896 | 73776 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 | 24 | 24 |
| Number of code blocks - C | 5 | 9 | 3 | 5 | 9 |
| Code block size including CRC (bits) (Note 2) | 7408 | 8224 | 6008 | 7408 | 8224 |
| Total number of bits per slot | 57024 | 114048 | 27648 | 57024 | 114048 |
| Total symbols per slot | 14256 | 28512 | 6912 | 14256 | 28512 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos0* with *l0*= 0 as per Table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [9]. | | | | | |

Table A.2.3-5: FRC parameters for FR2 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos1* and 1 transmission layer (16QAM, R=658/1024)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Reference channel | D-FR2-A.2.3-11 | D-FR2-A.2.3-12 | D-FR2-A.2.3-13 | D-FR2-A.2.3-14 | D-FR2-A.2.3-15 |
| Subcarrier spacing [kHz] | 60 | 60 | 120 | 120 | 120 |
| Allocated resource blocks | 66 | 132 | 32 | 66 | 132 |
| CP-OFDM Symbols per slot (Note 1) | 8 | 8 | 8 | 8 | 8 |
| Modulation | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Code Rate | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 |
| Payload size (bits) | 16392 | 32776 | 7936 | 16392 | 32776 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | - | 24 | 24 |
| Number of code blocks - C | 2 | 4 | 1 | 2 | 4 |
| Code block size including CRC (bits) (Note 2) | 8232 | 8224 | 7960 | 8232 | 8224 |
| Total number of bits per slot | 25344 | 50688 | 12288 | 25344 | 50688 |
| Total symbols per slot | 6336 | 12672 | 3072 | 6336 | 12672 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos1* with *l0*= 0 and *l* =8 as per Table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [9]. | | | | | |

Table A.2.3-6: FRC parameters for FR2 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos1* and 2 transmission layers (16QAM, R=658/1024)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Reference channel | D-FR2-A.2.3-16 | D-FR2-A.2.3-17 | D-FR2-A.2.3-18 | D-FR2-A.2.3-19 | D-FR2-A.2.3-20 |
| Subcarrier spacing [kHz] | 60 | 60 | 120 | 120 | 120 |
| Allocated resource blocks | 66 | 132 | 32 | 66 | 132 |
| CP-OFDM Symbols per slot (Note 1) | 8 | 8 | 8 | 8 | 8 |
| Modulation | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Code Rate | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 |
| Payload size (bits) | 32776 | 65576 | 15880 | 32776 | 65576 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 | 24 | 24 |
| Number of code blocks - C | 4 | 8 | 2 | 4 | 8 |
| Code block size including CRC (bits) (Note 2) | 8224 | 8224 | 7976 | 8224 | 8224 |
| Total number of bits per slot | 50688 | 101376 | 24576 | 50688 | 101376 |
| Total symbols per slot | 12672 | 25344 | 6144 | 12672 | 25344 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos1* with *l0*= 0 and *l* =8 as per Table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [9]. | | | | | |

### A.2.4 Fixed Reference Channels for PUSCH performance requirements (64QAM, R=567/1024)

The parameters for the reference measurement channels are specified in table A.2.4-1 for FR1 PUSCH performance requirements:

- FRC parameters are specified in table A.2.4-1 for FR1 PUSCH with transform precoding disabled, *Additional DM-RS position = pos1* and 1 transmission layer.

The parameters for the reference measurement channels are specified in table A.2.4-2 and table A.2.4-3 for FR2 PUSCH performance requirements:

- FRC parameters are specified in table A.2.4-2 for FR2 PUSCH with transform precoding disabled, *Additional DM-RS position = pos0* and 1 transmission layer.

- FRC parameters are specified in table A.2.4-3 for FR2 PUSCH with transform precoding disabled, *Additional DM-RS position = pos1* and 1 transmission layer.

Table A.2.4-1: FRC parameters for FR1 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos1* and 1 transmission layer (64QAM, R=567/1024)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Reference channel | D-FR1-A.2.4-1 | D-FR1-A.2.4-2 | D-FR1-A.2.4-3 | D-FR1-A.2.4-4 | D-FR1-A.2.4-5 | D-FR1-A.2.4-6 | D-FR1-A.2.4-7 |
| Subcarrier spacing [kHz] | 15 | 15 | 15 | 30 | 30 | 30 | 30 |
| Allocated resource blocks | 25 | 52 | 106 | 24 | 51 | 106 | 273 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Modulation | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Code Rate | 567/1024 | 567/1024 | 567/1024 | 567/1024 | 567/1024 | 567/1024 | 567/1024 |
| Payload size (bits) | 12040 | 25104 | 50184 | 11528 | 24576 | 50184 | 131176 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of code blocks - C | 2 | 3 | 6 | 2 | 3 | 6 | 16 |
| Code block size including CRC (bits) (Note 2) | 6056 | 8400 | 8392 | 5800 | 8224 | 8392 | 8224 |
| Total number of bits per slot | 21600 | 44928 | 91584 | 20736 | 44064 | 91584 | 235872 |
| Total symbols per slot | 3600 | 7488 | 15264 | 3456 | 7344 | 15264 | 39312 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos1*, *l0*= 2 and *l* =11 for PUSCH mapping type A, *l0*= 0 and *l* =10 for PUSCH mapping type B as per table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [9]. | | | | | | | |

Table A.2.4-2: FRC parameters for FR2 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos0* and 1 transmission layer (64QAM, R=567/1024)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Reference channel | G-FR2-A.2.4-1 | G-FR2-A.2.4-2 | G-FR2-A.2.4-3 | G-FR2-A.2.4-4 | G-FR2-A.2.4-5 |
| Subcarrier spacing [kHz] | 60 | 60 | 120 | 120 | 120 |
| Allocated resource blocks | 66 | 132 | 32 | 66 | 132 |
| CP-OFDM Symbols per slot (Note 1) | 9 | 9 | 9 | 9 | 9 |
| Modulation | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Code Rate | 567/1024 | 567/1024 | 567/1024 | 567/1024 | 567/1024 |
| Payload size (bits) | 23568 | 47112 | 11528 | 23568 | 47112 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 | 24 | 24 |
| Number of code blocks - C | 3 | 6 | 2 | 3 | 6 |
| Code block size including CRC (bits) (Note 2) | 7888 | 7880 | 5800 | 7888 | 7880 |
| Total number of bits per slot | 42768 | 85536 | 20736 | 42768 | 85536 |
| Total symbols per slot | 7128 | 14256 | 3456 | 7128 | 14256 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos0* with *l0*= 0 as per Table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [9]. | | | | | |

Table A.2.4-3: FRC parameters for FR2 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos1* and 1 transmission layer (64QAM, R=567/1024)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Reference channel | G-FR2-A.2.4-6 | G-FR2-A.2.4-7 | G-FR2-A.2.4-8 | G-FR2-A.2.4-9 | G-FR2-A.2.4-10 |
| Subcarrier spacing [kHz] | 60 | 60 | 120 | 120 | 120 |
| Allocated resource blocks | 66 | 132 | 32 | 66 | 132 |
| CP-OFDM Symbols per slot (Note 1) | 8 | 8 | 8 | 8 | 8 |
| Modulation | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Code Rate | 567/1024 | 567/1024 | 567/1024 | 567/1024 | 567/1024 |
| Payload size (bits) | 21000 | 42016 | 10248 | 21000 | 42016 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 | 24 | 24 |
| Number of code blocks - C | 3 | 5 | 2 | 3 | 5 |
| Code block size including CRC (bits) (Note 2) | 7032 | 8432 | 5160 | 7032 | 8432 |
| Total number of bits per slot | 38016 | 76032 | 18432 | 38016 | 76032 |
| Total symbols per slot | 6336 | 12672 | 3072 | 6336 | 12672 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos1* with *l0*= 0 and *l* =8 as per Table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [9]. | | | | | |

### A.2.5 PRACH Test preambles

Table A.2.5-1: Test preambles for Normal Mode in FR1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Burst format | SCS (kHz) | Ncs | Logical sequence index | v |
| 0 | 1.25 | 13 | 22 | 32 |
| A1, A2, A3, | 15 | 23 | 0 | 0 |
| B4, C0, C2 | 30 | 46 | 0 | 0 |

Table A.2.5-2: Test preambles for Normal Mode in FR2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Burst format | SCS (kHz) | Ncs | Logical sequence index | v |
| A1, A2, A3, | 60 | 69 | 0 | 0 |
| B4, C0, C2 | 120 | 69 | 0 | 0 |

*<END OF THE CHANGE 3>*

*<START OF THE CHANGE 4>*

## A.3 IAB-MT Fixed Reference Channels

### A.3.1 Fixed Reference Channels for PDSCH performance requirements (16QAM)

The parameters for the reference measurement channels are specified in table A.3.1-1 for FR1 PDSCH performance requirements.

The parameters for the reference measurement channels are specified in table A.3.1-2 for FR2 PDSCH performance requirements.

Table A.3.1-1: FRC parameters for FR1 PDSCH performance requirements, 1-4 transmission layers, 16QAM

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | |
| Reference channel |  | M-FR1-A.3.1-1 | M-FR1-A.3.1-2 | M-FR1-A.3.1-3 |
| Channel bandwidth | MHz | 40 | 40 | 40 |
| Subcarrier spacing | kHz | 30 | 30 | 30 |
| Allocated resource blocks | PRBs | 106 | 106 | 106 |
| Number of consecutive PDSCH symbols |  | 12 | 12 | 12 |
| MCS table |  | 64QAM | 64QAM | 64QAM |
| MCS index |  | 13 | 13 | 13 |
| Modulation |  | 16QAM | 16QAM | 16QAM |
| Target Coding Rate |  | 0.48 | 0.48 | 0.48 |
| Number of MIMO layers |  | 1 | 3 | 4 |
| Number of DMRS REs |  | 12 | 24 | 24 |
| Overhead for TBS determination |  | 0 | 0 | 0 |
| Information Bit Payload per Slot |  | 26632 | 73776 | 98376 |
| Transport block CRC per Slot |  | 24 | 24 | 24 |
| Number of Code Blocks per Slot |  | 4 | 9 | 12 |
| Binary Channel Bits Per Slot |  | 55968 | 152640 | 203520 |

Table A.3.1-2: FRC parameters for FR2 PDSCH performance requirements, 1-2 transmission layers, 16QAM

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | |
| Reference channel |  | M-FR2-A.3.1-1 | M-FR2-A.3.1-2 | M-FR2-A.3.1-3 |
| Channel bandwidth | MHz | 50 | 100 | 100 |
| Subcarrier spacing | kHz | 60 | 120 | 120 |
| Allocated resource blocks | PRBs | 66 | 66 | 66 |
| Number of consecutive PDSCH symbols |  | 13 | 13 | 13 |
| MCS table |  | 64QAM | 64QAM | 64QAM |
| MCS index |  | 13 | 13 | 13 |
| Modulation |  | 16QAM | 16QAM | 16QAM |
| Target Coding Rate |  | 0.48 | 0.48 | 0.48 |
| Number of MIMO layers |  | 2 | 1 | 2 |
| Number of DMRS REs |  | 12 | 12 | 12 |
| Overhead for TBS determination |  | 6 | 6 | 6 |
| Information Bit Payload per Slot |  | 34816 | 17424 | 34816 |
| Transport block CRC per Slot |  | 24 | 24 | 24 |
| Number of Code Blocks per Slot |  | 5 | 3 | 5 |
| Binary Channel Bits Per Slot |  | 73128 | 36564 | 73128 |

### A.3.2 Fixed Reference Channels for PDSCH performance requirements (64QAM)

The parameters for the reference measurement channels are specified in table A.3.2-1 for FR1 PDSCH performance requirements.

The parameters for the reference measurement channels are specified in table A.3.2-2 for FR2 PDSCH performance requirements.

Table A.3.2-1: FRC parameters for FR1 PDSCH performance requirements, 2 transmission layers, 64QAM

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| Reference channel |  | M-FR1-A.3.2-1 |
| Channel bandwidth | MHz | 40 |
| Subcarrier spacing | kHz | 30 |
| Allocated resource blocks | PRBs | 106 |
| Number of consecutive PDSCH symbols |  | 12 |
| MCS table |  | 64QAM |
| MCS index |  | 19 |
| Modulation |  | 64QAM |
| Target Coding Rate |  | 0.51 |
| Number of MIMO layers |  | 2 |
| Number of DMRS REs |  | 12 |
| Overhead for TBS determination |  | 0 |
| Information Bit Payload per Slot |  | 83976 |
| Transport block CRC per Slot |  | 24 |
| Number of Code Blocks per Slot |  | 10 |
| Binary Channel Bits Per Slot |  | 167904 |

Table A.3.2-2: FRC parameters for FR2 PDSCH performance requirements, 1-2 transmission layers, 64QAM

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Unit | Value | |
| Reference channel |  | M-FR2-A.3.2-1 | M-FR2-A.3.2-2 |
| Channel bandwidth | MHz | 100 | 100 |
| Subcarrier spacing | kHz | 120 | 120 |
| Allocated resource blocks | PRBs | 66 | 66 |
| Number of consecutive PDSCH symbols |  | 13 | 13 |
| MCS table |  | 64QAM | 64QAM |
| MCS index |  | 18 | 17 |
| Modulation |  | 64QAM | 64QAM |
| Target Coding Rate |  | 0.46 | 0.43 |
| Number of MIMO layers |  | 1 | 2 |
| Number of DMRS REs |  | 12 | 12 |
| Overhead for TBS determination |  | 6 | 6 |
| Information Bit Payload per Slot |  | 25104 | 47112 |
| Transport block CRC per Slot |  | 24 | 24 |
| Number of Code Blocks per Slot |  | 3 | 6 |
| Binary Channel Bits Per Slot |  | 54846 | 109692 |

### A.3.3 Fixed Reference Channels for PDSCH performance requirements (256QAM)

The parameters for the reference measurement channels are specified in table A.3.3-1 for FR1 PDSCH performance requirements.

Table A.3.3-1: FRC parameters for FR1 PDSCH performance requirements, 1 transmission layer, 256QAM

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| Reference channel |  | M-FR1-A.3.3-1 |
| Channel bandwidth | MHz | 40 |
| Subcarrier spacing | kHz | 30 |
| Allocated resource blocks | PRBs | 106 |
| Number of consecutive PDSCH symbols |  | 12 |
| MCS table |  | 256QAM |
| MCS index |  | 24 |
| Modulation |  | 256QAM |
| Target Coding Rate |  | 0.82 |
| Number of MIMO layers |  | 1 |
| Number of DMRS REs |  | 12 |
| Overhead for TBS determination |  | 0 |
| Information Bit Payload per Slot |  | 92200 |
| Transport block CRC per Slot |  | 24 |
| Number of Code Blocks per Slot |  | 11 |
| Binary Channel Bits Per Slot |  | 111936 |

### A.3.4 Fixed Reference Channels for PDCCH performance requirements

The parameters for the reference measurement channels are specified in table A.3.4-1 for FR1 PDCCH performance requirements.

The parameters for the reference measurement channels are specified in table A.3.4-2 for FR2 PDCCH performance requirements.

Table A.3.4-1: FR1 PDCCH Reference Channels

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | |
| Reference channel |  | M-FR1-A.3.4-1 | M-FR1-A.3.4-2 | M-FR1-A.3.4-3 |
| Subcarrier spacing | kHz | 30 | 30 | 30 |
| CORESET frequency domain allocation |  | 102 | 102 | 90 |
| CORESET time domain allocation |  | 1 | 1 | 1 |
| Aggregation level |  | 2 | 4 | 8 |
| DCI Format |  | 1\_0 | 1\_1 | 1\_1 |
| Payload (without CRC) | Bits | 41 | 53 | 53 |

Table A.3.4-2: FR2 PDCCH Reference Channels

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | |
| Reference channel |  | M-FR2-A.3.4-1 | M-FR2-A.3.4-2 | M-FR2-A.3.4-3 |
| Subcarrier spacing | kHz | 120 | 120 | 120 |
| CORESET frequency domain allocation |  | 60 | 60 | 60 |
| CORESET time domain allocation |  | 1 | 1 | 1 |
| Aggregation level |  | 2 | 4 | 8 |
| DCI Format |  | 1\_0 | 1\_1 | 1\_1 |
| Payload (without CRC) | Bits | 40 | 56 | 56 |

### A.3.5 Fixed Reference Channels for CSI reporting performance requirements

This clause defines the DL signal applicable to the reporting of channel status information.

Tables in this clause specifies the mapping of CQI index to Information Bit payload, which complies with the CQI definition specified in clause 5.2.2.1 of TS 38.214 [11] and with MCS definition specified in clause 5.1.3 of TS 38.214 [11].

Table A.3.5-1: Fixed Reference Channels for FR1 CSI reporting with CQI table 2 and MCS table 2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Reference channel | | | | M-FR1-A.3.5-1 | M-FR1-A.3.5-2 | M-FR1-A.3.5-3 | M-FR1-A.3.5-4 |
| Number of allocated PDSCH resource blocks | | | | 106 | 106 | 106 | 106 |
| Number of consecutive PDSCH symbols | | | | 12 | 12 | 12 | 12 |
| Number of PDSCH MIMO layers | | | | 1 | 2 | 3 | 4 |
| Number of DMRS REs (Note 1) | | | | 24 | 24 | 24 | 24 |
| Overhead for TBS determination | | | | 0 | 0 | 0 | 0 |
| Available RE-s for PDSCH | | | | 12720 | 12720 | 12720 | 12720 |
| CQI index | Spectral efficiency | MCS index | Modulation | Information Bit Payload per Slot | | | |
| 0 | OOR | OOR | OOR | N/A | N/A | N/A | N/A |
| 1 | 0.1523 | 0 | QPSK | 2976 | 5896 | 8976 | 11784 |
| 2 | 0.3770 | 1 | 4744 | 9480 | 14344 | 18976 |
| 3 | 0.8770 | 3 | 11016 | 22536 | 33816 | 45096 |
| 4 | 1.4766 | 5 | 16QAM | 18960 | 37896 | 56368 | 75792 |
| 5 | 1.9141 | 7 | 24576 | 49176 | 73776 | 98376 |
| 6 | 2.4063 | 9 | 30728 | 61480 | 92200 | 122976 |
| 7 | 2.7305 | 11 | 64QAM | 34816 | 69672 | 104496 | 139376 |
| 8 | 3.3223 | 13 | 42016 | 83976 | 127080 | 167976 |
| 9 | 3.9023 | 15 | 49176 | 98376 | 147576 | 196776 |
| 10 | 4.5234 | 17 | 57376 | 114776 | 172176 | 229576 |
| 11 | 5.1152 | 19 | 65576 | 131176 | 196776 | 262376 |
| 12 | 5.5547 | 21 | 256QAM | 69672 | 139376 | 213176 | 278776 |
| 13 | 6.2266 | 23 | 79896 | 159880 | 237776 | 319784 |
| 14 | 6.9141 | 25 | 88064 | 176208 | 262376 | 352440 |
| 15 | 7.4063 | 27 | 94248 | 188576 | 278776 | 376896 |
| NOTE 1: Number of DMRS REs includes the overhead of the DM-RS CDM groups without data  NOTE 2: PDSCH is only scheduled on slots which are full DL | | | | | | | |

Table A.3.5-2: Fixed Reference Channels for FR2 CSI reporting with CQI table 1 and MCS table 1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Reference channel | | | | M-FR2-A.3.5-1 | M-FR2-A.3.5-2 |
| Number of allocated PDSCH resource blocks | | | | 66 | 66 |
| Number of consecutive PDSCH symbols | | | | 12 | 12 |
| Number of PDSCH MIMO layers | | | | 1 | 2 |
| Number of DMRS REs (Note 1) | | | | 24 | 24 |
| Overhead for TBS determination | | | | 6 | 6 |
| Available RE-s | | | | 7590 | 7590 |
| CQI index | Spectral efficiency | MCS index | Modulation | Information Bit Payload per Slot | |
| 0 | OOR | OOR | OOR | N/A | N/A |
| 1 | 0.1523 | 0 | QPSK | 1800 | 3624 |
| 2 | 0.2344 | 0 | 1800 | 3624 |
| 3 | 0.3770 | 2 | 2856 | 5640 |
| 4 | 0.6016 | 4 | 4480 | 8968 |
| 5 | 0.8770 | 6 | 6528 | 13064 |
| 6 | 1.1758 | 8 | 8712 | 17928 |
| 7 | 1.4766 | 11 | 16QAM | 11016 | 22032 |
| 8 | 1.9141 | 13 | 14343 | 28680 |
| 9 | 2.4063 | 15 | 17928 | 35856 |
| 10 | 2.7305 | 18 | 64QAM | 20496 | 40976 |
| 11 | 3.3223 | 20 | 25104 | 50184 |
| 12 | 3.9023 | 22 | 29192 | 58384 |
| 13 | 4.5234 | 24 | 33816 | 67584 |
| 14 | 5.1152 | 26 | 38936 | 77896 |
| 15 | 5.5547 | 28 | 42016 | 83976 |
| NOTE 1: Number of DMRS REs includes the overhead of the DM-RS CDM groups without data  NOTE 2: PDSCH is only scheduled on slots which are full DL | | | | | |

Table A.3.5-3: PDSCH Reference Channel for FR1 PMI reporting requirements

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Unit | Value | |
| Reference channel |  | M-FR1-A.3.5-5 | M-FR1-A.3.5-6 |
| Channel bandwidth | MHz | 40 | 40 |
| Subcarrier spacing | kHz | 30 | 30 |
| Allocated resource blocks | PRBs | 106 | 106 |
| Number of consecutive PDSCH symbols |  | 12 | 12 |
| MCS table |  | 64QAM | 64QAM |
| MCS index |  | 13 | 13 |
| Modulation |  | 16QAM | 16QAM |
| Target Coding Rate |  | 0.48 | 0.48 |
| Number of MIMO layers |  | 1 | 2 |
| Number of DMRS REs (Note 3) |  | 24 | 24 |
| Overhead for TBS determination |  | 0 | 0 |
| Information Bit Payload per Slot | Bits | 24576 | 49176 |
| For Slot i = 20 |  |  |  |
| Transport block CRC per Slot | Bits | 24 | 24 |
| Number of Code Blocks per Slot | CBs | 3 | 6 |
| Binary Channel Bits Per Slot | Bits | 50880 | 101760 |

Table A.3.5-4: PDSCH Reference Channel for FR2 PMI reporting requirements

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| Reference channel |  | M-FR2-A.3.5-3 |
| Channel bandwidth | MHz | 100 |
| Subcarrier spacing | kHz | 120 |
| Allocated resource blocks | PRBs | 66 |
| Number of consecutive PDSCH symbols |  | 12 |
| MCS table |  | 64QAM |
| MCS index |  | 13 |
| Modulation |  | 16QAM |
| Target Coding Rate |  | 0.48 |
| Number of MIMO layers |  | 1 |
| Number of DMRS REs (Note 3) |  | 24 |
| Overhead for TBS determination |  | 6 |
| Information Bit Payload per Slot |  | 14344 |
| Transport block CRC per Slot |  | 24 |
| Number of Code Blocks per Slot |  | 2 |
| Binary Channel Bits Per Slot |  | 30360 |

*<END OF THE CHANGE 4>*

*<START OF THE CHANGE 5>*

Annex G (Normative):   
Propagation conditions

Void

Annex H (informative):   
Change history

*<END OF THE CHANGE 5>*