**3GPP TSG-RAN WG4 Meeting # 99-e R4-2111396**

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**Source: Nokia, Nokia Shanghai Bell**

**Title: bigTP draft to TS 38.176-2 Demodulation performance**

**Agenda item: 6.3.6.1**

**Document for: Email Approval**

1. Introduction

In RAN4#99-e, work on the performance part of Integrated Access and Backhaul continued. The outcome of the discussions and agreements are captured in the summary [1] and WF [2] respectively.

The big CR approach is used for IAB Demod (NR\_IAB-Perf). This contribution merges the endorsed demodulation performance TPs for TS 38.176-2 into one big TP, and applies some editorial improvements agreed in the email discussions on the reflector. The following tdocs have been merged:

* R4-2108605, TP to TS 38.176-2: Demodulation manufacturer declarations, Intel Corporation.
* R4-2108594, draftTP to TS 38.176-2 IAB-DU performance requirements and parts of DU and MT appendix, Nokia, Nokia Shanghai Bell.
* R4-2108599, pCR on IAB-MT radiated conformance testing (General and Demodulation) to TS 38.176-2, Huawei, HiSilicon.
* R4-2108600, pCR to 38.176-2: Introduction of CSI-RS performance tests and requirements, Ericsson.
* R4-2108591, pCR on IAB radiated conformance testing (FRCs and PRACH test preambles) to TS 38.176-2, Huawei, HiSilicon.

It should be noted that:

* Style “H6” was used for all section titles of level 6 and below.
* A missing Clause Annex J.3 was added by the editor with empty content because it was missing but referenced from CSI-RS reporting requirements.
* Demodulation-related Declaration identifiers were kept in square brackets. Additionally, in the Declaration description we have specified whether it is “IAB-DU only:” or “IAB-MT only:”.

References

1. R4-2108684, Email discussion summary for [99-e][325] NR\_IAB\_Demod, RAN4#99-e, Nokia, Nokia Shanghai Bell.
2. R4-2108589, WF on Rel-16 NR IAB demodulation requirements, RAN4#99-e, Nokia, Nokia Shanghai Bell.
3. R4-2110944, TS 38.176-2 v.0.1.0 - update after RAN4#98bis meeting, RAN4#99-e, Nokia, Nokia Shanghai Bell.

<<Start of change for clause 4.6>>

## 4.6 Manufacturer's declarations

The following IAB manufacturer's declarations listed in table 4.6-1, when applicable to the IAB under test, are required to be provided by the manufacturer for radiated requirements testing for *IAB type 1-H,* *IAB type 1-O* and *IAB type 2-O*. Declarations may be provided independently for IAB-MT and IAB-DU. The applicability columns for different IAB-types in table 4.6-1 designate applicability for both IAB-DU and IAB-MT, unless otherwise stated.

For the *IAB type 1-H* declarations required for the conducted requirements testing, refer to TS 38.176-1 [3], clause 4.6.

**Table 4.6-1 Manufacturers declarations for *IAB type 1-H, IAB type 1-O* and *IAB type 2-O* radiated test requirements**

| **Declaration identifier** | **Declaration** | **Description** | **Applicability**  **(Note 1)** | | |
| --- | --- | --- | --- | --- | --- |
|  |  |  | ***IAB* *type 1-H***  **(Note 2)** | ***IAB type 1-O*** | ***IAB type 2-O*** |
| D.1 | Coordinate system reference point | Location of coordinated system reference point in reference to an identifiable physical feature of the IAB-MT or IAB-DU enclosure. | x | x | x |
| D.2 | Coordinate system orientation | Orientation of the coordinate system in reference to an identifiable physical feature of the IAB enclosure. | x | x | x |
| D.3 | Beam identifier | A unique title to identify a beam, e.g. a, b, c or 1, 2, 3. The vendor may declare any number of beams with unique identifiers. The minimum set to declare for conformance, corresponds to the beams at the reference beam direction with the highest intended EIRP, and covering the properties listed below:  1) A beam with the narrowest intended BeWθ and narrowest intended BeWϕ possible when narrowest intended BeWθ is used.  2) A beam with the narrowest intended BeWϕ and narrowest intended BeWθ possible when narrowest intended BeWϕ is used.  3) A beam with the widest intended BeWθ and widest intended BeWϕ possible when widest intended BeWθ is used.  4) A beam with the widest intended BeWϕ and widest intended BeWθ possible when widest intended BeWϕ is used.  5) A beam which provides the highest intended EIRP of all possible beams.  When selecting the above five beam widths for declaration, all beams that the IAB is intended to produce shall be considered, including beams that during operation may be identified by any kind of cell or UE specific reference signals, with the exception of any type of beam that is created from a group of transmitters that are not all phase synchronised.  (Note 3) | x | x | x |
| D.4 | *Operating bands* and frequency ranges | List of NR *operating band(s)* supported by the IAB-DU or IAB-MT and if applicable, frequency range(s) within the *operating band(s)* that the IAB can operate in supported bands declared for every beam (D.3).  (Note 4) | c | x | x |
| D.5 | IAB requirements set | Declaration of one of the IAB *requirement*'*s set* as defined for *IAB type 1-H*, *IAB type 1-O*, *or IAB type 2-O*. | c | x | x |
| D.6 | IAB class | Declared as Wide Area IAB-DU, Medium Range IAB-DU, or Local Area IAB-DU.  Declared as Wide Area IAB-MT, or Local Area IAB-MT. | c | x | x |
| D.7 | IAB channel band width and SCS support | IAB-DU or IAB-MT supported SCS and channel bandwidth per supported SCS. Declared for each beam (D.3) and each *operating band* (D.4). | c | x | x |
| D.8 | *OTA peak directions set* reference beam direction pair | The beam direction pair, describing the reference beam peak direction and the reference beam centre direction. Declared for every beam (D.3). | x | x | x |
| D.9 | OTA peak directions set | The OTA peak directions set for each beam. Declared for every beam (D.3). | x | x | x |
| D.10 | *OTA peak directions set* maximum steering direction(s) | The *beam direction pair(s)* corresponding to the following points:  1) The beam peak direction corresponding to the maximum steering from the reference beam centre direction in the positive Φ direction, while the θ value being the closest possible to the reference beam centre direction.  2) The beam peak direction corresponding to the maximum steering from the reference beam centre direction in the negative *Φ* direction, while the *θ value being the closest possible to the* reference beam centre direction*.*  3) The beam peak direction corresponding to the maximum steering from the reference beam centre direction in the positive *θ* direction, while the *Φ value being the closest possible to the* reference beam centre direction.  4) The beam peak direction corresponding to the maximum steering from the reference beam centre direction in the negative *θ* direction, while the *Φ value being the closest possible to the* reference beam centre direction*.*  The maximum steering direction(s) may coincide with *the reference beam centre direction*.  Declared for every beam (D.3). | x | x | x |
| D.11 | Rated beam EIRP | The rated EIRP level per carrier (Prated,c,EIRP) at the *beam peak direction* associated with a particular *beam direction pair* for each of the declared maximum steering directions (D.10), as well as the reference *beam direction pair* (D.8). Declared for every beam (D.3).  (Note 12, 14, 18) | x | x | x |
| D.12 | Beamwidth | The *beamwidth* for the reference *beam direction pair* and the four maximum steering directions. Declared for every beam (D.3). | x | x | x |
| D.13 | Equivalent beams | List of beams which are declared to be equivalent.  Equivalent beams imply that the beams are expected to have identical *OTA peak directions sets* and intended to have identical spatial properties at all steering directions within the *OTA peak directions set* when presented with identical signals. All declarations (D.4 – D.12) made for the beams are identical and the transmitter unit*,* RDN and antenna array responsible for generating the beam are of identical design. | x | x | x |
| D.14 | Parallel beams | List of beams which have been declared equivalent (D.13) and can be generated in parallel using independent RF power resources.  Independent power resources mean that the beams are transmitted from mutually exclusive transmitter units. | x | x | x |
| D.15 | Number of carriers at maximum TRP | The number of carriers per operating band the IAB is capable of generating at maximum TRP declared for every beam (D.3). | n/a | x | x |
| D.16 | Operating bands with multi-band dependencies | List of *operating bands* which are generated using transceiver units supporting operation in multiple *operating bands* through common active RF components. Declared for each *operating band* for which multi-band transceiver is used. | c | x | n/a |
| D.17 | Maximum radiated IAB RF Bandwidth | Maximum *Base Station RF Bandwidth* in the *operating band*, declared for each supported operating band (D.4).  (Note 15) | c | x | x |
| D.18 | Maximum *Radio Bandwidth* of the *operating band* with multi-band dependencies | Largest *Radio Bandwidth* that can be supported by the *operating bands* with multi-band dependencies.  Declared for each supported *operating band* which has multi-band dependencies (D.16). | c | x | n/a |
| D.19 | Total RF bandwidth (BWtot) | Total RF bandwidth BWtot of transmitter and receiver, declared per the band combinations (D.52). | c | x | x |
| D.20 | CA-only operation | Declared of CA-only (with equal power spectral density among carriers) but not multiple carriers operation, declared per *operating band* (D.4) and per beam (D.3). | c | x | x |
| D.21 | Maximum number of supported carriers per *operating band* in multi-band operations | Maximum number of supported carriers per supported *operating band* declared to have multi-band dependencies (D.16). | c | x | n/a |
| D.22 | Contiguous or non-contiguous spectrum operation support | Ability of IAB-DU or IAB-MT to support contiguous or non-contiguous (or both) frequency distribution of carriers when operating multi-carrier in an operating band. | c | x | x |
| D.23 | OSDD identifier | A unique identifier for the OSDD. | x | x | n/a |
| D.24 | OSDD operating band support | Operating band supported by the OSDD, declared for every OSDD (D.23).  (Note 5) | x | x | n/a |
| D.25 | OTA sensitivity supported IAB channel bandwidth and SCS | The IAB-DU or IAB-MTsupported SCS and channel bandwidth per supported SCS by each OSDD. | x | x | n/a |
| D.26 | Redirection of receiver target support | Ability to redirect the receiver target related to the OSDD. | x | x | n/a |
| D.27 | Minimum EIS for FR1 (EISminSENS) | The minimum EISminSENS requirement (i.e. maximum allowable EIS value) applicable to all sensitivity RoAoA per OSDD.  Declared per NR supported channel BW for the OSDD (D.30).  The lowest EIS value for all the declared OSDD's is called minSENS, while its related range of angles of arrival is called *minSENS RoAoA*.  (Note 6) | x | x | n/a |
| D.28 | EIS REFSENS for FR2 (EISREFSENS\_50M) | The EISREFSENS\_50M level applicable in the OTA REFSENS RoAoA, (used as a basis for the derivation of the FR2 EISREFSENS for other channel bandwidths supported by IAB).(Note 7) | n/a | n/a | x |
| D.29 | Receiver target reference direction Sensitivity Range of Angle of Arrival | The sensitivity RoAoA associated with the receiver target reference direction (D.31) for each OSDD. | x | x | n/a |
| D.30 | Receiver target redirection range | For each OSDD the associated union of all the sensitivity RoAoA achievable through redirecting the receiver target related to the OSDD.  (Note 8) | x | x | n/a |
| D.31 | Receiver target reference direction | For each OSDD an associated direction inside the receiver target redirection range (D.30).  (Note 9) | x | x | n/a |
| D.32 | Conformance test directions sensitivity RoAoA | For each OSDD that includes a receiver target redirection range, four sensitivity RoAoA comprising the conformance test directions (D.33). | x | x | n/a |
| D.33 | Conformance test directions | For each OSDD four conformance test directions.  If the OSDD includes a receiver target redirection range the following four directions shall be declared:  1) The direction determined by the maximum φ value achievable inside the receiver target redirection range, while θ value being the closest possible to the receiver target reference direction.  2) The direction determined by the minimum φ value achievable inside the receiver target redirection range, while θ value being the closest possible to the receiver target reference direction.  3) The direction determined by the maximum θ value achievable inside the receiver target redirection range, while φ value being the closest possible to the receiver target reference direction.  4) The direction determined by the minimum θ value achievable inside the receiver target redirection range, while φ value being the closest possible to the receiver target reference direction.  If an OSDD does not include a receiver target redirection range the following 4 directions shall be declared:  1) The direction determined by the maximum φ value achievable inside the sensitivity RoAoA, while θ value being the closest possible to the receiver target reference direction.  2) The direction determined by the minimum φ value achievable inside the sensitivity RoAoA, while θ value being the closest possible to the receiver target reference direction.  3) The direction determined by the maximum θ value achievable inside the sensitivity RoAoA, while φ value being the closest possible to the receiver target reference direction.  4) The direction determined by the minimum θ value achievable inside the sensitivity RoAoA, while φ value being the closest possible to the receiver target reference direction. | x | x | n/a |
| D.34 | OTA coverage range | Declared as a single range of directions within which selected TX OTA requirements are intended to be met.  (Note 10) | x | x | x |
| D.35 | *OTA coverage range* reference direction | The direction describing the reference direction of the *OTA converge range* (D.34).  (Note 11) | x | x | x |
| D.36 | OTA coverage range maximum directions | The directions corresponding to the following points:  1) The direction determined by the maximum φ value achievable inside the *OTA coverage range*, while θ value being the closest possible to the *OTA coverage range* reference direction.  2) The direction determined by the minimum φ value achievable inside the *OTA coverage range*, while θ value being the closest possible to the *OTA coverage range* reference direction.  3) The direction determined by the maximum θ value achievable inside the *OTA coverage range*, while φ value being the closest possible to the *OTA coverage range* reference direction.  4) The direction determined by the minimum θ value achievable inside the OTA coverage range, while φ value being the closest possible to the OTA coverage range reference direction. | x | x | x |
| D.37 | The rated carrier OTA IAB power, Prated,c,TRP | Prated,c,TRP is declared as TRP OTA power per carrier, declared per supported operating band.  (Note 12, 14, 18) | n/a | x | x |
| D.38 | Rated transmitter TRP, Prated,t,TRP | Rated total radiated output power*.*  Declared per supported *operating band*.  (Note 12,14, 18) | n/a | x | x |
| D.39 | CLTA placement for co-location test | The manufacturer shall declare the side of EUT where radiating elements are placed closest to the edge of EUT when applicable. The CLTA shall be placed at the EUT side where radiating elements are placed closest. | n/a | x | n/a |
| D.40 | Spurious emission category | Declare the IAB-DU or IAB-MTspurious emission category as either category A or B with respect to the limits for spurious emissions, as defined in Recommendation ITU-R SM.329 [5]. | c | x | x |
| D.41 | Additional operating band unwanted emissions | The manufacturer shall declare whether the IAB under test is intended to operate in geographic areas where the additional operating band unwanted emission limits defined in clause 6.7.4 apply. | c | x | x |
| D.42 | Co-existence with other systems | The manufacturer shall declare whether the IAB under test is intended to operate in geographic areas where one or more of the systems GSM850, GSM900, DCS1800, PCS1900, UTRA FDD, UTRA TDD, E-UTRA and/or PHS operating in another operating band are deployed. | c | x | x |
| D.43 | Co-location with other base stations | The manufacturer shall declare whether the IAB under test is intended to operate co-located with Base Stations of one or more of the systems GSM850, GSM900, DCS1800, PCS1900, UTRA FDD, UTRA TDD and/or E-UTRA operating in another operating band. | c | x | n/a |
| D.44 | Single-band RIB or multi-band RIB | List of single-band RIB and/or multi-band RIB for the supported operating bands (D.4). | c | x | n/a |
| D.45 | Single or multiple carrier | IAB capability to operate with a single carrier (only) or multiple carriers. Declared per supported operating band, per RIB.  (Note 17) | c | x | x |
| D.46 | Maximum number of supported carriers per *operating band* | Maximum number of supported carriers. Declared per supported operating band, per RIB.  (Note 15) | c | x | x |
| D.47 | Total maximum number of supported carriers | Maximum number of supported carriers for all supported operating bands. Declared per RIB. | c | x | x |
| D.48 | Other band combination multi-band restrictions | Declare any other limitation under simultaneous operation in the declared band combinations (D.16), which have any impact on the test configuration generation. | c | x | n/a |
| D.49 | Ncells | Number corresponding to the minimum number of cells that can be transmitted by an IAB-DU or IAB-MT in a particular *operating band*. Declared per *operating band* (D.4). | c | n/a | n/a |
| D.50 | Maximum supported power difference between carriers | Maximum supported power difference between carriers in each supported *operating band*. Declared per *operating band* (D.4). | c | x | x |
| D.51 | Maximum supported power difference between carriers is different *operating bands* | Maximum supported power difference between any two carriers in any two different supported *operating bands*. Declared per operating bands combination (D.52). (Note 19) | c | x | n/a |
| D.52 | Operating band combination support | List of *operating bands* combinations supported by *single-band RIB(s)* and/or *multi-band RIB(s)* of the IAB-DU or IAB-MT. | c | x | n/a |
| D.53 | OTA REFSENS RoAoA | Range of angles of arrival associated with the OTA REFSENS. | n/a | x | x |
| D.54 | OTA REFSENS receiver target reference direction | Reference direction inside the OTA REFSENS RoAoA (D.53). | n/a | x | x |
| D.55 | OTA REFSENS conformance test directions | The following four OTA REFSENS conformance test directions shall be declared:  1) The direction determined by the maximum φ value achievable inside the OTA REFSENS RoAoA, while θ value being the closest possible to the OTA REFSENS receiver target reference direction.  2) The direction determined by the minimum φ value achievable inside the OTA REFSENS RoAoA, while θ value being the closest possible to the OTA REFSENS receiver target reference direction.  3) The direction determined by the maximum θ value achievable inside the OTA REFSENS RoAoA, while φ value being the closest possible to the OTA REFSENS receiver target reference direction.  4) The direction determined by the minimum θ value achievable inside the OTA REFSENS RoAoA, while φ value being the closest possible to the OTA REFSENS receiver target reference direction. | n/a | x | x |
| D.56 | Supported frequency range of the NR *operating band* | List of supported frequency ranges representing *fractional bandwidths* (FBW) of *operating bands* with FBW larger than 6%. | x | x | x |
| D.57 | Rated beam EIRP at lower end of the *fractional bandwidth* (Prated,c,FBWlow) | The rated EIRP level per carrier at lower frequency range of the *fractional bandwidth* (Prated,c,FBWlow), at the *beam peak direction* associated with a particular *beam direction pair* for each of the declared maximum steering directions (D.10), as well as the reference *beam direction pair* (D.8).  Declared per beam for all supported frequency ranges (D.56).  (Note 12, 13, 14, 15, 18) | x | x | x |
| D.58 | Rated beam EIRP at higher frequency range of the *fractional bandwidth* (Prated,c,FBWhigh) | The rated EIRP level per carrier at higher frequency range of the *fractional bandwidth* (Prated,c,FBWhigh), at the *beam peak direction* associated with a particular *beam direction pair* for each of the declared maximum steering directions (D.10), as well as the reference *beam direction pair* (D.8).  Declared per beam for all supported frequency ranges in (D.56).  (Note 12, 13, 14 ,15, 18) | x | x | x |
| D.59 | Relation between supported maximum RF bandwidth, number of carriers and Rated maximum TRP | If the rated transmitter TRP and total number of supported carriers are not simultaneously supported, the manufacturer shall declare the following additional parameters:  - The reduced number of supported carriers at the rated transmitter TRP;  - The reduced total output power at the maximum number of supported carriers. | n/a | x | x |
| D.60 | Inter-band CA | Declaration of operating band(s) combinations supporting inter‑band CA. Declared per operating band combination (D.52). | c | x | x |
| D.61 | Intra-band contiguous CA | Declaration of operating band(s) supporting intra-band contiguous CA. Declared per *operating band* with CA support. | c | x | x |
| D.62 | Intra-band non-contiguous CA | Declaration of operating band(s) supporting intra-band non‑contiguous CA. Declared per operating band with CA support. | c | x | x |
| D.63 | Total maximum number of supported carriers in multi-band operation | Maximum number of supported carriers for all supported *operating bands* declared to have multi-band dependencies (D.16)*.* | c | x | n/a |
| D.IAB-1 | Same RF implementation | Declaration whether IAB-MT and IAB-DU have the same RF implementation. | c | x | x |
| D.IAB-2 | IAB-MT test model PT-RS configuration | Declaration of PT-RS configuration in IAB-MT test model: without PT-RS, with PT-RS or both. |  |  | x |
| [D.100] | PUSCH mapping type | IAB-DU only: Declaration of the supported PUSCH mapping type for FR1 as specified in [x], i.e., type A, type B or both. | c | x | n/a |
| [D.101] | PUSCH additional DM-RS positions | IAB-DU only: Declaration of the supported additional DM-RS position(s) for FR2, i.e., pos0, pos1, or both. | n/a | n/a | x |
| [D.102] | PUCCH format | IAB-DU only: Declaration of the supported PUCCH format(s) as specified in [x], i.e., format 0, format 1, format 2, format 3, format 4. | c | x | x |
| [D.103] | PRACH format and SCS | IAB-DU only: Declaration of the supported PRACH format(s) as specified in [x], i.e., format: 0, A1, A2, A3, B4, C0, C2.  Declaration of the supported SCS(s) per supported PRACH format with short sequence, as specified in [x], i.e.:  - For IAB type 1-O: 15 kHz, 30 kHz or both.  - For IAB type 1-O: 60 kHz, 120 kHz or both. | c | x | x |
| [D.104] | Additional DM-RS for PUCCH format 3 | IAB-DU only: Declaration of the supported additional DM-RS for PUCCH format 3: without additional DM-RS, with additional DM-RS or both. | c | x | x |
| [D.105] | Additional DM-RS for PUCCH format 4 | IAB-DU only: Declaration of the supported additional DM-RS for PUCCH format 4: without additional DM-RS, with additional DM-RS or both. | c | x | x |
| [D.106] | PUSCH PT-RS | IAB-DU only: Declaration of PT-RS in PUSCH support: without PT-RS, with PT-RS or both. | n/a | n/a | x |
| [D.107] | PUCCH multi-slot | Declaration of multi-slot PUCCH support. | c | x | n/a |
| [D.108] | UL CA | IAB-DU only: For the highest supported SCS, declaration of the carrier combination with the largest aggregated bandwidth. If there is more than one combination, the carrier combination with the largest number of carriers shall be declared. | c | x | x |
| [D.109] | Modulation order | IAB-DU only: Declaration of the supported modulation orders:  QPSK, 16QAM, 64QAM | TBA | TBA | TBA |
| [D.110] | Transform precoding | IAB-DU only: Declaration on the supporting of transform precoding | TBA | TBA | TBA |
| [D.200] | 256QAM | IAB-MT only: Declaration on the supporting of 256QAM modulation order | TBA | TBA | TBA |
| [D.201] | Testing of PMI reporting | IAB-MT only: Declaration on the testing of PMI reporting, i.e. tested or not tested. |  |  |  |
| [D.202] | Testing of RI reporting | IAB-MT only: Declaration on the testing of RI reporting, i.e. tested or not tested. |  |  |  |
| NOTE 1: Manufacturer declarations applicable per IAB *requirement set* were marked as "x". Manufacturer declarations not applicable per IAB *requirement set* were marked as "n/a".  NOTE 2: For *IAB type 1-H*, the only radiated declarations are related to EIRP and EIS requirements. For *IAB type 1-H* declarations required for the conducted requirements testing, refer to TS 38.176-1 [3]. For declarations marked as 'c', related conducted declarations in TS 38.176-1 [3] apply. When separately declared, they shall still use the same declaration identifier.  NOTE 3: Depending on the capability of the system some of these beams may be the same. For those same beams, testing is not repeated.  NOTE 4: These *operating bands* are related to their respective single‑band RIBs.  NOTE 5: As each identified OSDD has a declared minimum EIS value (D.27), multiple operating band can only be declared if they have the same minimum EIS declaration.  NOTE 6: If the *IAB type 1-H* or *IAB type 1-O* is not capable of redirecting the receiver target related to the OSDD then there is only one RoAoA applicable to the OSDD.  NOTE 7: Although EISREFSENS\_50M level is based on a reference measurement channel with BWChannel = 50 MHz, it does not imply that IAB-DU or IAB-MT has to support 50 MHz channel bandwidth.  NOTE 8: Not applicable for *IAB type 2-O*.  NOTE 9: For an OSDD without receiver target redirection range, this is a direction inside the sensitivity RoAoA.  NOTE 10: *OTA coverage range* is used for conformance testing of such TX OTA requirements as occupied bandwidth, frequency error, TAE or EVM.  NOTE 11: The *OTA coverage reference* direction may be the same as the Reference beam direction pair (D.8) but does not have to be.  NOTE 12: If an *IAB type 2-O* is capable of 64QAM DL operation but not capable of 256QAM DL operation, then up to two rated output power declarations may be made. One declaration is applicable when configured for 64QAM transmissions and the other declaration is applicable when not configured for 64QAM transmissions.  NOTE 13: If D.57 and D.58 are declared for certain frequency range (D.56), there shall be no "Rated beam EIRP" declaration (D.11) for the *operating band* containing that particular frequency range.  NOTE 14: If an *IAB type 1-H* or *IAB type 1-O* is capable of 256QAM DL operation then two rated output power declarations may be made. One declaration is applicable when configured for 256QAM transmissions and the other declaration is applicable when not configured for 256QAM transmissions.  NOTE 15: Parameters for contiguous or non-contiguous spectrum operation in the operating band are assumed to be the same unless they are separately declared.  NOTE 16: void  NOTE 17: In case of IAB *type 1-H*, this declaration applies per *TAB connector*.  NOTE 18: If a *IAB type 2-O* is capable of 256QAM DL operation, then up to three rated output power declarations may be made. One declaration is applicable when configured for 256QAM transmissions, a different declaration is applicable when configured for 64QAM transmissions and the other declaration is applicable when not configured neither for 256QAM nor 64QAM transmissions.  NOTE 19: The power difference is declared at highest rated output power. | | | | | |

<<End of change for clause 4.6>>

<<Start of change for clause 8>>

# 8 Radiated performance requirements

## 8.1 IAB-DU performance requirements

### 8.1.1 General

#### 8.1.1.1 Scope and definitions

Radiated performance requirements specify the ability of the *IAB type 1-O* or *IAB 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 BS are specified for the fixed reference channels and propagation conditions defined in TS 38.174 [x] annex A and annex G, respectively. The requirements only apply to those FRCs that are supported by the IAB-DU.

The radiated performance requirements for *IAB type 1-O* and for the *IAB type 2-O* are limited to two OTA *demodulations branches* as described in clause 8.1.1.2. 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: 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.

The method of synchronization with the TE is left to implementation. Neither the use of downlink signal configuration nor the use of proprietary means is precluded. In tests performed with signal generators a synchronization signal may be provided between the IAB-DU and the signal generator, or a common (e.g., GNSS) source may be provided to both IAB node and the signal generator, to enable correct timing of the wanted signal.

The 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.

#### 8.1.1.2 OTA demodulation branches

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

If the *IAB type 1-O*, or the *IAB 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 type 1-O*, or the *IAB 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).

#### 8.1.1.3 Applicability rule

##### 8.1.1.3.1 General

Unless otherwise stated, for a IAB-DU declared to support more than 2 demodulation branches (for *IAB type 1-O* and *IAB type 2-O*), the performance requirement tests for 2 demodulation branches shall apply, and the mapping between connectors and demodulation branches is up to BS implementation.

The tests requiring more than [20] dB SNR level are set to N/A in the test requirements.

##### 8.1.1.3.2 Applicability of PUSCH performance requirements

8.1.1.3.2.1 Applicability of requirements for different subcarrier spacings

Unless otherwise stated, PUSCH requirement tests shall apply only for each subcarrier spacing declared to be supported (see D.7 in table 4.6-1).

Unless otherwise stated, if IAB-DU supports more than one SCS then PUSCH requirement tests with highest modulation order shall apply only with lowest supported SCS and PUSCH requirement tests with other modulation orders shall apply only with highest supported SCS. Otherwise all modulation orders are tested on supported SCS.

8.1.1.3.2.2 Applicability of requirements for different channel bandwidths

For each subcarrier spacing declared to be supported, the test requirements for a specific channel bandwidth shall apply only if the IAB-DU supports it (see D.7 in table 4.6-1).

Unless otherwise stated, for each subcarrier spacing declared to be supported, the tests shall be done only for the widest supported channel bandwidth. If performance requirement is not specified for this widest supported channel bandwidth, the tests shall be done by using performance requirement for the closest channel bandwidth lower than this widest supported bandwidth; the tested PRBs shall then be centered in this widest supported channel bandwidth.

8.1.1.3.2.3 Applicability of requirements for different configurations

Unless otherwise stated, for *IAB type 1-O*, PUSCH requirement tests shall apply only for the mapping type declared to be supported (see [D.100] in table 4.6-1). If both mapping type A and type B are declared to be supported, the tests shall be done for either type A or type B; the same chosen mapping type shall then be used for all tests.

Unless otherwise stated, for *IAB type 2-O*, PUSCH requirement tests shall apply only for the additional DM-RS position declared to be supported (see [D.101] in table 4.6-1). If both options (i.e., pos0 and pos1) are declared to be supported, the tests shall be done for pos1.

Unless otherwise stated, for *IAB type 2-O*, PUSCH requirement tests with transform precoding disabled shall apply for the PT-RS option declared to be supported (see [D.106] in table 4.6-1). If both PT-RS options (without and with PT-RS) are declared to be supported, the tests shall be done for either without or with PT-RS only; the same chosen option shall then be used for all tests.

Unless otherwise stated, for *IAB type 2-O*, PUSCH requirement tests with transform precoding enabled shall be done for without PT-RS.

8.1.1.3.2.4 Applicability of requirements for uplink carrier aggregation

The tests for uplink carrier aggregation shall be carried out according to the declaration (see [D.108] in table 4.6-1).

Unless otherwise stated, the tests for uplink carrier aggregation shall apply only for PUSCH with transform precoding disabled, and shall be conducted on per component carrier basis.

8.1.1.3.2.5 Applicability of requirements for TDD with different UL-DL patterns

Unless otherwise stated, for each subcarrier spacing declared to be supported, if IAB-DU supports multiple TDD UL-DL patterns, only one of the supported TDD UL-DL patterns shall be used for all tests.

8.1.1.3.2.6 Applicability of requirements for transform precoding

Unless otherwise stated, the tests with transform precoding enabled shall apply only, if the IAB-DU supports it (see [D.110] in table 4.6-1).

##### 8.1.1.3.3 Applicability of PUCCH performance requirements

8.1.1.3.3.1 Applicability of requirements for different formats

Unless otherwise stated, PUCCH requirement tests shall apply only for each PUCCH format declared to be supported (see [D.102] in table 4.6-1).

8.1.1.3.3.2 Applicability of requirements for different subcarrier spacings

Unless otherwise stated, PUCCH requirement tests shall apply only for each subcarrier spacing declared to be supported (see D.7 in table 4.6-1).

8.1.1.3.3.3 Applicability of requirements for different channel bandwidths

For each subcarrier spacing declared to be supported by the IAB-DU, the test requirements for a specific channel bandwidth shall apply only if the IAB-DU supports it (see D.7 in table 4.6-1).

Unless otherwise stated, for each subcarrier spacing declared to be supported, the tests shall be done only for the widest supported channel bandwidth. If performance requirement is not specified for this widest supported channel bandwidth, the tests shall be done by using performance requirement for the closest channel bandwidth lower than this widest supported bandwidth; the tested PRBs shall then be centered in this widest supported channel bandwidth.

8.1.1.3.3.4 Applicability of requirements for different configurations

Unless otherwise stated, PUCCH format 3 requirement tests shall apply only for the additional DM-RS configuration declared to be supported (see [D.104] in table 4.6-1). If both options (without and with additional DM-RS) are declared to be supported, the tests shall be done for either without or with additional DM-RS; the same chosen option shall then be used for all tests.

Unless otherwise stated, PUCCH format 4 requirement tests shall apply only for the additional DM-RS configuration declared to be supported (see [D.105] in table 4.6-1). If both options (without and with additional DM-RS) are declared to be supported, the tests shall be done for either without or with additional DM-RS; the same chosen option shall then be used for all tests.

8.1.1.3.3.5 Applicability of requirements for multi-slot PUCCH

Unless otherwise stated, multi-slot PUCCH requirement tests shall apply only if the IAB-DU supports it (see [D.107] in table 4.6-1).

##### 8.1.1.3.4 Applicability of PRACH performance requirements

8.1.1.3.4.1 Applicability of requirements for different formats

For IAB-DU declares to support more than one PRACH formats, limit the number of tests to any two cases chosen by the manufacturer. If IAB-DU declares to support more than one PRACH formats where formats for both long and short PRACH sequences are presented, require choosing formats with different sequences (see [D.103] in table 4.6-1).

8.1.1.3.4.2 Applicability of requirements for different subcarrier spacings

Unless otherwise stated, for each PRACH format with short sequence declared to be supported, for each FR, the tests shall apply only for the smallest supported subcarrier spacing in the FR (see [D.103] in table 4.6-1).

8.1.1.3.4.3 Applicability of requirements for different channel bandwidths

Unless otherwise stated, for the subcarrier spacing to be tested, the test requirements shall apply only for anyone channel bandwidth declared to be supported (see D.7 in table 4.6-1).

### 8.1.2 Performance requirements for PUSCH

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

##### 8.1.2.1.1 Definition and applicability

The performance requirement of PUSCH is determined by a minimum required throughput for a given SNR. The required throughput is expressed as a fraction of maximum throughput for the FRCs listed in annex A. The performance requirements assume HARQ re-transmissions.

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

##### 8.1.2.1.2 Minimum Requirement

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

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

##### 8.1.2.1.3 Test purpose

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

##### 8.1.2.1.4 Method of test

8.1.2.1.4.1 Initial conditions

Test environment: Normal, see annex B.2.

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

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

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

8.1.2.1.4.2 Procedure

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

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

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

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

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

Table 8.1.2.1.4.2-1: Test parameters for testing PUSCH

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

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

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

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

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

|  |  |  |  |
| --- | --- | --- | --- |
| IAB-DU type | Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| IAB type 1-O | 15 | 5 | -86.5 - ΔOTAREFSENS dBm / 4.5 MHz |
|  |  | 10 | -83.3 - ΔOTAREFSENS dBm / 9.36 MHz |
|  |  | 20 | -80.2 - ΔOTAREFSENS dBm / 19.08 MHz |
|  | 30 | 10 | -83.6 - ΔOTAREFSENS dBm / 8.64 MHz |
|  |  | 20 | -80.4 - ΔOTAREFSENS dBm / 18.36 MHz |
|  |  | 40 | -77.2 - ΔOTAREFSENS dBm / 38.16 MHz |
|  |  | 100 | -73.1 - ΔOTAREFSENS dBm / 98.28 MHz |
| IAB type 2-O | 60 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 47.52 MHz |
|  |  | 100 | EISREFSENS\_50M + ΔFR2\_REFSENS + 18 dBm / 95.04 MHz |
|  | 120 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 46.08 MHz |
|  |  | 100 | EISREFSENS\_50M + ΔFR2\_REFSENS + 18 dBm / 95.04 MHz |
|  |  | 200 | EISREFSENS\_50M + ΔFR2\_REFSENS + 21 dBm / 190.08 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.53 in table 4.6-1 and clause 7.1.  NOTE 2: ΔFR2\_REFSENS = -3 dB as described in clause 7.1, since the OTA REFSENS reference direction (as declared in D.54 in table 4.6-1) is used for testing.  NOTE 3: EISREFSENS\_50M as declared in D.28 in table 4.6-1. | | | |

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

##### 8.1.2.1.5 Test Requirement

8.1.2.1.5.1 Test requirement for IAB type 1-O

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

Table 8.1.2.1.5.1-1: Test requirements for PUSCH with 70% of maximum throughput, Type A, 5 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (annex J) | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-1 | pos1 | -1.7 |
|  |  | TDLC300-100 Low | D-FR1-A.2.3-1 | pos1 | 10.7 |
|  |  | TDLA30-10 Low | D-FR1-A.2.4-1 | pos1 | 12.9 |
| 2 | 2 | TDLB100-400 Low | D-FR1-A.2.1-8 | pos1 | 1.8 |
|  |  | TDLC300-100 Low | D-FR1-A.2.3-8 | pos1 | 19.0 |

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

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

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

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

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

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

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

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

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

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

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

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

Table 8.1.2.1.5.1-8: Test requirements for PUSCH with 70% of maximum throughput, Type B, 5 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (annex J) | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | TDLB100-400 Low | D-FR1-A.2.1-1 | pos1 | -1.7 |
|  |  | TDLC300-100 Low | D-FR1-A.2.3-1 | pos1 | 10.8 |
|  |  | TDLA30-10 Low | D-FR1-A.2.4-1 | pos1 | 13.1 |
| 2 | 2 | TDLB100-400 Low | D-FR1-A.2.1-8 | pos1 | 2.3 |
|  |  | TDLC300-100 Low | D-FR1-A.2.3-8 | pos1 | 19.1 |

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

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

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

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

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

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

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

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

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

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

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

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

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

8.1.2.1.5.2 Test requirement for IAB type 2-O

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

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

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

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

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

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

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

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

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

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

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

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

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

##### 8.1.2.2.1 Definition and applicability

The performance requirement of PUSCH is determined by a minimum required throughput for a given SNR. The required throughput is expressed as a fraction of maximum throughput for the FRCs listed in annex A. The performance requirements assume HARQ re-transmissions.

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

##### 8.1.2.2.2 Minimum Requirement

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

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

##### 8.1.2.2.3 Test Purpose

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

##### 8.1.2.2.4 Method of test

8.1.2.2.4.1 Initial Conditions

Test environment: Normal, see clause B.2.

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

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

8.1.2.2.4.2 Procedure

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

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

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

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

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

Table 8.1.2.2.4.2-1: Test parameters for testing PUSCH

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

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

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

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

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

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

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

##### 8.1.2.2.5 Test Requirement

8.1.2.2.5.1 Test requirement for IAB type 1-O

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

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

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

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

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

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

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

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

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

8.1.2.2.5.2 Test requirement for IAB type 2-O

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

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

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

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

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

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

##### 8.1.2.3.1 Definition and applicability

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

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

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

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

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

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

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

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

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

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

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

##### 8.1.2.3.2 Minimum Requirement

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

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

##### 8.1.2.3.3 Test Purpose

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

##### 8.1.2.3.4 Method of test

8.1.2.3.4.1 Initial Conditions

Test environment: Normal; see annex B.2.

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

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

8.1.2.3.4.2 Procedure

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

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

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

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

5) The characteristics of the wanted signal shall be configured to the corresponding UL reference measurement channel defined in annex A, and according to additional test parameters listed in table 8.1.2.3.4.2-1. The UCI information bit payload per slot is equal to 7bits with CSI part 1 5bits, CSI part 2 2bits, and the UCI information bit payload per slot is equal to 40 bits with CSI part 1 20bits, CSI part 2 20 bits.

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

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

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

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

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

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

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

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

##### 8.1.2.3.5 Test Requirement

8.1.2.3.5.1 Test requirement for IAB type 1-O

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

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

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

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

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

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

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

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

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

8.1.2.3.5.2 Test requirement for IAB type 2-O

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

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

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

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

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

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

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

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

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

### 8.1.3 Performance requirements for PUСCH

#### 8.1.3.1 Performance requirements for PUCCH format 0

##### 8.1.3.1.1 Definition and applicability

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

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

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

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

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

##### 8.1.3.1.2 Minimum Requirement

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

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

##### 8.1.3.1.3 Test Purpose

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

##### 8.1.3.1.4 Method of test

8.1.3.1.4.1 Initial Conditions

Test environment: Normal, see annex B.2.

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

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

8.1.3.1.4.2 Procedure

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

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

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

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

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

Table 8.1.3.1.4.2-1: Test parameters

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

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

7) Adjust the test signal mean power so the calibrated radiated SNR value at the IAB-DU receiver is as specified in clause 8.1.3.1.5.1 and 8.1.3.1.5.2 for *IAB type 1-O* and *IAB type 2-O* respectively, and that the SNR at the IAB-DU receiver is not impacted by the noise floor.

The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level quoted in table 8.1.3.1.4.2-2.

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

|  |  |  |  |
| --- | --- | --- | --- |
| IAB-DU type | Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| IAB type 1-O | 15 | 5 | -83.5 - ΔOTAREFSENS dBm / 4.5 MHz |
|  |  | 10 | -80.3 - ΔOTAREFSENS dBm / 9.36 MHz |
|  |  | 20 | -77.2 - ΔOTAREFSENS dBm / 19.08 MHz |
|  | 30 | 10 | -80.6 - ΔOTAREFSENS dBm / 8.64 MHz |
|  |  | 20 | -77.4 - ΔOTAREFSENS dBm / 18.36 MHz |
|  |  | 40 | -74.2 - ΔOTAREFSENS dBm / 38.16 MHz |
|  |  | 100 | -70.1 - ΔOTAREFSENS dBm / 98.28 MHz |
| IAB type 2-O | 60 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 47.52 MHz |
|  |  | 100 | EISREFSENS\_50M + ΔFR2\_REFSENS + 18 dBm / 95.04 MHz |
|  | 120 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 46.08 MHz |
|  |  | 100 | EISREFSENS\_50M + ΔFR2\_REFSENS + 18 dBm / 95.04 MHz |
|  |  | 200 | EISREFSENS\_50M + ΔFR2\_REFSENS + 21 dBm / 190.08 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.53 in table 4.6-1 and clause 7.1.  NOTE 2: ΔFR2\_REFSENS = -3 dB as described in clause 7.1 since the OTA REFSENS reference direction (as declared in D.54 in table 4.6-1) is used for testing.  NOTE 3: EISREFSENS\_50M as declared in D.28 in table 4.6-1. | | | |

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



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

##### 8.1.3.1.5 Test Requirement

8.1.3.1.5.1 Test requirement for IAB type 1-O

The fraction of falsely detected ACKs shall be less than 1% and the fraction of correctly detected ACKs shall be larger than 99% for the SNR listed in table 8.1.3.1.5.1-1 and in table 8.1.3.1.5.1-2.

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

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Number | Number of | Propagation conditions and | Number of | Channel bandwidth / SNR (dB) | | |
| of TX antennas | demodulation branches | correlation matrix (annex J) | OFDM symbols | 5 MHz | 10 MHz | 20 MHz |
| 1 | 2 | TDLC300-100 Low | 1 | 10.0 | 9.4 | 9.9 |
|  |  |  | 2 | 3.4 | 4.3 | 3.9 |

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

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

8.1.3.1.5.2 Test requirement for IAB type 2-O

The fraction of falsely detected ACKs shall be less than 1% and the fraction of correctly detected ACKs shall be larger than 99% for the SNR listed in table 8.1.3.1.5.2-1 and in table 8.1.3.1.5.2-2.

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

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

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

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

#### 8.1.3.2 Performance requirements for PUCCH format 1

##### 8.1.3.2.1 NACK to ACK detection

8.1.3.2.1.1 Definition and applicability

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

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

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

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

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

8.1.3.2.1.2 Minimum Requirement

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

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

8.1.3.2.1.3 Test Purpose

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

8.1.3.2.1.4 Method of test

8.1.3.2.1.4.1 Initial Conditions

Test environment: Normal; see annex B.2.

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

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

8.1.3.2.1.4.2 Procedure

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

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

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

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

5) The characteristics of the wanted signal shall be configured according to TS 38.211 [x], and according to additional test parameters listed in table 8.1.3.2.1.4.2-1.

Table 8.1.3.2.1.4.2-1: Test parameters

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

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

7) Adjust the test signal mean power so the calibrated radiated SNR value at the IAB-DU receiver is as specified in clause 8.1.3.2.1.5.1 and 8.1.3.2.1.5.2 for IAB type 1-O and IAB type 2-O respectively, and that the SNR at the IAB-DU receiver is not impacted by the noise floor.

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

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

|  |  |  |  |
| --- | --- | --- | --- |
| IAB type | Subcarrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| IAB type 1-O | 15 kHz | 5 | -83.5 - ΔOTAREFSENS dBm / 4.5 MHz |
|  |  | 10 | -80.3 – ΔOTAREFSENS dBm / 9.36 MHz |
|  |  | 20 | -77.2 – ΔOTAREFSENS dBm / 19.08 MHz |
|  | 30 kHz | 10 | -80.6 – ΔOTAREFSENS dBm / 8.64 MHz |
|  |  | 20 | -77.4 – ΔOTAREFSENS dBm / 18.36 MHz |
|  |  | 40 | -74.2 – ΔOTAREFSENS dBm / 38.16 MHz |
|  |  | 100 | -70.1 – ΔOTAREFSENS dBm / 98.28 MHz |
| IAB type 2-O | 60 kHz | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 47.52 MHz |
|  |  | 100 | EISREFSENS\_50M + ΔFR2\_REFSENS + 18 dBm / 95.04 MHz |
|  |  | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 46.08 MHz |
|  |  | 100 | EISREFSENS\_50M + ΔFR2\_REFSENS + 18 dBm / 95.04 MHz |
|  |  | 200 | EISREFSENS\_50M + ΔFR2\_REFSENS + 21 dBm / 190.08 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.53 in table 4.6-1 and clause 7.1.  NOTE 2: ΔFR2\_REFSENS = -3 dB as described in clause 7.1, since the OTA REFSENS reference direction (as declared in D.54 in table 4.6-1) is used for testing.  NOTE 3: EISREFSENS\_50M as declared in D.28 in table 4.6-1. | | | |

8) The signal generator sends random codeword from applicable codebook, in regular time periods. The following statistics are kept: the number of ACK bits detected in the idle periods and the number of NACK bits detected as ACK.

8.1.3.2.1.5 Test Requirement

8.1.3.2.1.5.1 Test requirement for IAB type 1-O

The fraction of falsely detected ACK bits shall be less than 1 % and the fraction of NACK bits falsely detected as ACK shall be less than 0.1 % for the SNR listed in tables 8.1.3.2.1.5.1-1 and table 8.1.3.2.1.5.1-2.

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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of TX | Number of Demodulation | Propagation conditions and | Channel bandwidth / SNR (dB) | | |
| antennas | Branches | correlation matrix (annex J) | 5 MHz | 10 MHz | 20 MHz |
| 1 | 2 | TDLC300-100 Low | -3.2 | -3.0 | -3.0 |

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

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

8.1.3.2.1.5.2 Test requirement for IAB type 2-O

The fraction of falsely detected ACK bits shall be less than 1 % and the fraction of NACK bits falsely detected as ACK shall be less than 0.1 % for the SNR listed in tables 8.1.3.2.1.5.2-1 and table 8.1.3.2.1.5.2-2.

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

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

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

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

##### 8.1.3.2.2 ACK missed detection

8.1.3.2.2.1 Definition and applicability

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

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

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

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

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

8.1.3.2.2.2 Minimum Requirement

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

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

8.1.3.2.2.3 Test Purpose

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

8.1.3.2.2.4 Method of test

8.1.3.2.2.4.1 Initial Conditions

Test environment: Normal; see annex B.2.

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

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

8.1.3.2.2.4.2 Procedure

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

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

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

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

5) The characteristics of the wanted signal shall be configured according to TS 38.211 [x], and according to additional test parameters listed in table 8.1.3.2.2.4.2-1.

Table 8.1.3.2.2.4.2-1: Test Parameters

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

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

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

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

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

|  |  |  |  |
| --- | --- | --- | --- |
| IAB type | Subcarrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| IAB type 1-O | 15 kHz | 5 | -83.5 – ΔOTAREFSENS dBm / 4.5 MHz |
|  |  | 10 | -80.3 – ΔOTAREFSENS dBm / 9.36 MHz |
|  |  | 20 | -77.2 – ΔOTAREFSENS dBm / 19.08 MHz |
|  | 30 kHz | 10 | -80.6 – ΔOTAREFSENS dBm / 8.64 MHz |
|  |  | 20 | -77.4 – ΔOTAREFSENS dBm / 18.36 MHz |
|  |  | 40 | -74.2 – ΔOTAREFSENS dBm / 38.16 MHz |
|  |  | 100 | -70.1 – ΔOTAREFSENS dBm / 98.28 MHz |
| IAB type 2-O | 60 kHz | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 47.52 MHz |
|  |  | 100 | EISREFSENS\_50M + ΔFR2\_REFSENS + 18 dBm / 95.04 MHz |
|  |  | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 46.08 MHz |
|  |  | 100 | EISREFSENS\_50M + ΔFR2\_REFSENS + 18 dBm / 95.04 MHz |
|  |  | 200 | EISREFSENS\_50M + ΔFR2\_REFSENS + 21 dBm / 47.52 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.53 in table 4.6-1 and clause 7.1.  NOTE 2: ΔFR2\_REFSENS = -3 dB as described in clause 7.1, since the OTA REFSENS reference direction (as declared in D.54 in table 4.6-1) is used for testing.  NOTE 3: EISREFSENS\_50M as declared in D.28 in table 4.6-1. | | | |

8) The tester sends random codewords from applicable codebook, in regular time periods. The following statistics are kept: the number of ACK bits falsely detected in the idle periods and the number of missed ACK bits. Each falsely detected ACK bit in the idle periods is accounted as one error for the statistics of false ACK detection, and each missed ACK bit is accounted as one error for the statistics of missed ACK detection.

Note that the procedure described in this clause for ACK missed detection has the same condition as that described in clause 8.1.3.2.1.4.2 for NACK to ACK detection. Both statistics are measured in the same testing.

8.1.3.2.2.5 Test Requirement

8.1.3.2.2.5.1 Test requirement for IAB type 1-O

The fraction of falsely detected ACK bits shall be less than 1% and the fraction of correctly detected ACK bits shall be larger than 99% for the SNR listed in tables 8.1.3.2.2.5-1 and table 8.1.3.2.2.5-2.

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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of TX | Number of Demodulation | Propagation conditions and | Channel bandwidth / SNR (dB) | | |
| antennas | Branches | correlation matrix (annex J) | 5 MHz | 10 MHz | 20 MHz |
| 1 | 2 | TDLC300-100 Low | -4.4 | -3.8 | -4.4 |

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

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

8.1.3.2.2.5.2 Test requirement for IAB type 2-O

The fraction of falsely detected ACK bits shall be less than 1% and the fraction of correctly detected ACK bits shall be larger than 99% for the SNR listed in tables 8.1.3.2.2.5.2-1 and table 8.1.3.2.2.5.2-2.

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

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

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

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

#### 8.1.3.3 Performance requirements for PUCCH format 2

##### 8.1.3.3.1 ACK missed detection performance requirements

8.1.3.3.1.1 Definition and applicability

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

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

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

Which specific test(s) are applicable to IAB DU is based on the test applicability rules defined in clause 8.1.1.3.

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

8.1.3.3.1.2 Minimum Requirement

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

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

8.1.3.3.1.3 Test Purpose

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

8.1.3.3.1.4 Method of test

8.1.3.3.1.4.1 Initial Conditions

Test environment: Normal, see clause B.2.

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

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

8.1.3.3.1.4.2 Procedure

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

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

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

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

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

Table 8.1.3.3.1.4.2-1: Test parameters

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

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

7) Adjust the test signal mean power so the calibrated radiated SNR value at the IAB DU receiver is as specified in clause 8.1.3.3.1.5.1 and 8.1.3.3.1.5.2 for *IAB type 1-O* and *IAB type 2-O* respectively, and that the SNR at the IAB DU receiver is not impacted by the noise floor.

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

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

|  |  |  |  |
| --- | --- | --- | --- |
| IAB type | Sub-carrier spacing  (kHz) | Channel bandwidth  (MHz) | AWGN power level |
| IAB type 1-O | 15 kHz | 5 | -83.5 - ΔOTAREFSENS dBm / 4.5 MHz |
|  |  | 10 | -80.3 - ΔOTAREFSENS dBm / 9.36 MHz |
|  |  | 20 | -77.2 -ΔOTAREFSENS dBm / 19.08 MHz |
|  | 30 kHz | 10 | -80.6 - ΔOTAREFSENS dBm / 8.64 MHz |
|  |  | 20 | -77.4 - ΔOTAREFSENS dBm / 18.36 MHz |
|  |  | 40 | -74.2 - ΔOTAREFSENS dBm / 38.16 MHz |
|  |  | 100 | -70.1 - ΔOTAREFSENS dBm / 98.28 MHz |
| IAB type 2-O | 60 kHz | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 47.52MHz |
|  |  | 100 | EISREFSENS\_50M + ΔFR2\_REFSENS + 18 dBm / 95.04 MHz |
|  | 120 kHz | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 46.08 MHz |
|  |  | 100 | EISREFSENS\_50M + ΔFR2\_REFSENS + 18 dBm / 95.04 MHz |
|  |  | 200 | EISREFSENS\_50M + ΔFR2\_REFSENS + 21 dBm / 190.08 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.53 in table 4.6-1 and clause 7.1.  NOTE 2: ΔFR2\_REFSENS = -3 dB as declared in clause 7.1, since the OTA REFSENS receiver target reference direction (as declared in D.54 in table 4.6-1) is used for testing.  NOTE 3: EISREFSENS\_50M as declared in D.28 in table 4.6-1. | | | |

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



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

8.1.3.3.1.5 Test Requirement

8.1.3.3.1.5.1 Test requirement for IAB type 1-O

The fraction of falsely detected ACKs shall be less than 1% and the fraction of correctly detected ACKs shall be larger than 99% for the SNR listed in table 8.1.3.3.1.5.1-1 and table 8.1.3.3.1.5.1-2.

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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of | Number of | Propagation | Channel bandwidth / SNR (dB) | | |
| TX antennas | demodulation branches | conditions and correlation matrix (annex J) | 5 MHz | 10 MHz | 20 MHz |
| 1 | 2 | TDLC300-100 Low | 6.4 | 6.2 | 6.5 |

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

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

8.1.3.3.1.5.2 Test requirement for IAB type 2-O

The fraction of falsely detected ACKs shall be less than 1% and the fraction of correctly detected ACKs shall be larger than 99% for the SNR listed in table 8.1.3.3.1.5.2-1 and table 8.1.3.3.1.5.2.-2

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

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

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

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

##### 8.1.3.3.2 UCI BLER performance requirements

8.1.3.3.2.1 Definition and applicability

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

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

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

8.1.3.3.2.2 Minimum Requirement

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

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

8.1.3.3.2.3 Test Purpose

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

8.1.3.3.2.4 Method of test

8.1.3.3.2.4.1 Initial Conditions

Test environment: Normal, see clause B.2.

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

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

8.1.3.3.2.4.2 Procedure

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

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

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

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

5) The characteristics of the wanted signal shall be configured according to TS 38.211 [x], and according to additional test parameters listed in table 8.1.3.3.2.4.2-1.

Table 8.1.3.3.2.4.2-1: Test parameters

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

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

7) Adjust the test signal mean power so the calibrated radiated SNR value at the IAB DU receiver is as specified in clause 8.1.3.3.2.5.1 and 8.1.3.3.2.5.2 for *IAB type 1-O* and *IAB type 2-O* respectively, and that the SNR at the IAB DU receiver is not impacted by the noise floor.

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

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

|  |  |  |  |
| --- | --- | --- | --- |
| IAB type | Sub-carrier spacing  (kHz) | Channel bandwidth  (MHz) | AWGN power level |
| IAB type 1-O | 15 kHz | 5 | -83.5 - ΔOTAREFSENS dBm / 4.5 MHz |
|  |  | 10 | -80.3 - ΔOTAREFSENS dBm / 9.36 MHz |
|  |  | 20 | -77.2 -ΔOTAREFSENS dBm / 19.08 MHz |
|  | 30 kHz | 10 | -80.6 - ΔOTAREFSENS dBm / 8.64 MHz |
|  |  | 20 | -77.4 - ΔOTAREFSENS dBm / 18.36 MHz |
|  |  | 40 | -74.2 - ΔOTAREFSENS dBm / 38.16 MHz |
|  |  | 100 | -70.1 - ΔOTAREFSENS dBm / 98.28 MHz |
| IAB type 2-O | 60 kHz | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 47.52MHz |
|  |  | 100 | EISREFSENS\_50M + ΔFR2\_REFSENS + 18 dBm / 95.04 MHz |
|  | 120 kHz | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 46.08 MHz |
|  |  | 100 | EISREFSENS\_50M + ΔFR2\_REFSENS + 18 dBm / 95.04 MHz |
|  |  | 200 | EISREFSENS\_50M + ΔFR2\_REFSENS + 21 dBm / 190.08 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.53 in table 4.6-1 and clause 7.1.  NOTE 2: ΔFR2\_REFSENS = -3 dB as declared in clause 7.1.  NOTE 3: EISREFSENS\_50M as declared in D.28 in table 4.6-1. | | | |

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



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

8.1.3.3.2.5 Test Requirement

8.1.3.3.2.5.1 Test requirement for IAB type 1-O

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

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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of | Number of | Propagation | Channel bandwidth / SNR (dB) | | |
| TX antennas | demodulation branches | conditions and correlation matrix (annex J) | 5 MHz | 10 MHz | 20 MHz |
| 1 | 2 | TDLC300-100 Low | 0.8 | 1.4 | 1.8 |

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

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

8.1.3.3.2.5.2 Test requirement for IAB type 2-O

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

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

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

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

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

#### 8.1.3.4 Performance requirements for PUCCH format 3

##### 8.1.3.4.1 Definition and applicability

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

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

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

Which specific test(s) are applicable to IAB DU is based on the test applicability rules defined in clause 8.1.1.3.

##### 8.1.3.4.2 Minimum Requirement

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

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

##### 8.1.3.4.3 Test Purpose

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

##### 8.1.3.4.4 Method of test

8.1.3.4.4.1 Initial Conditions

Test environment: Normal; see annex B.2.

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

Direction to be tested:

- OTA REFSENS *receiver target reference direction* (see D.54 in table 4.6-1).

8.1.3.4.4.2 Procedure

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

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

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

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

5) The characteristics of the wanted signal shall be configured according to TS 38.211 [x], and according to additional test parameters listed in table 8.1.3.4.4.2-1.

Table 8.1.3.4.4.2-1: Test parameters

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

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

7) Adjust the test signal mean power so the calibrated radiated SNR value at the IAB-DU receiver is as specified in clause 8.1.3.4.5.1 and 8.1.3.4.5.2 for *IAB type 1-O* and *IAB type 2-O* respectively, and the SNR at the IAB-DU receiver is not impacted by the noise floor.

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

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

|  |  |  |  |
| --- | --- | --- | --- |
| IAB type | Subcarrier spacing  (kHz) | Channel bandwidth (MHz) | AWGN power level |
| IAB type 1-O | 15 | 5 | -83.5 - ΔOTAREFSENS dBm / 4.5MHz |
|  |  | 10 | -80.3 - ΔOTAREFSENS dBm / 9.36MHz |
|  |  | 20 | -77.2 - ΔOTAREFSENS dBm / 19.08MHz |
|  | 30 | 10 | -80.6 - ΔOTAREFSENS dBm / 8.64MHz |
|  |  | 20 | -77.4 - ΔOTAREFSENS dBm / 18.36MHz |
|  |  | 40 | -74.2 - ΔOTAREFSENS dBm / 38.16MHz |
|  |  | 100 | -70.1 - ΔOTAREFSENS dBm / 98.28MHz |
| IAB type 2-O | 60 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm/ 47.52MHz |
|  |  | 100 | EISREFSENS\_50M + ΔFR2\_REFSENS + 18 dBm/ 95.04 MHz |
|  | 120 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm/ 46.08 MHz |
|  |  | 100 | EISREFSENS\_50M + ΔFR2\_REFSENS + 18 dBm/ 95.04 MHz |
|  |  | 200 | EISREFSENS\_50M + ΔFR2\_REFSENS + 21 dBm/ 190.08 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.53 in table 4.6-1 and clause 7.1.  NOTE 2: ΔFR2\_REFSENS = -3 dB as described in clause 7.1, since the OTA REFSENS receiver target reference direction (as declared in D.54 in table 4.6-1) is used for testing.  NOTE 3: EISREFSENS\_50M as declared in D.28 in table 4.6-1. | | | |

##### 8.1.3.4.5 Test Requirement

8.1.3.4.5.1 Test requirement for IAB type 1-O

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

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

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test Number | Number of TX | Number of | Propagation conditions | Additional DM-RS | Channel bandwidth / SNR (dB) | | |
|  | antennas | demodulation branches | and correlation matrix (annex J) | configuration | 5 MHz | 10 MHz | 20 MHz |
| 1 | 1 | 2 | TDLC300-100 Low | No additional DM-RS | 0.8 | 1.7 | 0.9 |
|  |  |  |  | Additional DM-RS | 0.5 | 1.1 | 0.5 |
| 2 | 1 | 2 | TDLC300-100 Low | No additional DM-RS | 2.0 | 2.8 | 2.6 |

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

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

8.1.3.4.5.2 Test requirement for IAB type 2-O

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

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

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

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

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

#### 8.1.3.5 Performance requirements for PUCCH format 4

##### 8.1.3.5.1 Definition and applicability

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

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

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

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

##### 8.1.3.5.2 Minimum Requirement

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

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

##### 8.1.3.5.3 Test Purpose

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

##### 8.1.3.5.4 Method of test

8.1.3.5.4.1 Initial Conditions

Test environment: Normal; see annex B.2.

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

Direction to be tested:

- OTA REFSENS *receiver target reference direction* (see D.54 in table 4.6-1).

8.1.3.5.4.2 Procedure

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

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

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

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

5) The characteristics of the wanted signal shall be configured according to TS 38.211 [x], and according to additional test parameters listed in table 8.1.3.4.4.2-1.

Table 8.1.3.5.4.2-1: Test parameters

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

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

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

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

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

|  |  |  |  |
| --- | --- | --- | --- |
| IAB type | Subcarrier spacing  (kHz) | Channel bandwidth (MHz) | AWGN power level |
| IAB type 1-O | 15 | 5 | -83.5 - ΔOTAREFSENS dBm / 4.5MHz |
|  |  | 10 | -80.3 - ΔOTAREFSENS dBm / 9.36MHz |
|  |  | 20 | -77.2 - ΔOTAREFSENS dBm / 19.08MHz |
|  | 30 | 10 | -80.6 - ΔOTAREFSENS dBm / 8.64MHz |
|  |  | 20 | -77.4 - ΔOTAREFSENS dBm / 18.36MHz |
|  |  | 40 | -74.2 - ΔOTAREFSENS dBm / 38.16MHz |
|  |  | 100 | -70.1 - ΔOTAREFSENS dBm / 98.28MHz |
| IAB type 2-O | 60 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm/ 47.52 MHz |
|  |  | 100 | EISREFSENS\_50M + ΔFR2\_REFSENS + 18 dBm/ 95.04 MHz |
|  | 120 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm/ 46.08 MHz |
|  |  | 100 | EISREFSENS\_50M + ΔFR2\_REFSENS + 18 dBm/ 95.04 MHz |
|  |  | 200 | EISREFSENS\_50M + ΔFR2\_REFSENS + 21 dBm/ 190.08 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.53 in table 4.6-1 and clause 7.1.  NOTE 2: ΔFR2\_REFSENS = -3 dB as described in clause 7.1, since the OTA REFSENS receiver target reference direction (as declared in D.54 in table 4.6-1) is used for testing.  NOTE 3: EISREFSENS\_50M as declared in D.28 in table 4.6-1. | | | |

##### 8.1.3.5.5 Test Requirement

8.1.3.5.5.1 Test requirement for IAB type 1-O

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

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

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation | Propagation conditions and correlation matrix | Additional DM‑RS | Channel bandwidth / SNR (dB) | | |
|  | branches | (annex J) | configuration | 5 MHz | 10 MHz | 20 MHz |
| 1 | 2 | TDLC300-100 Low | No additional DM-RS | 2.4 | 3.2 | 2.8 |
|  |  |  | Additional DM‑RS | 2.2 | 3.0 | 2.4 |

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

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

8.1.3.5.5.2 Test requirement for IAB type 2-O

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

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

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

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

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

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

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

8.1.3.6.1.1 NACK to ACK detection

8.1.3.6.1.1.1 Definition and applicability

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

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

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

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

8.1.3.6.1.1.2 Minimum Requirement

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

8.1.3.6.1.1.3 Test Purpose

8.1.3.6.1.1.4 Method of test

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

8.1.3.6.1.1.4.1 Initial Conditions

Test environment: Normal; see annex B.2.

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

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

8.1.3.6.1.1.4.1 Procedure

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

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

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

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

5) The characteristics of the wanted signal shall be configured according to TS 38.211 [x], and according to additional test parameters listed in table 8.1.3.6.1.1.4.2-1.

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

|  |  |
| --- | --- |
| Parameter | Test |
| Number of information bits | 2 |
| Number of PRBs | 1 |
| Number of symbols | 14 |
| First PRB prior to frequency hopping | 0 |
| Intra-slot frequency hopping | disabled |
| Inter-slot frequency hopping | enabled |
| First PRB after frequency hopping | The largest PRB index - (nrofPRBs – 1) |
| Group and sequence hopping | neither |
| Hopping ID | 0 |
| Initial cyclic shift | 0 |
| First symbol | 0 |
| Index of orthogonal cover code (*timeDomainOCC*) | 0 |
| Number of slots for PUCCH repetition | 2 |
| Cyclic prefix | normal |

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

7) Adjust the test signal mean power so the calibrated radiated SNR value at the IAB DU receiver is as specified in clause 8.1.3.6.1.1.5.1 for *IAB type 1-O*, and that the SNR at the IAB DU receiver is not impacted by the noise floor.

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

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

|  |  |  |  |
| --- | --- | --- | --- |
| IAB type | Subcarrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| IAB type 1-O | 15 kHz | 5 | -83.5 – ΔOTAREFSENS dBm / 4.5 MHz |
|  |  | 10 | -80.3 – ΔOTAREFSENS dBm / 9.36 MHz |
|  |  | 20 | -77.2 – ΔOTAREFSENS dBm / 19.08 MHz |
|  | 30 kHz | 10 | -80.6 – ΔOTAREFSENS dBm / 8.64 MHz |
|  |  | 20 | -77.4 – ΔOTAREFSENS dBm / 18.36 MHz |
|  |  | 40 | -74.2 – ΔOTAREFSENS dBm / 38.16 MHz |
|  |  | 100 | -70.1 – ΔOTAREFSENS dBm / 98.28 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.53 in table 4.6-1 and clause 7.1. | | | |

8) The tester sends random codeword from applicable codebook, in regular time periods. The following statistics are kept: the number of ACK bits detected in the idle periods and the number of NACK bits detected as ACK.

8.1.3.6.1.1.5 Test Requirement

8.1.3.6.1.1.5.1 Test requirement for IAB type 1-O

The fraction of falsely detected ACK bits shall be less than 1% and the fraction of NACK bits falsely detected as ACK shall be less than 0.1% for the SNR listed in table 8.1.3.6.1.1.5.1-1.

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

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

8.1.3.6.1.2 ACK missed detection

8.1.3.6.1.2.1 Definition and applicability

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

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

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

8.1.3.6.1.2.2 Minimum Requirement

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

8.1.3.6.1.2.3 Test Purpose

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

8.1.3.6.1.2.4 Method of test

8.1.3.6.1.2.4.1 Initial Conditions

Test environment: Normal; see annex B.2.

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

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

8.1.3.6.1.2.4.1 Procedure

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

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

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

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

5) The characteristics of the wanted signal shall be configured according to TS 38.211 [x], and according to additional test parameters listed in table 8.1.3.6.1.2.4.2-1.

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

|  |  |
| --- | --- |
| Parameter | Test |
| Number of information bits | 2 |
| Number of PRBs | 1 |
| Number of symbols | 14 |
| First PRB prior to frequency hopping | 0 |
| Intra-slot frequency hopping | disabled |
| Inter-slot frequency hopping | enabled |
| First PRB after frequency hopping | The largest PRB index - (nrofPRBs – 1) |
| Group and sequence hopping | neither |
| Hopping ID | 0 |
| Initial cyclic shift | 0 |
| First symbol | 0 |
| Index of orthogonal cover code (*timeDomainOCC*) | 0 |
| Number of slots for PUCCH repetition | 2 |
| Cyclic prefix | normal |

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

7) Adjust the test signal mean power so the calibrated radiated SNR value at the IAB DU receiver is as specified in clause 8.1.3.6.1.2.5.1 for *IAB type 1-O*, and that the SNR at the IAB DU receiver is not impacted by the noise floor.

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

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

|  |  |  |  |
| --- | --- | --- | --- |
| IAB type | Subcarrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| IAB type 1-O | 15 kHz | 5 | -83.5 – ΔOTAREFSENS dBm / 4.5 MHz |
|  |  | 10 | -80.3 – ΔOTAREFSENS dBm / 9.36 MHz |
|  |  | 20 | -77.2 – ΔOTAREFSENS dBm / 19.08 MHz |
|  | 30 kHz | 10 | -80.6 – ΔOTAREFSENS dBm / 8.64 MHz |
|  |  | 20 | -77.4 – ΔOTAREFSENS dBm / 18.36 MHz |
|  |  | 40 | -74.2 – ΔOTAREFSENS dBm / 38.16 MHz |
|  |  | 100 | -70.1 – ΔOTAREFSENS dBm / 98.28 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.53 in table 4.6-1 and clause 7.1. | | | |

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



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

8.1.3.6.1.2.5 Test Requirement

8.1.3.6.1.2.5.1 Test requirement for IAB type 1-O

The fraction of falsely detected ACK bits shall be less than 1% and the fraction of correctly detected ACK bits shall be larger than 99% for the SNR listed in table 8.1.3.6.1.2.5.1-1.

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

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

### 8.1.4 Performance requirements for PRACH

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

##### 8.1.4.1.1 Definition and applicability

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

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

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

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

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

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

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

##### 8.1.4.1.2 Minimum requirement

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

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

##### 8.1.4.1.3 Test purpose

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

##### 8.1.4.1.4 Method of test

8.1.4.1.4.1 Initial conditions

Test environment: Normal, see clause B.2.

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

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

8.1.4.1.4.2 Procedure

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

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

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

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

5) The characteristics of the wanted signal shall be configured according to the corresponding UL reference measurement channel defined in annex A and the test parameter *msg1-FrequencyStart* is set to 0.

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

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

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

|  |  |  |  |
| --- | --- | --- | --- |
| IAB type | Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| IAB type 1-O | 15 | 5 | -83.5 - ΔOTAREFSENS dBm / 4.5MHz |
|  |  | 10 | -80.3 - ΔOTAREFSENS dBm / 9.36MHz |
|  |  | 20 | -77.2 - ΔOTAREFSENS dBm / 19.08MHz |
|  | 30 | 10 | -80.6 - ΔOTAREFSENS dBm / 8.64MHz |
|  |  | 20 | -77.4 - ΔOTAREFSENS dBm / 18.36MHz |
|  |  | 40 | -74.2 - ΔOTAREFSENS dBm / 38.16MHz |
|  |  | 100 | -70.1 - ΔOTAREFSENS dBm / 98.28MHz |
| IAB type 2-O | 60 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 47.52 MHz |
|  |  | 100 | EISREFSENS\_50M + ΔFR2\_REFSENS + 18 dBm / 95.04 MHz |
|  | 120 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 46.08 MHz |
|  |  | 100 | EISREFSENS\_50M + ΔFR2\_REFSENS + 18 dBm / 95.04 MHz |
|  |  | 200 | EISREFSENS\_50M + ΔFR2\_REFSENS + 21 dBm / 190.08 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.53 in table 4.6-1 and clause 7.1.  NOTE 2: ΔFR2\_REFSENS = -3 dB as described in clause 7.1, since the OTA REFSENS receiver target reference direction (as declared in D.54 in table 4.6-1) is used for testing.  NOTE 3: EISREFSENS\_50M as declared in D.28 in table 4.6-1. | | | |

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

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

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



Figure 8.1.4.1.4.2-1: PRACH preamble test pattern

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



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

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



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

##### 8.1.4.1.5 Test requirement for Normal Mode

8.1.4.1.5.1 Test requirement for IAB type 1-O

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

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

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

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

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

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

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

8.1.4.1.5.2 Test requirement for IAB type 2-O

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

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

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

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

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

## 8.2 IAB-MT performance requirements

### 8.2.1 General

#### 8.2.1.1 Scope and definitions

Radiated performance requirements specify the ability of the *IAB-MT type 1-O* and *IAB-MT type 2-O* to correctly demodulate 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 J. The requirements only apply to those FRCs that are supported by the IAB-MT.

The radiated performance requirements for *IAB-MT type 1-O* and for *IAB-MT type 2-O* are limited to two OTA *demodulations branches* as described in clause 8.1.1.2. 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: IAB-MT can support more than 2 *demodulation branches*, however OTA conformance testing can only be performed for 1 or 2 *demodulation branches*.

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 General

##### 8.2.2.1.1 Applicability rule for IAB-MT

8.2.2.1.1.1 General

Unless otherwise stated, for a IAB-MT declared to support more than 2 demodulation branches (for *IAB-MT type 1-O* and *IAB-MT type 2-O*), the performance requirement tests for 2 demodulation branches shall apply, and the mapping between connectors and demodulation branches is up to IAB-MT implementation.

The tests requiring more than [20] dB SNR level are set to N/A in the test requirements.

###### 8.2.2.1.1.2 Applicability of requirements for different subcarrier spacings

Unless otherwise stated, the tests shall apply only for each subcarrier spacing declared to be supported (see D.7 in table 4.6-1).

8.2.2.1.1.3 Applicability of requirements for TDD with different UL-DL patterns

Unless otherwise stated, for each subcarrier spacing declared to be supported, if IAB-MT supports multiple TDD UL-DL patterns, only one of the supported TDD UL-DL patterns shall be used for all tests.

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

#### 8.2.2.2 Performance requirements for PDSCH

##### 8.2.2.2.1 Definition and applicability

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 re-transmissions.

Which specific test(s) are applicable to IAB-MT is based on the test applicability rules defined in clause 8.2.2.1.1.

##### 8.2.2.2.2 Minimum requirements

For *IAB type 1-O*, the minimum requirement is in TS 38.174 [x], clause 11.2.2.1.1.

For *IAB type 2-O*, the minimum requirement is in TS 38.174 [x], clause 11.2.2.2.1.

##### 8.2.2.2.3 Test purpose

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

##### 8.2.2.2.4 Method of test

8.2.2.2.4.1 Initial conditions

Test environment: Normal, see annex B.2.

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

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

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

8.2.2.2.4.2 Test procedure

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

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

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

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

5) The characteristics of the wanted signal shall be configured according to the corresponding DL reference measurement channel defined in annex A, and according to additional test parameters listed in table 8.2.2.2.4.2-1.

Table: 8.2.2.2.4.2-1 Test parameters for testing PDSCH

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | IAB type 1-O | IAB type 2-O |
| Cyclic prefix | | Normal | Normal |
| Default TDD UL-DL pattern (Note 1) | | 7D1S2U, S=6D:4G:4U | 3D1S1U, S=10D:2G:2U |
| HARQ | Maximum number of HARQ transmissions | 4 | 4 |
| RV sequence | 0, 2, 3, 1 | 0, 2, 3, 1 |
| DM-RS | DM-RS configuration type | 1 | 1 |
| DM-RS duration | single-symbol DM-RS | single-symbol DM-RS |
| DM-RS position (*l0*) | 2 | 2 |
| Additional DM-RS position | pos1 | 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 | 1 |
| 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 | {1000} for Rank 1 tests {1000-1001} for Rank 2 tests |
| DM-RS sequence generation | NID0=0 | NID0=0 |
| Time domain resource assignment | PDSCH mapping type | A | A |
| Start symbol | 2 | 1 |
| Allocation length | 12 | 13 |
| Frequency domain resource assignment | RB assignment | Full applicable test bandwidth | Full applicable test bandwidth |
| PT-RS configuration | Frequency density (*KPT-RS*) | Not configured | 2 |
| Time density (*LPT-RS*) | 1 |
| PRB bundling size | | 2 | 2 |
| VRB-to-PRB mapping type | | Not interleaved | 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 | 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. | | | |

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

7) Adjust the test signal mean power so the calibrated radiated SNR value at the IAB-MT receiver is as specified in clause 8.2.2.2.5.1 and 8.2.2.2.5.2 for *IAB type 1-O* and *IAB type 2-O* respectively, and that the SNR at the IAB receiver is not impacted by the noise floor.

The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level in table 8.2.2.2.4.2-2.

Table 8.2.2.2.4.2-2: AWGN power level at the IAB-MT input

|  |  |  |  |
| --- | --- | --- | --- |
| IAB type | Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| IAB type 1-O | 30 | 40 | -77.2 - ΔOTAREFSENS dBm / 38.16 MHz |
| IAB type 2-O | 60 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 47.52 MHz |
| 120 | 100 | EISREFSENS\_50M + ΔFR2\_REFSENS + 18 dBm / 95.04 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.53 in table 4.6-1 and clause 7.1.  NOTE 2: ΔFR2\_REFSENS = -3 dB as described in clause 7.1, since the OTA REFSENS reference direction (as declared in D.54 in table 4.6-1) is used for testing.  NOTE 3: EISREFSENS\_50M as declared in D.28 in table 4.6-1. | | | |

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

##### 8.2.2.2.5 Test requirements

8.2.2.2.5.1 Test requirement for IAB type 1-O

The throughput shall be equal to or larger than the fraction of maximum throughput for the FRCs stated in Table 8.2.2.2.5.1-1 and 8.2.2.2.5.1-2 at the given SNR with the test parameters stated in Table 8.2.2.2.4.2-1.

Table 8.2.2.2.5.1-1: Minimum requirements for PDSCH Type A with Rank 1

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Test number | FRC (Annex A) | Bandwidth (MHz) / Subcarrier spacing (kHz) | Propagation conditions (Annex J) | Antenna configuration | Fraction of maximum throughput (%) | SNR  (dB) |
| 1-1 | M-FR1-A.3.3-1 | 40/30 | TDLA30-10 | 2x2, ULA Low | 70 | [26.3] |
| 1-2 | M-FR1-A.3.1-1 | 40/30 | TDLA30-10 | 2x2, ULA Low | 30 | [3.2] |

Table 8.2.2.2.5.1-2: Minimum requirements for PDSCH Type A with Rank 2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Test number | FRC (Annex A) | Bandwidth (MHz) / Subcarrier spacing (kHz) | Propagation conditions (Annex J) | Antenna configuration | Fraction of maximum throughput (%) | SNR  (dB) |
| 2-1 | M-FR1-A.3.2-1 | 40/30 | TDLA30-10 | 2x2, ULA Low | 70 | [20.8] |

8.2.2.2.5.2 Test requirement for IAB type 2-O

The throughput shall be equal to or larger than the fraction of maximum throughput for the FRCs stated in Table 8.2.2.2.5.2-1 and 8.2.2.2.5.2-2 at the given SNR with the test parameters stated in Table 8.2.2.2.4.2-1.

Table 8.2.2.2.5.2-1: Minimum requirements for PDSCH Type A with Rank 1

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Test number | FRC (Annex A) | Bandwidth (MHz) / Subcarrier spacing (kHz) | Propagation conditions (Annex J) | Antenna configuration | Fraction of maximum throughput (%) | SNR  (dB) |
| 1-1 | M-FR2-A.3.1-1 | 100/120 | TDLA30-75 | 2x2, ULA Low | 30 | [4.1] |
| 1-2 | M-FR2-A.3.2-1 | 100/120 | TDLA30-75 | 2x2, ULA Low | 70 | [13.5] |

Table 8.2.2.2.5.2-2: Minimum requirements for PDSCH Type A with Rank 2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Test number | FRC (Annex A) | Bandwidth (MHz) / Subcarrier spacing (kHz) | Propagation conditions (Annex J) | Antenna configuration | Fraction of maximum throughput (%) | SNR  (dB) |
| 2-1 | M-FR2-A.3.1-2 | 100/120 | TDLA30-75 | 2x2, ULA Low | 70 | [15.9] |
| 2-2 | M-FR2-A.3.1-3 | 50/60 | TDLA30-75 | 2x2, ULA Low | 70 | [16.0] |
| 2-3 | M-FR2-A.3.2-2 | 100/120 | TDLA30-75 | 2x2, ULA Low | 70 | [20.3] |

#### 8.2.2.3 Demodulation performance requirements for PDCCH

##### 8.2.2.3.1 Definition and applicability

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

Which specific test(s) are applicable to IAB-MT is based on the test applicability rules defined in clause 8.2.2.1.1.

##### 8.2.2.3.2 Minimum requirement

For *IAB type 1-O*, the minimum requirement is in TS 38.174 [x], clause 11.2.2.1.2.

For *IAB type 2-O*, the minimum requirement is in TS 38.174 [x], clause 11.2.2.2.2.

##### 8.2.2.3.3 Test purpose

The test shall verify the receiver's ability to detect the Downlink Scheduling Grant (Pm-dsg) under multipath fading propagation conditions for a given SNR.

##### 8.2.2.3.4 Method of test

8.2.2.3.4.1 Initial conditions

Test environment: Normal, see annex B.2.

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

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

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

8.2.2.3.4.2 Test procedure

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

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

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

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

5) The characteristics of the wanted signal shall be configured according to the corresponding DL reference measurement channel defined in annex A, and according to additional test parameters listed in table 8.2.2.3.4.2-1.

Table: 8.2.2.3.4.2-1 Test parameters for testing PDSCH

|  |  |  |
| --- | --- | --- |
| Parameter | IAB type 1-O | IAB-type 2-O |
| Cyclic prefix | Normal | Normal |
| Default TDD UL-DL pattern (Note 1) | 7D1S2U, S=6D:4G:4U | 3D1S1U, S=10D:2G:2U |
| DM-RS sequence generation | NID=0 | NID=0 |
| Frequency domain resource allocation for CORESET | Start from RB = 0 with contiguous RB allocation | Start from RB = 0 with contiguous RB allocation |
| CCE to REG mapping type | Interleaved | Interleaved |
| Interleaver size | 3 | 3 for test with aggregation level 2, 8 2 for test with aggregation level 4 |
| REG bundle size | 2 for test with aggregation level 2, 4  6 for test with aggregation level 8 | 2 for test with aggregation level 2, 8 6 for test with aggregation level 4 |
| Shift Index | 0 | 0 |
| Slots for PDCCH monitoring | Each slot | Each slot |
| Number of PDCCH candidates for the tested aggregation level | 1 | 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 | 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. | | |

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

7) Adjust the test signal mean power so the calibrated radiated SNR value at the IAB-MT receiver is as specified in clause 8.2.2.3.5.1 and 8.2.2.3.5.2 for *IAB type 1-O* and *IAB type 2-O* respectively, and that the SNR at the IAB receiver is not impacted by the noise floor.

The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level in table 8.2.2.3.4.2-2.

Table 8.2.2.3.4.2-2: AWGN power level at the IAB-MT input

|  |  |  |  |
| --- | --- | --- | --- |
| IAB type | Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| IAB type 1-O | 30 | 40 | -77.2 - ΔOTAREFSENS dBm / 38.16 MHz |
| IAB type 2-O | 60 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 47.52 MHz |
| 120 | 100 | EISREFSENS\_50M + ΔFR2\_REFSENS + 18 dBm / 95.04 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.53 in table 4.6-1 and clause 7.1.  NOTE 2: ΔFR2\_REFSENS = -3 dB as described in clause 7.1, since the OTA REFSENS reference direction (as declared in D.54 in table 4.6-1) is used for testing.  NOTE 3: EISREFSENS\_50M as declared in D.28 in table 4.6-1. | | | |

8) For reference channels applicable to the IAB, measure the miss-detection of the Downlink Scheduling Grant (Pm-dsg).

##### 8.2.2.3.5 Test requirements

8.2.2.3.5.1 Test requirement for IAB type 1-O

The Pm-dsg shall be equal to or smaller than 1%, for the cases stated in Table 8.2.2.3.5.1-1 at the given SNR with the test parameters stated in Table 8.2.2.3.4.2-1.

Table 8.2.2.3.5.1-1: Minimum requirements for PDCCH

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test number | Bandwidth (MHz) / Subcarrier spacing (kHz) | CORESET RB | CORESET duration | Aggregation level | FRC (Annex A) | Propagation conditions (Annex J) | Antenna configuration | Pm-dsg (%) | SNR  (dB) |
| 1 | 40/30 | 102 | 1 | 2 | M-FR1-A.3.4-1 | TDLA30-10 | 1x2, ULA Low | 1 | [7.9] |
| 2 | 40/30 | 102 | 1 | 4 | M-FR1-A.3.4-1 | TDLA30-10 | 1x2, ULA Low | 1 | [5.8] |
| 3 | 40/30 | 90 | 1 | 8 | M-FR1-A.3.4-1 | TDLA30-10 | 2x2, ULA Low | 1 | [0.3] |

8.2.2.3.5.2 Test requirement for IAB type 2-O

The Pm-dsg shall be equal to or smaller than 1%, for the cases stated in Table 8.2.2.3.5.2-1 at the given SNR with the test parameters stated in Table 8.2.2.3.4.2-1.

Table 8.2.2.3.5.2-1: Minimum requirements for PDCCH

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test number | Bandwidth (MHz) / Subcarrier spacing (kHz) | CORESET RB | CORESET duration | Aggregation level | FRC (Annex A) | Propagation conditions (Annex J) | Antenna configuration | Pm-dsg (%) | SNR  (dB) |
| 1 | 100/120 | 60 | 1 | 2 | M-FR2-A.3.4-1 | TDLA30-75 | 1x2, ULA Low | 1 | [8.1] |
| 2 | 100/120 | 60 | 1 | 4 | M-FR2-A.3.4-2 | TDLA30-75 | 1x2, ULA Low | 1 | [4.6] |
| 3 | 100/120 | 60 | 1 | 8 | M-FR2-A.3.4-3 | TDLA30-75 | 2x2, ULA Low | 1 | [1.9] |

### 8.2.3 CSI reporting requirements

#### 8.2.3.1 General

##### 8.2.3.1.1 Applicability of requirements

Editor’s note: Applicability of requirements to be added

##### 8.2.3.1.2 Common test parameters

Parameters specified in Table 8.2.3.1.2-1 are applied for all test cases in this clause unless otherwise stated.

**Table 8.2.3.1.2-1: Test parameters for CSI test cases**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | | | Unit | Value FR1 | Value FR2 |
| PDSCH transmission scheme | | |  | Transmission scheme 1 | Transmission scheme 1 |
| Duplex mode | | |  | TDD | TDD |
| PTRS epre-Ratio | | |  | N/A | 0 |
| Actual carrier configuration | Offset between Point A and the lowest usable subcarrier on this carrier (Note 3) | | RBs | 0 | 0 |
| Subcarrier spacing | | kHz | 30 | 120 |
| DL BWP configuration #1 | Cyclic prefix | |  | Normal | Normal |
| RB offset | | RBs | 0 | 0 |
| Number of contiguous PRB | | PRBs | 106 | 66 |
| Active DL BWP index | | |  | 1 | 1 |
| PDSCH configuration | | Mapping type |  | Type A | Type A |
| k0 |  | 0 | 0 |
| Starting symbol (S) |  | 2 | 2 |
| Length (L) |  | 12 | 12 |
| PDSCH aggregation factor |  | 1 | 1 |
| PRB bundling type |  | Static | Static |
| PRB bundling size |  | 2 | 2 |
| Resource allocation type |  | Type 0 | type 0 |
| RBG size |  |  | Config 2 |
| VRB-to-PRB mapping type |  | Non-interleaved | Non-interleaved |
| VRB-to-PRB mapping interleaver bundle size |  | N/A | N/A |
| PDSCH DMRS configuration | | DMRS Type |  | Type 1 | Type 1 |
| Number of additional DMRS |  | 1 | 1 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 | 1 |
| DMRS ports indexes |  | {1000} | {1000} |
| Number of PDSCH DMRS CDM group(s) without data |  | 2 | 2 |
| PTRS configuration | | Frequency density (*KPT-RS*) |  | N/A | 2 |
| Time density (*LPT-RS*) |  | N/A | 1 |
| Resource Element Offset |  | N/A | 2 |
| NZP CSI-RS for CSI acquisition | | Frequency Occupation |  | Start PRB 0  Number of PRB = BWP size | Start PRB 0  Number of PRB = BWP size |
| Redundancy version coding sequence | | |  | {0,2,3,1} | {0,2,3,1} |
| 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 [x] or 38.101-2 [x] for tested channel bandwidth and subcarrier spacing. | | | | | |

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

##### 8.2.3.2.1 Definition and applicability

The performance requirement of CSI reporting is determined by the reporting variance and the BLER performance using the transport format indicated by the reported CQI. The purpose is to verify that the reported CQI values are in accordance with the CQI definition given in TS 38.214 [x]. 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.

##### 8.2.3.2.2 Minimum requirement

The minimum requirement for *IAB-MT type 1-O* is in TS 38.174 [x] clause 11.2.3.1.1

The minimum requirement for *IAB-MT type 2-O* is in TS 38.174 [x] clause 11.2.3.2.2.

##### 8.2.3.2.3 Test purpose

The test shall verify the receiver's ability to report correct median CQI and expected BLER performance under AWGN conditions.

##### 8.2.3.2.4 Method of test

8.2.3.2.4.1 Initial conditions

Test environment: Normal, see annex B.2.

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

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

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

8.2.3.2.4.2 Procedure

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

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

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

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

5) The characteristics of the wanted signal shall be configured according to the corresponding DL reference measurement channel defined in annex A, and according to additional test parameters listed in table 8.2.3.2.4.2-2 or 8.2.3.2.4.2-2.

Table 8.2.3.2.4.2-1: Test parameters for testing CQI reporting requirements for FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | | | Unit | Test 1 | | Test 2 | |
| Bandwidth | | | MHz | 40 | | | |
| Subcarrier spacing | | | kHz | 30 | | | |
| Duplex Mode | | |  | TDD | | | |
| SNR | | | dB | 8 | 9 | 14 | 15 |
| Propagation channel | | |  | AWGN | | | |
| Antenna configuration | | |  | 2×2 with static channel specified in Annex J.1 | | | |
| Beamforming Model | | |  | As specified in Annex J.3.1 | | | |
| 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 | | | |
| CSI-IM configuration | CSI-IM resource Type | |  | Periodic | | | |
| CSI-IM RE pattern | |  | 0 | | | |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) | |  | (4, 9) | | | |
| CSI-IM 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 | | | |
| CQI/RI/PMI delay | | | ms | 9.5 | | | |
| Maximum number of HARQ transmission | | |  | 1 | | | |
| Measurement channel | | |  | As specified in Table A.2.6-1, M-FR1-A.3.5-1 | | | |

Table 8.2.3.2.4.2-2: Test parameters for testing CQI reporting requirements for FR2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | | | Unit | Test 1 | | Test 2 | |
| Bandwidth | | | MHz | 100 | | | |
| Subcarrier spacing | | | kHz | 120 | | | |
| Duplex Mode | | |  | TDD | | | |
| SNRBB | | | dB | 8 | 9 | 14 | 15 |
| Propagation channel | | |  | AWGN | | | |
| Antenna configuration | | |  | 2×2 with static channel specified in Annex J.1 | | | |
| Beamforming Model | | |  | As specified in Annex J.3.1 | | | |
| 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 | | | |
| CSI-IM configuration | CSI-IM resource Type | |  | Periodic | | | |
| CSI-IM RE pattern | |  | 1 | | | |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) | |  | (8, 13) | | | |
| CSI-IM timeConfig  periodicity and offset | | slot | 8/1 | | | |
| ReportConfigType | | |  | Periodic | | | |
| CQI-table | | |  | Table 1 | | | |
| reportQuantity | | |  | cri-RI-PMI-CQI | | | |
| timeRestrictionForChannelMeasurements | | |  | Not configured | | | |
| timeRestrictionForInterferenceMeasurements | | |  | Not configured | | | |
| 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 | | | |
| CQI/RI/PMI delay | | | ms | 8.375 | | | |
| Maximum number of HARQ transmission | | |  | 1 | | | |
| Measurement channel | | |  | As specified in Table A.2.6-3, M-FR2-A.3.5-2 | | | |

7) Adjust the test signal mean power so the calibrated radiated SNR value at the IAB-MT receiver is as specified in clause 8.2.3.2.5.1 and 8.2.3.2.5.2 for *IAB type 1-O* and *IAB type 2-O* respectively, and that the SNR at the IAB-MT receiver is not impacted by the noise floor.

The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level in table 8.2.3.2.4.2-2.

Table 8.2.3.2.4.2-2: AWGN power level at the IAB-MT input

|  |  |  |  |
| --- | --- | --- | --- |
| BS type | Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| IAB-MT type 1-O | 30 | 40 | -77.2 - ΔOTAREFSENS dBm / 38.16 MHz |
| IAB-MT type 2-O | 120 | 100 | EISREFSENS\_50M + ΔFR2\_REFSENS + 18 dBm / 95.04 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.53 in table 4.6-1 and clause 7.1.  NOTE 2: ΔFR2\_REFSENS = -3 dB as described in clause 7.1, since the OTA REFSENS reference direction (as declared in D.54 in table 4.6-1) is used for testing.  NOTE 3: EISREFSENS\_50M as declared in D.28 in table 4.6-1. | | | |

8) For reference channels applicable to the IAB-MT, measure the median CQI and the BLER at (median CQI +1) and (median CQI -1).

##### 8.2.3.2.5 Test requirement

8.2.3.2.5.1 Test requirement for IAB type 1-O

For the parameters specified in Table 8.2.3.2.4.2-1, 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.

8.2.3.2.5.2 Test requirement for IAB type 2-O

For the parameters specified in Table 8.2.3.2.4.2-2, the minimum requirements are specified by the following:

a) the reported CQI value 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, 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, 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 Information (PMI)

##### 8.2.3.3.1 Definition and applicability

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 IAB-MT 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 IAB-MT reports, and is the throughput measured at with random precoding.

##### 8.2.3.3.2 Minimum requirement

The minimum requirement for *IAB-MT type 1-O* is in TS 38.174 [x] clause 11.2.3.1.2.

The minimum requirement for *IAB-MT type 2-O* is in TS 38.174 [x] clause 11.2.3.2.3.

##### 8.2.3.3.3 Test purpose

The test shall verify the receiver's ability to report correct PMI under the defined fading conditions.

##### 8.2.3.3.4 Method of test

8.2.3.3.4.1 Initial conditions

Test environment: Normal, see annex B.2.

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

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

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

8.2.3.3.4.2 Procedure

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

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

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

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

5) The characteristics of the wanted signal shall be configured according to the corresponding DL reference measurement channel defined in annex A, and according to additional test parameters listed in table 8.2.3.3.4.2-1.

Table 8.2.3.3.4.2-1: Test parameters for testing PMI reporting requirements

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | Unit | FR1 | FR2 |
| Bandwidth | | MHz | 40 | 100 |
| Subcarrier spacing | | kHz | 30 | 120 |
| Duplex Mode | |  | TDD | TDD |
| TDD DL-UL configuration | |  | 7D1S2U, S=6D:4G:4U | 3D1S1U, S=10D:2G:2U |
| Propagation channel | |  | TDLA30-5 | TDLA30-35 |
| Antenna configuration | |  | High XP 4 x 2  (N1,N2) = (2,1)  High XP 8 x 2  (N1,N2) = (4,1) | 2 x 2 ULA Low |
| Beamforming Model | |  | As specified in Annex J.3.1 | As specified in Annex J.3.1 |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type |  | Periodic |  |
| Number of CSI-RS ports (*X*) |  | Test for 4 TX ports: 4  Test for 8 TX ports: 8 | 2 |
| CDM Type |  | Test for 4 TX ports: FD-CDM2  Test for 8 TX ports: CDM4 (FD2, TD2) | FD-CDM2 |
| Density (ρ) |  | 1 | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0, k1) |  | Test for 4 TX ports: Row 4 (0,-)  Test for 8 TX ports: Row 8, (4,6) | Row 3, (6,-) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | Test for 4 TX ports, 2RX: (13,-)  Test for 8 TX ports: (5,-) | (13,-) |
| CSI-RS  interval and offset | Slot | 10/1 | 8/1 |
| ReportConfigType | |  | Periodic | Periodic |
| Sub-band Size | | RB | 16 | 8 |
| csi-ReportingBand | |  | 1111111 | 111111111 |
| CSI-Report periodicity and offset | | slot | 10/9 | 8/3 |
| pmi-FormatIndicator | |  | Wideband | Wideband |
| Codebook configuration | Codebook Type |  | typeI-SinglePanel | typeI-SinglePanel |
| Codebook Mode |  | 1 | 1 |
| (CodebookConfig-N1,CodebookConfig-N2) |  | Test for 4 TX ports: (2,1)  Test for 8 TX ports: (4,1) | NA |
| (CodebookConfig-O1,CodebookConfig-O2) |  | Test for 4 TX ports: (4,1)  Test for 8 TX ports: (4,1) | NA |
| CodebookSubsetRestriction |  | Test for 4 TX ports: 11111111  Test for 8 TX ports: 0x FFFF | 001111 |
| RI Restriction |  | Test for 4 TX ports: 00000001  Test for 8 TX ports: 00000010 | NA |
| Maximum number of HARQ transmission | |  | 4 | 4 |
| CQI/RI/PMI delay | | ms | 5.5 | Test 1: 1.375  Test 2: 1.75 |
| Measurement channel | |  | Test for 4 TX ports: M-FR1-A.3.5-1  Test for 8 TX ports: M-FR1-A.3.5-2 | M-FR2-A.3.5-3 |
| 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 FR1 / 0.125 ms FR2 granularity) with equal probability of each applicable i1, i2 combination.  Note 3: If the IAB-MT 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 J.2.3.2.3.  Note 5: SSB, TRS, CSI-RS and/or other unspecified test parameters with respect to TS 38.101-4 [x] are left up to test implementation, if transmitted or needed. | | | | |

7) Adjust the test signal mean power so the calibrated radiated SNR value at the IAB-MT receiver is as specified in clause 8.2.3.3.5.1 and 8.2.3.3.5.2 for *IAB type 1-O* and *IAB type 2-O* respectively, and that the SNR at the IAB-MT receiver is not impacted by the noise floor.

The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level in table 8.2.3.3.4.2-2.

Table 8.2.3.3.4.2-2: AWGN power level at the IAB-MT input

|  |  |  |  |
| --- | --- | --- | --- |
| BS type | Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| IAB-MT type 1-O | 30 | 40 | -77.2 - ΔOTAREFSENS dBm / 38.16 MHz |
| IAB-MT type 2-O | 120 | 100 | EISREFSENS\_50M + ΔFR2\_REFSENS + 18 dBm / 95.04 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.53 in table 4.6-1 and clause 7.1.  NOTE 2: ΔFR2\_REFSENS = -3 dB as described in clause 7.1, since the OTA REFSENS reference direction (as declared in D.54 in table 4.6-1) is used for testing.  NOTE 3: EISREFSENS\_50M as declared in D.28 in table 4.6-1. | | | |

8) For reference channels applicable to the IAB-MT, measure the ratio of the throughput obtained when following the PMI feedback to the throughput obtained when applying random PMI as described in subsection 8.2.3.3.1.

##### 8.2.3.3.5 Test requirement

8.2.3.3.5.1 Test requirement for IAB type 1-O

** as defined in subsection 8.2.3.3.1 shall be greater than the indicated requirement.

Table 8.2.3.3.5.1-1 PMI reporting requirements for FR1

|  |  |  |
| --- | --- | --- |
| Parameter | Test | Requirement |
| ** | 4TX, 2RX | 1.3 |
| ** | 8TX, 2RX | 1.5 |

8.2.3.3.5.2 Test requirement for IAB type 2-O

** as defined in subsection 8.2.3.3.1 shall be greater than the indicated requirement.

Table 8.2.3.3.5.1-2 PMI reporting requirements for FR2

|  |  |
| --- | --- |
| Parameter | Requirement |
| ** | 1.05 |

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

##### 8.2.3.4.1 Definition and applicability

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.

##### 8.2.3.4.2 Minimum requirement

The minimum requirement for *IAB-MT type 1-O* is in TS 38.174 [x] clause 11.2.3.1.3.

The minimum requirement for *IAB-MT type 2-O* is in TS 38.174 [x] clause 11.2.3.2.4.

##### 8.2.3.4.3 Test purpose

The test shall verify the receiver's ability to report correct RI under the defined fading conditions.

##### 8.2.3.4.4 Method of test

8.2.3.4.4.1 Initial conditions

Test environment: Normal, see annex B.2.

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

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

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

8.2.3.4.4.2 Procedure

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

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

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

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

5) The characteristics of the wanted signal shall be configured according to the corresponding DL reference measurement channel defined in annex A, and according to additional test parameters listed in table 8.2.3.4.4.2-1.

Table 8.2.3.4.4.2-1: Test parameters for testing RI reporting requirements

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | | | Unit | FR1 | FR2 |
| Bandwidth | | | MHz | 40 | 100 |
| Subcarrier spacing | | | kHz | 30 | 120 |
| Duplex Mode | | |  | TDD | TDD |
| TDD Slot Configuration | | |  | 7D1S2U, S=6D:4G:4U | 3D1S1U, S=10D:2G:2U |
| SNR | | | dB | Test 1: 0  Test 2: 20  Test 3: 20 | Test 1: 0  Test 2: 16  Test 3: 16 |
| Propagation channel | | |  | TDLA30-5 | TDLA30-35 |
| Antenna configuration | | |  | Test 1, 2: ULA Low 2x2  Test 3: ULA High 2x2 | Test 1, 2: ULA Low 2x2  Test 3: XP High 2x2 |
| Beamforming Model | | |  | As defined in Annex J.3.1 | As defined in Annex J.3.1 |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type | |  | Periodic | Periodic |
| Number of CSI-RS ports (*X*) | |  | 2 | 2 |
| CDM Type | |  | FD-CDM2 | FD-CDM2 |
| Density (ρ) | |  | 1 | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0, k1 ) | |  | Row 3 (6,-) | Row 3 (6,-) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) | |  | (13,-) | (13,-) |
| NZP CSI-RS-timeConfig  periodicity and offset | | slot | 10/1 | 10/1 |
| CSI-IM configuration | CSI-IM resource Type | |  | Periodic | Periodic |
| CSI-IM RE pattern | |  | Pattern 0 | Pattern 1 |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) | |  | (4,9) | (8,13) |
| CSI-IM timeConfig  periodicity and offset | | slot | 10/1 | 8/1 |
| ReportConfigType | | |  | Periodic | Periodic |
| CQI-table | | |  | Table 2 | Table 1 |
| reportQuantity | | |  | cri-RI-PMI-CQI | cri-RI-PMI-CQI |
| cqi-FormatIndicator | | |  | Wideband | Wideband |
| pmi-FormatIndicator | | |  | Wideband | Wideband |
| Sub-band Size | | | RB | 16 | 8 |
| csi-ReportingBand | | |  | 1111111 | 1111111 |
| CSI-Report periodicity and offset | | | slot | 10/9 | 8/3 |
| Codebook configuration | | Codebook Type |  | typeI-SinglePanel | typeI-SinglePanel |
| Codebook Mode |  | 1 | 1 |
| (CodebookConfig-N1,CodebookConfig-N2) |  | N/A | N/A |
| CodebookSubsetRestriction |  | 000011 for fixed rank 1,  010000 for fixed rank 2,  010011 for following rank | 000011 for fixed rank 1,  010000 for fixed rank 2,  010011 for following rank |
| RI Restriction |  | N/A | N/A |
| CQI/RI/PMI delay | | | ms | 9.5 | 1.375 |
| Maximum number of HARQ transmission | | |  | 1 | 1 |
| RI Configuration | | |  | Test 1: Fixed RI = 2 and follow RI  Tests 2, 3: Fixed RI = 1 and follow RI | Test 1: Fixed RI = 2 and follow RI  Tests 2, 3: 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 [x] are left up to test implementation, if transmitted or needed. | | | | | |

7) Adjust the test signal mean power so the calibrated radiated SNR value at the IAB-MT receiver is as specified in table 8.2.3.4.4.2-1 for *IAB type 1-O* and *IAB type 2-O* respectively, and that the SNR at the IAB-MT receiver is not impacted by the noise floor.

The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level in table 8.2.3.4.4.2-2.

Table 8.2.3.4.4.2-2: AWGN power level at the IAB-MT input

|  |  |  |  |
| --- | --- | --- | --- |
| BS type | Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| IAB-MT type 1-O | 30 | 40 | -77.2 - ΔOTAREFSENS dBm / 38.16 MHz |
| IAB-MT type 2-O | 120 | 100 | EISREFSENS\_50M + ΔFR2\_REFSENS + 18 dBm / 95.04 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.53 in table 4.6-1 and clause 7.1.  NOTE 2: ΔFR2\_REFSENS = -3 dB as described in clause 7.1, since the OTA REFSENS reference direction (as declared in D.54 in table 4.6-1) is used for testing.  NOTE 3: EISREFSENS\_50M as declared in D.28 in table 4.6-1. | | | |

8) For reference channels applicable to the IAB-MT, measure the ratio of the throughput obtained when following the RI feedback to the throughput obtained when applying random RI as described in subsection 8.2.3.4.5.

##### 8.2.3.4.5 Test requirement

8.2.3.4.5.1 Test requirement for IAB type 1-O

The test requirement for RI reporting is defined as

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

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

For the parameters specified in Table 8.2.3.4.4.2-1, the test requirements are specified in Table 8.2.3.4.5.1-1.

Table 8.2.3.4.5.1-1 Test requirements for RI reporting

|  |  |  |  |
| --- | --- | --- | --- |
|  | Test 1 | Test 2 | Test 3 |
| **1 | N/A | 1.05 | 0.9 |
|  | 1.0 | N/A | N/A |

8.2.3.4.5.2 Test requirement for IAB type 2-O

The test requirement for RI reporting is defined as

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

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

For the parameters specified in Table 8.2.3.4.4.2-1, the test requirements are specified in Table 8.2.3.4.5.2-1.

Table 8.2.3.4.5.2-1 Test requirements for RI reporting

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

<<End of change for clause 8 >>

<<Start of Change for ANNEX A2 and A3>>

Annex A (normative): IAB Reference measurement channels

# A.1 IAB-DU Reference measurement channels

Editor’s note: unchanged text parts skipped.

# 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 and table A.2.1-2 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.2.1-3 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 [x].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [x]. | | | | | | | |

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 [x].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [x]. | | | | | | | |

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 [x].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [x]. | | |

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 [x].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [x]. | | | | | |

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 [x].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [x]. | | | | | |

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 [x].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [x]. | | |

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 [x].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [x]. | | | | | |

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 [x].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [x]. | | | | | |

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 [x].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [x]. | | |

## 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 [x].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [x]. | | | | | |

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 [x].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [x]. | | | | | |

## 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.1.3-5 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 [x].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [x]. | | | | | | | |

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 [x].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [x]. | | | | | | | |

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 [x].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [x]. | | | | | |

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 [x].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [x]. | | | | | |

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 [x].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [x]. | | | | | |

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 [x].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [x]. | | | | | |

## 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 [x].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [x]. | | | | | | | |

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 | D-FR2-A.2.4-1 | D-FR2-A.2.4-2 | D-FR2-A.2.4-3 | D-FR2-A.2.4-4 | D-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 [x].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [x]. | | | | | |

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 | D-FR2-A.2.4-6 | D-FR2-A.2.4-7 | D-FR2-A.2.4-8 | D-FR2-A.2.4-9 | D-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 [x].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [x]. | | | | | |

## 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 |

# 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: Fixed Reference Channels for FR1 PDSCH (16QAM)

|  |  |  |  |
| --- | --- | --- | --- |
| 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 | 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 | 490/1024 | 490/1024 | 490/1024 |
| 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 (bits) | 26632 | 73776 | 98376 |
| Transport block CRC per Slot (bits) | 24 | 24 | 24 |
| Number of Code Blocks per Slot | 4 | 9 | 12 |
| Binary Channel Bits Per Slot (bits) | 55968 | 152640 | 203520 |

Table A.3.1-2: Fixed Reference Channels for FR2 PDSCH (16QAM)

|  |  |  |  |
| --- | --- | --- | --- |
| Reference channel | M-FR2-A.3.1-1 | M-FR2-A.3.1-2 | M-FR2-A.3.1-3 |
| Channel bandwidth (MHz) | 100 | 100 | 50 |
| Subcarrier spacing (kHz) | 120 | 120 | 60 |
| Allocated resource blocks | 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 | 490/1024 | 490/1024 | 490/1024 |
| Number of MIMO layers | 1 | 2 | 2 |
| Number of DMRS REs | 12 | 12 | 12 |
| Overhead for TBS determination | 6 | 6 | 6 |
| Information Bit Payload per Slot (bits) | 17424 | 34816 | 34816 |
| Transport block CRC per Slot (bits) | 24 | 24 | 24 |
| Number of Code Blocks per Slot | 3 | 5 | 5 |
| Binary Channel Bits Per Slot (bits) | 36564 | 73128 | 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: Fixed Reference Channels for FR1 PDSCH (64QAM)

|  |  |
| --- | --- |
| Reference channel | M-FR1-A.3.2-1 |
| Channel bandwidth (MHz) | 40 |
| Subcarrier spacing (kHz) | 30 |
| Allocated resource blocks | 106 |
| Number of consecutive PDSCH symbols | 12 |
| MCS table | 64QAM |
| MCS index | 19 |
| Modulation | 64QAM |
| Target Coding Rate | 517/1024 |
| Number of MIMO layers | 2 |
| Number of DMRS REs | 12 |
| Overhead for TBS determination | 0 |
| Information Bit Payload per Slot (bits) | 83976 |
| Transport block CRC per Slot (bits) | 24 |
| Number of Code Blocks per Slot | 10 |
| Binary Channel Bits Per Slot (bits) | 167904 |

Table A.3.2-2: Fixed Reference Channels for FR2 PDSCH (64QAM)

|  |  |  |
| --- | --- | --- |
| 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 | 66 | 66 |
| Number of consecutive PDSCH symbols | 13 | 13 |
| MCS table | 64QAM | 64QAM |
| MCS index | 18 | 17 |
| Modulation | 64QAM | 64QAM |
| Target Coding Rate | 466/1024 | 438/1024 |
| Number of MIMO layers | 1 | 2 |
| Number of DMRS REs | 12 | 12 |
| Overhead for TBS determination | 6 | 6 |
| Information Bit Payload per Slot (bits) | 25104 | 47112 |
| Transport block CRC per Slot (bits) | 24 | 24 |
| Number of Code Blocks per Slot | 3 | 6 |
| Binary Channel Bits Per Slot (bits) | 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: Fixed Reference Channels for FR1 PDSCH (256QAM)

|  |  |
| --- | --- |
| Reference channel | M-FR1-A.3.3-1 |
| Channel bandwidth (MHz) | 40 |
| Subcarrier spacing (kHz) | 30 |
| Allocated resource blocks | 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 (bits) | 92200 |
| Transport block CRC per Slot (bits) | 24 |
| Number of Code Blocks per Slot | 11 |
| Binary Channel Bits Per Slot (bits) | 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: Fixed Reference Channels for FR1 PDCCH

|  |  |  |  |
| --- | --- | --- | --- |
| 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: Fixed Reference Channels for FR2 PDCCH

|  |  |  |  |
| --- | --- | --- | --- |
| 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 requirements

The parameters for the reference measurement channels are specified in table A.3.5-1 for FR1 CQI and RI reporting requirements with CQI table 2 and MCS table 2.

The parameters for the reference measurement channels are specified in table A.3.5-2 for FR1 PMI reporting requirements.

The parameters for the reference measurement channels are specified in table A.3.5-3 for FR2 CQI and RI reporting requirements with CQI table 1 and MCS table 1.

The parameters for the reference measurement channels are specified in table A.3.5-4 for FR2 PMI reporting requirements.

Table A.3.5-1: FRC for FR1 CQI and RI 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 FR1 PMI reporting (16QAM)

|  |  |  |
| --- | --- | --- |
| 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 | 106 | 106 |
| Number of consecutive PDSCH symbols | 12 | 12 |
| MCS table | 64QAM | 64QAM |
| MCS index | 13 | 13 |
| Modulation | 16QAM | 16QAM |
| Target Coding Rate | 490/1024 | 490/1024 |
| Number of MIMO layers | 1 | 2 |
| Number of DMRS REs | 24 | 24 |
| Overhead for TBS determination | 0 | 0 |
| Information Bit Payload per Slot (bits) | 24576 | 49176 |
| Transport block CRC per Slot (bits) | 24 | 24 |
| Number of Code Blocks per Slot | 3 | 6 |
| Binary Channel Bits Per Slot (bits) | 50880 | 101760 |

Table A.3.5-3: FRC for FR2 CQI and RI 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.3.5-4: Fixed Reference Channels for FR2 PMI reporting (16QAM)

|  |  |
| --- | --- |
| Reference channel | M-FR2-A.3.5-3 |
| Channel bandwidth (MHz) | 100 |
| Subcarrier spacing (kHz) | 120 |
| Allocated resource blocks | 66 |
| Number of consecutive PDSCH symbols | 12 |
| MCS table | 64QAM |
| MCS index | 13 |
| Modulation | 16QAM |
| Target Coding Rate | 490/1024 |
| Number of MIMO layers | 1 |
| Number of DMRS REs | 24 |
| Overhead for TBS determination | 6 |
| Information Bit Payload per Slot (bits) | 14344 |
| Transport block CRC per Slot (bits) | 24 |
| Number of Code Blocks per Slot | 2 |
| Binary Channel Bits Per Slot (bits) | 30360 |

<<End of Change for ANNEX A2 and A3>>

<<Start of Change for ANNEX C>>

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

Editor’s note: unchanged text parts skipped.

# C.3 Measurement of performance requirements

## C.3.1 IAB-DU Test Tolerances

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

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

## C.3.2 IAB-MT Test Tolerances

### C.3.2.1 Demodulation Performance

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

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

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

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

### C.3.2.2 Channel State Information Reporting

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

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

<<End of Change for ANNEX C>>

<<Start of Change for ANNEX E>>

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

Editor’s note: unchanged text parts skipped.

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

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



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

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

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

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

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

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



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

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

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

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

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

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



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

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

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

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

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

<<End of Change for ANNEX E>>

<<Start of Change for ANNEX J>>

Annex J (normative):   
Propagation conditions

# J.1 Static propagation condition

The propagation for the static performance measurement is an Additive White Gaussian Noise (AWGN) environment. No fading or multi-paths exist for this propagation model.

## J.1.1 IAB-MT Receiver with 2 Rx

For 1 port transmission the channel matrix is defined in the frequency domain by:

.



For 2 port transmission the channel matrix is defined in the frequency domain by:

.



For 4 port transmission the channel matrix is defined in the frequency domain by:



For 8 port transmission the channel matrix is defined in the frequency domain by:



# J.2 Multi-path fading propagation conditions

The multipath propagation conditions consist of several parts:

- A delay profile in the form of a "tapped delay-line", characterized by a number of taps at fixed positions on a sampling grid. The profile can be further characterized by the r.m.s. delay spread and the maximum delay spanned by the taps.

- A combination of channel model parameters that include the Delay profile and the Doppler spectrum that is characterized by a classical spectrum shape and a maximum Doppler frequency.

- Different models are used for FR1 (410 MHz - 7.125GHz) and FR2 (24.25 GHz – 52.6 GHz).

## J.2.1 Delay profiles

The delay profiles are simplified from the TR 38.901 [x] TDL models. The simplification steps are shown below for information. These steps are only used when new delay profiles are created. Otherwise, the delay profiles specified in annex J.2.1.1 and J.2.1.2 can be used as such.

Step 1: Use the original TDL model from TR 38.901 [x].

Step 2: Re-order the taps in ascending delays.

Step 3: Perform delay scaling according to the procedure described in clause 7.7.3 in TR 38.901 [x].

Step 4: Apply the quantization to the delay resolution 5 ns. This is done simply by rounding the tap delays to the nearest multiple of the delay resolution.

Step 5: If multiple taps are rounded to the same delay bin, merge them by calculating their linear power sum.

Step 6: If there are more than 12 taps in the quantized model, merge the taps as follows

- Find the weakest tap from all taps (both merged and unmerged taps are considered)

- If there are two or more taps having the same value and are the weakest, select the tap with the smallest delay as the weakest tap.

- When the weakest tap is the first delay tap, merge taps as follows

- Update the power of the first delay tap as the linear power sum of the weakest tap and the second delay tap.

- Remove the second delay tap.

- When the weakest tap is the last delay tap, merge taps as follows

- Update the power of the last delay tap as the linear power sum of the second-to-last tap and the last tap.

- Remove the second-to-last tap.

- Otherwise

- For each side of the weakest tap, identify the neighbour tap that has the smaller delay difference to the weakest tap.

- When the delay difference between the weakest tap and the identified neighbour tap on one side equals the delay difference between the weakest tap and the identified neighbour tap on the other side.

- Select the neighbour tap that is weaker in power for merging.

- Otherwise, select the neighbour tap that has smaller delay difference for merging.

- To merge, the power of the merged tap is the linear sum of the power of the weakest tap and the selected tap.

- When the selected tap is the first tap, the location of the merged tap is the location of the first tap. The weakest tap is removed.

- When the selected tap is the last tap, the location of the merged tap is the location of the last tap. The weakest tap is removed.

- Otherwise, the location of the merged tap is based on the average delay of the weakest tap and selected tap. If the average delay is on the sampling grid, the location of the merged tap is the average delay. Otherwise, the location of the merged tap is rounded towards the direction of the selected tap (e.g. 10 ns & 20 ns 🡪 15 ns, 10 ns & 25 ns 🡪 20 ns, if 25 ns had higher or equal power; 15 ns, if 10 ns had higher power). The weakest tap and the selected tap are removed.

- Repeat step 6 until the final number of taps is 12.

Step 7: Round the amplitudes of taps to one decimal (e.g. -8.78 dB 🡪 -8.8 dB)

Step 8: If the delay spread has slightly changed due to the tap merge, adjust the final delay spread by increasing or decreasing the power of the last tap so that the delay spread is corrected.

Step 9: Re-normalize the highest tap to 0 dB.

NOTE 1: Some values of the delay profile created by the simplification steps may differ from the values in tables J.2.1.1-2, J.2.1.1-3, J.2.1.1-4, and J.2.1.2-2 for the corresponding model.

NOTE 2: For Step 5 and Step 6, the power values are expressed in the linear domain using 6 digits of precision. The operations are in the linear domain.

### J.2.1.1 Delay profiles for FR1

The delay profiles for FR1 are selected to be representative of low, medium and high delay spread environment. The resulting model parameters are specified in J.2.1.1-1 and the tapped delay line models are specified in tables J.2.1.1-2 ~ J.2.1.1-4.

Table J.2.1.1-1: Delay profiles for NR channel models

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Model | Number of  channel taps | Delay spread  (r.m.s.) | Maximum excess tap delay (span) | Delay resolution |
| TDLA30 | 12 | 30 ns | 290 ns | 5 ns |
| TDLB100 | 12 | 100 ns | 480 ns | 5 ns |
| TDLC300 | 12 | 300 ns | 2595 ns | 5 ns |

Table J.2.1.1-2 TDLA30 (DS = 30 ns)

|  |  |  |  |
| --- | --- | --- | --- |
| Tap # | Delay (ns] | Power (dB) | Fading distribution |
| 1 | 0 | -15.5 | Rayleigh |
| 2 | 10 | 0 |  |
| 3 | 15 | -5.1 |  |
| 4 | 20 | -5.1 |  |
| 5 | 25 | -9.6 |  |
| 6 | 50 | -8.2 |  |
| 7 | 65 | -13.1 |  |
| 8 | 75 | -11.5 |  |
| 9 | 105 | -11.0 |  |
| 10 | 135 | -16.2 |  |
| 11 | 150 | -16.6 |  |
| 12 | 290 | -26.2 |  |

Table J.2.1.1-3 TDLB100 (DS = 100ns)

|  |  |  |  |
| --- | --- | --- | --- |
| Tap # | Delay (ns] | Power (dB) | Fading distribution |
| 1 | 0 | 0 | Rayleigh |
| 2 | 10 | -2.2 |  |
| 3 | 20 | -0.6 |  |
| 4 | 30 | -0.6 |  |
| 5 | 35 | -0.3 |  |
| 6 | 45 | -1.2 |  |
| 7 | 55 | -5.9 |  |
| 8 | 120 | -2.2 |  |
| 9 | 170 | -0.8 |  |
| 10 | 245 | -6.3 |  |
| 11 | 330 | -7.5 |  |
| 12 | 480 | -7.1 |  |

Table J.2.1.1-4 TDLC300 (DS = 300 ns)

|  |  |  |  |
| --- | --- | --- | --- |
| Tap # | Delay (ns] | Power (dB) | Fading distribution |
| 1 | 0 | -6.9 | Rayleigh |
| 2 | 65 | 0 |  |
| 3 | 70 | -7.7 |  |
| 4 | 190 | -2.5 |  |
| 5 | 195 | -2.4 |  |
| 6 | 200 | -9.9 |  |
| 7 | 240 | -8.0 |  |
| 8 | 325 | -6.6 |  |
| 9 | 520 | -7.1 |  |
| 10 | 1045 | -13.0 |  |
| 11 | 1510 | -14.2 |  |
| 12 | 2595 | -16.0 |  |

### J.2.1.2 Delay profiles for FR2

The delay profiles for FR2 are specified in J.2.1.2-1 and the tapped delay line models are specified in table J.2.1.2-2.

Table J.2.1.2-1: Delay profiles for NR channel models

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Model | Number of  channel taps | Delay spread  (r.m.s.) | Maximum excess tap delay (span) | Delay resolution |
| TDLA30 | 12 | 30 ns | 290 ns | 5 ns |

Table J.2.1.2-2: TDLA30 (DS = 30 ns)

|  |  |  |  |
| --- | --- | --- | --- |
| Tap # | Delay (ns] | Power (dB) | Fading distribution |
| 1 | 0 | -15.5 | Rayleigh |
| 2 | 10 | 0 |  |
| 3 | 15 | -5.1 |  |
| 4 | 20 | -5.1 |  |
| 5 | 25 | -9.6 |  |
| 6 | 50 | -8.2 |  |
| 7 | 65 | -13.1 |  |
| 8 | 75 | -11.5 |  |
| 9 | 105 | -11.0 |  |
| 10 | 135 | -16.2 |  |
| 11 | 150 | -16.6 |  |
| 12 | 290 | -26.2 |  |

## J.2.2 Combinations of channel model parameters

The propagation conditions used for the performance measurements in multi-path fading environment are indicated as a combination of a channel model name and a maximum Doppler frequency, i.e., TDLA<DS>-<Doppler>, TDLB<DS>-<Doppler> or TDLC<DS>-<Doppler> where '<DS>' indicates the desired delay spread and '<Doppler>' indicates the maximum Doppler frequency (Hz).

Table J.2.2-1 and J.2.2-2 show the propagation conditions that are used for the performance measurements in multi-path fading environment for low, medium and high Doppler frequencies for FR1 and FR2, respectively.

Table J.2.2-1: Channel model parameters for FR1

|  |  |  |
| --- | --- | --- |
| Combination name | Model | Maximum Doppler frequency |
| TDLA30-5 | TDLA30 | 5 Hz |
| TDLA30-10 | TDLA30 | 10 Hz |
| TDLB100-400 | TDLB100 | 400 Hz |
| TDLC300-100 | TDLC300 | 100 Hz |

Table J.2.2-2: Channel model parameters for FR2

|  |  |  |
| --- | --- | --- |
| Combination name | Model | Maximum Doppler frequency |
| TDLA30-75 | TDLA30 | 75 Hz |
| TDLA30-300 | TDLA30 | 300 Hz |

## J.2.3 MIMO channel correlation matrices

The MIMO channel correlation matrices defined in J.2.3 apply for the antenna configuration using uniform linear arrays at both IAB-DU and IAB-MT and for the antenna configuration using cross polarized antennas.

### J.2.3.1 MIMO correlation matrices using Uniform Linear Array (ULA)

The MIMO channel correlation matrices defined in J.2.3.1 apply for the antenna configuration using uniform linear array (ULA) at both IAB-DU and IAB-MT.

#### J.2.3.1.1 Definition of MIMO correlation matrices

Table J.2.3.1.1-1 defines the correlation matrix for the IAB-DU.

Table J.2.3.1.1-1: IAB-DU correlation matrix

|  |  |
| --- | --- |
|  | IAB-DU correlation |
| One antenna |  |
| Two antennas |  |
| Four antennas |  |
| Eight antennas |  |

Table J.2.3.1.1-2 defines the correlation matrix for the IAB-MT:

Table J.2.3.1.1-2: IAB-MT correlation matrix

|  |  |  |  |
| --- | --- | --- | --- |
|  | One antenna | Two antennas | Four antennas |
| IAB-MT correlation |  |  |  |

Table J.2.3.1.1-3 defines the channel spatial correlation matrix. The parameters, *α* and *β* in table J.2.3.1.1-3 defines the spatial correlation between the antennas at the IAB-DU and IAB-MT respectively.



Table J.2.3.1.1-3: correlation matrices



|  |  |
| --- | --- |
| 1x2 case |  |
| 1x4 case |  |
| 2x2 case |  |
| 2x4 case |  |
| 4x4 case |  |

For cases with more antennas at either IAB-DU or IAB-MT or both, the channel spatial correlation matrix can still be expressed as the Kronecker product of and according to.



#### J.2.3.1.2 MIMO correlation matrices at high, medium and low level

The and for different correlation types are given in table J.2.3.1.2-1.



Table J.2.3.1.2-1: Correlation for high, medium and low level

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Low correlation | | Medium correlation | | High correlation | |
| α | β | α | β | α | β |
| 0 | 0 | 0.9 | 0.3 | 0.9 | 0.9 |

The correlation matrices for high, medium and low correlation are defined in table J.2.3.1.2-2, J.2.3.1.2-3 and J.2.3.1.2-4 as below.

The values in table J.2.3.1.2-2 have been adjusted for the 2x4 and 4x4 high correlation cases to ensure the correlation matrix is positive semi-definite after round-off to 4 digit precision. This is done using the equation:



Where the value "a" is a scaling factor such that the smallest value is used to obtain a positive semi-definite result. For the 2x4 high correlation case, a=0.00010. For the 4x4 high correlation case, a=0.00012.

The same method is used to adjust the 4x4 medium correlation matrix in table J.2.3.1.2-3 to ensure the correlation matrix is positive semi-definite after round-off to 4 digit precision with a =0.00012.

Table J.2.3.1.2-2: MIMO correlation matrices for high correlation

|  |  |
| --- | --- |
| 1x2 case |  |
| 2x2 case |  |
| 2x4 case |  |
| 4x4 case |  |

Table J.2.3.1.2-3: MIMO correlation matrices for medium correlation

|  |  |
| --- | --- |
| 1x2 case | N/A |
| 2x2 case |  |
| 2x4 case |  |
| 4x4 case |  |

Table J.2.3.1.2-4: MIMO correlation matrices for low correlation

|  |  |
| --- | --- |
| 1x2 case |  |
| 1x4 case |  |
| 1x8 case |  |
| 2x2 case |  |
| 2x4 case |  |
| 2x8 case |  |
| 4x4 case |  |

In table J.2.3.1.2-4, is a identity matrix.



NOTE: For completeness, the correlation matrices were defined for high, medium and low correlation but performance requirements exist only for low correlation.

### J.2.3.2 Multi-antenna channel models using cross polarized antennas

The MIMO channel correlation matrices defined in J.2.3.2 apply to two cases as presented below:

- One TX antenna and multiple RX antennas case, with cross polarized antennas used at gNB

- Multiple TX antennas and multiple RX antennas case, with cross polarized antennas used at both UE and gNB

The cross-polarized antenna elements with +/-45 degrees polarization slant angles are deployed at gNB. For one TX antenna case, antenna element with +90 degree polarization slant angle is deployed at UE. For multiple TX antennas case, cross-polarized antenna elements with +90/0 degrees polarization slant angles are deployed at UE.

For the cross-polarized antennas, the N antennas are labelled such that antennas for one polarization are listed from 1 to N/2 and antennas for the other polarization are listed from N/2+1 to N, where N is the number of TX or RX antennas.

#### J.2.3.2.1 Definition of MIMO correlation matrices using cross polarized antennas

For the channel spatial correlation matrix, the following is used:



Where

- is the spatial correlation matrix at the UE with same polarization,



- is the spatial correlation matrix at the gNB with same polarization,



- is a polarization correlation matrix,



- is a permutation matrix, and



- denotes transpose.



Table J.2.3.2.1-1 defines the polarization correlation matrix.

Table J.2.3.2.1-1 : Polarization correlation matrix

|  |  |  |
| --- | --- | --- |
|  | One TX antenna | Multiple TX antennas |
| Polarization correlation matrix |  |  |

The matrixis defined as



where and is the number of TX and RX antennas respectively, and is the ceiling operator.



The matrix is used to map the spatial correlation coefficients in accordance with the antenna element labelling system described in J.2.3.2.



#### J.2.3.2.2 Spatial correlation matrices at IAB-MT and IAB-DU sides

##### J.2.3.2.2.1 Spatial correlation matrices at IAB-MT side

For 1-antenna transmitter, .



For 2-antenna transmitter using one pair of cross-polarized antenna elements, .



For 4-antenna transmitter using two pairs of cross-polarized antenna elements, .



##### J.2.3.2.2.2 Spatial correlation matrices at IAB-DU side

For 2-antenna receiver using one pair of cross-polarized antenna elements, .



For 4-antenna receiver using two pairs of cross-polarized antenna elements,.



For 8-antenna receiver using four pairs of cross-polarized antenna elements,.



#### J.2.3.2.3 MIMO correlation matrices using cross polarized antennas

The values for parameters *α*, *β* and *γ* for low spatial correlation are given in table J.2.3.2.3-1.

Table J.2.3.2.3-1: Values for parameters α,  and γ

|  |  |  |
| --- | --- | --- |
| Low spatial correlation | | |
| α |  | γ |
| 0 | 0 | 0 |
| Note 1: Value of *α* applies when more than one pair of cross-polarized antenna elements at gNB side.  Note 2: Value of *β* applies when more than one pair of cross-polarized antenna elements at UE side. | | |

The correlation matrices for low spatial correlation are defined in table J.2.3.2.3-2 as below.

Table J.2.3.2.3-2: MIMO correlation matrices for low spatial correlation

|  |  |
| --- | --- |
| 1x8 case |  |
| 2x8 case |  |

In table J.2.3.2.3-2, is a identity matrix.



# J.3 Physical signals, channels mapping and precoding

## J.3.1 General

Void

Editor’s note: Clause Annex J.3 was added because it is missing but is referenced from other tables. Text to be added later.

<<End of change for ANNEX J>>