**3GPP T****SG-RAN WG4 Meeting #98-bis-e Draft R4-2107094**

**Electronic Meeting, Apr. 12-20, 2021**

**Source: Nokia, Nokia Shanghai Bell**

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

**Agenda item: 5.3.5.1**

**Document for: Email Approval**

# Introduction

In RAN4#98e, the work split for the introduction of IAB demodulation performance requirements was agreed [1].

In this contribution, we present a first TP draft of the following sections in the newly created TS 38.176‑2 [2][3].

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **IAB demodulation draftCR, bigCR, and bigTP work-splits - TS 38.176-2** | | | | | **Company** | | **TS 38.176-2 bigTR Demod** | | | | | Nokia | | **TS 38.176-2 Radiated conformance testing (draftCRs)** | | | | |  | |  | 4.6 Manufacturer declarations | | | | Intel | |  | 8 Radiated performance requirements | | | |  | |  |  | IAB-DU performance requirements | | | Nokia | |  |  |  | General (incl. applicability rule), PUSCH FR1&FR2, PUCCH FR1&FR2, PRACH FR1&FR2 | | |  |  | IAB-MT performance requirements | | | Huawei | |  |  |  | General (all excluding conducted) | | |  |  |  | Demodulation (Radiated requirements/FR2) | | |  |  |  |  | General (incl. applicability, etc), PDSCH, PDCCH, PBCH, SDR, SDR CA | |  |  |  | CSI reporting (Radiated requirements/FR2) | | Ericsson | |  |  |  |  | General, CQI, PMI, RI | |  |  |  | ~~Demod for interworking (verification in FR2)~~ | | |  |  |  | ~~CSI reporting for interworking (verification in FR2)~~ | | |  | Appendix | | | |  | |  |  | FRCs/RMCs & PRACH Test preambles | | | Huawei | |  |  | Rest (incl. test setup/TT/etc.) | | | Nokia | |

# Discussion and notes

During our drafting and combining process for this bigTP, we have made a few observations, which might be of interest to companies following the structure and style outlined by this initial bigTP for submissions in the next meeting.

Pertaining to the editorial WF [4]:

**Observation 1**: The editorial WF was created with 38.174 and 38.104 in mind. There are some differences between 38.104 and 38.141-1/2 that can motivate deviation from the noted WF.

**Observation 2**: This draft TP for 38.176-2 is intended to be more aligned with the structure of 38.141-2 than 38.104 (whenever a collision in styles was noted).   
For example, the type 1-O and 2-O section splitting points differ between 38.104 and 38.141.

Pertaining to expectations and goals of this bigTP:

**Observation 3**: The expectation for this bigTP is to be noted.

**Observation 4**: Please do not use the text from this TP as a draft basis, but restart from the orignal 38.104/38.141 specifcaiton and be wary of using correct sytles. However, the heading skeleton from this bigTP should be fine.

**Observation 5**: The text in this draft bigTP is included for information and example purposes only. It does not constitute technical agreement or endorsement, above what was agreed in prior WFs.

**Observation 6**: Some example text blocks have been inlcuded, where it seemed necessary to test the structure of the bigTP, most straighforward sections are filled with TBA.

Pertaining to formating of this bigTP:

**Observation 7**: Some headings in the TP have up to 9 subdivisions/levels.  
Follwoing RAN5 (eg. 38.521-4) we formated level 6 and below with “H6”.  
The valididty of such heading depths should be confirmed in the next meeting.

**Observation 8**: To create this draft, the latest version of the 38.176-2 skeleton was procured directly from the spec editor, wich is thus not officially approved yet.

# References

1. R4-2103994, WF on Rel-16 NR IAB demodulation requirements, Nokia, RAN4#98-e.
2. TS 38.176-2, NR; Integrated Access and Backhaul (IAB) conformance testing; Part 2: Radiated conformance testing.
3. RP-210442, Revised WID: Perf. part: Integrated Access and Backhaul for NR, Qualcomm, RAN#91-e.
4. R4-2106089, WF on Rel-16 NR IAB specification editorial issues, Ericsson, RAN4#98bis-e.

## 4.6 Manufacturer's declarations

**<<Start of first change>>**

The following IAB manufacturer's declarations listed in tables 4.6-1, 4.6-2 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* for IAB-DU and IAB-MT node respectively.

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

Table 4.6-1 Manufacturers declarations for *IAB-DU 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.TBA | PUSCH mapping type | Declaration of the supported PUSCH mapping type for FR1 as specified in TS 38.211 [20], i.e., type A, type B or both. | c | x | n/a |
| D.TBA | PUSCH additional DM-RS positions | Declaration of the supported additional DM-RS position(s) for FR2, i.e., pos0, pos1, or both. | n/a | n/a | x |
| D.TBA | PUCCH format | Declaration of the supported PUCCH format(s) as specified in TS 38.211 [20], i.e., format 0, format 1, format 2, format 3, format 4. | c | x | x |
| D.TBA | PRACH format and SCS | Declaration of the supported PRACH format(s) as specified in TS 38.211 [20], 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 TS 38.211 [20], 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.TBA | Additional DM-RS for PUCCH format 3 | 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.TBA | Additional DM-RS for PUCCH format 4 | 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.TBA | PUSCH PT-RS | Declaration of PT-RS in PUSCH support: without PT-RS, with PT-RS or both. | n/a | n/a | x |
| D.TBA | PUCCH multi-slot | Declaration of multi-slot PUCCH support. | c | x | n/a |
| D.TBA | UL CA | 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.TBA | Modulation order | Declaration of the supported modulation orders:  QPSK, 16QAM, 64QAM | TBA | TBA | TBA |
| D.TBA | Transorm precoding | Declararation on the supporting of transform precoding | TBA | TBA | TBA |
| 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". | | | | | |

Table 4.6-2 Manufacturers declarations for *IAB-MT 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.TBA | 256QAM | Declaration on the supporting of 256QAM modulation order | TBA | TBA | TBA |
| 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". | | | | | |

**<<end of first change>>**

# 8 Radiated performance requirements

**<<Start of second change>>**

## 8.1 IAB-DU performance requirements

### 8.1.1 General

#### 8.1.1.1 Scope and definitions

TBA

#### 8.1.1.2 OTA demodulation branches

TBA

#### 8.1.1.3 Applicability rule

##### 8.1.1.3.1 General

8.1.1.3.2 Applicability of PUSCH performance requirements

8.1.1.3.2.1 Applicability of requirements for different subcarrier spacings

TBA

8.1.1.3.2.2 Applicability of requirements for different channel bandwidths

TBA

8.1.1.3.2.3 Applicability of requirements for different configurations

TBA

8.1.1.3.2.4 Applicability of requirements for uplink carrier aggregation

TBA

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

TBA

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.1xx in table [x.x-x]).

##### 8.1.1.3.3 Applicability of PUCCH performance requirements

8.1.1.3.3.1 Applicability of requirements for different formats

TBA

8.1.1.3.3.2 Applicability of requirements for different subcarrier spacings

TBA

8.1.1.3.3.3 Applicability of requirements for different channel bandwidths

TBA

8.1.1.3.3.4 Applicability of requirements for different configurations

TBA

8.1.1.3.3.5 Applicability of requirements for multi-slot PUCCH

TBA

##### 8.1.1.3.4 Applicability of PRACH performance requirements

8.1.1.3.4.1 Applicability of requirements for different formats

TBA

8.1.1.3.4.2 Applicability of requirements for different subcarrier spacings

TBA

8.1.1.3.4.3 Applicability of requirements for different channel bandwidths

### 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

TBA

##### 8.1.2.1.2 Minimum Requirement

TBA

##### 8.1.2.1.3 Test purpose

TBA

##### 8.1.2.1.4 Method of test

8.1.2.1.4.1 Initial conditions

TBA

8.1.2.1.4.2 Procedure

TBA

##### 8.1.2.1.5 Test Requirement

8.1.2.1.5.1 Test requirement for IAB type 1-O

TBA

8.1.2.1.5.2 Test requirement for IAB type 2-O

TBA

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

##### 8.1.2.2.1 Definition and applicability

TBA

##### 8.1.2.2.2 Minimum Requirement

TBA

##### 8.1.2.2.3 Test Purpose

TBA

##### 8.1.2.2.4 Method of test

8.1.2.2.4.1 Initial Conditions

TBA

8.1.2.2.4.2 Procedure

TBA

##### 8.1.2.2.5 Test Requirement

8.1.2.2.5.1 Test requirement for IAB type 1-O

TBA

8.1.2.2.5.2 Test requirement for IAB type 2-O

TBA

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

##### 8.1.2.3.1 Definition and applicability

TBA

##### 8.1.2.3.2 Minimum Requirement

TBA

##### 8.1.2.3.3 Test Purpose

TBA

##### 8.1.2.3.4 Method of test

8.1.2.3.4.1 Initial Conditions

TBA

8.1.2.3.4.2 Procedure

TBA

##### 8.1.2.3.5 Test Requirement

TBA

### 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

TBA

##### 8.1.3.1.2 Minimum Requirement

TBA

##### 8.1.3.1.3 Test Purpose

TBA

##### 8.1.3.1.4 Method of test

8.1.3.1.4.1 Initial Conditions

TBA

8.1.3.1.4.2 Procedure

TBA

##### 8.1.3.1.5 Test Requirement

8.1.3.1.5.1 Test requirement for IAB type 1-O

TBA

8.1.3.1.5.2 Test requirement for IAB type 2-O

TBA

#### 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

TBA

8.1.3.2.1.2 Minimum Requirement

TBA

8.1.3.2.1.3 Test Purpose

TBA

8.1.3.2.1.4 Method of test

8.1.3.2.1.4.1 Initial Conditions

TBA

8.1.3.2.1.4.2 Procedure

TBA

8.1.3.2.1.5 Test Requirement

8.1.3.2.1.5.1 Test requirement for IAB type 1-O

TBA

8.1.3.2.1.5.2 Test requirement for IAB type 2-O

TBA

##### 8.1.3.2.2 ACK missed detection

8.1.3.2.2.1 Definition and applicability

TBA

8.1.3.2.2.2 Minimum Requirement

TBA

8.1.3.2.2.3 Test Purpose

TBA

8.1.3.2.2.4 Method of test

8.1.3.2.2.4.1 Initial Conditions

TBA

8.1.3.2.2.4.2 Procedure

TBA

8.1.3.2.2.5 Test Requirement

8.1.3.2.2.5.1 Test requirement for IAB type 1-O

TBA

8.1.3.2.2.5.2 Test requirement for IAB type 2-O

TBA

#### 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

TBA

8.1.3.3.1.2 Minimum Requirement

TBA

8.1.3.3.1.3 Test Purpose

TBA

8.1.3.3.1.4 Method of test

8.1.3.3.1.4.1 Initial Conditions

TBA

8.1.3.3.1.4.2 Procedure

TBA

8.1.3.3.1.5 Test Requirement

8.1.3.3.1.5.1 Test requirement for IAB type 1-O

TBA

8.1.3.3.1.5.2 Test requirement for IAB type 2-O

TBA

##### 8.1.3.3.2 UCI BLER performance requirements

8.1.3.3.2.1 Definition and applicability

TBA

8.1.3.3.2.2 Minimum Requirement

TBA

8.1.3.3.2.3 Test Purpose

8.1.3.3.2.4 Method of test

8.1.3.3.2.4.1 Initial Conditions

TBA

8.1.3.3.2.4.2 Procedure

TBA

8.1.3.3.2.5 Test Requirement

8.1.3.3.2.5.1 Test requirement for IAB type 1-O

TBA

8.1.3.3.2.5.2 Test requirement for IAB type 2-O

TBA

#### 8.1.3.4 Performance requirements for PUCCH format 3

##### 8.1.3.4.1 Definition and applicability

TBA

##### 8.1.3.4.2 Minimum Requirement

TBA

##### 8.1.3.4.3 Test Purpose

TBA

##### 8.1.3.4.4 Method of test

8.1.3.4.4.1 Initial Conditions

TBA

8.1.3.4.4.2 Procedure

TBA

##### 8.1.3.4.5 Test Requirement

8.1.3.4.5.1 Test requirement for IAB type 1-O

TBA

8.1.3.4.5.2 Test requirement for IAB type 2-O

TBA

#### 8.1.3.5 Performance requirements for PUCCH format 4

##### 8.1.3.5.1 Definition and applicability

TBA

##### 8.1.3.5.2 Minimum Requirement

TBA

##### 8.1.3.5.3 Test Purpose

TBA

##### 8.1.3.5.4 Method of test

8.1.3.5.4.1 Initial Conditions

TBA

8.1.3.5.4.2 Procedure

TBA

##### 8.1.3.5.5 Test Requirement

8.1.3.5.5.1 Test requirement for IAB type 1-O

TBA

8.1.3.5.5.2 Test requirement for IAB type 2-O

TBA

#### 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

TBA

8.1.3.6.1.1.2 Minimum Requirement

TBA

8.1.3.6.1.1.3 Test Purpose

8.1.3.6.1.1.4 Method of test

TBA

8.1.3.6.1.1.4.1 Initial Conditions

TBA

8.1.3.6.1.1.4.1 Procedure

TBA

8.1.3.6.1.1.5 Test Requirement

8.1.3.6.1.1.5.1 Test requirement for IAB type 1-O

TBA

8.1.3.6.1.1.5.2 Test requirement for IAB type 2-O

TBA

8.1.3.6.1.2 ACK missed detection

8.1.3.6.1.2.1 Definition and applicability

TBA

8.1.3.6.1.2.2 Minimum Requirement

TBA

8.1.3.6.1.2.3 Test Purpose

TBA

8.1.3.6.1.2.4 Method of test

8.1.3.6.1.2.4.1 Initial Conditions

TBA

8.1.3.6.1.2.4.1 Procedure

TBA

8.1.3.6.1.2.5 Test Requirement

8.1.3.6.1.2.5.1 Test requirement for IAB type 1-O

TBA

8.1.3.6.1.2.5.1 Test requirement for IAB type 2-O

TBA

### 8.1.4 Performance requirements for PRACH

#### 8.1.4.1 Performance requirements for PRACH false alarm probability and missed detection

##### 8.1.4.1.1 Definition and applicability

TBA

##### 8.1.4.1.2 Minimum requirement

TBA

##### 8.1.4.1.3 Test purpose

TBA

##### 8.1.4.1.4 Method of test

8.1.4.1.4.1 Initial conditions

TBA

8.1.4.1.4.2 Procedure

TBA

##### 8.1.4.1.5 Test requirement for Normal Mode

8.1.4.1.5.1 Test requirement for IAB type 1-O

TBA

8.1.4.1.5.2 Test requirement for IAB type 2-O

TBA

## 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 X. 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 8.2.1.2. 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*.

[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.]

Editor’s note: The above paragraph might no longer be required, if the test setup form the appendix is referenced.

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*).

#### 8.2.1.2 Applicability of requirements

##### 8.2.1.2.1 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.

##### 8.2.1.2.2 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.xxx in table xxx).

##### 8.2.1.2.3 Applicability of requirements for different channel bandwidths

Unless otherwise stated, for each subcarrier spacing declared to be supported, the tests for a specific channel bandwidth shall apply only if the IAB-MT supports it (see D.xxx in table xxx).

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.

##### 8.2.1.2.4 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.

### 8.2.2 Demodulation performance requirements

##### 8.2.2.1 Performance requirements for PDSCH

##### 8.2.2.1.1 Definition and applicability

##### 8.2.2.1.2 Minimum requirement

The performance requirements are determined by a minimum required throughput for a given SNR. The throughput shall be equal to or larger than the fraction of maximum throughput for the FRCs defined in annex A, for the cases stated in Table 8.2.2.1.2-2 to 8.2.2.1.2-3 at the given SNR with the test parameters stated in Table 8.2.2.1.2-1.

Table: 8.2.2.1.2-1 Test parameters for testing PDSCH

|  |  |  |
| --- | --- | --- |
| Parameter | | Value |
| Cyclic prefix | | Normal |
| Default TDD UL-DL pattern (Note 1) | | 3D1S1U, S=10D:2G:2U |
| HARQ | Maximum number of HARQ transmissions | 4 |
| RV sequence | 0, 2, 3, 1 |
| DM-RS | DM-RS configuration type | 1 |
| DM-RS duration | single-symbol DM-RS |
| DM-RS position (*l0*) | 2 |
| Additional DM-RS position | pos1 |
| Number of DM-RS CDM group(s) without data | 1 |
| DM-RS port(s) | {1000} for Rank 1 tests {1000-1001} for Rank 2 tests |
| DM-RS sequence generation | NID0=0 |
| Time domain resource assignment | PDSCH mapping type | A |
| Start symbol | 1 |
| Allocation length | 13 |
| Frequency domain resource assignment | RB assignment | Full applicable test bandwidth |
| PT-RS configuration | Frequency density (*KPT-RS*) | 2 |
| Time density (*LPT-RS*) | 1 |
| PRB bundling size | | 2 |
| VRB-to-PRB mapping type | | Not interleaved |
| PDSCH & PDSCH DMRS Precoding configuration | | Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i1, i2 combination, and with PRB bundling granularity |
| Note 1: The same requirements are applicable to TDD with different UL-DL patterns. | | |

Table 8.2.2.1.2-2: Minimum requirements for PDSCH Type A with Rank 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test number | FRC (Annex A) | Modulation format and code rate | Bandwidth (MHz) / Subcarrier spacing (kHz) | Propagation conditions (Annex G) | Antenna configuration | Fraction of maximum throughput (%) | SNR  (dB) |
| 1-1 | M-FR2-Ax-x | 16QAM, 0.48 | 100/120 | TDLA30-75 | 2x2, ULA Low | 30 | TBD |
| 1-2 | M–FR2-Ax-x | 64QAM, 0.46 | 100/120 | TDLA30-75 | 2x2, ULA Low | 70 | TBD |

Table 8.2.2.1.2-3: Minimum requirements for PDSCH Type A with Rank 2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test number | FRC (Annex A) | Modulation format and code rate | Bandwidth (MHz) / Subcarrier spacing (kHz) | Propagation conditions (Annex G) | Antenna configuration | Fraction of maximum throughput (%) | SNR  (dB) |
| 2-1 | M-FR1-Ax-x | 16QAM, 0.48 | 100/120 | TDLA30-75 | 2x2, ULA Low | 70 | TBD |
| 2-2 | M-FR1-Ax-x | 16QAM, 0.48 | 50/60 | TDLA30-75 | 2x2, ULA Low | 70 | 14.3 |
| 2-3 | M-FR1-Ax-x | 64QAM, 0.43 | 100/120 | TDLA30-75 | 2x2, ULA Low | 70 | 18.6 |

##### 8.2.2.1.3 Test purpose

##### 8.2.2.1.4 Method of test

8.2.2.1.4.1 Initial conditions

8.2.2.1.4.2 Procedure

##### 8.2.2.1.5 Test requirements

8.2.2.1.5.1 Test requirement for IAB type 1-O

8.2.2.1.5.2 Test requirement for IAB type 2-O

#### 8.2.2.2 Performance requirements for PDCCH

##### 8.2.2.2.1 Definition and applicability

##### 8.2.2.2.2 Minimum requirement

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

The Pm-dsg shall be equal to or smaller than 1%, for the cases stated in Table 8.2.2.2.2-2 at the given SNR with the test parameters stated in Table 8.2.2.2.2-1.

Table: 8.2.2.2.2-1 Test parameters for testing PDCCH

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

Table 8.2.2.2.2-2: Minimum requirements for PDCCH

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test number | Bandwidth (MHz) / Subcarrier spacing (kHz) | CORESET RB | CORESET duration | Aggregation level | FRC (Annex A) | Propagation conditions (Annex G) | Antenna configuration | Pm-dsg (%) | SNR  (dB) |
| 1 | 100/120 | 60 | 1 | 2 | M-FR1-Ax-x | TDLA30-75 | 1x2, ULA Low | 1 | 6.4 |
| 2 | 100/120 | 60 | 1 | 4 | M -FR1-Ax-x | TDLA30-75 | 1x2, ULA Low | 1 | TBD |
| 3 | 100/120 | 60 | 1 | 8 | M -FR1-Ax-x | TDLA30-75 | 2x2, ULA Low | 1 | 0.1 |

##### 8.2.2.2.3 Test purpose

##### 8.2.2.2.4 Method of test

8.2.2.2.4.1 Initial conditions

8.2.2.2.4.2 Procedure

##### 8.2.2.2.5 Test requirements

8.2.2.2.5.1 Test requirement for IAB type 1-O

8.2.2.2.5.2 Test requirement for IAB type 2-O

### 8.2.3 CSI reporting requirements

#### 8.2.3.1 General

##### 8.2.3.1.1 Applicability of requirements

##### 8.2.3.1.1.1 General

##### 8.2.3.1.1.2 Applicability of requirements for XXX

#### 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 [11]. To account for sensitivity of the input SNR the reporting definition is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

Which specific test(s) are applicable to IAB-MT is based on the test applicability rules defined in clause 8.1.2.1.

##### 8.2.3.2.2 Minimum requirement

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

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

##### 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.x.3.4.2-1.

**Table 8.x.3.4.2-1: Test parameters for testing CQI reporting requirements**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **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 |
| PDCCH & PDCCH DMRS Precoding configuration |  | Single Panel Type I, Random precoder chosen from precoder index 0 an 2, selection updated per slot |  |
| 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 |
| ZP CSI-RS for CSI acquisition | | Frequency Occupation |  | Start PRB 0  Number of PRB = BWP size | Start PRB 0  Number of PRB = BWP size |
| Note 1: PDSCH is not scheduled on slots containing CSI-RS or slots which are not full DL.  Note 2: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH transmission.  Note 3: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-1 [3] or 38.101-2 [4] for tested channel bandwidth and subcarrier spacing. | | | | | |

7) Adjust the test signal mean power so the calibrated radiated SNR value at the IAB-MT receiver is as specified in clause 8.x.3.1.5.1 and 8.x.3.1.5.2 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.x.3.4.2-2.

**Table 8.x.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 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.x.3.4.3.1-1, and using the downlink physical channels specified in Annex C.3.1, 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.

**Table 8.x.3.4.3.1-1: CQI reporting definition test**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **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 B.1 | | | |
| Beamforming Model | | |  | As specified in Annex B.4.1 | | | |
| 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 | | | |
| timeRestrictionForChannelMeasurements | | |  | Not configured | | | |
| timeRestrictionForInterferenceMeasurements | | |  | Not configured | | | |
| cqi-FormatIndicator | | |  | Wideband | | | |
| pmi-FormatIndicator | | |  | Wideband | | | |
| Sub-band Size | | | RB | 16 | | | |
| Csi-ReportingBand | | |  | 1111111 | | | |
| CSI-Report periodicity and offset | | | slot | 10/9 | | | |
| aperiodicTriggeringOffset | | |  | Not configured | | | |
| 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.4-2, TBS.2-4 | | | |

8.2.3.2.5.2 Test requirement for IAB type 2-O

For the parameters specified in Table 8.x.3.4.3.2-1, and using the downlink physical channels specified in Annex C.5.1, 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.

**Table 8.x.3.4.4.2-1 Test parameters**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **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 B.1 | | | |
| Beamforming Model | | |  | As specified in Annex B.4.1 | | | |
| 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 | | | |
| aperiodicTriggeringOffset | | |  | *Not configured* | | | |
| 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.4-1, TBS.1-2 | | | |

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

##### 8.2.3.3.1 Definition and applicability

##### 8.2.3.3.2 Minimum requirement

##### 8.2.3.3.3 Test purpose

##### 8.2.3.3.4 Method of test

8.2.3.3.4.1 Initial conditions

8.2.3.3.4.2 Procedure

##### 8.2.3.3.5 Test requirement

8.2.3.3.5.1 Test requirement for IAB type 1-O

8.2.3.3.5.2 Test requirement for IAB type 2-O

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

##### 8.2.3.4.1 Definition and applicability

##### 8.2.3.4.2 Minimum requirement

##### 8.2.3.4.3 Test purpose

##### 8.2.3.4.4 Method of test

8.2.3.4.4.1 Initial conditions

8.2.3.4.4.2 Procedure

##### 8.2.3.4.5 Test requirement

8.2.3.4.5.1 Test requirement for IAB type 1-O

8.2.3.4.5.2 Test requirement for IAB type 2-O

**<<end of second change>>**

Annex A (normative):   
Reference measurement channels

**<<start of third change>>**

## A.1 IAB-DU Fixed Reference Channels

### A.1.1 Fixed Reference Channels for PUSCH performance requirements (QPSK, R=193/1024)

The parameters for the reference measurement channels are specified in table A.1.1-1 and table A.1.1-2 for FR1 PUSCH performance requirements:

- FRC parameters are specified in table A.1.1-1 for FR1 PUSCH with transform precoding disabled, Additional DM-RS position = pos1 and 1 transmission layer.

- FRC parameters are specified in table A.1.1-2 for FR1 PUSCH with transform precoding disabled, Additional DM-RS position = pos1 and 2 transmission layers.

- FRC parameters are specified in table A.1.1-3 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.1.1-4 to table A.1.1-9 for FR2 PUSCH performance requirements:

- FRC parameters are specified in table A.1.1-4 for FR2 PUSCH with transform precoding disabled, Additional DM-RS position = pos0 and 1 transmission layer.

- FRC parameters are specified in table A.1.1-5 for FR2 PUSCH with transform precoding disabled, Additional DM-RS position = pos0 and 2 transmission layers.

- FRC parameters are specified in table A.1.1-6 for FR2 PUSCH with transform precoding enabled, Additional DM-RS position = pos0 and 1 transmission layer.

- FRC parameters are specified in table A.1.1-7 for FR2 PUSCH with transform precoding disabled, Additional DM-RS position = pos1 and 1 transmission layer.

- FRC parameters are specified in table A.1.1-8 for FR2 PUSCH with transform precoding disabled, Additional DM-RS position = pos1 and 2 transmission layers.

- FRC parameters are specified in table A.1.1-9 for FR2 PUSCH with transform precoding enabled, Additional DM-RS position = pos1 and 1 transmission layer.

**Table A.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-A1.1-1** | **D-FR1-A1.1-2** | **D-FR1-A1.1-3** | **D-FR1-A1.1-4** | **D-FR1-A1.1-5** | **D-FR1-A1.1-6** | **D-FR1-A1.1-7** |
| 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 (Note 2) | 193/1024 | 193/1024 | 193/1024 | 193/1024 | 193/1024 | 193/1024 | 193/1024 |
| Payload size (bits) | 1352 | 2856 | 5768 | 1320 | 2792 | 5768 | 14856 |
| Transport block CRC (bits) | 16 | 16 | 24 | 16 | 16 | 24 | 24 |
| Code block CRC size (bits) | - | - | 24 | - | - | 24 | 24 |
| Number of code blocks - C | 1 | 1 | 2 | 1 | 1 | 2 | 4 |
| Code block size including CRC (bits) (Note 2) | 1368 | 2872 | 2920 | 1336 | 2808 | 2920 | 3744 |
| Total number of bits per slot | 7200 | 14976 | 30528 | 6912 | 14688 | 30528 | 78624 |
| Total symbols per slot | 3600 | 7488 | 15264 | 3456 | 7344 | 15264 | 39312 |
| NOTE 1: *DM-RS configuration type*  = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos1*, *l0*= 2 and *l* =11 for PUSCH mapping type A, *l0*= 0 and *l* =10 for PUSCH mapping type B as per table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [9]. | | | | | | | |

### A.1.2 Fixed Reference Channels for PUSCH performance requirements (16QAM, R=434/1024)

The parameters for the reference measurement channels are specified in table A.1.2-1 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.1.2-2 for FR2 PUSCH performance requirements with transform precoding disabled, additional DM-RS position = pos1 and 2 transmission layers.

### A.1.3 Fixed Reference Channels for PUSCH performance requirements (16QAM, R=658/1024)

The parameters for the reference measurement channels are specified in table A.1.3-1 and table A.1.3-2 for FR1 PUSCH performance requirements:

- FRC parameters are specified in table A.1.3-1 for FR1 PUSCH with transform precoding disabled, Additional DM-RS position = pos1 and 1 transmission layer.

- FRC parameters are specified in table A.1.3-2 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.1.3-3 to table A.1.3-6 for FR2 PUSCH performance requirements:

- FRC parameters are specified in table A.1.3-3 for FR2 PUSCH with transform precoding disabled, Additional DM-RS position = pos0 and 1 transmission layer.

- FRC parameters are specified in table A.1.3-4 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.1.3-6 for FR2 PUSCH with

### A.1.4 Fixed Reference Channels for PUSCH performance requirements (64QAM, R=567/1024)

The parameters for the reference measurement channels are specified in table A.1.4-1 for FR1 PUSCH performance requirements:

- FRC parameters are specified in table A.1.4-1 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.1.4-2 and table A.1.4-3 for FR2 PUSCH performance requirements:

- FRC parameters are specified in table A.1.4-2 for FR2 PUSCH with transform precoding disabled, Additional DM-RS position = pos0 and 1 transmission layer.

- FRC parameters are specified in table A.1.4-3 for FR2 PUSCH with transform precoding disabled, Additional DM-RS position = pos1 and 1 transmission layer.

### A.1.5 PRACH Test preambles

## A.2 IAB-MT Fixed Reference Channels

### A.2.1 Fixed Reference Channels for PDSCH performance requirements (16QAM)

The parameters for the reference measurement channels are specified in table A.2.1-1 for FR1 PDSCH performance requirements.

The parameters for the reference measurement channels are specified in table A.2.1-2 for FR2 PDSCH performance requirements.

**Table A.2.1-1: FRC parameters for FR1 PDSCH performance requirements, 1-4 transmission layers, 16QAM**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **Value** | | | |
| Reference channel |  | **M-FR1-A2.1-1** | **M-FR1-A2.1-2** | **M-FR1-A2.1-3** | **M-FR1-A2.1-4** |
| Channel bandwidth | MHz | 40 | 40 | 40 | 40 |
| Subcarrier spacing | kHz | 30 | 30 | 30 | 30 |
| Allocated resource blocks | PRBs | 106 | 106 | 106 | 106 |
| Number of consecutive PDSCH symbols |  | 12 | 12 | 12 | 12 |
| MCS table |  | 64QAM | 64QAM | 64QAM | 64QAM |
| MCS index |  | 13 | 13 | 13 | 13 |
| Modulation |  | 16QAM | 16QAM | 16QAM | 16QAM |
| Target Coding Rate |  | 0.48 | 0.48 | 0.48 | 0.48 |
| Number of MIMO layers |  | 1 | 2 | 3 | 4 |
| Number of DMRS REs |  | 12 | 12 | 24 | 24 |
| Overhead for TBS determination |  | 0 | 0 | 0 | 0 |
| Information Bit Payload per Slot |  | 26632 | 53288 | 73776 | 98376 |
| Transport block CRC per Slot |  | 24 | 24 | 24 | 24 |
| Number of Code Blocks per Slot |  | 4 | 7 | 9 | 12 |
| Binary Channel Bits Per Slot |  | 55968 | 111936 | 152640 | 203520 |

**Table A.2.1-2: FRC parameters for FR2 PDSCH performance requirements, 1-2 transmission layers, 16QAM**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **Value** | | | | |
| Reference channel |  | **M-FR2-A2.1-1** | **M-FR2-A2.1-2** | **M-FR2-A2.1-3** | **M-FR2-A2.1-4** | **M-FR2-A2.1-5** |
| Channel bandwidth | MHz | 50 | 50 | 100 | 100 | 200 |
| Subcarrier spacing | kHz | 60 | 120 | 120 | 120 | 120 |
| Allocated resource blocks | PRBs | 66 | 32 | 66 | 66 | 132 |
| Number of consecutive PDSCH symbols |  | 13 | 13 | 13 | 13 | 13 |
| MCS table |  | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| MCS index |  | 13 | 13 | 13 | 13 | 13 |
| Modulation |  | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Target Coding Rate |  | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 |
| Number of MIMO layers |  | 2 | 2 | 1 | 2 | 2 |
| Number of DMRS REs |  | 12 | 12 | 12 | 12 | 12 |
| Overhead for TBS determination |  | 6 | 6 | 6 | 6 | 6 |
| Information Bit Payload per Slot |  | 34816 | 16896 | 17424 | 34816 | 69672 |
| Transport block CRC per Slot |  | 24 | 24 | 24 | 24 | 24 |
| Number of Code Blocks per Slot |  | 5 | 3 | 3 | 5 | 9 |
| Binary Channel Bits Per Slot |  | 73128 | 35456 | 36564 | 73128 | 146256 |

### A.2.2 Fixed Reference Channels for PDSCH performance requirements (64QAM)

The parameters for the reference measurement channels are specified in table A.2.2-1 for FR1 PDSCH performance requirements.

The parameters for the reference measurement channels are specified in table A.2.2-2 for FR2 PDSCH performance requirements.

### A.2.3 Fixed Reference Channels for PDSCH performance requirements (256QAM)

The parameters for the reference measurement channels are specified in table A.2.3-1 for FR1 PDSCH performance requirements.

### A.2.4 Fixed Reference Channels for PDCCH performance requirements

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

The parameters for the reference measurement channels are specified in table A.2.4-2 for FR2 PDCCH performance requirements.

### A.2.5 Fixed Reference Channels for CSI reporting requirements

**<<end of third change>>**

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

**<<start of FORTH change>>**

## C.3 Measurement of performance requirements

### C.3.1 IAB-DU TTs

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

|  |  |  |  |
| --- | --- | --- | --- |
| Test | Minimum Requirement in TS 38.104 [2] | Test Tolerance (TTOTA) | Test requirement in the present document |
| 8.2.1 Performance requirements for PUSCH with transform precoding disabled | See clause 11.2.1.1 | 0.6 dB | Formula: SNR + TTOTA  T-put limit unchanged |
| 8.2.2 Performance requirements for PUSCH with transform precoding enabled | See clause 11.2.1.2 | 0.6 dB | Formula: SNR + TTOTA  T-put limit unchanged |
| 8.2.3 Performance requirements for UCI multiplexed on PUSCH | See clause 11.2.1.3 | 0.6 dB | Formula: SNR + TTOTA  BLER limit unchanged |
| 8.3.1 Performance requirements for PUCCH format 0 | See clause 11.3.1.2 | 0.6 dB | Formula: SNR + TTOTA  False ACK limit unchanged  Correct ACK limit unchanged |
| 8.3.2 Performance requirements for PUCCH format 1 | See clause 11.3.1.3 | 0.6 dB | Formula: SNR + TTOTA  False ACK limit unchanged  False NACK limit unchanged  Correct ACK limit unchanged |
| 8.3.3 Performance requirements for PUCCH format 2 | See clause 11.3.1.4 | 0.6 dB | Formula: SNR + TTOTA  False ACK limit unchanged  Correct ACK limit unchanged  UCI BLER limit unchanged |
| 8.3.4 Performance requirements for PUCCH format 3 | See clause 11.3.1.5 | 0.6 dB | Formula: SNR + TTOTA  UCI BLER limit unchanged |
| 8.3.5 Performance requirements for PUCCH format 4 | See clause 11.3.1.6 | 0.6 dB | Formula: SNR + TTOTA  UCI BLER limit unchanged |
| 8.3.6 Performance requirements for multi-slot PUCCH | See clause 11.3.1.7 | 0.6 dB | Formula: SNR + TTOTA  False ACK limit unchanged  False NACK limit unchanged  Correct ACK limit unchanged |
| 8.4.1 PRACH false alarm probability and missed detection | See clause 11.4.1 | 0.6 dB for fading cases  0.3 dB for AWGN cases | Formula: SNR + TTOTA  PRACH False detection limit unchanged  PRACH detection limit unchanged |
| NOTE: TT values are applicable for normal condition unless otherwise stated. | | | |

Table C.3.1-2: Derivation of test requirements (FR2 OTA performance tests)

|  |  |  |  |
| --- | --- | --- | --- |
| Test | Minimum requirement in TS 38.104 [2] | Test Tolerance (TTOTA) | Test requirement in the present document |
| 8.2.1 Performance requirements for PUSCH with transform precoding disabled | See clause 11.2.2.1 | 0.6 dB | Formula: SNR + TTOTA  T-put limit unchanged |
| 8.2.2 Performance requirements for PUSCH with transform precoding enabled | See clause 11.2.2.2 | 0.6 dB | Formula: SNR + TTOTA  T-put limit unchanged |
| 8.2.3 Performance requirements for UCI multiplexed on PUSCH | See clause 11.2.2.3 | 0.6 dB | Formula: SNR + TTOTA  BLER limit unchanged |
| 8.3.1 Performance requirements for PUCCH format 0 | See clause 11.3.2.2 | 0.6 dB | Formula: SNR + TTOTA  False ACK limit unchanged  Correct ACK limit unchanged |
| 8.3.2 Performance requirements for PUCCH format 1 | See clause 11.3.2.3 | 0.6 dB | Formula: SNR + TTOTA  False ACK limit unchanged  False NACK limit unchanged  Correct ACK limit unchanged |
| 8.3.3 Performance requirements for PUCCH format 2 | See clause 11.3.2.4 | 0.6 dB | Formula: SNR + TTOTA  False ACK limit unchanged  Correct ACK limit unchanged  UCI BLER limit unchanged |
| 8.3.4 Performance requirements for PUCCH format 3 | See clause 11.3.2.5 | 0.6 dB | Formula: SNR + TTOTA  UCI BLER limit unchanged |
| 8.3.5 Performance requirements for PUCCH format 4 | See clause 11.3.2.6 | 0.6 dB | Formula: SNR + TTOTA  UCI BLER limit unchanged |
| 8.4.1 PRACH false alarm probability and missed detection | See clause 11.4.2 | 0.6 dB for fading cases  0.3 dB for AWGN cases | 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 TTs

TBA

**<<end of forth change>>**

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

**<<start of fifth change>>**

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

### E.X.1 PUSCH and PUCCH single antenna port in multipath fading

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

### E.X.3 PUSCH, PRACH, CSI in static AWGN

**<<end of fifth change>>**

Annex J (normative):  
Propagation conditions

**<<start of sixth change>>**

## 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.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 - 7.125 GHz) and FR2 (24.25 GHz – 52.6 GHz).

### J.2.1 Delay profiles

The delay profiles are simplified from the TR 38.901 [xx] 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 J.2.1.1 can be used as such.

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

- 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 [xx].

- 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, and J.2.1.1-4 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 G.2.1.1-2 ~ table 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 |  |
| 2 | 10 | 0 |  |
| 3 | 15 | -5.1 |  |
| 4 | 20 | -5.1 |  |
| 5 | 25 | -9.6 |  |
| 6 | 50 | -8.2 | Rayleigh |
| 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 |  |
| 2 | 10 | -2.2 |  |
| 3 | 20 | -0.6 |  |
| 4 | 30 | -0.6 |  |
| 5 | 35 | -0.3 |  |
| 6 | 45 | -1.2 | Rayleigh |
| 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 |  |
| 2 | 65 | 0 |  |
| 3 | 70 | -7.7 |  |
| 4 | 190 | -2.5 |  |
| 5 | 195 | -2.4 |  |
| 6 | 200 | -9.9 | Rayleigh |
| 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.2.2 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 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.

**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 |
| TDLC300-600 | TDLC300 | 600 Hz |
| TDLC300-1200 | TDLC300 | 1200 Hz |

### J.2.3 MIMO channel correlation matrices

The MIMO channel correlation matrices defined in annex G.2.3 apply for the antenna configuration using uniform linear arrays at both IAB and UE and for the antenna configuration using cross polarized antennas.

#### J.2.3.1 MIMO correlation matrices using Uniform Linear Array

The MIMO channel correlation matrices defined in annex G.2.3.1 apply for the antenna configuration using uniform linear array (ULA) at both IAB and UE.

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

Table G.2.3.1.1-1 defines the correlation matrix for the IAB.

**Table G.2.3.1.1-1: IAB correlation matrix**

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

Table G.2.3.1.1-2 defines the correlation matrix for the UE:

**Table G.2.3.1.1-2: UE correlation matrix**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **One antenna** | **Two antennas** | **Four antennas** |
| UE correlation |  |  |  |

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

**Table G.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 or UE 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 α and β for different correlation types are given in table G.2.3.1.2-1.

**Table G.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 G.2.3.1.2-2, G.2.3.1.2-3 and G.2.3.1.2-4 as below.

The values in table G.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 G.2.3.1.2-3 to insure the correlation matrix is positive semi-definite after round-off to 4 digit precision with a = 0.00012.

**Table G.2.3.1.2-2: MIMO correlation matrices for high correlation**

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

**Table G.2.3.1.2-3: MIMO correlation matrices for medium correlation**

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

**Table G.2.3.1.2-4: MIMO correlation matrices for low correlation**

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

In table G.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 annex G.2.3.2 apply to two cases as presented below:

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

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

The cross-polarized antenna elements with +/-45 degrees polarization slant angles are deployed at IAB. 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 IAB with same polarization,

-  is a polarization correlation matrix,

-  is a permutation matrix, and

- denotes transpose.

Table G.2.3.2.1-1 defines the polarization correlation matrix.

**Table G.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 G.2.3.2.

##### J.2.3.2.2 Spatial correlation matrices at UE and IAB sides

J.2.3.2.2.1 Spatial correlation matrices at UE 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 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 G.2.3.2.3-1.

**Table G.2.3.2.3-1: Values for parameters α,  and γ**

|  |  |  |
| --- | --- | --- |
| **Low spatial correlation** | | |
|  |  |  |
| 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 G.2.3.2.3-2 as below.

**Table G.2.3.2.3-2: MIMO correlation matrices for low spatial correlation**

|  |  |
| --- | --- |
| 1x8 case |  |
| 2x8 case |  |

In table G.2.3.2.3-2,  is a  identity matrix.

**<<end of sixth change>>**