**3GPP TSG-RAN4 WG4 Meeting #** **100-e *R4-2115866***

**Electronic meeting, August. 16- 27, 2021**

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| *CR-Form-v12.1* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.174** | **CR** | xxx | **rev** | - | **Current version:** | **16.3.0** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network | **X** | Core Network |  |

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| ***Title:*** | Big CR for TS 38.174 Maintenance | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | MCC, CATT | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | IAB-Core  NR\_IAB-Perf | | | | |  | ***Date:*** | | | 2021-08-29 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | F |  | | | | | ***Release:*** | | | Rel-16 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-15 (Release 15) Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | This big CRs merge the mutile endorsed draf CRs: R4-2114431, R4-2114432, R4-2115703, R4-2115715, R4-2115718.  The reason for change in each endorsed draft CR is copied below.  R4-2114431 Side conditions in IAB-MT RRC connection mobility requirements in TS 38.174  To define side conditions in IAB-MT RRM core equirements  R4-2114432 Correction to IAB-MT RRM tests in TS 38.174  To correct reference to SNR conditions for IAB-MT supporting 4 Rx which is defined in TS 38.174.  R4-2115703 CR on further clear up on general chapter  Missing the test specificaiton reference  R4-2115715 draftCR on IAB-MT conducted performance requirements (General and Demodulation) in TS 38.174  Provide updated draft CR for NR IAB-MT conducted performance requirements (General and Demodulation) as per work split.  R4-2115718 draftCR to TS 38.174 IAB-MT CSI reporting radiated performance requirements  Provide corrections to the first published version of the TS sections on IAB-MR CSI reporting radiated perefomance requirements as per work split. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | The summary of change in each each endorsed draft CR is copied below.  R4-2114431 Side conditions in IAB-MT RRC connection mobility requirements in TS 38.174  Side conditions in terms of SSB Es/Iot and min SSB\_RP for different IAB-MT class and IAB type are defined in annex H.1 of TS 38.174.  The references to the above side conditions in annex H.1 are included in the following core requirements:   * IAB-MT RRC connection re-establishment requirements * IAB-MT RRC connection release with redirection requirements   R4-2114432 Correction to IAB-MT RRM tests in TS 38.174  In current RM tests the SNR during the test time is incorrectly referenced to TS 38.133.  For testing of an IAB-MT which supports 4RX on all bands, the SNR during the test time is defined in clause G.1.3 of TS 38.174.  R4-2115703 CR on further clear up on general chapter  Update the test specificaiton reference  R4-2115715 draftCR on IAB-MT conducted performance requirements (General and Demodulation) in TS 38.174  For introducing IAB-MT conducted performance requirements (General and Demodulation), update clause 2, 8.2, Annex I.  R4-2115718 draftCR to TS 38.174 IAB-MT CSI reporting radiated performance requirements   1. Editorial changes 2. Clearning Section 11.2.3.2.1.1 with requirement applicailbity | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | The consequences if not approved for each endorsed draft CR are coppied below.  R4-2114431 Side conditions in IAB-MT RRC connection mobility requirements in TS 38.174  Incorrect side conditions in IAB-MT RRC connection mobility requirements.  R4-2114432 Correction to IAB-MT RRM tests in TS 38.174  Incorrect SNR conditions for IAB-MT supporting 4 Rx.  R4-2115703 CR on further clear up on general chapter  Missing the test specificaiton reference  R4-2115715 draftCR on IAB-MT conducted performance requirements (General and Demodulation) in TS 38.174  There will be inconsistence between the specification 38.174 and RAN 4 agreements.  R4-2115718 draftCR to TS 38.174 IAB-MT CSI reporting radiated performance requirements  It will be inconsistencies in the specification 38.174 | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | R4-2114431 Side conditions in IAB-MT RRC connection mobility requirements in TS 38.174  12.1.1.1.2.1, 12.1.1.3.2.1  R4-2114432 Correction to IAB-MT RRM tests in TS 38.174  G.2.3.1.1.1, G.2.3.1.2.1, G.2.3.1.3.1 and G.2.3.1.4.1  R4-2115703 CR on further clear up on general chapter  2; 4.2  R4-2115715 draftCR on IAB-MT conducted performance requirements (General and Demodulation) in TS 38.174  2, 8.2, Annex I  R4-2115718 draftCR to TS 38.174 IAB-MT CSI reporting radiated performance requirements  11.2.3.2 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **x** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | | **X** |  | Test specifications | | | | TS 38.176-1, TS 38.176-2 | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

***<Start of change1>***

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 38.104: “NR; Base Station (BS) radio transmission and reception”

[3] 3GPP TS 38.101-1: “NR User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone”

[4] 3GPP TS 38.101-2: “NR User Equipment (UE) radio transmission and reception: Part 2: Range 2 Standalone”

[5] 3GPP TS 38.101-3: "NR; User Equipment (UE) radio transmission and reception; Part 3: Range 1 and Range 2 Interworking operation with other radios "

[6] 3GPP TS 38.133: “NR: Requirements for support of radio resource management”

[7] 3GPP TS 38.300: "NR; Overall description; Stage-2".

[8] 3GPP TS 38.211: "NR; Physical channels and modulation”.

[9] 3GPP TS 38.212 "NR; Multiplexing and channel coding".

[10] 3GPP TS 38.213: "NR; Physical layer procedures for control".

[11] 3GPP TS 38.214: "NR; Physical layer procedures for data".

[12] 3GPP TS 38.215: "NR; Physical layer measurements".

[13] 3GPP TS 38.304: "NR; User Equipment (UE) procedures in idle mode".

[14] 3GPP TS 38.321: "NR; Medium Access Control (MAC) protocol specification".

[15] 3GPP TS 38.331: "NR; Radio Resource Control (RRC); Protocol specification".

[16] ITU-R Recommendation SM.329: "Unwanted emissions in the spurious domain".

[17] ERC Recommendation 74-01, "Unwanted emissions in the spurious domain".

[18] ITU-R Recommendation M.1545: “Measurement uncertainty as it applies to test limits for the terrestrial component of International Mobile Telecommunications – 2000”

[19] Recommendation ITU-R SM.328: "Spectra and bandwidth of emissions".

[20] "Title 47 of the Code of Federal Regulations (CFR)", Federal Communications Commission.

[21] 3GPP TS 38.141-2: "NR; Base Station (BS) conformance testing; Part 2: Radiated conformance testing".

[22] 3GPP TS 38.141-1: "NR; Base Station (BS) conformance testing; Part 1: Conducted conformance testing".

[23] 3GPP TS 38.521-1: “NR; User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: Range 1 Standalone”.

[24] 3GPP TS 38.521-2: “NR; User Equipment (UE) conformance specification; Radio transmission and reception; Part 2: Range 2 Standalone”.

[25] 3GPP TS 38.176-1: "NR; Integrated Access and Backhaul (IAB) conformance testing; Part 1: Conducted conformance testing".

[26] 3GPP TS 38.176-2: "NR; Integrated Access and Backhaul (IAB) conformance testing; Part 2: Radiated conformance testing".

[27] 3GPP TR 38.901: "Study on channel model for frequencies from 0.5 to 100 GHz"

***<End of change1>***

***<Start of change2>***

## 4.2 Relationship between minimum requirements and test requirements

Conformance to the present specification is demonstrated by fulfilling the test requirements specified in the conformance specification TS 38.176-1 [25] and TS 38.176-2 [26].

The minimum requirements given in this specification make no allowance for measurement uncertainty. The test specifications TS 38.176-1 [25] and TS 38.176-2 [26] define test tolerances. These test tolerances are individually calculated for each test. The test tolerances are used to relax the minimum requirements in this specification to create test requirements. For some requirements, including regulatory requirements, the test tolerance is set to zero.

The measurement results returned by the test system are compared - without any modification - against the test requirements as defined by the shared risk principle.

The shared risk principle is defined in recommendation ITU‑R M.1545 [18].

***<End of change2>***

***<Start of change3>***

## 8.2 IAB-MT requirements

### 8.2.1 General

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

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

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

SNR = S / N

Where:

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

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

### 8.2.2 Demodulation performance requirements

#### 8.2.2.1 Performance requirements for PDSCH

##### 8.2.2.1.1 General

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

Table: 8.2.2.1.1-1 Test parameters for testing PDSCH

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

##### 8.2.2.1.2 Minimum requirements

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

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

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

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

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

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

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

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

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

#### 8.2.2.2 Performance requirements for PDCCH

##### 8.2.2.2.1 General

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

Table: 8.2.2.2.1-1 Test parameters for testing PDCCH

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

##### 8.2.2.2.2 Minimum requirements

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

Table 8.2.2.2.2-1: Minimum requirements for PDCCH

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

***<End of change3>***

***<Start of change4>***

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

##### 11.2.3.2.1 General

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

11.2.3.2.1.1 Void

Void

11.2.3.2.1.2 Common test parameters

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

Table 11.2.3.2.1.2-1: Test parameters for CSI test cases

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | | Unit | Value |
| PDSCH transmission scheme | | |  | Transmission scheme 1 |
| Duplex Mode | | |  | TDD |
| PTRS *epre-Ratio* | | |  | 0 |
| Actual carrier configuration | | Offset between Point A and the lowest usable subcarrier on this carrier (Note 3) | RBs | 0 |
| Subcarrier spacing | kHz | 120 |
| DL BWP configuration #1 | | Cyclic prefix |  | Normal |
| RB offset | RBs | 0 |
| Number of contiguous PRB | PRBs | Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-2 [4] for tested channel bandwidth and subcarrier spacing |
| Active DL BWP index | | |  | 1 |
| PDSCH configuration | Mapping type | |  | Type A |
| *k0* | |  | 0 |
| Starting symbol (S) | |  | 2 |
| Length (L) | |  | 12 |
| PDSCH aggregation factor | |  | 1 |
| PRB bundling type | |  | Static |
| PRB bundling size | |  | 2 |
| Resource allocation type | |  | Type 0 |
| RBG size | |  | Config2 |
| VRB-to-PRB mapping type | |  | Non-interleaved |
| VRB-to-PRB mapping interleaver bundle size | |  | N/A |
| PDSCH DMRS configuration | DMRS Type | |  | Type 1 |
| Number of additional DMRS | |  | 1 |
| DMRS ports indexes | |  | {1000} for Rank1  {1000,1001} for Rank2 |
| Maximum number of OFDM symbols for DL front loaded DMRS | |  | 1 |
| Number of PDSCH DMRS CDM group(s) without data | |  | 2 |
| PTRS configuration | Frequency density (*KPT-RS*) | |  | 2 |
| Time density (*LPT-RS*) | |  | 1 |
| Resource Element Offset | |  | 2 |
| NZP CSI-RS for CSI acquisition | | Frequency Occupation |  | Start PRB 0  Number of PRB = BWP size |
| Number of HARQ Processes | | |  | 8 |
| HARQ ACK/NACK bundling | | |  | Multiplexed |
| Redundancy version coding sequence | | |  | {0,2,3,1} |
| Physical signals, channels mapping and precoding | | |  | As specified in Annex I.3.1 |
| Note 1: PDSCH is scheduled only on full DL slots without CSI-RS resource and TRS allocated.  Note 2: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-2 [4] for tested channel bandwidth and subcarrier spacing. | | | | |

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

11.2.3.2.2.1 General

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

Table 11.2.3.2.2.1-1: Test parameters

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

11.2.3.2.2.2 Minimum requirements

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

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

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

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

11.2.3.2.3.1 General

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

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



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

Table 11.2.3.2.3.1-1: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Test 1** |
| Bandwidth | | MHz | 100 |
| Subcarrier spacing | | kHz | 120 |
| Default TDD UL-DL pattern (Note 1) | |  | 3D1S1U |
| Special Slot Configuration | |  | 10D+2G+2U |
| Propagation channel | |  | TDLA30-35 |
| Antenna configuration | |  | 2 x 2 ULA Low |
| Beamforming Model | |  | As specified in Annex I.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, l1) |  | (13,-) |
| CSI-RS  interval and offset | slot | 8/1 |
| ReportConfigType | |  | Periodic |
| CQI-table | |  | Table 1 |
| reportQuantity | |  | cri-RI-PMI-CQI |
| cqi-FormatIndicator | |  | Wideband |
| pmi-FormatIndicator | |  | Wideband |
| Sub-band Size | | RB | 8 |
| csi-ReportingBand | |  | 111111111 |
| CSI-Report interval and offset | | slot | 8/3 |
| Codebook configuration | Codebook Type |  | typeI-SinglePanel |
| Codebook Mode |  | 1 |
| (CodebookConfig-N1,CodebookConfig-N2) |  | N/A |
| CodebookSubsetRestriction |  | 001111 |
| RI Restriction |  | N/A |
| CQI/RI/PMI delay | | ms | 1.75 |
| Maximum number of HARQ transmission | |  | 4 |
| Measurement channel | |  | M-FR2-A.3.5-3 |
| Note 1: The same requirements are applicable for TDD with different UL-DL pattern.  Note 2: For random precoder selection, the precoder shall be updated in each slot (0.125 ms granularity).  Note 3: If the UE reports in an available uplink reporting instance at slot #n based on PMI estimation at a downlink slot not later than slot#(n-4), this reported PMI cannot be applied at the gNB downlink before slot#(n+4).  Note 4: Randomization of the principle beam direction shall be used as specified in Annex I.2.3.2.3.  Note 5: SSB, TRS, CSI-RS and/or other unspecified test parameters with respect to TS 38.101-4 [TBA] are left up to test implementation, if transmitted or needed. | | | |

11.2.3.2.3.2 Minimum requirements

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

Table 11.2.3.2.3.2-1: Minimum requirement

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

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

11.2.3.2.4.1 General

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

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

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

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

Table 11.2.3.2.4.1-1: Test parameters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Test 1** | **Test 2** | **Test 3** |
| Bandwidth | | | MHz | 100 | 100 | 100 |
| Subcarrier spacing | | | kHz | 120 | 120 | 120 |
| Duplex Mode | | |  | TDD | TDD | TDD |
| Default TDD UL-DL pattern (Note 1) | | |  | 3D1S1U | 3D1S1U | 3D1S1U |
| Special Slot Configuration | | |  | 10D+2G+2U | 10D+2G+2U | 10D+2G+2U |
| SNR | | | dB | 0 | 16 | 16 |
| Propagation channel | | |  | TDLA30-35 | TDLA30-35 | TDLA30-35 |
| Antenna configuration | | |  | ULA Low 2x2 | ULA Low 2x2 | XP High 2x2 |
| Beamforming Model | | |  | As defined in Annex I.3.1 | As defined in Annex I.3.1 | As defined in Annex I.3.1 |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type | |  | Periodic | Periodic | Periodic |
| Number of CSI-RS ports (*X*) | |  | 2 | 2 | 2 |
| CDM Type | |  | FD-CDM2 | FD-CDM2 | FD-CDM2 |
| Density (ρ) | |  | 1 | 1 | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0, k1 ) | |  | Row 3 (6,-) | Row 3 (6,-) | Row 3 (6,-) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) | |  | (13,-) | (13,-) | (13,-) |
| NZP CSI-RS-timeConfig  interval and offset | | slot | 8/1 | 8/1 | 8/1 |
| ReportConfigType | | |  | Periodic | Periodic | Periodic |
| CQI-table | | |  | Table 1 | Table 1 | Table 1 |
| reportQuantity | | |  | cri-RI-PMI-CQI | cri-RI-PMI-CQI | cri-RI-PMI-CQI |
| cqi-FormatIndicator | | |  | Wideband | Wideband | Wideband |
| pmi-FormatIndicator | | |  | Wideband | Wideband | Wideband |
| Sub-band Size | | | RB | 8 | 8 | 8 |
| csi-ReportingBand | | |  | 111111111 | 111111111 | 111111111 |
| CSI-Report interval and offset | | | slot | 8/3 | 8/3 | 8/3 |
| Codebook configuration | | Codebook Type |  | typeI-SinglePanel | typeI-SinglePanel | typeI-SinglePanel |
| Codebook Mode |  | 1 | 1 | 1 |
| (CodebookConfig-N1,CodebookConfig-N2) |  | N/A | N/A | N/A |
| CodebookSubsetRestriction |  | 010000 for fixed rank 2,  010011 for following rank | 000011 for fixed rank 1,  010011 for following rank | 000011 for fixed rank 1,  010011 for following rank |
| RI Restriction |  | N/A | N/A | N/A |
| CQI/RI/PMI delay | | | ms | 1.375 | 1.375 | 1.375 |
| Maximum number of HARQ transmission | | |  | 1 | 1 | 1 |
| RI Configuration | | |  | Fixed RI = 2 and follow RI | Fixed RI = 1 and follow RI | Fixed RI = 1 and follow RI |
| Note 1: The same requirements are applicable to with different UL-DL patterns.  Note 2: SSB, TRS, CSI-RS and/or other unspecified test parameters with respect to TS 38.101-4 [TBA] are left up to test implementation, if transmitted or needed.  Note 3: Measurements channels are specified in Table A.3.5-2. M-FR2-A.3.5-1 is used for Rank 1 case. M-FR2-A.3.5-2 is used for Rank 2 case. | | | | | | |

11.2.3.2.4.2 Minimum requirements

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

Table 11.2.3.2.4.2-1: Minimum requirement

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

***<End of change4>***

***<Start of change5>***

###### 12.1.1.1.2.1 IAB MT Re-establishment delay requirement

The IAB-MT re-establishment delay (TIAB-MT\_re-establish\_delay) is the time between the moments when any of the conditions requiring RRC re-establishment as defined in clause 5.3.7 in TS 38.331 [15] is detected by the IAB-MT and when the IAB-MT sends PRACH to the target PCell. The IAB-MT re-establishment delay (TIAB-MT\_re-establish\_delay) requirement shall be less than:

The intra-frequency target NR cell shall be considered detectable if each relevant SSB can satisfy that:

- the conditions of SSB\_RP and SSB Ês/Iot according to Annex H.1.1.1 for a corresponding IAB-MT class and IAB type are fulfilled.

The inter-frequency target NR cell shall be considered detectable when for each relevant SSB:

- the conditions of SSB\_RP and SSB Ês/Iot according to Annex H.1.1.2 for a corresponding IAB-MT class and IAB type are fulfilled.

Tidentify\_intra\_NR: It is the time to identify the target intra-frequency NR cell and it depends on whether the target NR cell is known cell or unknown cell and on the frequency range (FR) of the target NR cell. If the IAB-MT is not configured with intra-frequency NR carrier for RRC re-establishment then Tidentify\_intra\_NR=0; otherwise Tidentify\_intra\_NR shall not exceed the values defined in Table 12.1.1.1.2.1-1.

Tidentify\_inter\_NR,i: It is the time to identify the target inter-frequency NR cell on inter-frequency carrier *i* configured for RRC re-establishment and it depends on whether the target NR cell is known cell or unknown cell and on the frequency range (FR) of the target NR cell. Tidentify\_inter\_NR,i shall not exceed the values defined in Table 12.1.1.1.2.1-2.

TSMTC: It is the periodicity of the SMTC occasion configured for the intra-frequency carrier. If the IAB-MT has been provided with higher layer signaling of *smtc2* [15] and is not capable of 4 SMTC configurations per frequency [15], then TSMTC follows *smtc1* or *smtc2* according to the physical cell ID of the target cell. If the IAB-MT has been provided with higher layer signaling of *smtcj*, where 1≤*j*≤4 [15] and is also capable of 4 SMTC configurations per frequency [15], then TSMTC follows *smtcj* according to the physical cell ID of the target cell.

TSMTC,i: It is the periodicity of the SMTC occasion configured for the inter-frequency carrier *i*. If the IAB-MT is not capable of 4 SMTC configurations per frequency [15], then the requirements shall apply provided that the IAB-MT is configured with only one SMTC configuration for each inter-frequency carrier *i* according to the physical cell ID of the target cell. If the IAB-MT has been provided with higher layer signaling of *smtcj*, where 1≤*j*≤4 [15] and is also capable of 4 SMTC configurations per frequency [15], then TSMTC follows *smtcj* configured for the inter-frequency carrier *i* according to the physical cell ID of the target cell. If the IAB-MT is not provided with SMTC configuration then the IAB-MT may assume that the target SSB periodicity is no larger than 160 ms.

TSI-NR: It is the time required for receiving all the relevant system information according to the reception procedure and the RRC procedure delay of system information blocks defined in TS 38.331 [15] for the target NR cell.

TPRACH: It is the delay uncertainty in acquiring the first available PRACH occasion in the target NR cell. TPRACH can be up to the summation of SSB to PRACH occasion association period and 10 ms. SSB to PRACH occasion associated period is defined in clause 14 of TS 38.213 [10].

Nfreq: It is the total number of NR frequencies to be monitored for RRC re-establishment; Nfreq = 1 if the target intra-frequency NR cell is known, else Nfreq = 2 and Tidentify\_intra\_NR = 0 if the target inter-frequency NR cell is known.

There is no requirement if the target cell does not contain the IAB-MT context or if the SSB transmission periodicity is larger than 160 ms.

In the requirement defined in the below tables, the target FR1 cell is known if it has been meeting the relevant cell identification requirement during the last 5 seconds otherwise it is unknown.

Table 12.1.1.1.2.1-1: Time to identify target NR cell for RRC connection re-establishment to NR intra-frequency cell

|  |  |  |  |
| --- | --- | --- | --- |
| Serving cell SSB Ês/Iot (dB) | Frequency range (FR) of target NR cell | Tidentify\_intra\_NR [ms] | |
|  |  | Known NR cell | Unknown NR cell |
| ≥ -8 | FR1 | MAX (1600 ms, 5 x TSMTC) | MAX (6400 ms, 10 x TSMTC) |
| ≥ -8 | FR2 | N/A | MAX (8000 ms, 80 x TSMTC)) |
| < -8 | FR1 | N/A | 6400Note1 |
| < -8 | FR2 | N/A | 28160Note1 |
| Note 1: The IAB-MT is not required to successfullyidentify a cell on any NR frequency layer when TSMTC >160 ms and serving cell SSB Ês/Iot < -8 dB. | | | |

Table 12.1.1.1.2.1-2: Time to identify target NR cell for RRC connection re-establishment to NR inter-frequency cell

|  |  |  |  |
| --- | --- | --- | --- |
| Serving cell SSB Ês/Iot (dB) | Frequency range (FR) of target NR cell | Tidentify\_inter\_NR, i [ms] | |
|  |  | Known NR cell | Unknown NR cell |
| ≥ -8 | FR1 | MAX (1600 ms, 6 x TSMTC, i) | MAX (6400 ms, 13 x TSMTC, i) |
| ≥ -8 | FR2 | N/A | MAX (8000 ms, 104 x TSMTC, i)) |
| < -8 | FR1 | N/A | 6400Note1 |
| < -8 | FR2 | N/A | 32000Note1 |
| Note 1: The IAB-MT is not required to successfully identify a cell on any NR frequency layer when TSMTC,i >160 ms and serving cell SSB Ês/Iot < -8 dB. | | | |

***<End of change5>***

***<Start of change6>***

12.1.1.3.2.1 RRC connection release with redirection to NR

The IAB-MT shall be capable of performing the RRC connection release with redirection to the target NR cell within Tconnection\_release\_redirect\_NR.

The time delay (Tconnection\_release\_redirect\_NR) is the time between the end of the last slot containing the RRC command, “*RRCRelease*” (TS 38.331 [15]) on the NR PDSCH and the time the IAB-MT starts to send random access to the target NR cell. The time delay (Tconnection\_release\_redirect\_NR) shall be less than:

Tconnection\_release\_redirect\_NR = TRRC\_procedure\_delay + Tidentify-NR + TSI-NR + TRACH

The target NR cell shall be considered detetable when for each relevant SSB, the side conditions should be met that,

* the conditions of SSB\_RP and SSB Ês/Iot according to Annex H.1.1.3 for a corresponding IAB-MT class and IAB type are fulfilled.

TRRC\_procedure\_delay: It is the RRC procedure delay for processing the received message “*RRCRelease*” as defined in clause 6.2.2 of TS 38.331 [15].

Tidentify-NR: It is the time to identify the target NR cell and depends on the frequency range (FR) of the target NR cell. It is defined in Table 12.1.1.3.2-1. Note that Tidentify-NR = TPSS/SSS-sync + Tmeas, in which TPSS/SSS-sync is the cell search time and Tmeas is the measurement time due to cell selection criteria evaluation.

TSI-NR: It is the time required for acquiring all the relevant system information of the target NR cell. This time depends upon whether the IAB-MT is provided with the relevant system information of the target NR cell or not by the old NR cell before the RRC connection is released.

TRACH: It is the delay uncertainty in acquiring the first available PRACH occasion in the target NR cell. TRACH can be up to the summation of SSB to PRACH occasion association period and 10 ms. SSB to PRACH occasion associated period is defined in clause 14 of TS 38.213 [10].

Trs is the SMTC periodicity of the target NR cell if the IAB-MT has been provided with an SMTC configuration for the target cell in the redirection command, otherwise Trs is the SMTC periodicity configured in the *measObjectNR* having the same SSB frequency and subcarrier spacing configured for the RRC connection release with redirection. If the IAB-MT is not capable of 4 SMTC configurations per frequency [15], then the requirements shall apply provided that the IAB-MT is configured with only one SMTC configuration on carrier configured configured for RRC connection release with redirection. If the IAB-MT has been provided with higher layer signaling of *smtcj*, where 1≤*j*≤4 [15] and is also capable of 4 SMTC configurations per frequency [15], then Tsmtc follows *smtcj* according to the physical cell ID of the target cell. If the IAB-MT is not provided with SMTC configuration or measurement object for the frequency which is also configured for the RRC connection release with redirection then the requirement in this clause is applied with Trs = 160 ms if the SSB transmission periodicity is not larger than 160 ms.

- There is no requirement if the SSB transmission periodicity is larger than 160ms.

**Table 12.1.1.3.2-1: Time to identify target NR cell for RRC connection release with redirection to NR**

|  |  |
| --- | --- |
| **Frequency range (FR) of target NR cell** | **Tidentify-NR** |
| FR1 | MAX (5440 ms, 11×Trs) |
| FR2 | MAX (7040 ms, 8×11×Trs) |

***<End of change6>***

***<Start of change7>***

#### G.2.3.1 Radio link Monitoring

##### G.2.3.1.1 Radio Link Monitoring Out-of-sync Test for FR1 PCell configured with SSB-based RLM RS in non-DRX mode

G.2.3.1.1.1 Test Purpose and Environment

The purpose of this test is to verify that the IAB-MT properly detects the out of sync and in sync for the purpose of monitoring downlink radio link quality of the PCell. This test will partly verify the FR1 radio link monitoring requirements in clause 12.3.1.

In the test, IAB-MT is configured to perform RLM on SSB, with *detectionResource* included in *RadioLinkMonitoringRS* set to SSB#0 and SSB#1, and *purpose* set to ‘*rlf*’. Supported test configurations are shown in table G.2.3.1.1.1-1. The test parameters are given in Tables G.2.3.1.1-2 and G.2.3.1.1.1-3 below. There is one cell (Cell 1), which is the active NR cell, in the test. The test consists of three successive time periods, with time duration of T1, T2 and T3 respectively. Figure G.2.3.1.1.1-1 shows the variation of the downlink SNR in the active cell to emulate out-of-sync and in-sync states. Prior to the start of the time duration T1, the IAB-MT shall be fully synchronized to Cell 1. The IAB-MT shall be configured for periodic CSI reporting with a reporting periodicity of 5 ms.

Table G.2.3.1.1.1-1: Supported test configurations for FR1 PCell

|  |  |
| --- | --- |
| Configuration | Description |
| 1 | TDD, SSB SCS 15 kHz, data SCS 15 kHz, BW 10 MHz |
| 2 | TDD, SSB SCS 30 kHz, data SCS 30 kHz, BW 40 MHz |
| Note: The IAB-MT is only required to pass in one of the supported test configurations in FR1 | |

Table G.2.3.1.1.1-2: General test parameters for FR1 out-of-sync testing in non-DRX mode

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | | Unit | Value |
|  | | |  | Test 1 |
| Active PCell | | |  | Cell 1 |
| RF Channel Number | | |  | 1 |
| Duplex mode | | Config 1,2 |  | TDD |
| BWchannel | | Config 1 | MHz | 10: NRB,c = 52 |
|  | | Config 2 |  | 40: NRB,c = 106 |
| DL initial BWP configuration | | Config 1, 2 |  | DLBWP.0.1 |
| DL dedicated BWP configuration | | Config 1, 2 |  | DLBWP.1.1 |
| UL initial BWP configuration | | Config 1, 2 |  | ULBWP.0.1 |
| UL dedicated BWP configuration | | Config 1, 2 |  | ULBWP.1.1 |
| TDD Configuration | | Config 1 |  | TDDConf.1.1 |
| Config 2 |  | TDDConf.2.1 |
| CORESET Reference Channel | | Config 1 |  | CR.1.1 TDD |
| Config 2 |  | CR.2.1 TDD |
| SSB Configuration | | Config 1 |  | SSB.1 FR1 |
| Config 2 |  | SSB.2 FR1 |
| SMTC Configuration | | Config 1 |  | SMTC.1 |
| Config 2 |  | SMTC.1 |
| PDSCH/PDCCH subcarrier spacing | | Config 1 |  | 15 kHz |
| Config 2 |  | 30 kHz |
| PRACH Configuration | | Config 1 |  | TBD |
| Config 2 |  | TBD |
| SSB index assigned as RLM RS | | |  | 0 |
| OCNG parameters | | |  | OP.1 |
| CP length | | |  | Normal |
| Correlation Matrix and Antenna Configuration | | |  | 2x2 Low |
| Out of sync transmission parameters | DCI format | |  | 1-0 |
| Number of Control OFDM symbols | |  | 2 |
| Aggregation level | | CCE | 8 |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | | dB | 4 |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | | dB | 4 |
| DMRS precoder granularity | |  | REG bundle size |
| REG bundle size | |  | 6 |
| DRX | | |  | OFF |
| Layer 3 filtering | | |  | *Enabled* |
| T310 timer | | | ms | *0* |
| T311 timer | | | ms | 1000 |
| N310 | | |  | 1 |
| N311 | | |  | 1 |
| CSI-RS configuration for CSI reporting | | Config 1 |  | CSI-RS.1.1 TDD |
| Config 2 |  | CSI-RS.2.1 TDD |
| CSI-RS for tracking | | Config 1 |  | TRS.1.1 TDD |
| Config 2 |  | TRS.1.2 TDD |
| T1 | | | s | 0.2 |
| T2 | | | s | 1.08 |
| T3 | | | s | 1.08 |
| D1 | | | s | 1.04 |
| Note 1: All configurations are assigned to the IAB-MT prior to the start of time period T1.  Note 2: IAB-MT-specific PDCCH is not transmitted after T1 starts. | | | | |

Table G.2.3.1.1.1-3: Cell specific test parameters for FR1 (Cell 1) for out-of-sync radio link monitoring tests in non-DRX mode

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | | Unit | Test 1 | | |
|  | |  | T1 | T2 | T3 |
| EPRE ratio of PDCCH DMRS to SSS | | dB | 4 | | |
| EPRE ratio of PDCCH to PDCCH DMRS | | dB | 0 | | |
| EPRE ratio of PBCH DMRS to SSS | | dB | 0 | | |
| EPRE ratio of PBCH to PBCH DMRS | | dB |
| EPRE ratio of PSS to SSS | | dB |
| EPRE ratio of PDSCH DMRS to SSS | | dB |
| EPRE ratio of PDSCH to PDSCH DMRS | | dB |
| EPRE ratio of OCNG DMRS to SSS | | dB |
| EPRE ratio of OCNG to OCNG DMRS | | dB |
| SNR on RLM-RS | Config 1 | dB | 1 | -7 | -15 |
|  | Config 2 | 1 | -7 | -15 |
|  | Config 3 | 1 | -7 | -15 |
| SNR on other channels and signals | Config 1, 2, 3 | dB | 1 | | |
|  | Config 1 | dBm/SCS | -98 | | |
| Config 2 | -95 | | |
| Propagation condition | |  | TDL-C 300ns 100Hz | | |
| Note 1: OCNG shall be used such that the resources in Cell 1 are fully allocated and a constant total transmitted power spectral density is achieved for all OFDM symbols.  Note 2: The signal contains PDCCH for IAB-MTs other than the device under test as part of OCNG.  Note 3: SNR levels correspond to the signal to noise ratio over the SSS REs.  Note 4: The SNR in time periods T1, T2 and T3 is denoted as SNR1, SNR2 and SNR3 respectively in Figure G.2.3.1.1.1-1.  Note 5: The SNR values are specified for testing an IAB-MT which supports 2RX on at least one band. For testing of an IAB-MT which supports 4RX on all bands, the SNR during T3 is defined in clause G.1.3. | | | | | |



Figure G.2.3.1.1.1-1: SNR variation for out-of-sync testing

G.2.3.1.1.2 Test Requirements

The IAB-MT behaviour in each test during time durations T1, T2 and T3 shall be as follows:

During the period from time point A to time point B the IAB-MT shall transmit uplink signal at least in all uplink slots configured for CSI transmission according to the configured periodic CSI reporting.

The IAB-MT shall stop transmitting uplink signal no later than time point C (D1 second after the start of the time duration T3).

The rate of correct events observed during repeated tests shall be at least 90%.

##### G.2.3.1.2 Radio Link Monitoring In-sync Test for FR1 PCell configured with SSB-based RLM RS in non-DRX mode

G.2.3.1.2.1 Test Purpose and Environment

The purpose of this test is to verify that the IAB-MT properly detects the out of sync and in sync for the purpose of monitoring downlink radio link quality of the PCell. This test will partly verify the FR1 radio link monitoring requirements in clause 12.3.1.

In the test, IAB-MT is configured to perform RLM on SSB, with *detectionResource* included in *RadioLinkMonitoringRS* set to SSB#0 and SSB#1, and *purpose* set to ‘*rlf*’. Supported test configurations are shown in table G.2.3.1.2.1-1. The test parameters are given in Tables G.2.3.1.2.1-2, and G.2.3.1.2.1-3 below. There is one cell (Cell 1), which is the active cell, in the test. The test consists of five successive time periods, with time duration of T1, T2, T3, T4 and T5 respectively. Figure G.2.3.1.2.1-1 shows the variation of the downlink SNR in the active cell to emulate out-of-sync and in-sync states. Prior to the start of the time duration T1, the IAB-MT shall be fully synchronized to Cell 1. Prior to the start of the time duration T1, the IAB-MT shall be fully synchronized to Cell 1. The IAB-MT shall be configured for periodic CSI reporting with a reporting periodicity of 5 ms.

Table G.2.3.1.2.1-1: Supported test configurations for FR1 PCell

|  |  |
| --- | --- |
| Configuration | Description |
| 1 | TDD, SSB SCS 15 kHz, data SCS 15 kHz, BW 10 MHz |
| 2 | TDD, SSB SCS 30 kHz, data SCS 30 kHz, BW 40 MHz |
| Note: The IAB-MT is only required to pass in one of the supported test configurations in FR1 | |

Table G.2.3.1.2.1-2: General test parameters for FR1 in-sync testing in non-DRX mode

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | | | | Unit | Value |
|  | | | |  | Test 1 |
| Active PCell | | | |  | Cell 1 |
| RF Channel Number | | | |  | 1 |
| Duplex mode | | | Config 1, 2 |  | TDD |
| BWchannel | | | Config 1 | MHz | 10: NRB,c = 52 |
| Config 2 | 40: NRB,c = 106 |
| DL initial BWP configuration | | | Config 1, 2 |  | DLBWP.0.1 |
| DL dedicated BWP configuration | | | Config 1, 2 |  | DLBWP.1.1 |
| UL initial BWP configuration | | | Config 1, 2 |  | ULBWP.0.1 |
| UL dedicated BWP configuration | | | Config 1, 2 |  | ULBWP.1.1 |
| TDD Configuration | | | Config 1 |  | TDDConf.1.1 |
| Config 2 |  | TDDConf.2.1 |
| CORESET Reference Channel | | | Config 1 |  | CR.1.1 TDD |
| Config 2 |  | CR.2.1 TDD |
| SSB Configuration | | | Config 1 |  | SSB.1 FR1 |
| Config 2 |  | SSB.2 FR1 |
| SMTC Configuration | | | Config 1,2 |  | SMTC.1 |
| PDSCH/PDCCH subcarrier spacing | | | Config 1 |  | 15 kHz |
| Config 2 |  | 30 kHz |
| PRACH Configuration | | | Config 1 |  | TBD |
| Config 2 |  | TBD |
| SSB index assigned as RLM RS | | | |  | 0 |
| OCNG parameters | | | |  | OP.1 |
| CP length | | | |  | Normal |
| Correlation Matrix and Antenna Configuration | | | |  | 2x2 Low |
| In sync transmission parameters | DCI format | | |  | 1-0 |
| Number of Control OFDM symbols | | |  | 2 |
| Aggregation level | | | CCE | 4 |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | | | dB | 0 |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | | | dB | 0 |
| DMRS precoder granularity | | |  | REG bundle size |
| REG bundle size | | |  | 6 |
| Out of sync transmission parameters | DCI format | | |  | 1-0 |
| Number of Control OFDM symbols | | |  | 2 |
| Aggregation level | | | CCE | 8 |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | | | dB | 4 |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | | | dB | 4 |
| DMRS precoder granularity | | |  | REG bundle size |
| REG bundle size | | |  | 6 |
| DRX | | | |  | OFF |
| Layer 3 filtering | | | |  | *Enabled* |
| T310 timer | | | | ms | 1000 |
| T311 timer | | | | ms | 1000 |
| N310 | | | |  | 1 |
| N311 | | | |  | 1 |
| CSI-RS configuration for CSI reporting | | Config 1 | |  | CSI-RS.1.1 TDD |
| Config 2 | |  | CSI-RS.2.1 TDD |
| CSI-RS for tracking | | Config 1 | |  | TRS.1.1 TDD |
| Config 2 | |  | TRS.1.2 TDD |
| T1 | | | | s | 0.2 |
| T2 | | | | s | 0.2 |
| T3 | | | | s | 1.04 |
| T4 | | | | s | 0.2 |
| T5 | | | | s | 2.02 |
| D1 | | | | s | 1.98 |
| Note 1: All configurations are assigned to the IAB-MT prior to the start of time period T1.  Note 2: IAB-MT-specific PDCCH is not transmitted after T1 starts. | | | | | |

Table G.2.3.1.2.1-3: Cell specific test parameters for FR1 (Cell 1) for in-sync radio link monitoring tests in non-DRX mode

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | | Unit | Test 1 | | | | |
|  | |  | T1 | T2 | T3 | T4 | T5 |
| EPRE ratio of PDCCH DMRS to SSS | | dB | 4 | | | | |
| EPRE ratio of PDCCH to PDCCH DMRS | | dB | 0 | | | | |
| EPRE ratio of PBCH DMRS to SSS | | dB | 0 | | | | |
| EPRE ratio of PBCH to PBCH DMRS | | dB |
| EPRE ratio of PSS to SSS | | dB |
| EPRE ratio of PDSCH DMRS to SSS | | dB |
| EPRE ratio of PDSCH to PDSCH DMRS | | dB |
| EPRE ratio of OCNG DMRS to SSS | | dB |
| EPRE ratio of OCNG to OCNG DMRS | | dB |
| SNR on RLM-RS | Config 1 | dB | 1 | -7 | -15 | -4.5 | 1 |
|  | Config 2 |  | 1 | -7 | -15 | -4.5 | 1 |
|  | Config 3 |  | 1 | -7 | -15 | -4.5 | 1 |
| SNR on other channels and signals | Config 1, 2, 3 | dB | 1 |  |  |  |  |
|  | Config 1 | dBm/SCS | -98 | | | | |
| Config 2 | -95 | | | | |
| Propagation condition | |  | TDL-C 300ns 100Hz | | | | |
| Note 1: OCNG shall be used such that the resources in Cell 1 are fully allocated and a constant total transmitted power spectral density is achieved for all OFDM symbols.  Note 2: The signal contains PDCCH for IAB-MTs other than the device under test as part of OCNG.  Note 3: SNR levels correspond to the signal to noise ratio over the SSS REs.  Note 4: The SNR in time periods T1, T2, T3, T4 and T5 is denoted as SNR1, SNR2, SNR3, SNR4 and SNR5 respectively in Figure G.2.3.1.2.1-1.  Note 5: The SNR values are specified for testing an IAB-MT which supports 2RX on at least one band. For testing of an IAB-MT which supports 4RX on all bands, the SNR during T3 and T4 is modified as specified in clause G.1.3. | | | | | | | |



Figure G.2.3.1.2.1-1: SNR variation for in-sync testing

G.2.3.1.2.2 Test Requirements

The IAB-MT behaviour in each test during time durations T1, T2, T3, T4 and T5 shall be as follows:

During the period from time point A to time point F (D1 second after the start of time duration T5) the IAB-MT shall transmit uplink signal at least in all uplink slots configured for CSI transmission according to the configured periodic CSI reporting.

The rate of correct events observed during repeated tests shall be at least 90%.

##### G.2.3.1.3 Radio Link Monitoring Out-of-sync Test for FR2 PCell configured with SSB-based RLM RS in non-DRX mode

G.2.3.1.3.1 Test Purpose and Environment

The purpose of this test is to verify that the IAB-MT properly detects the out of sync and in sync for the purpose of monitoring downlink radio link quality of the PCell. This test will partly verify the FR2 radio link monitoring requirements in clause 12.3.1.

In the test, IAB-MT is configured to perform RLM on SSB, with *detectionResource* included in *RadioLinkMonitoringRS* set to SSB#0 and SSB#1, and *purpose* set to ‘*rlf*’. Supported test configurations are shown in table G.2.3.1.3.1-1. The test parameters are given in Tables G.2.3.1.3.1-2 and G.2.3.1.3.1-3 below. There is one cell (Cell 1), which is the active NR cell, in the test. The test consists of three successive time periods, with time duration of T1, T2 and T3 respectively. Figure G.2.3.1.3.1-1 shows the variation of the downlink SNR in the active cell to emulate out-of-sync and in-sync states, and Figure G.2.3.1.3.1-2 shows the Time multiplexed downlink transmissions from each Angle of Arrival. Prior to the start of the time duration T1, the IAB-MT shall be fully synchronized to Cell 1. The IAB-MT shall be configured for periodic CSI reporting with a reporting periodicity of 5 ms.

Table G.2.3.1.3.1-1: Supported test configurations for FR2 PCell

|  |  |
| --- | --- |
| Configuration | Description |
| 1 | TDD, SSB SCS 120 KHz, data SCS 120KHz, BW 100 MHz |

Table G.2.3.1.3.1-2: General test parameters for FR2 out-of-sync testing in non-DRX mode

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | | Unit | Value |
| Test 1 |
| Active PCell | | |  | Cell 1 |
| RF Channel Number | | |  | 1 |
| Duplex mode | | Config 1 |  | TDD |
| BWchannel | | Config 1 |  | 100: NRB,c = 66 |
| DL initial BWP configuration | | Config 1 |  | DLBWP.0.1 |
| DL dedicated BWP configuration | | Config 1 |  | DLBWP.1.1 |
| UL initial BWP configuration | | Config 1 |  | ULBWP.0.1 |
| UL dedicated BWP configuration | | Config 1 |  | ULBWP.1.1 |
| TDD Configuration | | Config 1 |  | TDDConf.3.1 |
| CORESET Reference Channel | | Config 1 |  | CR.3.1 TDD |
| SSB Configuration | | Config 1 |  | SSB.1 FR2 |
| SMTC Configuration | | Config 1 |  | SMTC.1 |
| PDSCH/PDCCH subcarrier spacing | | Config 1 |  | 120 KHz |
| PRACH Configuration | | Config 1 |  | TBD |
| SSB index assigned as RLM RS | | Config 1 |  | 0,1 |
| OCNG parameters | | |  | OP.2 |
| CP length | | |  | Normal |
| Out of sync transmission parameters | DCI format | |  | 1-0 |
| Number of Control OFDM symbols | |  | 2 |
| Aggregation level | | CCE | 8 |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | | dB | 4 |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | | dB | 4 |
| DMRS precoder granularity | |  | REG bundle size |
| REG bundle size | |  | 6 |
| DRX | | |  | OFF |
| Layer 3 filtering | | |  | *Enabled* |
| T310 timer | | | ms | *0* |
| T311 timer | | | ms | 1000 |
| N310 | | |  | 1 |
| N311 | | |  | 1 |
| CSI-RS for CSI reporting | | Config 1 |  | CSI-RS.3.1 TDD |
| TCI states for PDCCH/PDSCH | | |  | TCI.State.2 |
| CSI-RS for tracking | | Config 1 |  | TRS.2.1 TDD |
| T1 | | | s | 0.2 |
| T2 | | | s | 4.88 |
| T3 | | | s | 4.88 |
| D1 | | | s | 4.84 |
| Note 1: All configurations are assigned to the IAB-MT prior to the start of time period T1.  Note 2: IAB-MT-specific PDCCH is not transmitted after T1 starts. | | | | |

Table G.2.3.1.3.1-3: OTA related cell specific test parameters for FR2 (Cell 1) for out-of-sync radio link monitoring tests in non-DRX mode

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | | Unit | Test 1 | | | | | |
| T1 | T2 | T3 | T1 | T2 | T3 |
| AoA setup | |  | Setup 2 as specified in clause G.1.8.2 | | | | | |
| **AoA1** | | | **AoA2** | | |
| EPRE ratio of PDCCH DMRS to SSS | | dB | 4 | | | Not sent | | |
| EPRE ratio of PDCCH to PDCCH DMRS | | dB | 0 | | |
| EPRE ratio of PBCH DMRS to SSS | | dB |
| EPRE ratio of PBCH to PBCH DMRS | | dB |
| EPRE ratio of PSS to SSS | | dB |
| EPRE ratio of PDSCH DMRS to SSS | | dB |
| EPRE ratio of PDSCH to PDSCH DMRS | | dB |
| EPRE ratio of OCNG DMRS to SSS | | dB |
| EPRE ratio of OCNG to OCNG DMRS | | dB |
| ssb-Index 0 SNR | Config 1 | dB | 2Note 6 | -6Note 6 | -15 |
| ssb-Index 1 SNR | Config 1 |  | Not sent | | | 2Note 6 | -15 | -15 |
| SNR on other channels and signals | Config 1 | dB | 2Note 6 | | | N/A | | |
|  | Config 1 | dBm/ 15kHz | -92.1 | | | -92.1 | | |
| Time multiplexing of the downlink transmissions from each AoA | |  | Defined in Figure G.2.3.1.3.1-2 | | | | | |
| Propagation condition | |  | TDL-A 30ns 75Hz | | | TDL-A 30ns 75Hz | | |
| Note 1: OCNG shall be used such that the resources in Cell 1 are fully allocated and a constant total transmitted power spectral density is achieved for all OFDM symbols.  Note 2: The signal contains PDCCH for IAB-MTs other than the device under test as part of OCNG.  Note 3: SNR levels correspond to the signal to noise ratio over the SSS REs.  Note 4: The SNR values are specified for testing an IAB-MT which supports 2RX on at least one band. For testing of an IAB-MT which supports 4RX on all bands, the SNR during T3 is defined in clause G.1.3.  Note 5: Void  Note 6: This value allows up to 1dB degradation from applied SNR to IAB-MT baseband | | | | | | | | |

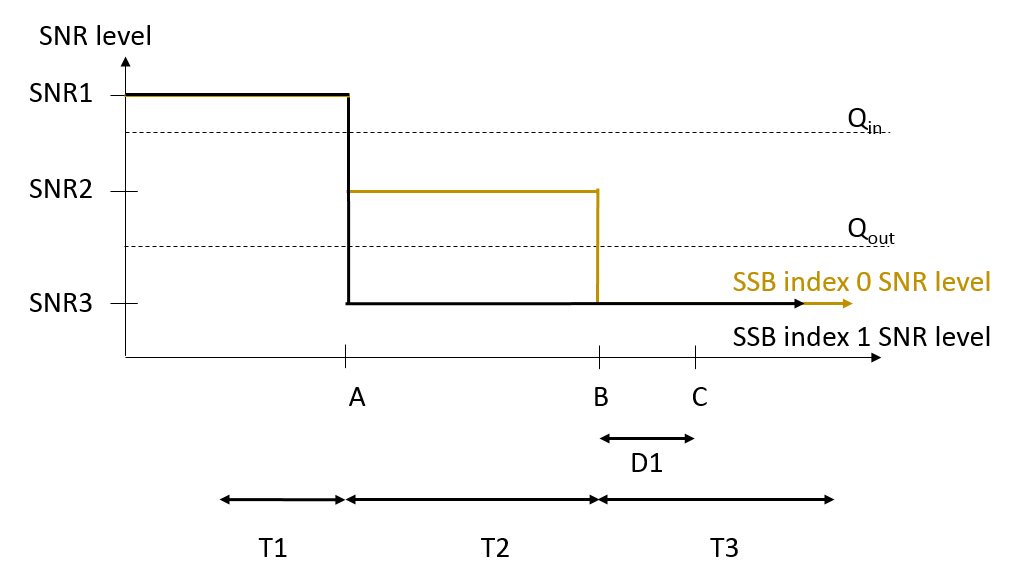


Figure G.2.3.1.3.1-1: SNR variation for out-of-sync testing



Figure G.2.3.1.3.1-2: Time multiplexed downlink transmissions

G.2.3.1.3.2 Test Requirements

The IAB-MT behavior in each test during time durations T1, T2 and T3 shall be as follows:

During the period from time point A to time point B the IAB-MT shall transmit uplink signal at least in all uplink slots configured for CSI transmission according to the configured periodic CSI reporting.

The IAB-MT shall stop transmitting uplink signal no later than time point C (D1 second after the start of the time duration T3).

The rate of correct events observed during repeated tests shall be at least 90%.

##### G.2.3.1.4 Radio Link Monitoring In-sync Test for FR2 PCell configured with SSB-based RLM RS in non-DRX mode

G.2.3.1.4.1 Test Purpose and Environment

The purpose of this test is to verify that the IAB-MT properly detects the out of sync and in sync for the purpose of monitoring downlink radio link quality of the PCell. This test will partly verify the FR2 radio link monitoring requirements in clause 12.3.1.

In the test, IAB-MT is configured to perform RLM on SSB, with *detectionResource* included in *RadioLinkMonitoringRS* set to SSB#0 and SSB#1, and *purpose* set to ‘*rlf*’. Supported test configurations are shown in table G.2.3.1.4.1-1. The test parameters are given in Tables G.2.3.1.4.1-2, and G.2.3.1.4.1-3 below. There is one cell (Cell 1), which is the active cell, in the test. The test consists of five successive time periods, with time duration of T1, T2, T3, T4 and T5 respectively. Figure G.2.3.1.4.1-1 shows the variation of the downlink SNR in the active cell to emulate out-of-sync and in-sync states, and Figure G.2.3.1.4.1-2 shows the Time multiplexed downlink transmissions from each Angle of Arrival. Prior to the start of the time duration T1, the IAB-MT shall be fully synchronized to Cell 1. Prior to the start of the time duration T1, the IAB-MT shall be fully synchronized to Cell 1. The IAB-MT shall be configured for periodic CSI reporting with a reporting periodicity of 5 ms.

Table G.2.3.1.4.1-1: Supported test configurations for FR2 PCell

|  |  |
| --- | --- |
| Configuration | Description |
| 1 | TDD, SSB SCS 120 KHz, data SCS 120KHz, BW 100 MHz |

Table G.2.3.1.4.1-2: General test parameters for FR2 in-sync testing in non-DRX mode

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | | Unit | Value |
|  | | |  | Test 1 |
| Active PCell | | |  | Cell 1 |
| RF Channel Number | | |  | 1 |
| Duplex mode | | Config 1 |  | TDD |
| BWchannel | | Config 1 |  | 100: NRB,c = 66 |
| DL initial BWP configuration | | Config 1 |  | DLBWP.0.1 |
| DL dedicated BWP configuration | | Config 1 |  | DLBWP.1.1 |
| UL initial BWP configuration | | Config 1 |  | ULBWP.0.1 |
| UL dedicated BWP configuration | | Config 1 |  | ULBWP.1.1 |
| TDD Configuration | | Config 1 |  | TDDConf.3.1 |
| CORESET Reference Channel | | Config 1 |  | CR.3.1 TDD |
| SSB Configuration | | Config 1 |  | SSB.1 FR2 |
| SMTC Configuration | | Config 1 |  | SMTC.3 |
| PDSCH/PDCCH subcarrier spacing | | Config 1 |  | 120 KHz |
| PRACH Configuration | | Config 1 |  | TBD |
| SSB index assigned as RLM RS | | Config 1 |  | 0,1 |
| OCNG parameters | | |  | OP.2 |
| CP length | | |  | Normal |
| In sync transmission parameters | DCI format | |  | 1-0 |
| Number of Control OFDM symbols | |  | 2 |
| Aggregation level | | CCE | 4 |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | | dB | 0 |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | | dB | 0 |
| DMRS precoder granularity | |  | REG bundle size |
| REG bundle size | |  | 6 |
| Out of sync transmission parameters | DCI format | |  | 1-0 |
| Number of Control OFDM symbols | |  | 2 |
| Aggregation level | | CCE | 8 |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | | dB | 4 |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | | dB | 4 |
| DMRS precoder granularity | |  | REG bundle size |
| REG bundle size | |  | 6 |
| DRX | | |  | OFF |
| Layer 3 filtering | | |  | *Enabled* |
| T310 timer | | | ms | 4000 |
| T311 timer | | | ms | 1000 |
| N310 | | |  | 1 |
| N311 | | |  | 1 |
| CSI-RS for CSI reporting | | Config 1 |  | CSI-RS.3.1 TDD |
| TCI states for PDCCH/PDSCH | | |  | TCI.State.2 |
| CSI-RS for tracking | | Config 1 |  | TRS.2.1 TDD |
| T1 | | | s | 0.2 |
| T2 | | | s | 0.2 |
| T3 | | | s | 4.84 |
| T4 | | | s | 0.2 |
| T5 | | | s | 7.84 |
| D1 | | | s | 7.8 |
| Note 1: All configurations are assigned to the IAB-MT prior to the start of time period T1.  Note 2: IAB-MT-specific PDCCH is not transmitted after T1 starts. | | | | |

Table G.2.3.1.4.1-3: OTA related cell specific test parameters for FR2 (Cell 1) for in-sync radio link monitoring tests in non-DRX mode

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | | Unit | Test 1 | | | | | | | | | | | | | | | | | | |
|  | |  | T1 | T2 | | T3 | | T4 | | T5 | | T1 | | T2 | | T3 | | T4 | | T5 | |
| AoA setup | |  | Setup 2 as specified in clause G.1.8.2 | | | | | | | | | | | | | | | | | | |
|  | |  | **AoA1** | | | | | | | | | | **AoA2** | | | | | | | | |
| EPRE ratio of PDCCH DMRS to SSS | | dB | 4 | | | | | | | | | | Not sent | | | | | | | | |
| EPRE ratio of PDCCH to PDCCH DMRS | | dB | 0 | | | | | | | | | |
| EPRE ratio of PBCH DMRS to SSS | | dB |
| EPRE ratio of PBCH to PBCH DMRS | | dB |
| EPRE ratio of PSS to SSS | | dB |
| EPRE ratio of PDSCH DMRS to SSS | | dB |
| EPRE ratio of PDSCH to PDSCH DMRS | | dB |
| EPRE ratio of OCNG DMRS to SSS | | dB |
| EPRE ratio of OCNG to OCNG DMRS | | dB |
| ssb-Index 0 SNR | Config 1 | dB | 2Note 6 | | -6Note 6 | | -15 | | -4.5 | | 2Note 6 | |
| ssb-Index 1 SNR | Config 1 |  | Not sent | | | | | | | | | | 2Note 6 | | -15 | | -15 | | -15 | | -15 |
| SNR on other channels and signals | Config 1 | dB | 2Note 6 | | | | | | | | | | N/A | | | | | | | | |
|  | Config 1 | dBm/ 15kHz | -92.1 | | | | | | | | | | -92.1 | | | | | | | | |
| Time multiplexing of the downlink transmissions from each AoA | |  | Defined in Figure G.2.3.1.4.1-2 | | | | | | | | | | | | | | | | | | |
| Propagation condition | |  | TDL-A 30ns 75Hz | | | | | | | | | | TDL-A 30ns 75Hz | | | | | | | | |
| Note 1: OCNG shall be used such that the resources in Cell 1 are fully allocated and a constant total transmitted power spectral density is achieved for all OFDM symbols.  Note 2: The signal contains PDCCH for IAB-MTs other than the device under test as part of OCNG.  Note 3: SNR levels correspond to the signal to noise ratio over the SSS REs.  Note 4: The SNR values are specified for testing an IAB-MT which supports 2RX on at least one band. For testing of an IAB-MT which supports 4RX on all bands, the SNR during T3 is defined in clause G.1.3.  Note 5: Void.  Note 6: This value allows up to 1dB degradation from applied SNR to IAB-MT baseband | | | | | | | | | | | | | | | | | | | | | |

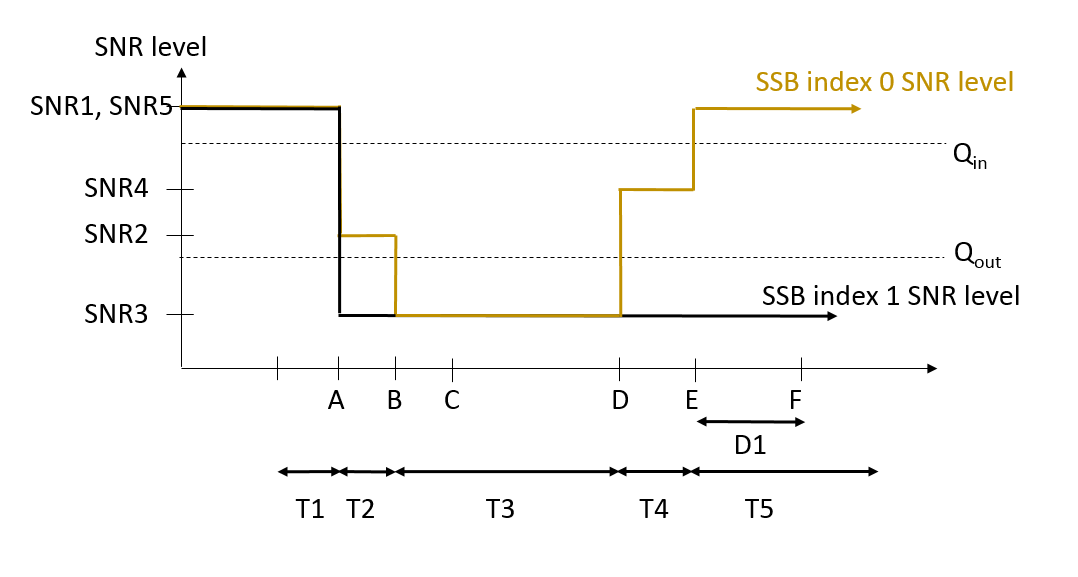


Figure G.2.3.1.4.1-1: SNR variation for in-sync testing



**Figure G.2.3.1.4.1-2: Time multiplexed downlink transmissions**

***<End of change7>***

***<Start of change8>***

Annex I (normative):  
Propagation conditions

I.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.

I.1.1 IAB-MT receiver with 2RX

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:



I.2 Multi-path fading propagation conditions

I.2.1 General

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).

I.2.2 Delay profiles

I.2.2.1 General

The delay profiles are simplified from the TR 38.901 [27] 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 I.2.2.1 can be used as such.

- Step 1: Use the original TDL model from TR 38.901 [27].

- 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 [27].

- 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 I.2.2.2-2, I.2.2.2-3, and I.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.

I.2.2.2 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 I.2.2.2-1 and the tapped delay line models are specified in tables I.2.2.2-2 ~ table I.2.2.2-4.

**Table I.2.2.2-1: 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 |
| TDLB100 | 12 | 100 ns | 480 ns | 5 ns |
| TDLC300 | 12 | 300 ns | 2595 ns | 5 ns |

**Table I.2.2.2-2: 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 I.2.2.2-3: 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 I.2.2.2-4: 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 |  |

I.2.3 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 I.2.3-1 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 I.2.3-1: 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 |

I.2.4 MIMO channel correlation matrices

I.2.4.1 General

The MIMO channel correlation matrices defined in annex I.2.4 apply for the antenna configuration using uniform linear arrays at both IAB-DU/gNB and IAB-MT/UE and for the antenna configuration using cross polarized antennas.

I.2.4.2 MIMO correlation matrices using Uniform Linear Array

I.2.4.2.1 General

The MIMO channel correlation matrices defined in annex I.2.4.2 apply for the antenna configuration using uniform linear array (ULA) at both IAB-DU/gNB and IAB-MT/UE.

I.2.4.2.2 Definition of MIMO correlation matrices

Table I.2.4.2.2-1 defines the correlation matrix for the IAB-DU or gNB.

**Table I.2.4.2.2-1: IAB-DU or gNB correlation matrix**

|  |  |
| --- | --- |
|  | **IAB-DU or gNB correlation** |
| One antenna |  |
| Two antennas |  |
| Four antennas |  |
| Eight antennas |  |
| Note: The matrix applies to the IAB-DU for IAB-DU requirements and gNB for IAB-MT requirements. | |

Table I.2.4.2.2-2 defines the correlation matrix for the IAB-MT or UE:

**Table I.2.4.2.2-2: IAB-MT or UE correlation matrix**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **One antenna** | **Two antennas** | **Four antennas** |
| IAB-MT / UE correlation |  |  |  |
| Note: The matrix applies to the UE for IAB-DU requirements and IAB-MT for IAB-MT requirements. | | | |

Table I.2.4.2.2-3 defines the channel spatial correlation matrix. The parameters, *α* and *β* in table I.2.4.2.2-3 defines the spatial correlation between the antennas at the IAB-DU/gNB and IAB-MT/UE respectively.

**Table I.2.4.2.2-3: correlation matrices**

|  |  |
| --- | --- |
| 1x2 case |  |
| 1x4 case |  |
| 2x2 case |  |
| 2x4 case |  |
| 4x4 case |  |
| NOTE 1: RgNB refers to an IAB-DU for IAB-DU requirements or a gNB for IAB-MT requirements.  NOTE 2: RUE refers to an UE for IAB-DU requirements or and IAB-MT for IAB-MT requirements | |

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

I.2.4.2.3 MIMO correlation matrices at high, medium and low level

The α and β for different correlation types are given in table I.2.4.2.3-1.

**Table I.2.4.2.3-1: 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 I.2.4.2.3-2, I.2.4.2.3-3 and I.2.4.2.3-4 as below.

The values in table I.2.4.2.3-2 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 I.2.4.2.3-3 to insure the correlation matrix is positive semi-definite after round-off to 4 digit precision with a = 0.00012.

**Table I.2.4.2.3-2: MIMO correlation matrices for high correlation**

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

**Table I.2.4.2.3-3: MIMO correlation matrices for medium correlation**

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

**Table I.2.4.2.3-4: MIMO correlation matrices for low correlation**

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

In table I.2.4.12.3-4,  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.

I.2.4.3 Multi-antenna channel models using cross polarized antennas

I.2.4.3.1 General

The MIMO channel correlation matrices defined in annex I.2.4.3 apply to two cases as presented below:

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

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

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 IAB-MT/UE. For multiple TX antennas case, cross-polarized antenna elements with +90/0 degrees polarization slant angles are deployed at IAB-MT/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.

I.2.4.3.2 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 (IAB-DU requirements) or IAB-MT (IAB-MT requirements) with same polarization,

-  is the spatial correlation matrix at the IAB-DU (IAB-DU requirements) or gNB (IAB-MT requirements) with same polarization,

-  is a polarization correlation matrix,

-  is a permutation matrix, and

- denotes transpose.

Table I.2.4.3.2-1 defines the polarization correlation matrix.

**Table I.2.4.3.2-1: 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 I.2.4.3.

I.2.4.2.3 Spatial correlation matrices at IAB-MT/UE and IAB-DU/gNB sides

I.2.4.2.3.1 Spatial correlation matrices at IAB-MT/UE side

In this subclause, RUE refers to a UE for IAB-DU requirements or an IAB-MT for IAB-MT requirements.

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, .

I.2.4.2.3.2 Spatial correlation matrices at IAB-DU/gNB side

In this subclause, RgNB refers to an IAB-DU for IAB-DU requirements or a gNB for IAB-MT requirements.

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,.

I.2.4.2.4 MIMO correlation matrices using cross polarized antennas

The values for parameters *α*, *β* and *γ* for low spatial correlation are given in table I.2.4.2.4-1.

**Table I.2.4.2.4-1: 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 IAB-DU/gNB side.  Note 2: Value of *β* applies when more than one pair of cross-polarized antenna elements at IAB-MT/UE side. | | |

The correlation matrices for low spatial correlation are defined in table I.2.4.2.4-2 as below.

**Table I.2.4.2.4-2: MIMO correlation matrices for low spatial correlation**

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

In table I.2.4.2.4-2,  is a  identity matrix.

I.3 Physical signals, channels mapping and precoding

I.3.1 General

Unless otherwise stated, the transmission on antenna port(s) is defined by using a precoder matrix  of size , where is the number of physical transmit antenna elements configured per test , is the number of ports for a reference signal or physical channel configured per test, and is the first port for that reference signal or physical channel as defined in clauses 7.3 and 7.4 in TS 38.211 [8]. This precoder takes as an input a block of signals for antenna port(s) , , , with  being the number of modulation symbols per antenna port including the reference signal symbols, and generates a block of signals the elements of which are to be mapped onto the frequency-time index pair as per the test configuration but transmitted on different physical antenna elements:

For Clause 8.2.3 and 11.2.3, the transmission of PDCCH and PDCCH DMRS on antenna port is defined by using a precoder matrix  of size 2x1. This precoder takes as an input a block of signals for antenna port(s) , and generates a block of signals the elements of which are to be mapped onto the frequency-time index pair as per the test configuration but transmitted on different physical antenna elements:

The precoder matrix is specific to the test case configuration.  is defined in Clause 5.2.2.2 of TS 38.214 [11].

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

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

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

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

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

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

***<End of change8>***