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Technical Specification

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Integrated access and backhaul radio transmission and reception

(Release 16)

** 

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# Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

In the present document, certain modal verbs have the following meanings:

**shall** indicates a mandatory requirement to do something

**shall not** indicates an interdiction (prohibition) to do something

NOTE 1: The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

NOTE 2: The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

**should** indicates a recommendation to do something

**should not** indicates a recommendation not to do something

**may** indicates permission to do something

**need not** indicates permission not to do something

NOTE 3: The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

**can** indicates that something is possible

**cannot** indicates that something is impossible

NOTE 4: The constructions "can" and "cannot" shall not to be used as substitutes for "may" and "need not".

**will** indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**will not** indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**might** indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

**might not** indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

**is** (or any other verb in the indicative mood) indicates a statement of fact

**is not** (or any other negative verb in the indicative mood) indicates a statement of fact

NOTE 5: The constructions "is" and "is not" do not indicate requirements.

# Scope

The present document establishes the minimum RF characteristics and minimum performance requirements of NR Integrated access and backhaul (IAB).

# 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”

# 3 Definitions, symbols and abbreviations

## 3.1 Definitions

For the purposes of the present document, the terms given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

Definition format (Normal)

<defined term>: <definition>.

## 3.2 Symbols

For the purposes of the present document, the following symbols apply:

Definition format (Normal)

<defined term>: <definition>.

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

Abbreviation format (EW)

<ACRONYM> <Explanation>

# 4 General

## 4.1 Relationship with other core specifications

The present document is a single-RAT specification for an IAB\_DU and IAB-MT, covering RF characteristics and minimum performance requirements and RRM requirements for the IAB\_MT. Conducted and radiated core requirements are defined for the IAB node architectures and IAB node types defined in subclause 4.3.

The applicability of each requirement is described in clause 4.6.

## 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 [Test specification references].

The minimum requirements given in this specification make no allowance for measurement uncertainty. The test specifications [Test specification references] 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].

## 4.3 Conducted and radiated requirement reference points

### 4.3.2 IAB type 1-H

For *IAB type 1-H*, the requirements are defined for two points of reference, signified by radiated requirements and conducted requirements.



Figure 4.3.2-1: Radiated and conducted reference points for *IAB type 1-H*

Radiated characteristics are defined over the air (OTA), where the *operating band* specific radiated interface is referred to as the *Radiated Interface Boundary* (RIB). Radiated requirements are also referred to as OTA requirements. The (spatial) characteristics in which the OTA requirements apply are detailed for each requirement.

Conducted characteristics are defined at individual or groups of *TAB connectors* at the *transceiver array boundary*, which is the conducted interface between the transceiver unit array and the composite antenna.

The transceiver unit array is part of the composite transceiver functionality generating modulated transmit signal structures and performing receiver combining and demodulation.

The transceiver unit array contains an implementation specific number of transmitter units and an implementation specific number of receiver units. Transmitter units and receiver units may be combined into transceiver units. The transmitter/receiver units have the ability to transmit/receive parallel independent modulated symbol streams.

The composite antenna contains a radio distribution network (RDN) and an antenna array. The RDN is a linear passive network which distributes the RF power generated by the transceiver unit array to the antenna array, and/or distributes the radio signals collected by the antenna array to the transceiver unit array, in an implementation specific way.

How a conducted requirement is applied to the *transceiver array boundary* is detailed in the respective requirement subclause.

### 4.3.3 IAB type 1-O and IAB type 2-O

For *IAB type 1-O* and *IAB type 2-O*, the radiated characteristics are defined over the air (OTA), where the *operating band* specific radiated interface is referred to as the *Radiated Interface Boundary* (RIB). Radiated requirements are also referred to as OTA requirements. The (spatial) characteristics in which the OTA requirements apply are detailed for each requirement.



Figure 4.3.3-1: Radiated reference points for *IAB type 1-O* and *IAB type 2-O*

For an *IAB-DU type 1-O* the transceiver unit array must contain at least 8 transmitter units and at least 8 receiver units. Transmitter units and receiver units may be combined into transceiver units. For IAB-MT the transceiver unit array must contain at least FFS transmitter units and FFS receiver units. The transmitter/receiver units have the ability to transmit/receive parallel independent modulated symbol streams.

## 4.4 IAB classes

### 4.4.1 IAB-DU classes

The requirements in this specification apply to Wide Area IAB-DU, Medium Range IAB-DU and Local Area IAB-DU unless otherwise stated. The associated deployment scenarios for each class are exactly the same for IAB-DU with and without connectors.

For IAB-DU *type 1-O* and 2-O, BS classes are defined as indicated below:

- Wide Area IAB-DU are characterised by requirements derived from Macro Cell scenarios with a BS to UE minimum distance along the ground equal to 35 m.

- Medium Range IAB-DU are characterised by requirements derived from Micro Cell scenarios with a BS to UE minimum distance along the ground equal to 5 m.

- Local Area IAB-DU are characterised by requirements derived from Pico Cell scenarios with a BS to UE minimum distance along the ground equal to 2 m.

For *IAB-DU type* 1-H, BS classes are defined as indicated below:

- Wide Area IAB-DU are characterised by requirements derived from Macro Cell scenarios with a BS to UE minimum coupling loss equal to 70 dB.

- Medium Range IAB-DU are characterised by requirements derived from Micro Cell scenarios with a BS to UE minimum coupling loss equals to 53 dB.

- Local Area IAB-DU are characterised by requirements derived from Pico Cell scenarios with a BS to UE minimum coupling loss equal to 45 dB.

### 4.4.2 IAB-MT classes

*Detailed structure of the sub clause is TBD*

## 4.5 Regional requirements

Detailed structure of the subclause is TBD.

## 4.6 Applicability of requirements

## 4.7 Applicability of RRM requirements in this specification

### 4.7.1 Applicability of signalling characteristics related RRM requirements

The RRM requirements on the signalling characteristics for IAB MTs specified in section 12.3 shall apply only for the local area IAB class defined in section 4.4.

[Editor’s Note: The exact wording, especially the term ‘local area IAB class’, can be revised after RAN4 concludes the relevant discussion]

## 4.8 Requirements for contiguous and non-contiguous spectrum

Detailed structure of the subclause is TBD.

# 5 Operating bands and channel arrangement

## 5.1 General

Detailed structure of the subclause is TBD.

## 5.2 Operating bands

Operating bands will be added to the IAB specification as they are approved, no bands are precluded at this stage and can be added based on consensus. Currently the FR1 bands n41 and n79 from TS 38.104 [x] and all Rel-15 FR2 bands shown in table 5.2-1 are to be included in the IAB specification.

*Table 5.2-1. NR operating bands in FR1*

|  |  |  |
| --- | --- | --- |
| NR *operating band* | Uplink (UL) and Downlink (DL) *operating band*  FUL,low – FUL,high  FDL,low – FDL,high | Duplex mode |
| n41 | 2496 MHz – 2690 MHz | TDD |
| n79 | 4400 MHz – 5000 MHz | TDD |

Table 5.2-2: NR *operating bands* in FR2

|  |  |  |
| --- | --- | --- |
| NR *operating band* | Uplink (UL) and Downlink (DL) *operating band*  FUL,low – FUL,high  FDL,low – FDL,high | Duplex mode |
| n257 | 26500 MHz – 29500 MHz | TDD |
| n258 | 24250 MHz – 27500 MHz | TDD |
| n260 | 37000 MHz – 40000 MHz | TDD |
| n261 | 27500 MHz – 28350 MHz | TDD |

## 5.3 *Channel bandwidth*

Detailed structure of the subclause is TBD.

## 5.4 Channel arrangement

Detailed structure of the subclause is TBD.

# 6 Conducted transmitter characteristics

## 6.1 General

## 6.2 IAB output power

### 6.2.1 IAB-DU output power

Detailed structure of the subclause is TBD.

### 6.2.2 IAB-MT output power

Detailed structure of the subclause is TBD.

## 6.3 Output power dynamics

### 6.3.1 IAB-DU Output Power Dynamics

#### 6.3.1.1 General

The requirements in clause 6.3 apply during the *transmitter ON period*. Transmitted signal quality (as specified in clause 6.5) shall be maintained for the output power dynamics requirements of this clause.

Power control is used to limit the interference level.

#### 6.3.1.2 RE power control dynamic range

##### 6.3.1.2.1 General

The RE power control dynamic range is the difference between the power of an RE and the average RE power for a IAB-DU at maximum output power (Pmax,c,TABC) for a specified reference condition.

For *IAB-DU type 1-H* this requirement shall apply at each *TAB connector* supporting transmission in the *operating band*.

##### 6.3.1.2.2 Minimum requirement for *IAB-DU type 1-H*

The RE power control dynamic range is specified the same as the conducted RE power control dynamic range requirement for BS *type 1-H* in TS 38.104 [x], subclause 6.3.2.2.

#### 6.3.1.3 Total power dynamic range

##### 6.3.1.3.1 General

The IAB-DU total power dynamic range is the difference between the maximum and the minimum transmit power of an OFDM symbol for a specified reference condition.

For *IAB-DU type 1-H* this requirement shall apply at each *TAB connector* supporting transmission in the *operating band*.

NOTE: The upper limit of the dynamic range is the OFDM symbol power for a BS when transmitting on all RBs at maximum output power. The lower limit of the total power dynamic range is the average power for single RB transmission. The OFDM symbol shall carry PDSCH and not contain RS or SSB.

##### 6.3.1.3.2 Minimum requirement for IAB-DU *type 1-H*

The total power dynamic range is specified the same as the total power dynamic range requirement for BS *type 1-H* in TS 38.104x[x], subclause 6.3.3.2, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

### 6.3.2 IAB-MT Output Power Dynamics

Detailed structure of the subclause is TBD.

## 6.4 Transmit ON/OFF power

### 6.4.1 Transmitter OFF power

#### 6.4.1.1 General

Transmit OFF power requirements apply to TDD operation of IAB-DU and FDD/TDD operation of IAB-MT.

Transmitter OFF power is defined as the mean power measured over 70/N us filtered with a square filter of bandwidth equal to the *transmission bandwidth configuration* of the IAB (BWConfig) centred on the assigned channel frequency during the *transmitter OFF period*. N = SCS/15, where SCS is Sub Carrier Spacing in kHz.

For IAB-DU, for *multi-band connectors* and for *single band connectors* supporting transmission in multiple *operating bands*, the requirement is only applicable during the *transmitter OFF period* in all supported *operating bands*.

For IAB supporting intra-band contiguous CA, the transmitter OFF power is defined as the mean power measured over 70/N us filtered with a square filter of bandwidth equal to the *Aggregated IAB-DU/MT Channel Bandwidth* BWChannel\_CA centred on (Fedge,high+Fedge,low)/2 during the *transmitter OFF period*. N = SCS/15, where SCS is the smallest supported Sub Carrier Spacing in kHz in the *Aggregated IAB-DU (IAB-MT) Channel Bandwidth*.

#### 6.4.1.3 Minimum requirement for *IAB-DU type 1-H*

The BS requirements specified in 6.4.1.3 in TS 38.104 [TBD] apply to *IAB-DU type 1-H*.

#### 6.4.1.4 Minimum requirement for *IAB-MT type 1-H*

The BS requirements specified in 6.4.1.3 in TS 38.104 [TBD] apply to *IAB-MT type 1-H*.

### 6.4.2 Transmitter transient period

#### 6.4.2.1 General

Transmitter transient period requirements apply to TDD operation of IAB-DU and FDD/TDD operation of IAB-MT.

The transmitter transient period is the time period during which the transmitter is changing from the transmitter OFF period to the transmitter ON period or vice versa. The transmitter transient period is illustrated in figure 6.4.2.1-1 for IAB-DU and IAB-MT.

Transmitter output power

Time

Transmitter ON period

(DL/UL transmission)

Transmitter OFF

period

Transmitter OFF

period

Transmitter transient

period

OFF power level

ON power level

UL/DL transmission

GP or UL/DL transmission

Figure 6.4.2.1-1: Example of relations between transmitter ON period, transmitter OFF period and transmitter transient period for IAB-DU and IAB-MT

For IAB-DU type 1-H and IAB-MT type 1-H, this requirement shall be applied at each TAB connector supporting transmission in the operating band.

#### 6.4.2.2 Minimum requirement for IAB-DU type 1-H

The BS requirements specified in clause 6.4.2.2 in TS 38.104 [TBD] apply to IAB-DU type 1-H.

#### 6.4.2.3 Minimum requirement for IAB-MT type 1-H

The BS requirements specified in clause 6.4.2.2 in TS 38.104 [TBD] apply to IAB-MT type 1-H.

## 6.5 Transmitted signal quality

### 6.5.1 Frequency error

#### 6.5.1.1 IAB-DU frequency error

The requirements in clause 6.5.1 for BS type 1-H in TS 38.104 [x] apply to IAB-DU type 1-H.

### 6.5.2 Modulation quality

#### 6.5.2.1 IAB-DU modulation quality

The requirements in clause 6.5.2 for BS type 1-H in TS 38.104 [x] apply to IAB-DU type 1-H.

### 6.5.3 Time alignment error

#### 6.5.3.1 IAB-DU time alignment error

The requirements in clause 6.5.3 for BS type 1-H in TS 38.104 [x] apply to IAB-DU type 1-H.

## 6.6 Unwanted emissions

Detailed structure of the subclause is TBD.

## 6.7 Transmitter intermodulation

### 6.7.1 IAB-DU transmitter intermodulation

Detailed structure of the subclause is TBD.

### 6.7.2 IAB-MT transmitter intermodulation

Detailed structure of the subclause is TBD.

# 7 Conducted receiver characteristics

## 7.1 General

## 7.2 Reference sensitivity level

### 7.2.1 IAB-DU reference sensitivity level

#### 7.2.1.1 General

The reference sensitivity power level PREFSENS is the minimum mean power received at the *TAB connector* for *IAB-DU type 1-H* at which a throughput requirement shall be met for a specified reference measurement channel.

#### 7.2.1.2 Minimum requirements for *IAB-DU type 1-H*

The wide area IAB-DU reference sensitivity level is specified the same as the wide area BS reference sensitivity level requirement for BS *type 1-H* in TS 38.104x [2], subclause 7.2.2, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

The medium range IAB-DU reference sensitivity level is specified the same as the medium range BS reference sensitivity level requirement for BS *type 1-H* in TS 38.104x [2], subclause 7.2.2, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

The local area IAB-DU reference sensitivity level is specified the same as the local area BS reference sensitivity level requirement for BS *type 1-H* in TS 38.104x [2], subclause 7.2.2, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

Referenced requirements applying to NB IoT are not applicable to the IAB-DU

### 7.2.2 IAB-MT reference sensitivity level

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel as specified in annex A.1 with parameters specified in table 7.2.2-1 for Wide Area IAB-MT and in table 7.2.2-2 for Local Area IAB-MT.

Table 7.2.2-1: NR Wide Area IAB-MT reference sensitivity levels

|  |  |  |  |
| --- | --- | --- | --- |
| *IAB-MT channel bandwidth* (MHz) | Sub-carrier spacing (kHz) | Reference measurement channel | Reference sensitivity power level, PREFSENS  (dBm) |
|  |  |  |  |
|  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |
|  |  |  |  |
|  |  |  |  |
|  | | | |

Table 7.2.2-2: NR Local Area IAB-MT reference sensitivity levels

|  |  |  |  |
| --- | --- | --- | --- |
| *IAB\_MT channel bandwidth* (MHz) | Sub-carrier spacing (kHz) | Reference measurement channel | Reference sensitivity power level, PREFSENS  (dBm) |
|  |  |  |  |
|  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |
|  |  |  |  |
|  |  |  |  |
|  | | | |

## 7.3 Dynamic range

### 7.3.1 IAB-DU dynamic range

~~Detailed structure of the subclause is TBD~~.

#### 7.3.1.1 General

The dynamic range is specified as a measure of the capability of the receiver to receive a wanted signal in the presence of an interfering signal at the *antenna connector* for *IAB-DU type 1-C* or *TAB connector* for *IAB-DU type 1-H* inside the received *[IAB-DU] channel bandwidth*. In this condition, a throughput requirement shall be met for a specified reference measurement channel. The interfering signal for the dynamic range requirement is an AWGN signal.

#### 7.3.1.2 Minimum requirement for *IAB-DU type 1-H*

The wide area IAB-DU dynamic range is specified the same as the wide area BS dynamic requirement for BS *type 1-H* in TS 38.104x[x], subclause 7.3.2, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

The medium range IAB-DU dynamic range is specified the same as the medium range BS dynamic range requirement for BS *type 1-H* in TS 38.104x[x], subclause 7.3.2, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

The local area IAB-DU dynamic range is specified the same as the local area BS dynamic range requirement for BS *type 1-H* in TS 38.104x[x], subclause 7.3.2, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

Referenced requirements applying to NB IoT are not applicable to the IAB-DU

### 7.3.2 IAB-MT dynamic range

Detailed structure of the subclause is TBD.

## 7.4 In-band selectivity and blocking

Detailed structure of the subclause is TBD.

## 7.5 Out-of-band blocking

Detailed structure of the subclause is TBD.

## 7.6 Receiver spurious emissions

7.6.1 General

The receiver spurious emissions power is the power of emissions generated or amplified in a receiver unit that appear at the *TAB connector* (for *IAB-DU type 1-H and IAB-MT type 1-H*). The requirements apply to all IAB-DU and IAB-MT with separate RX and TX *TAB connectors*.

For *TAB connectors* supporting both RX and TX in TDD, the requirements apply during the *transmitter OFF period*.

For RX-only *multi-band* *connectors*, the spurious emissions requirements are subject to exclusion zones in each supported *operating band*. For *multi-band* *connectors* that both transmit and receive in *operating band* supporting TDD, RX spurious emissions requirements are applicable during the *TX OFF period*, and are subject to exclusion zones in each supported *operating band*.

For *IAB-DU type 1-H* manufacturer shall declare *TAB connector RX min cell groups*. Every *TAB connector* of *IAB-DU type 1‑H* supporting reception in an *operating band* shall map to one *TAB connector RX min cell group*, where mapping of *TAB connectors* to cells/beams is implementation dependent.

The number of active receiver units that are considered when calculating the conducted RX spurious emission limits (NRXU,counted) for IAB-DU *type 1-H* is calculated as follows:

NRXU,counted = *min(NRXU,active , 8* *× Ncells)*

NRXU,countedpercell is used for scaling of *basic limits* and is derived as NRXU,countedpercell = NRXU,counted / Ncells, where Ncells is defined in clause 6.1.

NOTE: NRXU,active is the number of actually active receiver units and is independent to the declaration of Ncells.

### 7.6.2. IAB-DU receiver spurious emissions

#### 7.6.2.1 Basic limits

The receiver spurious emissions *basic limits* are provided in table 7.6.2.1-1.

**Table 7.6.2.1-1: General IAB-DU receiver spurious emissions limits**

| **Spurious frequency range** | ***Basic limits*** | ***Measurement bandwidth*** | **Note** |
| --- | --- | --- | --- |
| 30 MHz – 1 GHz | -57 dBm | 100 kHz | Note 1 |
| 1 GHz – 12.75 GHz | -47 dBm | 1 MHz | Note 1, Note 2 |
| 12.75 GHz – 5th harmonic of the upper frequency edge of the UL *operating band* in GHz | -47 dBm | 1 MHz | Note 1, Note 2, Note 3 |
| NOTE 1: *Measurement bandwidth*s as in ITU-R SM.329 [16], s4.1.  NOTE 2: Upper frequency as in ITU-R SM.329 [16], s2.5 table 1.  NOTE 3: This spurious frequency range applies only for *operating bands* for which the 5th harmonic of the upper frequency edge of the UL*operating band* is reaching beyond 12.75 GHz.  NOTE 4: The frequency range from ΔfOBUE below the lowest frequency of the IAB transmitter *operating band* to ΔfOBUE above the highest frequency of the IAB transmitter *operating band* may be excluded from the requirement. ΔfOBUE is defined in clause [6.6.1]. For *multi-band* *connectors*, the exclusion applies for all supported *operating bands*. | | | |

#### 7.6.2.2 Minimum requirement for IAB-DU type 1-H

The RX spurious emissions requirements for *IAB-DU type 1-H* are that for each applicable *basic limit* specified in table 7.6.2.1-1 for each *TAB connector RX min cell group,* the power sum of emissions at respective *TAB connectors* shall not exceed the BS limits specified as the *basic limit*s + X, where X = 10log10(NRXU,countedpercell), unless stated differently in regional regulation.

The RX spurious emission requirements are applied per the *TAB connector RX min cell group* for all the configurations supported by the BS.

NOTE: Conformance to the IAB-DU receiver spurious emissions requirement can be demonstrated by meeting at least one of the following criteria as determined by the manufacturer:

1) The sum of the spurious emissions power measured on each *TAB connector* in the *TAB connector RX min cell group* shall be less than or equal to the IAB-DU limit above for the respective frequency span.

Or

2) The spurious emissions power at each *TAB connector* shall be less than or equal to the IAB-DU limit as defined above for the respective frequency span, scaled by -10log10(*n*), where *n* is the number of *TAB connectors* in the *TAB connector RX min cell group*.

### 7.6.2. IAB-MT receiver spurious emissions

Detailed structure of the subclause is TBD.

## 7.7 Receiver intermodulation

### 7.7.1 General

Third and higher order mixing of the two interfering RF signals can produce an interfering signal in the band of the desired channel. Intermodulation response rejection is a measure of the capability of the receiver to receive a wanted signal on its assigned channel frequency at TAB connector for IAB-DU type 1-H [and IAB-MT type 1-H] in the presence of two interfering signals which have a specific frequency relationship to the wanted signal.

### 7.7.2 Minimum requirement for *IAB-DU type 1-H*

The wide area IAB-DU receiver intermodulation requirement is specified the same as the wide area receiver intermodulation requirement for BS *type 1-H* in TS 38.104[x], subclause 7.7.2, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

The medium range IAB-DU receiver intermodulation requirement is specified the same as the medium range BS receiver intermodulation requirement for BS *type 1-H* in TS 38.104[x], subclause 7.7.2, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

The local area IAB-DU receiver intermodulation requirement is specified the same as the local area BS receiver intermodulation requirement for BS *type 1-H* in TS 38.104[x], subclause 7.7.2, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

Referenced requirements applying to NB-IoT are not applicable to the IAB-DU

### 7.7.3. Minimum requirement for *IAB-MT type 1-H*

Detailed structure of the subclause is TBD.

## 7.8 In-channel selectivity

### 7.8.1 General

In-channel selectivity (ICS) is a measure of the receiver ability to receive a wanted signal at its assigned resource block locations *TAB connector* for *IAB-DU type 1-H* in the presence of an interfering signal received at a larger power spectral density. In this condition a throughput requirement shall be met for a specified reference measurement channel. The interfering signal shall be an NR signal which is time aligned with the wanted signal.

### 7.8.2 Minimum requirement for *IAB-DU type 1-H*

The wide area IAB-DU receiver in-channel selectivity requirement is specified the same as the wide area receiver in-channel selectivity requirement for BS *type 1-H* in TS 38.104[x], subclause 7.8.2, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

The medium range IAB-DU receiver in-channel selectivity requirement is specified the same as the medium range BS receiver in-channel selectivity requirement for BS *type 1-H* in TS 38.104[x], subclause 7.8.2, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

The local area IAB-DU receiver in-channel selectivity requirement is specified the same as the local area BS receiver in-channel selectivity requirement for BS *type 1-H* in TS 38.104[x], subclause 7.8.2, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

Referenced requirements applying to NB-IoT are not applicable to the IAB-DU

# 8 Conducted performance requirements

Detailed structure of the subclause is TBD.

# 9 Radiated transmitter characteristics

## 9.1 General

## 9.2 Radiated transmit power

### 9.2.1 IAB-DU radiated transmit power

Detailed structure of the subclause is TBD.

### 9.2.2 IAB-MT radiated transmit power

Detailed structure of the subclause is TBD.

## 9.3 IAB output power

### 9.3.1 IAB-DU output power

Detailed structure of the subclause is TBD

### 9.3.2 IAB-MT output power

Detailed structure of the subclause is TBD

## 9.4 OTA output power dynamics

#### 9.4.1.1 General

The requirements in clause 9.4 apply during the *transmitter ON period*. Transmit signal quality (as specified in clause 9.6) shall be maintained for the output power dynamics requirements.

The OTA output power requirements are *directional requirements* and apply to the *beam peak directions* over the *OTA peak directions set*.

#### 9.4.1.2 OTA RE power control dynamic range

##### 9.4.1.2.1 General

The OTA RE power control dynamic range is the difference between the power of an RE and the average RE power for a BS at maximum output power (Pmax,c,EIRP) for a specified reference condition.

This requirement shall apply at each RIB supporting transmission in the *operating band*.

##### 9.4.1.2.2 Minimum requirement for *IAB-DU type 1-O*

The OTA RE power control dynamic range is specified the same as the conducted RE power control dynamic range requirement for BS *type 1-H* in TS 38.104x[x], subclause 6.3.2.2.

#### 9.4.1.3 OTA total power dynamic range

##### 9.4.1.3.1 General

The OTA total power dynamic range is the difference between the maximum and the minimum transmit power of an OFDM symbol for a specified reference condition.

This requirement shall apply at each RIB supporting transmission in the *operating band*.

NOTE 1: The upper limit of the OTA total power dynamic range is the IAB-DU maximum carrier EIRP (Pmax,c,EIRP) when transmitting on all RBs. The lower limit of the OTA total power dynamic range is the average EIRP for single RB transmission in the same direction using the same beam. The OFDM symbol carries PDSCH and not contain RS or SSB.

##### 9.4.1.3.2 Minimum requirement for *IAB-DU type 1-O*

The OTA total power dynamic range is specified the same as the total power dynamic range requirement for BS *type 1-H* in TS 38.104x[x], subclause 6.3.3.2, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

##### 9.4.1.3.3 Minimum requirement for *IAB-DU type 2-O*

The OTA total power dynamic range is specified the same as the OTA total power dynamic range requirement for BS *type 2-O* in TS 38.104x[x], subclause 9.4.3.3.

### 9.4.2 IAB-MU OTA Output Power Dynamics

Detailed structure of the subclause is TBD.

## 9.5 OTA transmit ON/OFF power

### 9.5.1 General

OTA transmit ON/OFF power requirements apply to TDD operation of IAB-DU and FDD/TDD operation of IAB-MT.

### 9.5.2 OTA transmitter OFF power

#### 9.5.2.1 General

OTA transmitter OFF power is defined as the mean power measured over 70/N µs filtered with a square filter of bandwidth equal to the *transmission bandwidth configuration* of the IAB (BWConfig) centred on the assigned channel frequency during the *transmitter OFF period*. N = SCS/15, where SCS is Sub Carrier Spacing in kHz.

For IAB supporting intra-band contiguous CA, the OTA transmitter OFF power is defined as the mean power measured over 70/N us filtered with a square filter of bandwidth equal to the *Aggregated IAB-DU/MT Channel Bandwidth* BWChannel\_CA centred on (Fedge,high+Fedge,low)/2 during the *transmitter OFF period*. N = SCS/15, where SCS is the smallest supported Sub Carrier Spacing in kHz in the *Aggregated IAB Channel Bandwidth*.

For *IAB type 1-O*, the transmitter OFF power is defined as the output power at the *co-location reference antenna* conducted output(s). For *IAB type 2-O* the transmitter OFF power is defined as TRP.

For *multi-band* *RIBs* and *single band RIBs* supporting transmission in multiple bands, the requirement is only applicable during the *transmitter OFF period* in all supported *operating bands*.

#### 9.5.2.2 Minimum requirement for IAB-DU type 1-O

The BS requirements specified in 9.5.2.2 in TS 38.104 [TBD] apply to *IAB-DU type 1-O*.

#### 9.5.2.3 Minimum requirement for IAB-DU type 2-O

The BS requirements specified in 9.5.2.3 in TS 38.104 [TBD] apply to *IAB-DU type 1-O*.

#### 9.5.2.4 Minimum requirement for IAB-MT type 1-O

The BS requirements specified in 9.5.2.2 in TS 38.104 [TBD] apply to *IAB-MT type 1-O*.

#### 9.5.2.5 Minimum requirement for IAB-MT type 2-O

The BS requirements specified in 9.5.2.3 in TS 38.104 [TBD] apply to *IAB-DU type 1-O*.

### 9.5.3 OTA transient period

#### 9.5.3.1 General

The OTA *transmitter transient period* is the time period during which the transmitter is changing from the tra*nsmitter OFF period* to the *transmitter ON period* or vice versa. The *transmitter transient period* is illustrated in figure 6.4.2.1-1 for IAB-DU and IAB-MT.

This requirement shall be applied at each RIB supporting transmission in the *operating band*.

#### 9.5.3.2 Minimum requirement for IAB-DU type 1-O

The BS requirements specified in 9.5.3.2 in TS 38.104 [TBD] apply to *IAB-DU type 1-O*.

#### 9.5.3.3 Minimum requirement for IAB-DU type 2-O

The BS requirements specified in 9.5.3.3 in TS 38.104 [TBD] apply to *IAB-DU type 2-O*.

#### 9.5.3.4 Minimum requirement for IAB-MT type 1-O

The BS requirements specified in 9.5.3.2 in TS 38.104 [TBD] apply to *IAB-MT type 1-O*.

#### 9.5.3.5 Minimum requirement for IAB-MT type 2-O

The BS requirements specified in 9.5.3.3 in TS 38.104 [TBD] apply to *IAB-MT type 2-O*.

## 9.6 OTA transmitted signal quality

### 9.6.1 OTA frequency error

#### 9.6.1.1 IAB-DU OTA frequency error

The requirements in clause 9.6.1 for BS type 1-O and type 2-O in TS 38.104 [x] apply to IAB-DU type 1-O and type 2-O respectively.

### 9.6.2 OTA modulation quality

#### 9.6.2.1 IAB-DU OTA modulation quality

The requirements in clause 9.6.2 for BS type 1-O and type 2-O in TS 38.104 [x] apply to IAB-DU type 1-O and type 2-O respectively.

### 9.6.3 OTA time alignment error

#### 9.6.3.1 IAB-DU OTA time alignment error

The requirements in clause 9.6.3 for BS type 1-O and type 2-O in TS 38.104 [x] apply to IAB-DU type 1-O and type 2-O respectively.

## 9.7 OTA unwanted emissions

Detailed structure of the subclause is TBD.

## 9.8 OTA transmitter intermodulation

### 9.8.1 IAB-DU OTA transmitter intermodulation

Detailed structure of the subclause is TBD.

### 9.8.2 IAB-MT OTA transmitter intermodulation

Detailed structure of the subclause is TBD.

# 10 Radiated receiver characteristics

## 10.1 General

## 10.2 OTA sensitivity

### 10.2.1 IAB-DU OTA sensitivity

#### 10.2.1.1 IAB-DU type 1-H and IAB-DU type 1-O

The OTA sensitivity requirement is a *directional requirement* based upon the declaration of one or more *OTA sensitivity direction declarations* (OSDD), related to a *IAB-DU type 1-H* and *IAB-DU type 1-O* receiver.

The IAB-DU reference sensitivity level is specified the same as the BS reference sensitivity level requirement for BSin TS 38.104x[2], subclause 10.2.1, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

#### 10.2.1.2 IAB-DU type 2-O

There is no OTA sensitivity requirement for FR2, the OTA sensitivity is the same as the OTA reference sensitivity in clause 10.3.

### 10.2.2 IAB-MT OTA sensitivity

#### 10.2.2.1 IAB-MT type 1-H

###### 10.2.2.1.1 General

The OTA sensitivity requirement is a *directional requirement* based upon the declaration of one or more *OTA sensitivity direction declarations* (OSDD), related to a *IAB-MT type 1-H* receiver.

The *IAB-MT type 1-H* may optionally be capable of redirecting/changing the *receiver target* by means of adjusting IAB-MT settings resulting in multiple *sensitivity RoAoA*. The *sensitivity RoAoA* resulting from the current IAB-MT settings is the active *sensitivity RoAoA*.

If the IAB-MT is capable of redirecting the *receiver target* related to the OSDD then the OSDD shall include:

- *IAB-MT channel bandwidth* and declared minimum EISlevel applicable to any active *sensitivity RoAoA* inside the *receiver target redirection range* in the OSDD.

- A declared *receiver target redirection range*, describing all the angles of arrival that can be addressed for the OSDD through alternative settings in the IAB-MT.

- Five declared *sensitivity RoAoA* comprising the conformance testing directions as detailed in [TS 38.141‑2 [x]].

- The *receiver target reference direction*.

NOTE 1: Some of the declared *sensitivity RoAoA* may coincide depending on the redirection capability.

NOTE 2: In addition to the declared *sensitivity RoAoA*, several *sensitivity RoAoA* may be implicitly defined by the *receiver target redirection range* without being explicitly declared in the OSDD.

If the IAB-MT is not capable of redirecting the *receiver target* related to the OSDD, then the OSDD includes only:

- The set(s) of RAT, *IAB-MT channel bandwidth* and declared minimum EISlevel applicable to the *sensitivity RoAoA* in the OSDD.

- One declared active *sensitivity RoAoA*.

- The *receiver target reference direction*.

NOTE 4: For IAB-MT without target redirection capability, the declared (fixed) *sensitivity RoAoA* is always the active *sensitivity RoAoA*.

The OTA sensitivity EIS level declaration shall apply to each supported polarization, under the assumption of *polarization match*.

###### 10.2.2.1.2 Minimum requirement

For a received signal whose AoA of the incident wave is within the active *sensitivity RoAoA* of an OSDD, the error rate criterion as described in clause 7.2.2 shall be met when the level of the arriving signal is equal to the minimum EIS level in the respective declared set of EIS level and *IAB-MT channel bandwidth*.

#### 10.2.2.2 IAB-MT type 2-O

There is no OTA sensitivity requirement for FR2, the OTA sensitivity is the same as the OTA reference sensitivity in clause 10.3.

## 10.3 OTA reference sensitivity level

### 10.3.1 General

The OTA REFSENS requirement is a *directional requirement* and is intended to ensure the minimum OTA reference sensitivity level for a declared *OTA REFSENS RoAoA*. The OTA reference sensitivity power level EISREFSENS is the minimum mean power received at the RIB at which a reference performance requirement shall be met for a specified reference measurement channel.

The OTA REFSENS requirement shall apply to each supported polarization, under the assumption of *polarization match*.

### 10.3.2 IAB-DU OTA reference sensitivity level

#### 10.3.2.1 Minimum requirement for *IAB-DU type 1-O*

The wide area IAB-DU reference sensitivity level is specified the same as the wide area BS reference sensitivity level requirement for BSin TS 38.104x[x], subclause 10.3.2, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

The medium range IAB-DU reference sensitivity level is specified the same as the medium range BS reference sensitivity level requirement for BSin TS 38.104x[x], subclause 10.3.2, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

The local area IAB-DU reference sensitivity level is specified the same as the local area BS reference sensitivity level requirement for BSin TS 38.104x[x], subclause 10.3.2, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

#### 10.3.2.2 Minimum requirement for *IAB-DU type 2-O*

The wide area IAB-DU reference sensitivity level is specified the same as the wide area BS reference sensitivity level requirement for BSin TS 38.104x[x], subclause 10.3.3, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

The medium range IAB-DU reference sensitivity level is specified the same as the medium range BS reference sensitivity level requirement for BSin TS 38.104x[x], subclause 10.3.3, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

The local area IAB-DU reference sensitivity level is specified the same as the local area BS reference sensitivity level requirement for BSin TS 38.104x[x], subclause 10.3.3, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

### 10.3.3 IAB-MT OTA reference sensitivity level

#### 10.3.3.1 Minimum requirement for *IAB-MT type 1-O*

Detailed structure of the subclause is TBD

#### 10.3.3.2 Minimum requirement for *IAB-MT type 2-O*

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel as specified in the corresponding table and annex A.1 when the OTA test signal is at the corresponding EISREFSENS level and arrives from any direction within the *OTA REFSENS RoAoA*.

EISREFSENS levels are derived from a single declared basis level EISREFSENS\_50M, which is based on a reference measurement channel with 50 MHz [*IAB-MT] channel bandwidth*. EISREFSENS\_50M itself is not a requirement and although it is based on a reference measurement channel with 50 MHz [*IAB-MT] channel bandwidth* it does not imply that IAB-MT has to support 50 MHz [*IAB-MT] channel bandwidth*.

For Wide Area IAB-MT, EISREFSENS\_50M is an integer value in the range -96 to -119 dBm. The specific value is declared by the vendor.

For Local Area IAB-MT, EISREFSENS\_50M is an integer value in the range -86 to -114 dBm. The specific value is declared by the vendor.

Table 10.3.3.2-1: FR2 OTA reference sensitivity requirement

|  |  |  |  |
| --- | --- | --- | --- |
| *[IAB-DU] channel Bandwidth*  (MHz) | Sub-carrier spacing (kHz) | Reference measurement channel | OTA reference sensitivity level, EISREFSENS (dBm) |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
| NOTE 1: EISREFSENS is the power level of a single instance of the reference measurement channel. This requirement shall be met for each consecutive application of a single instance of the reference measurement channel mapped to disjoint frequency ranges with a width corresponding to the number of resource blocks of the reference measurement channel each, except for one instance that might overlap one other instance to cover the full [*IAB-MT] channel bandwidth*.  NOTE 2: The declared EISREFSENS\_50M shall be within the range specified above. | | | |

## 10.4 OTA Dynamic range

### 10.4.1 IAB-DU OTA dynamic range

### 10.4.1.1 General

The OTA dynamic range is a measure of the capability of the receiver unit to receive a wanted signal in the presence of an interfering signal inside the received *[IAB-DU] channel bandwidth*.

The requirement shall apply at the RIB when the AoA of the incident wave of a received signal and the interfering signal are from the same direction and are within the *OTA REFSENS RoAoA.*

The wanted and interfering signals apply to each supported polarization, under the assumption of *polarization match*.

### 10.4.1.2 Minimum requirement for *IAB-DU type 1-O*

The wide area IAB-DU dynamic range is specified the same as the wide area BS dynamic requirement for BS *type 1-O* in TS 38.104x[x], subclause 10.4.2, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

The medium range IAB-DU dynamic range is specified the same as the medium range BS dynamic range requirement for BS *type 1-O* in TS 38.104x[x], subclause 10.4.2, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

The local area IAB-DU dynamic range is specified the same as the local area BS dynamic range requirement for BS *type 1-O* in TS 38.104x[x], subclause 10.4.2, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

### 10.4.2 IAB-MT OTA dynamic range

Detailed structure of the subclause is TBD.

## 10.5 OTA in-band selectivity and blocking

### 10.5.1 OTA adjacent channel selectivity

#### 10.5.1.1 General

OTA Adjacent channel selectivity (ACS) is a measure of the receiver’s ability to receive an OTA wanted signal at its assigned channel frequency in the presence of an OTA adjacent channel signal with a specified centre frequency offset of the interfering signal to the band edge of a victim system.

#### 10.5.1.2 Minimum requirement for *IAB-DU type 1-O*

Minimum requirement is the same as specified for BS type 1-O in TS38.104[2], subclause 10.5.1.2.

#### 10.5.1.3 Minimum requirement for *IAB-DU type 2-O*

Minimum requirement is the same as specified for BS type 2-O in TS38.104[2], subclause 10.5.1.3.

#### 10.5.1.4 Minimum requirement for *IAB-MT type 2-O*

The requirement shall apply at the RIB when the AoA of the incident wave of a received signal and the interfering signal are from the same direction and are within the -*OTA REFSENS RoAoA.*

The wanted and interfering signals apply to all supported polarizations, under the assumption o*f polarization match*.

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel.

For FR2, the OTA wanted and the interfering signal are specified in table 10.5.1.4-1 and table [ TBD] for ACS. The reference measurement channel for the OTA wanted signal is further specified in annex [ A.1]. The characteristics of the interfering signal is further specified in annex [ D].

The OTA ACS requirement is applicable outside the IAB-MT [ RF Bandwidth]. The OTA interfering signal offset is defined relative to the IAB-MT [ RF Bandwidth] edges.

For Wide Area IAB-MT, for RIBs supporting operation in *non-contiguous spectrum* within any *operating band*, the OTA ACS requirement shall apply in addition inside any sub-block gap, in case the sub-block gap size is at least as wide as the NR interfering signal in table [ TBD]. The OTA interfering signal offset is defined relative to the sub-block edges inside the sub-block gap.

Table 10.5.1.4-1: OTA ACS requirement for Wide Area and Local Area IAB MT

|  |  |  |
| --- | --- | --- |
| *IAB-MT channel bandwidth* of the lowest/highest carrier received (MHz) | Wanted signal mean power (dBm) | Interfering signal mean power (dBm) |
| 50, 100, 200, 400 | EISREFSENS + 6 dB (Note 3) | EISREFSENS\_50M + 27.7 + ΔFR2\_REFSENS (Note 1)  EISREFSENS\_50M + 26.7 + ΔFR2\_REFSENS (Note 2) |
| NOTE 1: Applicable to bands defined within the frequency spectrum range of 24.25 – 33.4 GHz  NOTE 2: Applicable to bands defined within the frequency spectrum range of 37 – 52.6 GHz  NOTE 3: EISREFSENS is given in subclause [ 10.3.3] | | |

### 10.5.2 OTA in-band blocking

10.5.2.1 General

The OTA in-band blocking characteristics is a measure of the receiver’s ability to receive a OTA wanted signal at its assigned channel in the presence of an unwanted OTA interferer, which is an NR signal for general blocking or an NR signal with one RB for narrowband blocking.

10.5.2.2 Minimum requirement for *IAB-DU type 1-O*

Minimum requirement is the same as specified for BS type 1-O in TS38.104[2], subclause 10.5.2.2.

10.5.2.3 Minimum requirement for *IAB DU type 2-O*

Minimum requirement is the same as specified for BS type 2-O in TS38.104[2], subclause 10.5.2.3.

10.5.2.4 Minimum requirement for *IAB-MT of type 2-O*

The requirement shall apply at the RIB when the AoA of the incident wave of a received signal and the interfering signal are from the same direction and are within the *OTA REFSENS RoAoA.*

The wanted and interfering signals apply to each supported polarization, under the assumption o*f polarization match*.

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel.

For Wide Area *IAB-MT type 2-O*, the OTA wanted and OTA interfering signals are provided at RIB using the parameters in table 10.5.2.4-1 for general OTA blocking requirements. The reference measurement channel for the wanted signal is further specified in annex [ A.1]. The characteristics of the interfering signal is further specified in annex D.

The OTA blocking requirements are applicable outside the IAB-MT [ RF Bandwidth]. The interfering signal offset is defined relative to the IAB-MT [ RF Bandwidth] edges.

For Wide Area *IAB-MT type 2-O* the OTA in-band blocking requirement shall apply from FUL\_low - ΔfOOB to FUL\_high + ΔfOOB*.* The ΔfOOB for *IAB-MT type 2-O* is defined in table 10.5.2.4-0.

**Table 10.5.2.4-0: ΔfOOB offset for NR *operating bands* for Wide Area IAB-MT in FR2**

|  |  |  |
| --- | --- | --- |
| **IAB-MT type** | ***Operating band* characteristics** | **ΔfOOB (MHz)** |
| *IAB-MT type 2-O* | FUL\_high – FUL\_low ≤ 3250 MHz | 1500 |

For Wide Area IAB-MT and for a RIBs supporting operation in *non-contiguous spectrum* within any *operating band*, the OTA blocking requirements apply in addition inside any sub-block gap, in case the sub-block gap size is at least as wide as twice the interfering signal minimum offset in table 10.5.2.4-1. The interfering signal offset is defined relative to the sub-block edges inside the sub-block gap.

**Table 10.5.2.4-1: General OTA blocking requirement for *Widea Area IAB-MT***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***IAB MT channel bandwidth* of the lowest/highest carrier received (MHz)** | **OTA wanted signal mean power (dBm)** | OTA interfering signal mean power (dBm) | **OTA interfering signal centre frequency offset**  **from the lower/upper IAB MT [ RF Bandwidth] edge or sub-block edge inside a sub-block gap (MHz)** | **Type of OTA interfering signal** |
| 50, 100, 200, 400 | EISREFSENS + 6 dB | EISREFSENS\_50M + 33 + ΔFR2\_REFSENS | ±75 | 50 MHz CP-OFDM NR signal,  60 kHz SCS, 64 RBs |
| NOTE: EISREFSENS and EISREFSENS\_50M are given in subclause [ 10.3.3]. | | | | |

--------------------------------------------------End of TP------------------------------------------------------

## 10.6 OTA out-of-band blocking

### 10.6.1 General

The OTA out-of-band blocking characteristics are a measure of the receiver unit ability to receive a wanted signal at the *RIB* at its assigned channel in the presence of an unwanted interferer.

### 10.6.2 FR1 OTA out-of-band blocking

The requirement shall apply at the RIBwhen the AoA of the incident wave of the received signal and the interfering signal are from the same direction and are within the [*minSENS RoAoA or refsens RoAoA*].

The wanted signal applies to each supported polarization, under the assumption of *polarization match.* The interferer shall be *polarization matched* in-band and the polarization maintained for out-of-band frequencies.

For OTA wanted and OTA interfering signals provided at the RIB using the parameters in table 10.6.2-2, the following requirements shall be met:

- The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel. The reference measurement channel for the OTA wanted signal is identified in clause 10.3.2 for each [*IAB-Node channel bandwidth*] and further specified in [annex A.1].

For a *multi-band RIB*, the OTA out-of-band requirement shall apply for each supported *operating band*, with the exception that the in-band blocking frequency ranges of all supported *operating bands* according to [clause 7.4.2.2] shall be excluded from the OTA out‑of‑band blocking requirement.

For OTA out-of-band blocking requirement apply from 30 MHz to FUL,low - ΔfOOB and from FUL,high + ΔfOOB up to 12750 MHz. The ΔfOOB for FR1 OTA out-of-band blocking requirement is defined in table 10.6.2-1.

Table 10.6.2-1: ΔfOOB

|  |  |
| --- | --- |
| *Operating band* characteristics | ΔfOOB (MHz) |
| FUL,high – FUL,low < 100 MHz | 20 |
| 100 MHz ≤ FUL,high – FUL,low ≤ 900 MHz | 60 |

Table 10.6.2-2: OTA out-of-band blocking performance requirement

|  |  |  |
| --- | --- | --- |
| Wanted signal mean power (dBm) | Interfering signal RMS field-strength (V/m) | Type of interfering Signal |
| [EISminSENS + TBD dB]  (Note 1) | [0.36] | CW |
| NOTE 1: EISminSENS depends on the *channel bandwidth* as specified in clause 9.2.  NOTE 2: The RMS field-strength level in V/m is related to the interferer EIRP level at a distance described as , where EIRP is in W and r is in m; for example, 0.36 V/m is equivalent to 36 dBm at fixed distance of 30 m. | | |

### 10.6.3 FR2 OTA out-of-band blocking

The requirement shall apply at the RIBwhen the AoA of the incident wave of the received signal and the interfering signal are from the same direction and are within the *OTA REFSENS RoAoA*.

The wanted signal applies to each supported polarization, under the assumption of *polarization match*. The interferer shall be polarization matched in-band and the polarization maintained for out-of-band frequencies.

For *IAB type 2-O* the OTA out-of-band blocking requirement apply from 30 MHz to FUL,low – 1500 MHz and from FUL,high + 1500 MHz up to 2nd harmonic of the upper frequency edge of the *operating band*.

For OTA wanted and OTA interfering signals provided at the RIB using the parameters in table 10.6.3-1, the following requirements shall be met:

- The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel. The reference measurement channel for the OTA wanted signal is identified in subclause 10.3.3 for each [*IAB Node channel bandwidth*].

**Table 10.6.3-1: OTA out-of-band blocking performance requirement**

| **Frequency range of interfering signal**  **(MHz)** | **Wanted signal mean power**  **(dBm)** | **Interferer RMS field-strength**  **(V/m)** | **Type of interfering signal** |
| --- | --- | --- | --- |
| 30 to 12750 | [EISREFSENS + TBD dB] | [0.36] | CW |
| 12750 to FUL,low – 1500 | [EISREFSENS + TBD dB] | [0.1] | CW |
| FUL,high + 1500 to 2nd harmonic of the upper frequency edge of the *operating band* | [EISREFSENS + TBD dB] | [0.1] | CW |

## 10.7 OTA receiver spurious emissions

### 10.7.1 General

The OTA RX spurious emission is the power of the emissions radiated from the antenna array from a receiver unit.

The metric used to capture OTA receiver spurious emissions for IAB-MT and IAB-DU for *IAB type 1-O* and *IAB type 2-O* is *total radiated power* (TRP), with the requirement defined at the RIB.

### 10.7.2 IAB-DU OTA receiver spurious emissions

#### 10.7.2.1 Minimum requirement for IAB-DU type 1-O

Minimum requirement is the same as specified for BS type 1-O in TS 38.104[2], subclause 10.7.2.

#### 10.7.2.2 Minimum requirement for IAB-DU type 2-O

Minimum requirement is the same as specified for BS type 2-O in TS 38.104[2], subclause 10.7.3.

### 10.7.3 IAB-MT OTA receiver spurious emissions

#### 10.7.3.1 Minimum requirement for IAB-MT type 1-O

#### 10.7.3.2 Minimum requirement for IAB-MT type 2-O

The OTA RX spurious emissions requirement shall apply during the *transmitter OFF period* only.

For the Wide Area *IAB-MT type 2-O*, the power of any RX spurious emission shall not exceed the limits in table 10.7.3.2-1.

10.7.3.2-1: Radiated Rx spurious emission limits for *IAB-MT type 2-O*

|  |  |  |  |
| --- | --- | --- | --- |
| Spurious  frequency range  (Note 4) | Limit (Note 5) | Measurement Bandwidth | Note |
| 30 MHz ↔ 1 GHz | -36 dBm | 100 kHz | Note 1 |
| 1 GHz ↔ 18 GHz | -30 dBm | 1 MHz | Note 1 |
| 18 GHz ↔ Fstep,1 | -20 dBm | 10 MHz | Note 2 |
| Fstep,1  ↔ Fstep,2 | -15 dBm | 10 MHz | Note 2 |
| Fstep,2 ↔ Fstep,3 | -10 dBm | 10 MHz | Note 2 |
| Fstep,4  ↔ Fstep,5 | -10 dBm | 10 MHz | Note 2 |
| Fstep,5  ↔ Fstep,6 | -15 dBm | 10 MHz | Note 2 |
| Fstep,6 ↔ 2nd harmonic of the upper frequency edge of the DL *operating band* | -20 dBm | 10 MHz | Note 2, Note 3 |
| NOTE 1: Bandwidth as in ITU-R SM.329 [16], s4.1.  NOTE 2: Limit and bandwidth as in ERC Recommendation 74-01 [17], Annex 2.  NOTE 3: Upper frequency as in ITU-R SM.329 [16], s2.5 table 1.  NOTE 4: The step frequencies Fstep,X are defined in table 10.7.3.2-2.  NOTE 5: Additional limits may apply regionally. | | | |

Table 10.7.3.2-2: Step frequencies for defining the radiated Rx spurious emission limits for *IAB-MT type 2-O*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Operating band | Fstep,1 (GHz) | Fstep,2 (GHz) | Fstep,3 (GHz) | Fstep,4 (GHz) | Fstep,5 (GHz) | Fstep,6 (GHz) |
| n257 | 18 | 23.5 | 25 | 31 | 32.5 | 41.5 |
| n258 | 18 | 21 | 22.75 | 29 | 30.75 | 40.5 |
| n260 | 25 | 34 | 35.5 | 41.5 | 43 | 52 |
| n261 | 18 | 25.5 | 26.0 | 29.85 | 30.35 | 38.35 |

## 10.8 OTA receiver intermodulation

### 10.8.1 General

Third and higher order mixing of the two interfering RF signals can produce an interfering signal in the band of the desired channel. Intermodulation response rejection is a measure of the capability of the receiver unit to receive a wanted signal on its assigned channel frequency in the presence of two interfering signals which have a specific frequency relationship to the wanted signal. The requirement is defined as a directional requirement at the RIB.

### 10.8.2 Minimum requirement for *IAB-DU type 1-O*

The wide area IAB-DU receiver intermodulation requirement is specified the same as the wide area receiver intermodulation requirement for BS *type 1-O* in TS 38.104[x], subclause 10.8.2, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

The medium range IAB-DU receiver intermodulation requirement is specified the same as the medium range BS receiver intermodulation requirement for BS *type 1-O* in TS 38.104[x], subclause 10.8.2, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

The local area IAB-DU receiver intermodulation requirement is specified the same as the local area BS receiver intermodulation requirement for BS *type 1-O* in TS 38.104x[x], subclause 10.8.2, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

### 10.8.3 Minimum requirement for *IAB-DU type 2-O*

The wide area IAB-DU receiver intermodulation requirement is specified the same as the wide area receiver intermodulation requirement for BS *type 2-O* in TS 38.104x[x], subclause 10.8.3, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

The medium range IAB-DU receiver intermodulation requirement is specified the same as the medium range BS receiver intermodulation requirement for BS *type 2-O* in TS 38.104x[x], subclause 10.8.3, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

The local area IAB-DU receiver intermodulation requirement is specified the same as the local area BS receiver intermodulation requirement for BS *type 2-O* in TS 38.104x[x], subclause 10.8.3, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

### 10.8.4 Minimum requirement for *IAB-MT type 1-O*

Detailed structure of the subclause is TBD.

## 10.9 OTA in-channel selectivity

### 10.9.1 General

In-channel selectivity (ICS) is a measure of the receiver ability to receive a wanted signal at its assigned resource block locations in the presence of an interfering signal received at a larger power spectral density. In this condition a throughput requirement shall be met for a specified reference measurement channel. The interfering signal shall be an NR signal as specified in annex [A.1] and shall be time aligned with the wanted signal

### 10.9.2 Minimum requirement for *IAB-DU* type 1-O

The wide area IAB-DU receiver in-channel selectivity requirement is specified the same as the wide area receiver in-channel selectivity requirement for BS *type 1-O* in TS 38.104[x], subclause 10.9.2, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

The medium range IAB-DU receiver in-channel selectivity requirement is specified the same as the medium range BS receiver in-channel selectivity requirement for BS *type 1-O* in TS 38.104[x], subclause 10.9.2, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

The local area IAB-DU receiver in-channel selectivity requirement is specified the same as the local area BS receiver in-channel selectivity requirement for BS *type 1-O* in TS 38.104[x], subclause 10.9.2, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

### 10.9.3 Minimum requirement for *IAB-DU type 2-O*

The wide area IAB-DU receiver in-channel selectivity requirement is specified the same as the wide area receiver in-channel selectivity requirement for BS *type 2-O* in TS 38.104[x], subclause 10.9.3, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

The medium range IAB-DU receiver in-channel selectivity requirement is specified the same as the medium range BS receiver in-channel selectivity requirement for BS *type 2-O* in TS 38.104[x], subclause 10.9.3, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

The local area IAB-DU receiver in-channel selectivity requirement is specified the same as the local area BS receiver in-channel selectivity requirement for BS *type 2-O* in TS 38.104[x], subclause 10.9.3, where references to *BS channel bandwidth* apply to *IAB-DU channel bandwidth*.

# 11 Radiated performance requirements

Detailed structure of the subclause is TBD.

# 12 Radio Resource Management requirements

## 12.1 RRC\_CONNECTED state mobility for IAB-MTs

### 12.1.1 RRC Connection Mobility Control

#### 12.1.1.1 SA: RRC Re-establishment

##### 12.1.1.1.1 Introduction

This clause contains requirements on the IAB-MT regarding RRC connection re-establishment procedure. RRC connection re-establishment is initiated when an IAB-MT in RRC\_CONNECTED state loses RRC connection due to any of failure cases, including radio link failure, handover failure, and RRC connection reconfiguration failure. The RRC connection re-establishment procedure is specified in clause TBD of TS 38.331 [15].

The requirements in this clause are applicable for RRC connection re-establishment to NR cell.

##### 12.1.1.1.2 Requirements

In RRC\_CONNECTED state the IAB-MT shall be capable of sending *RRCReestablishmentRequest* message within Tre-establish\_delay seconds from the moment it detects a loss in RRC connection. The total RRC connection delay (Tre-establish\_delay) shall be less than:

TUL\_grant: It is the time required to acquire and process uplink grant from the target PCell. The uplink grant is required to transmit *RRCReestablishmentRequest* message.

The IAB-MT re-establishment delay (TIAB-MT\_re-establish\_delay) is specified in clause 12.1.1.1.2.1.

###### 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 TBD 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:

- SS-RSRP related side conditions given in Annex TBD are fulfilled for a corresponding NR Band for FR1 and FR2, respectively, and

- the conditions of SSB\_RP and SSB Ês/Iot according to Annex TBD for a corresponding NR Band are fulfilled.

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

- SS-RSRP related side conditions given in Annex TBD are fulfilled for a corresponding NR Band for FR1 and FR2, respectively, and

- the conditions of SSB\_RP and SSB Ês/Iot according to Annex TBD for a corresponding NR Band 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. | | | |

#### 12.1.1.2 Random access

The requirements in clause 6.2.2 in TS 38.133 V16.3.0 [6] apply for IAB-MT.

[Editor’s note: The CR can be modified later to align the accuracy requirements for absolute power applied to the first preamble and the relative power applied to the additional preamble with RF’s conclusion.]

#### 12.1.1.3 SA: RRC Connection Release with Redirection

##### 12.1.1.3.1 Introduction

This clause contains requirements on the IAB-MT regarding RRC connection release with redirection procedure. RRC connection release with redirection is initiated by the *RRCRelease* message with redirection to NR from NR specified in TS 38.331 [15]. The RRC connection release with redirection procedure is specified in clause TBD of TS 38.331 [15].

##### 12.1.1.3.2 Requirements

###### 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 TBD for a corresponding NR Band are fulfilled.

TRRC\_procedure\_delay: It is the RRC procedure delay for processing the received message “*RRCRelease*” as defined in clause TBD 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) |

## 12.2 Timing

### 12.2.1 IAB-MT transmit timing

*Editor notes: The terminology of “downlink” and “uplink” could be revised and aligned with RF conclusion.*

#### 12.2.1.1 Introduction

The IAB-MT shall have capability to follow the frame timing change of the reference cell in connected state. The uplink frame transmission takes place before the reception of the first detected path (in time) of the corresponding downlink frame from the reference cell. IAB-MT belonging to local area IAB-MT class as defined in clause 4.4.2 and also capable of carrier aggregation shall use the SpCell as the reference cell for deriving the IAB-MT transmit timing for cells in the PTAG. IAB-MT initial transmit timing accuracy, gradual timing adjustment requirements are defined in the following requirements.

#### 12.2.1.2 Requirements

The IAB-MT initial transmission timing error shall be less than or equal to ±Te where the timing error limit value Te is specified in Table 12.2.1.2-1. This requirement applies for PUCCH, PUSCH and SRS or it is the PRACH transmission.

The IAB-MT shall meet the Te requirement for an initial transmission provided that at least one SSB is available at the IAB-MT during the last 160 ms. The reference point for the IAB-MT initial transmit timing control requirement shall be the downlink timing of the reference cell minus . The downlink timing is defined as the time when the first detected path (in time) of the corresponding downlink frame is received from the reference cell. *N*TA for PRACH is defined as 0.

 (in *Tc* units) for other channels is the difference between IAB-MT transmission timing and the downlink timing immediately after when the last timing advance in clause 12.2.2 was applied. *N*TA for other channels is not changed until next timing advance is received. The value ofdepends on the duplex mode of the cell in which the uplink transmission takes place and the frequency range (FR). is defined in Table 12.2.1.2-2.

Table 12.2.1.2-1: Te Timing Error Limit

|  |  |  |  |
| --- | --- | --- | --- |
| **Frequency Range** | **SCS of SSB signals ( kHz)** | **SCS of uplink signals ( kHz)** | **Te** |
| 1 | 15 | 15 | 12\*64\*Tc |
| 30 | 10\*64\*Tc |
| 60 | 10\*64\*Tc |
| 30 | 15 | 8\*64\*Tc |
| 30 | 8\*64\*Tc |
| 60 | 7\*64\*Tc |
| 2 | 120 | 60 | 3.5\*64\*Tc |
| 120 | 3.5\*64\*Tc |
| 240 | 60 | 3\*64\*Tc |
| 120 | 3\*64\*Tc |
| Note 1: Tc is the basic timing unit defined in TS 38.211 [8] | | | |

Table 12.2.1.2-2: The Value of 

|  |  |
| --- | --- |
| Frequency range and band of cell used for uplink transmission | (Unit: TC) |
| FR1 TDD band without LTE-NR coexistence case | 25600 (Note 1) |
| FR1 TDD band with LTE-NR coexistence case | 39936 (Note 1) |
| FR2 | 13792 |
| Note 1: The IAB-MT identifies  based on the information n-TimingAdvanceOffset as specified in TS 38.331 [15]. If IAB-MT is not provided with the information n-TimingAdvanceOffset, the default value of  is set as 25600 for FR1 band. | |

When it is the transmission for PUCCH, PUSCH and SRS transmission, the IAB-MT shall be capable of changing the transmission timing according to the received downlink frame of the reference cell except when the timing advance in clause 12.2.3 is applied.

##### 12.2.1.2.1 Gradual timing adjustment

When the transmission timing error between the IAB-MT and the reference timing exceeds ±Te then the IAB-MT is required to adjust its timing to within ±Te. The reference timing shall be  before the downlink timing of the reference cell. All adjustments made to the IAB-MT uplink timing shall follow these rules:

1) The maximum amount of the magnitude of the timing change in one adjustment shall be Tq.

2) The minimum aggregate adjustment rate shall be Tp per second.

3) The maximum aggregate adjustment rate shall be Tq per 200 ms.

where the maximum autonomous time adjustment step Tq and the aggregate adjustment rate Tp are specified in Table 12.2.1.2.1-1.

Table 12.2.1.2.1-1: Tq Maximum Autonomous Time Adjustment Step and Tp Minimum Aggregate Adjustment rate

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Range | SCS of uplink signals (kHz) | Tq | Tp |
| 1 | 15 | 5.5\*64\*Tc | 5.5\*64\*Tc |
| 30 | 5.5\*64\*Tc | 5.5\*64\*Tc |
| 60 | 5.5\*64\*Tc | 5.5\*64\*Tc |
| 2 | 60 | 2.5\*64\*Tc | 2.5\*64\*Tc |
| 120 | 2.5\*64\*Tc | 2.5\*64\*Tc |
| NOTE: Tc is the basic timing unit defined in TS 38.211 [8] | | | |

### 12.2.2 IAB-MT timer accuracy

Detailed structure of the subclause is TBD.

Editor’s Note: The need for this requirement is FFS

### 12.2.3 IAB-MT timing advance

The requirements in clause 7.3 in [6] apply for IAB-MT.

[Editor’s notes: The terminology of “downlink” and “uplink” could be revised and aligned with RF conclusion.]

### 12.2.4 Cell phase synchronization accuracy

#### 12.2.4.1 Introduction

Cell phase synchronization accuracy for TDD is defined as the maximum absolute deviation in frame start timing between any pair of cells on the same frequency that have overlapping coverage areas.

#### 12.2.4.2 Requirements

The cell phase synchronization accuracy measured at IAB DU antenna connectors shall be better than 3 µs.

## 12.3 Signalling Characteristics for IAB MTs

### 12.3.1 Radio Link Monitoring

#### 12.3.1.1 Introduction

The UE requirements in sub-clause 8.1.1 [6] apply for IAB-MT.

#### 12.3.1.2 Requirements for SSB based radio link monitoring

##### 12.3.1.2.1 Introduction

The requirements in this clause apply for each SSB based RLM-RS resource configured for PCell or PSCell, provided that the SSB configured for RLM is actually transmitted within IAB-MT active DL BWP during the entire evaluation period specified in clause 12.3.1.2.2.

**Table 12.3.1.2.1-1: PDCCH transmission parameters for out-of-sync evaluation**

|  |  |
| --- | --- |
| **Attribute** | **Value for BLER Configuration #0** |
| 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 | 4dB |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | 4dB |
| Bandwidth (PRBs) | 24 |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |

**Table 12.3.1.2.1-2: PDCCH transmission parameters for in-sync evaluation**

|  |  |
| --- | --- |
| **Attribute** | **Value for BLER Configuration #0** |
| DCI payload size | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 4 |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | 0dB |
| Bandwidth (PRBs) | 24 |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |

##### 12.3.1.2.2 Minimum requirement

IAB-MT shall be able to evaluate whether the downlink radio link quality on the configured RLM-RS resource estimated over the last TEvaluate\_out\_SSB [ms] period becomes worse than the threshold Qout\_SSB within TEvaluate\_out\_SSB [ms] evaluation period.

IAB-MT shall be able to evaluate whether the downlink radio link quality on the configured RLM-RS resource estimated over the last TEvaluate\_in\_SSB [ms] period becomes better than the threshold Qin\_SSB within TEvaluate\_in\_SSB [ms] evaluation period.

TEvaluate\_out\_SSB and TEvaluate\_in\_SSB are defined in Table 12.3.1.2.2-1 for FR1 with scaling factor K1.

TEvaluate\_out\_SSB and TEvaluate\_in\_SSB are defined in Table 12.3.1.2.2-2 for FR2 with scaling factor N=8 and K2.

*Editor’s note: K1 and K2 will eventually be replaced by their values once RAN4 finalizes these.*

For FR1,

- , when in the monitored cell there are measurement gaps configured for intra-frequency, inter-frequency or inter-RAT measurements, and these measurement gaps are overlapping with some but not all occasions of the SSB; and

- P = 1 when in the monitored cell there are no measurement gaps overlapping with any occasion of the SSB.

For FR2,

- , when RLM-RS resource is not overlapped with measurement gap and the RLM-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P is Psharing factor, when the RLM-RS resource is not overlapped with measurement gap and RLM-RS resource is fully overlapped with SMTC period (TSSB = TSMTCperiod).

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TSSB < 0.5\*TSMTCperiod

- , when the RLM-RS is partially overlapped with measurement gap and the RLM-RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TSSB = 0.5 × TSMTCperiod

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

* Psharing factor = 1
* if all of the reference signals configured for RLM outside measurement gap are not fully overlapped by intra-frequency SMTC occasions, or
* if all of the reference signal configured for RLM outside measurement gap and fully-overlapped by intra-frequency SMTC occasions are not overlapped by with the SSB symbols indicated by *SSB-ToMeasure* and 1 symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured;
* Psharing factor = 3, otherwise.

If the high layer in TS 38.331 [TBD] signaling of *smtc2*is present, TSMTCperiod follows *smtc2*; Otherwise TSMTCperiod follows *smtc1.*

Longer evaluation period would be expected if the combination of RLM-RS resource, SMTC occasion and measurement gap configurations does not meet previous conditions.

**Table 12.3.1.2.2-1: Evaluation period TEvaluate\_out\_SSB and TEvaluate\_in\_SSB for FR1**

|  |  |  |
| --- | --- | --- |
| **Configuration** | **TEvaluate\_out\_SSB (ms)** | **TEvaluate\_in\_SSB (ms)** |
| no DRX | Max(200 × K1, Ceil(10 × P × K1) × TSSB) | Max(100 × K1, Ceil(5 × P × K1) × TSSB) |
| NOTE: TSSB is the periodicity of the SSB configured for RLM. | | |

**Table 12.3.1.2.2-2: Evaluation period TEvaluate\_out\_SSB and TEvaluate\_in\_SSB for FR2**

|  |  |  |
| --- | --- | --- |
| **Configuration** | **TEvaluate\_out\_SSB (ms)** | **TEvaluate\_in\_SSB (ms)** |
| no DRX | Max(200 × K2, Ceil(10 × P × N × K2) × TSSB) | Max(100 × K2, Ceil(5 × P × N × K2) × TSSB) |
| NOTE: TSSB is the periodicity of the SSB configured for RLM. | | |

##### 12.3.1.2.3 Measurement restrictions for SSB based RLM

The UE requirements in sub-clause 8.1.2.3 [6] apply for IAB-MT.

#### 12.3.1.3 Requirements for CSI-RS based radio link monitoring

##### 12.3.1.3.1 Introduction

The requirements in this clause apply for each CSI-RS based RLM-RS resource configured for PCell or PSCell, provided that the CSI-RS configured for RLM is actually transmitted within IAB-MT active DL BWP during the entire evaluation period specified in clause 12.3.1.3.2. IAB-MT is not expected to perform radio link monitoring measurements on the CSI-RS configured as RLM-RS if the CSI-RS is not in the active TCI state of any CORESET configured in the IAB-MT active BWP.

**Table 12.3.1.3.1-1: PDCCH transmission parameters for out-of-sync evaluation**

|  |  |
| --- | --- |
| **Attribute** | **Value for BLER Configuration #0** |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 8 |
| Ratio of hypothetical PDCCH RE energy to average CSI-RS RE energy | 4dB |
| Ratio of hypothetical PDCCH DMRS energy to average CSI-RS RE energy | 4dB |
| Bandwidth (PRBs) | 48 |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |

**Table 12.3.1.3.1-2: PDCCH transmission parameters for in-sync evaluation**

|  |  |
| --- | --- |
| **Attribute** | **Value for BLER Configuration #0** |
| DCI payload size | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 4 |
| Ratio of hypothetical PDCCH RE energy to average CSI-RS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average CSI-RS RE energy | 0dB |
| Bandwidth (PRBs) | 48 |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |

##### 12.3.1.3.2 Minimum requirement

IAB-MT shall be able to evaluate whether the downlink radio link quality on the configured RLM-RS resource estimated over the last TEvaluate\_out\_CSI-RS [ms] period becomes worse than the threshold Qout\_CSI-RS within TEvaluate\_out\_CSI-RS [ms] evaluation period.

IAB-MT shall be able to evaluate whether the downlink radio link quality on the configured RLM-RS resource estimated over the last TEvaluate\_in\_CSI-RS [ms] period becomes better than the threshold Qin\_CSI-RS within TEvaluate\_in\_CSI-RS [ms] evaluation period.

- TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS are defined in Table 12.3.1.3.2-1 for FR1 with scaling factor K1.

- TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS are defined in Table 12.3.1.3.2-2 for FR2 with scaling factor K2.

*Editor’s note: K1 and K2 will eventually be replaced by their values once RAN4 finalizes these.*

The requirements of TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS apply provided that the CSI-RS for RLM is not in a resource set configured with repetition ON. The requirements do not apply when the CSI-RS resource in the active TCI state of CORESET is the same CSI-RS resource for RLM and the TCI state information of the CSI-RS resource is not given, wherein the TCI state information means QCL Type-D to SSB for L1-RSRP or CSI-RS with repetition ON.

For FR1,

- , when in the monitored cell there are measurement gaps configured for intra-frequency, inter-frequency or inter-RAT measurements, and these measurement gaps are overlapping with some but not all occasions of the CSI-RS; and

- P=1 when in the monitored cell there are no measurement gaps overlapping with any occasion of the CSI-RS.

For FR2,

- P=1, when the RLM-RS resource is not overlapped with measurement gap and also not overlapped with SMTC occasion.

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is not overlapped with SMTC occasion (TCSI-RS < MGRP)

- , when the RLM-RS resource is not overlapped with measurement gap and the RLM-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod).

- P = 3, when the RLM-RS resource is not overlapped with measurement gap and RLM-RS resource is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod).

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TCSI-RS < 0.5 × TSMTCperiod

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TCSI-RS = 0.5 × TSMTCperiod

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

If the high layer in TS 38.331 [TBD] signaling of *smtc2*is present, TSMTCperiod follows *smtc2*; Otherwise TSMTCperiod follows *smtc1.*

Note: The overlap between CSI-RS for RLM and SMTC means that CSI-RS based RLM is within the SMTC window duration.

Longer evaluation period would be expected if the combination of RLM-RS resource, SMTC occasion and measurement gap configurations does not meet previous conditions.

The values of Mout and Min used in Table 12.3.1.3.2-1 and Table 12.3.1.3.2-2 are defined as:

- Mout = 20 and Min = 10, if the CSI-RS resource configured for RLM is transmitted with higher layer CSI-RS parameter *density* [TBD, clause 7.4.1] set to 3 and over the bandwidth ≥ 24 PRBs.

**Table 12.3.1.3.2-1: Evaluation period TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS for FR1**

|  |  |  |
| --- | --- | --- |
| **Configuration** | **TEvaluate\_out\_CSI-RS (ms)** | **TEvaluate\_in\_CSI-RS (ms)** |
| no DRX | Max(200 × K1, Ceil(Mout×P × K1)×TCSI-RS) | Max(100 × K1, Ceil(Min×P × K1) × TCSI-RS) |
| NOTE: TCSI-RS is the periodicity of the CSI-RS resource configured for RLM. The requirements in this table apply for TCSI-RS equal to 5 ms, 10ms, 20 ms or 40 ms. | | |

**Table 12.3.1.3.2-2: Evaluation period TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS for FR2**

|  |  |  |
| --- | --- | --- |
| **Configuration** | **TEvaluate\_out\_CSI-RS (ms)** | **TEvaluate\_in\_CSI-RS (ms)** |
| no DRX | Max(200 × K2, Ceil(Mout×P × K2)×TCSI-RS) | Max(100 × K2, Ceil(Min×P × K2) × TCSI-RS) |
| NOTE: TCSI-RS is the periodicity of the CSI-RS resource configured for RLM. The requirements in this table apply for TCSI-RS equal to 5 ms, 10 ms, 20 ms or 40 ms. | | |

##### 12.3.1.3.3 Measurement restrictions for CSI-RS based RLM

The UE requirements in sub-clause 8.1.3.3 [6] apply for IAB-MT.

#### 12.3.1.4 Minimum requirement for IAB-MT turning off the transmitter

The UE requirements in sub-clause 8.1.5 [6] apply for IAB-MT.

#### 12.3.1.5 Minimum requirement for L1 indication

When the downlink radio link quality on all the configured RLM-RS resources is worse than Qout, layer 1 of the IAB-MT shall send an out-of-sync indication for the cell to the higher layers. A layer 3 filter shall be applied to the out-of-sync indications as specified in TS 38.331 [TBD].

When the downlink radio link quality on at least one of the configured RLM-RS resources is better than Qin, layer 1 of the IAB-MT shall send an in-sync indication for the cell to the higher layers. A layer 3 filter shall be applied to the in-sync indications as specified in TS 38.331 [TBD].

The out-of-sync and in-sync evaluations for the configured RLM-RS resources shall be performed as specified in clause 5 in TS 38.213 [TBD]. Two successive indications from layer 1 shall be separated by at least TIndication\_interval.

TIndication\_interval is max(10ms, TRLM-RS,M), where TRLM,M is the shortest periodicity of all configured RLM-RS resources for the monitored cell, which corresponds to TSSB specified in clause 12.3.1.2 if the RLM-RS resource is SSB, or TCSI-RS specified in clause 12.3.1.3 if the RLM-RS resource is CSI-RS.

#### 12.3.1.6 Scheduling availability of IAB-MT during radio link monitoring

The UE requirements in sub-clause 8.1.7 [6] apply for IAB-MT.

### 12.3.2 Link Recovery Procedure

#### 12.3.2.1 Introduction

The UE requirements in sub-clause 8.5.1 [6] apply for IAB-MT.

#### 12.3.2.2 Requirements for SSB based beam failure detection

##### 12.3.2.2.1 Introduction

The UE requirements in sub-clause 8.5.2.1 [6] apply for IAB-MT.

##### 12.3.2.2.2 Minimum requirement

IAB-MT shall be able to evaluate whether the downlink radio link quality on the configured SSB resource in set  estimated over the last TEvaluate\_BFD\_SSB ms period becomes worse than the threshold Qout\_LR\_SSB within TEvaluate\_BFD\_SSB ms period.

The value of TEvaluate\_BFD\_SSB is defined in Table 8.5.2.2-1 for FR1.

The value of TEvaluate\_BFD\_SSB is defined in Table 8.5.2.2-2 for FR2 with scaling factor N= 8.

For FR1,

- , when in the monitored cell there are measurement gaps configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the SSB.

- P=1 when in the monitored cell there are no measurement gaps overlapping with any occasion of the SSB.

For FR2,

- , when BFD-RS resource is not overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P = Psharing factor, when the BFD-RS resource is not overlapped with measurement gap and the BFD-RS resource is fully overlapped with SMTC period (TSSB = TSMTCperiod).

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TSSB < 0.5\*TSMTCperiod

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TSSB = 0.5\*TSMTCperiod

- , when the BFD-RS resource is partially overlapped with measurement gap (TSSB <MGRP) and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap.

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

* Psharing factor = 1
* if all of the reference signals configured for BFD outside measurement gap are not fully overlapped by intra-frequency SMTC occasions, or
* if all of the reference signal configured for BFD outside measurement gap and fully-overlapped by intra-frequency SMTC occasions are not overlapped by with the SSB symbols indicated by SSB-ToMeasure and 1 symbol before each consecutive SSB symbols indicated by SSB-ToMeasure and 1 symbol after each consecutive SSB symbols indicated by SSB-ToMeasure, given that SSB-ToMeasure is configured;
* Psharing factor = 3, otherwise.

If the IAB-MT is not capable of 4 SMTC configurations per frequency [15], and is provided with higher layer signaling of smtcj, where 1≤*j*≤2 [15], then TSMTCperiod follows smtcjmax where jmax is the maximum value of all j for which smtcj has been configured.

If the IAB-MT is capable of 4 SMTC configurations per frequency [15], and is provided with higher layer signaling of smtcj, where 1≤*j*≤4 [15], then TSMTCperiod follows smtcjmax where jmax is the maximum value of all j for which smtcj has been configured.

Longer evaluation period would be expected if the combination of BFD-RS resource, SMTC occasion and measurement gap configurations does not meet pervious conditions.

**Table 8.5.2.2-1: Evaluation period TEvaluate\_BFD\_SSB for FR1**

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_BFD\_SSB (ms)** |
| no DRX | Max(50, Ceil(5 × P) × TSSB) |
| Note: TSSB is the periodicity of SSB in the set . | |

**Table 8.5.2.2-2: Evaluation period TEvaluate\_BFD\_SSB for FR2**

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_BFD\_SSB (ms)** |
| no DRX | Max(50, Ceil(5 × P × N) × TSSB) |
| Note: TSSB is the periodicity of SSB in the set . | |

##### 12.3.2.2.3 Measurement restriction for SSB based beam failure detection

The UE requirements in sub-clause 8.5.2.3 [6] apply for IAB-MT.

#### 12.3.2.3 Requirements for CSI-RS based beam failure detection

##### 12.3.2.3.1 Introduction

The UE requirements in sub-clause 8.5.3.1 [6] apply for IAB-MT.

##### 12.3.2.3.2 Minimum requirement

IAB-MT shall be able to evaluate whether the downlink radio link quality on the CSI-RS resource in set  estimated over the last TEvaluate\_BFD\_CSI-RS ms period becomes worse than the threshold Qout\_LR\_CSI-RS within TEvaluate\_BFD\_CSI-RS ms period.

The value of TEvaluate\_BFD\_CSI-RS is defined in Table 8.5.3.2-1 for FR1.

The value of TEvaluate\_BFD\_CSI-RS is defined in Table 8.5.3.2-2 for FR2 with N=1. The requirements of TEvaluate\_BFD\_CSI-RS apply provided that the CSI-RS for BFD is not in a resource set configured with repetition ON. The requirements shall not apply when the CSI-RS resource in the active TCI state of CORESET is the same CSI-RS resource for BFD and the TCI state information of the CSI-RS resource is not given, wherein the TCI state information means QCL Type-D to SSB for L1-RSRP or CSI-RS with repetition ON.

For FR1,

- , when in the monitored cell there are measurement gaps configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the CSI-RS.

- P = 1 when in the monitored cell there are no measurement gaps overlapping with any occasion of the CSI-RS.

For FR2,

- P = 1, when the BFD-RS resource is not overlapped with measurement gap and also not overlapped with SMTC occasion.

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is not overlapped with SMTC occasion (TCSI-RS < MGRP)

- , when the BFD-RS resource is not overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod).

- P = Psharing factor, when the BFD-RS resource is not overlapped with measurement gap and the BFD-RS resource is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod).

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TCSI-RS < 0.5 × TSMTCperiod

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TCSI-RS = 0.5 × TSMTCperiod

- , when the BFD-RS resource is partially overlapped with measurement gap (TCSI-RS < MGRP) and the BFD-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap.

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 3**.**

If the IAB-MT is not capable of 4 SMTC configurations per frequency [15], and is provided with higher layer signaling of smtcj, where 1≤*j*≤2 [15], then TSMTCperiod follows smtcjmax where jmax is the maximum value of all j for which smtcj has been configured.

If the IAB-MT is capable of 4 SMTC configurations per frequency [15], and is provided with higher layer signaling of smtcj, where 1≤*j*≤4 [15], then TSMTCperiod follows smtcjmax where jmax is the maximum value of all j for which smtcj has been configured.

Note: The overlap between CSI-RS for BFD and SMTC means that CSI-RS for BFD is within the SMTC window duration.

Longer evaluation period would be expected if the combination of the BFD-RS resource, SMTC occasion and measurement gap configurations does not meet pervious conditions.

The values of MBFD used in Table 8.5.3.2-1 and Table 8.5.3.2-2 are defined as

- MBFD = 10, if the CSI-RS resource(s) in set  used for BFD is transmitted with Density = 3.

**Table 8.5.3.2-1: Evaluation period TEvaluate\_BFD\_CSI-RS for FR1**

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_BFD\_CSI-RS (ms)** |
| no DRX | Max(50, [MBFD × P] × TCSI-RS) |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the set . | |

**Table 8.5.3.2-2: Evaluation period TEvaluate\_BFD\_CSI-RS for FR2**

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_BFD\_CSI-RS (ms)** |
| no DRX | Max(50, [MBFD × P × N] × TCSI-RS) |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the set . | |

##### 12.3.2.3.3 Measurement restrictions for CSI-RS based beam failure detection

The UE requirements in sub-clause 8.5.3.3 [6] apply for IAB-MT.

#### 12.3.2.4 Minimum requirement for L1 indication

When the radio link quality on all the RS resources in set  is worse than Qout\_LR, layer 1 of the UE shall send a beam failure instance indication to the higher layers. A layer 3 filter may be applied to the beam failure instance indications as specified in TS 38.331 [15].

The beam failure instance evaluation for the RS resources in set  shall be performed as specified in clause 6 in TS 38.213 [10]. Two successive indications from layer 1 shall be separated by at least TIndication\_interval\_BFD.

TIndication\_interval\_BFD is max(2ms, TSSB-RS,M) ) or max(2ms, TCSI-RS,M), where TSSB-RS,M and TCSI-RS,M is the shortest periodicity of all RS resources in set  for the accessed cell, corresponding to either the shortest periodicity of the SSB in the set  or CSI-RS resource in the set .

#### 12.3.2.5 Requirements for SSB based candidate beam detection

##### 12.3.2.5.1 Introduction

The requirements in this clause apply for each SSB resource in the set  configured for a serving cell, provided that the SSBs configured for candidate beam detection are actually transmitted within IAB-MT active DL BWP during the entire evaluation period specified in clause 12.3.2.5.2.

##### 12.3.2.5.2 Minimum requirement

Upon request the IAB-MT shall be able to evaluate whether the L1-RSRP measured on the configured SSB resource in set  estimated over the last TEvaluate\_CBD\_SSB ms period becomes better than the threshold Qin\_LR provided SSB\_RP and SSB Ês/Iot are according to Annex Table in B.2.4.1 [6] for a corresponding band.

The IAB-MT shall monitor the configured SSB resources using the evaluation period in table 12.3.2.5.2-1 and 12.3.2.5.2-2 which is applicable to the non-DRX mode only.

The value of TEvaluate\_CBD\_SSB is defined in Table 12.3.2.5.2-1 for FR1.

The value of TEvaluate\_CBD\_SSB is defined in Table 12.3.2.5.2-2 for FR2 with scaling factor N=8.

Where,

For FR1,

- , when in the monitored cell there are measurement gaps configured for intra-frequency or inter-frequency [or inter-RAT measurements], which are overlapping with some but not all occasions of the SSB,

- P = 1 when in the monitored cell there are no measurement gaps overlapping with any occasion of the SSB.

For FR2,

- , when candidate beam detection RS is not overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P is Psharing factor , when candidate beam detection RS is not overlapped with measurement gap and candidate beam detection RS is fully overlapped with SMTC period (TSSB = TSMTCperiod).

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TSSB < 0.5 × TSMTCperiod

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TSSB = 0.5 × TSMTCperiod

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

* Psharing factor = 1
* if all of the reference signals configured for CBD outside measurement gap are not fully overlapped by intra-frequency SMTC occasions, or
* if all of the reference signal configured for CBD outside measurement gap and fully-overlapped by intra-frequency SMTC occasions are not overlapped by with the SSB symbols indicated by SSB-ToMeasure and 1 symbol before each consecutive SSB symbols indicated by SSB-ToMeasure and 1 symbol after each consecutive SSB symbols indicated by SSB-ToMeasure, given that SSB-ToMeasure is configured;
* Psharing factor = 3, otherwise.

**Table 12.3.2.5.2-1: Evaluation period TEvaluate\_CBD\_SSB for FR1**

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_CBD\_SSB (ms)** |
| non-DRX | Ceil(3 × P) × TSSB |
| Note: TSSB is the periodicity of SSB in the set . | |

**Table 12.3.2.5.2-2: Evaluation period TEvaluate\_CBD\_SSB for FR2**

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_CBD\_SSB (ms)** |
| non-DRX | Ceil(3 × P × N) × TSSB |
| Note: TSSB is the periodicity of SSB in the set . | |

##### 12.3.2.5.3 Measurement restriction for SSB based candidate beam detection

The UE requirements in sub-clause 8.5.5.3 [6] apply for IAB-MT.

#### 12.3.2.6 Requirements for CSI-RS based candidate beam detection

##### 12.3.2.6.1 Introduction

The requirements in this clause apply for each CSI-RS resource in the set  configured for a serving cell, provided that the CSI-RS resources configured for candidate beam detection are actually transmitted within IAB MT active DL BWP during the entire evaluation period specified in clause 12.3.2.6.2.

##### 12.3.2.6.2 Minimum requirement

Upon request the IAB-MT shall be able to evaluate whether the L1-RSRP measured on the configured CSI-RS resource in set  estimated over the last TEvaluate\_CBD\_CSI-RS [ms] period becomes better than the threshold Qin\_LR within TEvaluate\_CBD\_CSI-RS [ms] period provided CSI-RS Ês/Iot is according to Annex Table in B.2.4.2 [6] for a corresponding band.

The UE shall monitor the configured CSI-RS resources using the evaluation period in table 12.3.2.6.2-1 and 12.3.2.6.2-2 which is applicable to the non-DRX mode only.

The value of TEvaluate\_CBD\_CSI-RS is defined in Table 12.3.2.6.2-1 for FR1.

The value of TEvaluate\_CBD\_CSI-RS is defined in Table 12.3.2.6.2-2 for FR2 with scaling factor N=8.

For FR1,

- , when in the monitored cell there are measurement gaps configured for intra-frequency or inter-frequency[ or inter-RAT measurements], which are overlapping with some but not all occasions of the CSI-RS; and

- P = 1 when in the monitored cell there are no measurement gaps overlapping with any occasion of the CSI-RS.

For FR2,

- P = 1, when candidate beam detection RS is not overlapped with measurement gap and also not overlapped with SMTC occasion.

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is not overlapped with SMTC occasion (TCSI-RS < MGRP)

- , when candidate beam detection RS is not overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod).

- P = 3, when candidate beam detection RS is not overlapped with measurement gap and candidate beam detection RS is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod).

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TCSI-RS < 0.5 × TSMTCperiod

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TCSI-RS = 0.5 × TSMTCperiod

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

Longer evaluation period would be expected if the CSI-RS is on the same OFDM symbols with RLM, BFD, BM-RS, or other CBD-RS, according to the measurement restrictions defined in clause 12.3.2.6.3.

The values of MCBD used in Table 12.3.2.6.2-1 and Table 12.3.2.6.2-2 are defined as

- MCBD = 3, if the CSI-RS resource configured in the set  is transmitted with Density = 3.

**Table 12.3.2.6.2-1: Evaluation period TEvaluate\_CBD\_CSI-RS for FR1**

|  |  |
| --- | --- |
| **Configuration** | **TEvaluateC\_CBD\_CSI-RS (ms)** |
| non-DRX | Max(25, Ceil(MCBD × P) × TCSI-RS) |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the set . | |

**Table 12.3.2.6.2-2: Evaluation period TEvaluate\_CBD\_CSI-RS for FR2**

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_CBD\_CSI-RS (ms)** |
| non-DRX | Max(25, Ceil(MCBD × P × N) × TCSI-RS) |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the set . | |

##### 12.3.2.6.3 Measurement restriction for CSI-RS based candidate beam detection

The UE requirements in sub-clause 8.5.6.3 [6] apply for IAB-MT.

#### 12.3.2.7 Scheduling availability of IAB-MT during beam failure detection

The UE requirements in sub-clause 8.5.7 [6] apply for IAB-MT.

#### 12.3.2.8 Scheduling availability of IAB-MT during candidate beam detection

The UE requirements in sub-clause 8.5.8 [6] apply for IAB-MT.

Annex <A> (normative):  
<Normative annex for a Technical Specification>

Start each annex on a new page.

Annexes are labelled A, B, C, etc. and designated either "normative" or "informative" depending on their content.

Normative annexes only to appear in Technical Specifications. Use style "Heading 8".

Annex <X> (informative):

IAB-DU Error Vector Magnitude (FR1)

The Annex B in in TS 38.104 [x] apply to FR1 IAB-DU.

Annex X (normative):   
IAB-DU Error Vector Magnitude (FR2)

The Annex C in in TS 38.104 [x] apply to FR2 IAB-DU.

Change history

This is the last annex for TS/TSs which details the change history using the following table.  
This table is to be used for recording progress during the WG drafting process till TSG approval of this TS/TR.  
For TRs under change control, use one line per approved Change Request  
Date: use format YYYY-MM  
CR: four digits, leading zeros as necessary  
Rev: blank, or number (max two digits)  
Cat: use one of the letters A, B, C, D, F  
Subject/Comment: for TSs under change control, include full text of the subject field of the Change Request cover  
New vers: use format [n]n.[n]n.[n]n

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 09/2019 | RAN4#92 | R4-1910404 |  |  |  | Initial TS skeleton | 0.0.1 |
| 06/2020 | RAN4#95-e | R4-2007467 |  |  |  | Update of IAB TS | 0.0.2 |