**3GPP TSG-RAN WG4 Meeting #99-e DRAFT R4-2108582**

Online, 19 - 27 May 2021

**Source:** Huawei

**Title:** TP to TS 38.176-2 - OTA Tx dynamic range, clause 6.4

**Agenda Item:** 6.3.2.4.1

**Document for:** Approval

# Introduction

This is an updated version of R4-2111403 following review comments made in the 1st round of RAN4#99. Modifications include:

* The GTW agreement for the IAB-MT test requirements has been implemented:

*Agreement:*

IAB-MT type 1H/1O: -10 log(Maximum RB)- 5/10+/- ([5.5]+ TT)

IAB-MT type 2O: -10 log(Maximum RB)- 5/10 +/- ([6]+TT)

This text proposal completes clause 6.4 Output power dynamics in the conformance specification.

The following has been done

* IAB-DU tests are copied from 38.141-2,
* references to BS type 1-O and 2-O have been modified to IAB-DU type 1-O and 2-O
* References are highlighted in yellow to be checked when the skeleton is more complete.
  + References to test models etc, its not clear f we will keep reference to the BS spec or if they will be copied into this spec so we can reference internally.
* 5MHz CBW is removed from test requirements
* IAB-MT aggregate power control there is no specific test case (R4-2103997)
* For IAB-MT test requirement the TT is added as per the agreed MU spreadsheet.

# TP to TS 38.176-2 v0.1.0

**--- Start of changes ---**

# 2 References

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

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

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

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

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

[2] 3GPP TS 38.174: "NR Integrated access and backhaul radio transmission and reception".

[3] 3GPP TS 38.xxx-2: "NR Integrated access and backhaul radio conformance testing Part 1: Conducted conformance testing".

[x1] 3GPP TS 38.104: “NR; Base Station (BS) radio transmission and reception”

[x2] 3GPP TS 38.213: "NR; Physical layer procedures for control".

**--- Next change ---**

## 6.4 Output power dynamics

### 6.4.1 IAB-DU OTA Output Power Dynamics

#### 6.4.1.1 General

The requirements in clause 6.4 apply during the *transmitter ON period*. Transmit signal quality (as specified in clause 6.6) shall be maintained for the output power dynamics requirements.

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

#### 6.4.1.2 OTA RE power control dynamic range

##### 6.4.1.2.1 Definition and applicability

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*.

##### 6.4.1.2.2 Minimum requirement

The minimum requirement for *IAB-DU type 1-O* is in TS 38.174 [2], clause 9.4.1.2.

##### 6.4.1.2.3 Test purpose

No specific test or test requirements are defined for conducted RE power control dynamic range. The Error Vector Magnitude (EVM) test, as described in clause 6.5.4 provides sufficient test coverage for this requirement.

#### 6.4.1.3 OTA total power dynamic range

##### 6.4.1.3.1 Definition and applicability

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: The upper limit of the OTA total power dynamic range is the BS 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 symbols shall carry PDSCH and not contain PDCCH, RS or SSB.

##### 6.4.1.3.2 Minimum requirement

The minimum requirement for *BS type 1-O* is in TS 38.174 [2], clause 9.4.1.3.2.

The minimum requirement for *BS type 2-O* is in TS 38.174 [2], clause 9.4.1.3.3.

##### 6.4.1.3.3 Test purpose

The test purpose is to verify that the total power dynamic range is within the limits specified by the minimum requirement.

##### 6.4.1.3.4 Method of test

###### 6.4.1.3.4.1 Initial conditions

Test environment: Normal, see annex B.2.

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

Beams to be tested: Declared beam with the highest intended EIRP for the narrowest intended beam corresponding to the smallest BeWθ, or for the narrowest intended beam corresponding to the smallest BeWϕ (D.3, D.11).

Directions to be tested: The OTA peak directions set reference beam direction pair (D.8).

###### 6.4.1.3.4.2 Procedure

1) Place the IAB-DU at the positioner.

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

3) Orient the positioner (and IAB-DU) in order that the direction to be tested aligns with the test antenna.

4) Configure the beam peak direction of the IAB-DU according to the declared beam direction pair.

5) For IAB *type 1-O*, set the IAB-DU to transmit a signal according to the applicable test configuration in clause 4.8 using the corresponding test models:

- NR-FR1-TM3.1a if 256QAM is supported by IAB-DU without power back off;

- NR-FR1-TM3.1 if 256QAM is not supported by IAB-DU;

- NR-FR1-TM3.1 if 256QAM is supported by IAB-DU with power back off;

For *IAB type 2-O*, set the BS to transmit a signal according to the applicable test configuration in clause 4.8 using the corresponding test model:

- NR-FR2-TM3.1a if 256QAM is supported by BS without power back off, or

- NR-FR2-TM3.1 if 256QAM is supported by BS with power back off, or 256QAM is not supported by IAB-DU; with 64QAM signals if 64QAM is supported by BS without power back off, or;

- NR-FR2-TM3.1 with highest modulation order supported without power back off if 64QAM is not supported by IAB-DU, or;

- NR-FR2-TM3.1with highest modulation order supported without power back off if 64QAM is supported by IAB-DU with power back off;

6) Measure the OFDM symbol TX power as defined in annex L by measuring the EIRP for any two orthogonal polarizations (denoted p1 and p2) and calculate total radiated transmit power for particular *beam direction pair* as EIRP = EIRPp1 + EIRPp2.

7) For IAB *type 1-O*, set the BS to transmit a signal according to the applicable test configuration in clause 4.8 using the corresponding test models:

- NR-FR1-TM2a in TS 38.141-1 [3] clause 4.9.2.2.4 if 256QAM is supported by BS;

- NR-FR1-TM2 in TS 38.141-1 [3] clause 4.9.2.2.3 if 256QAM is not supported by BS;

For IAB *type 2-O*, set the BS to transmit a signal according to the applicable test configuration in clause 4.8 using the corresponding test models:

- NR-FR2-TM2a if 256QAM is supported by IAB-DU, or;

- NR-FR2-TM2 with highest modulation order supported if 256QAM is not supported by IAB-DU;

8) Measure the OFDM symbol TX power (OSTP) as defined in annex L by measuring the EIRP for any two orthogonal polarizations (denoted p1 and p2) and calculate total radiated transmit power for particular *beam direction pair* as EIRP = EIRPp1 + EIRPp2.

The measured OFDM symbols shall not contain RS or SSB.

In addition, for *multi-band RIB(s)*, the following steps shall apply:

9) For *multi-band RIBs* and single band tests, repeat the steps above per involved band where single band test configurations and test models shall apply with no carrier activated in the other band.

##### 6.4.1.3.5 Test requirements

###### 6.4.1.3.5.1 *IAB type 1-O*

The downlink (DL) total power dynamic range for each NR carrier shall be larger than or equal to the level in table 6.4.1.3.5.1-1.

Table 6.4.1.3.5.1-1: Total power dynamic range

|  |  |  |  |
| --- | --- | --- | --- |
| BS channel bandwidth (MHz) | Total power dynamic range  (dB) | | |
|  | 15 kHz SCS | 30 kHz SCS | 60 kHz SCS |
|  |  |  |  |
| 10 | 16.7 | 13.4 | 10 |
| 15 | 18.5 | 15.3 | 12.1 |
| 20 | 19.8 | 16.6 | 13.4 |
| 25 | 20.8 | 17.7 | 14.5 |
| 30 | 21.6 | 18.5 | 15.3 |
| 40 | 22.9 | 19.8 | 16.6 |
| 50 | 23.9 | 20.8 | 17.7 |
| 60 | N/A | 21.6 | 18.5 |
| 70 | N/A | 22.3 | 19.2 |
| 80 | N/A | 22.9 | 19.8 |
| 90 | N/A | 23.4 | 20.4 |
| 100 | N/A | 23.9 | 20.9 |

NOTE: Additional test requirements for the Error Vector Magnitude (EVM) at the lower limit of the dynamic range are defined in clause 6.6.

###### 6.4.1.3.5.2 IAB type 2-O

OTA total power dynamic range minimum requirement for IAB-DU *type 2-O* is specified such as for each NR carrier it shall be larger than or equal to the levels specified in table 6.3.1.3.5.2-1.

Table 6.4.1.3.5.2-1: Minimum requirement for *IAB-DU type 2-O* total power dynamic range

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SCS | 50 MHz | 100 MHz | 200 MHz | 400 MHz |
| (kHz) | OTA total power dynamic range (dB) | | | |
| 60 | 17.7 | 20.8 | 23.8 | N.A |
| 120 | 14.6 | 17.7 | 20.8 | 23.8 |

NOTE: Additional test requirements for the EVM at the lower limit of the dynamic range are defined in clause 6.6.

### 6.4.2 IAB-MT OTA Output Power Dynamics

#### 6.4.2.1 OTA total power dynamic range

##### 6.4.2.1.1 Definition and applicability

The OTA total power dynamic range is the difference between the maximum and the minimum controlled transmit power in the channel bandwidth for a specified reference condition. The maximum and minimum output powers are defined as the mean power in at least one sub-frame 1ms

Note. The specified reference condition(s) are specified in the conformance specification. Changes in the controlled transmit power in the channel bandwidth due to changes in the specified reference condition are not include as part of the dynamic range.

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

##### 6.4.2.1.2 Minimum requirement

The IAB-MT total power dynamic range is defined in TS 38.174 [2], clause 9.4.2.1

##### 6.4.2.1.3 Test purpose

The test purpose is to verify that the IAB-MT OTA total power dynamic range is within the limits specified by the minimum requirement.

##### 6.4.2.1.4 Method of test

###### 6.4.2.1.4.1 Initial conditions

Test environment: Normal, see annex B.2.

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

Beams to be tested: Declared beam with the highest intended EIRP for the narrowest intended beam corresponding to the smallest BeWθ, or for the narrowest intended beam corresponding to the smallest BeWϕ (D.3, D.11).

Directions to be tested: The OTA peak directions set reference beam direction pair (D.8).

###### 6.4.2.1.4.2 Procedure

1) Place the IAB-MT at the positioner.

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

3) Orient the positioner (and IAB-MT) in order that the direction to be tested aligns with the test antenna.

4) Configure the beam peak direction of the IAB-MT according to the declared beam direction pair.

5) For IAB *type 1-O*, set the IAB-MT to transmit a signal according to the applicable test configuration in clause 4.8 using the corresponding test models:

- NR -IAB-MT-FR1-TM3.1

For *IAB type 2-O*, set the BS to transmit a signal according to the applicable test configuration in clause 4.8 using the corresponding test model:

- NR-IAB-MT-FR2-TM3.1;

6) Measure the power by measuring the EIRP for any two orthogonal polarizations (denoted p1 and p2) over 1ms and calculate total EIRP for particular *beam direction pair* as EIRP = EIRPp1 + EIRPp2.

7) For IAB *type 1-O*, set the IAB-MT to transmit a signal according to the applicable test configuration in clause 4.8 using the corresponding test models:

- NR-IAB-MT-FR1-TM2

For IAB *type 2-O*, set the IAB-MT to transmit a signal according to the applicable test configuration in clause 4.8 using the corresponding test models:

- NR-IAB-MT-FR2-TM2;

8) Measure the power by measuring the EIRP for any two orthogonal polarizations (denoted p1 and p2) over 1ms and calculate total EIRP for particular *beam direction pair* as EIRP = EIRPp1 + EIRPp2..

In addition, for *multi-band RIB(s)*, the following steps shall apply:

9) For *multi-band RIBs* and single band tests, repeat the steps above per involved band where single band test configurations and test models shall apply with no carrier activated in the other band.

##### 6.4.2.1.5 Test requirements

###### 6.4.2.1.5.1 IAB type 1-O

For IAB-MT the ΔP between the power measured in step 6 and step 8 of clause 6.4.2.1.4.2 shall be:

Table 6.4.2.1.5.1-1: IAB type 1-0 Output power dynamics test requirements.

|  |  |  |
| --- | --- | --- |
| IAB-MT Type | IAB-MT channel bandwidth | Requirement (Note 1) |
| Wide area | ≤40MHz | 10 log(Maximum RB) -1.2 > ΔP ≥ 10 log(Maximum RB) + 11.2 |
| 40MHz < BW ≤ 100MHz | 10 log(Maximum RB) -1.5 > ΔP ≥ 10 log(Maximum RB) + 11.5 |
| Local area | ≤40MHz | 10 log(Maximum RB) + 3.8 > ΔP ≥ 10 log(Maximum RB) + 15.2 |
| 40MHz < BW ≤ 100MHz | 10 log(Maximum RB) + 3.5 > ΔP ≥ 10 log(Maximum RB) + 16.5 |
| Note 1: Step\_max is the power step between maximum and minimum power control settings. | | |

###### 6.4.2.1.5.2 IAB *type 2-O*

For IAB-MT the ΔP between the power measured in step 6 and step 8 of clause 6.4.2.1.4.2 shall be:

Table 6.4.2.1.5.2-1: IAB type 2-0 Output power dynamics test requirements.

|  |  |  |
| --- | --- | --- |
| IAB-MT Type | IAB-MT channel bandwidth | Requirement (Note 1) |
| Wide area | ≤40MHz | 10 log(Maximum RB) -1.2 > ΔP ≥ 10 log(Maximum RB) + 11.2 |
| 40MHz < BW ≤ 100MHz | 10 log(Maximum RB) -1.5 > ΔP ≥ 10 log(Maximum RB) + 11.5 |
| Local area | ≤40MHz | 10 log(Maximum RB) + 3.8 > ΔP ≥ 10 log(Maximum RB) + 15.2 |
| 40MHz < BW ≤ 100MHz | 10 log(Maximum RB) + 3.5 > ΔP ≥ 10 log(Maximum RB) + 16.5 |
| Note 1: Step\_max is the power step between maximum and minimum power control settings. | | |

#### 6.4.2.2 Relative power tolerance for local area IAB-MT

##### 6.4.2.2.1 Definition and applicability

The relative power tolerance is the ability of the transmitter to set its output power in a target sub-frame (1 ms) relatively to the power of the most recently transmitted reference sub-frame (1 ms) if the transmission gap between these sub-frames is less than or equal to 20 ms.

##### 6.4.2.2.2 Minimum requirement

The Power control for local area IAB-MT type 1-O is defined in TS 38.174 [2], clause 9.4.3.1.1

The Power control for local area IAB-MT type 2-O is defined in TS 38.174 [2], clause9.4.3.2.1

##### 6.4.2.2.3 Test purpose

No specific test or test requirements are defined for Relative power tolerance. The Total power dynamic range test, as described in clause 6.4.2.1 provides sufficient test coverage for this requirement.

#### 6.4.2.3 Aggregate power tolerance for local area IAB-MT

##### 6.4.2.3.1 Definition and applicability

The aggregate power control tolerance is the ability of the transmitter to maintain its power in a sub-frame (1 ms) during non-contiguous transmissions within [21 ms] in response to 0 dB commands with respect to the first transmission and all other power control parameters as specified in 3GPP TS 38.213 [x2] kept constant.

##### 6.4.2.3.2 Minimum requirement

The IAB-MT Aggregate power tolerance for local area IAB-MT type 1-O is defined in TS 38.174 [2], clause 9.4.3.1.2.

The IAB-MT Aggregate power tolerance for local area IAB-MT type 2-O is defined in TS 38.174 [2], clause 9.4.3.2.2.

##### 6.4.2.3.3 Test purpose

No specific test or test requirements are defined for IAB-MT Aggregate power tolerance.

**--- End of changes ---**