**3GPP TSG-RAN WG4 Meeting#98-bis-e R4-2106599**

**E-meeting,12th April– 20th April, 2021**

**Agenda item: 5.3.2.3.2**

**Source: ZTE Corporation**

**Title: TP to TS 38.176-1: RX IMD requirements**

**Document for:** **Approval**

1. Introduction

In the past RAN4#98e meetings, work split has been agreed among companies, therefore in this contribution, we want to share the draft TP for section 7.7 Rx IMD test for further discussion.

1. Reference

[1] R4-2103856 WF on IAB conformance specification work split and drafting guidelines, approved.

1. Annex

<Start of TP>

## 7.7 Receiver intermodulation

### 7.7.1 Definition and applicability

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 the *antenna connector* for *TAB connector* for *IAB 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

The minimum requirements for *IAB-DU type 1-H* are in TS 38.174 [2], clause 7.7.2.

The minimum requirements for *IAB-MT type 1-H* are in TS 38.174 [2], clause 7.7.3.

### 7.7.3 Test purpose

The test purpose is to verify the ability of the IAB node receiver to inhibit the generation of intermodulation products in its non-linear elements caused by the presence of two high-level interfering signals at frequencies with a specific relationship to the frequency of the wanted signal.

### 7.7.4 Method of test

#### 7.7.4.1 Initial conditions

Test environment: Normal; see annex B.2.

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

*IAB RF Bandwidth p*ositions to be tested for multi-carrier (MC) and/or CA:

- MRFBW for *single-band connector(s)*, see clause 4.9.1,

- BRFBW\_T'RFBW and B'RFBW\_TRFBW for *multi-band connector(s),* see clause 4.9.1.

NOTE: When testing in M (or MRFBW), if the interferer is fully or partially located outside the supported frequency range, then the test shall be done instead in B (or BRFBW) and T (or TRFBW), and only with the interferer located inside the supported frequency range.

#### 7.7.4.2 Procedure

The minimum requirement is applied to all connectors under test.

For *IAB type 1-H* the procedure is repeated until all *TAB connectors* necessary to demonstrate conformance have been tested; see clause 7.1.

1) Connect the connector under test to measurement equipment as shown in annex D.4.6 for *IAB type 1-H*.

2) Set the IAB node to transmit:

For IAB-DU:

- For single carrier operation set the connector under test to transmit at manufacturers declared *rated carrier output power* (Prated,c,AC or Prated,c,TABC, D.21).

- For a connector under test declared to be capable of multi-carrier and/or CA operation (D.15-D.16) set the connector under test to transmit on all carriers configured using the applicable test configuration and corresponding power setting specified in clauses 4.7 and 4.8 using the corresponding test models or set of physical channels in clause 4.9.2.

For IAB-MT:

- For single carrier operation set the connector under test to transmit at manufacturers declared *rated carrier output power* (Prated,c,AC or Prated,c,TABC, D.xx).

- For a connector under test declared to be capable of multi-carrier and/or CA operation (D.xx-D.xx) set the connector under test to transmit on all carriers configured using the applicable test configuration and corresponding power setting specified in clauses 4.x and 4.x using the corresponding test models or set of physical channels in clause 4.9.x.

3) Set the signal generator for the wanted signal to transmit as specified in table 7.7.5.1-1 and 7.7.5.1-3 for IAB-DU and table 7.7.5.2-1 and 7.7.5.2-3 for IAB-MT.

4) Set the signal generator for the interfering signal to transmit at the frequency offset and as specified in table 7.7.5.1-2 and 7.7.5.1-4 for IAB-DU and table 7.7.5.2-2 and 7.7.5.2-4 for IAB-MT.

5) Measure the throughput according to annex A.1.

In addition, for a *multi-band* *connector*, the following steps shall apply:

6) For *multi-band* *connector* 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.

### 7.7.5 Test requirements

#### 7.7.5.1 *IAB-DU type 1-H*

The throughputshall be ≥ 95% of the maximum throughput of the reference measurement channel, with a wanted signal at the assigned channel frequency and two interfering signals coupled to the *IAB-DU type 1-H* *TAB connector*, with the conditions specified in tables 7.7.5.1-1 and 7.7.5.1-2 for intermodulation performance and in tables 7.7.5.1-3, and 7.7.5.1-4 for narrowband intermodulation performance. The reference measurement channel for the wanted signal is identified in tables 7.2.5-1 to 7.2.5-3 for each channel bandwidth and further specified in annex A.1. The characteristics of the interfering signal is further specified in annex E.

The subcarrier spacing for the modulated interfering signal shall in general be the same as the subcarrier spacing for the wanted signal, except for the case of wanted signal subcarrier spacing 60 kHz and BS channel bandwidth <=20MHz, for which the subcarrier spacing of the interfering signal should be 30 kHz.

The receiver intermodulation requirement is applicable outside the IAB-DU RF Bandwidth or Radio Bandwidth edges. The interfering signal offset is defined relative to the IAB-DU RF Bandwidth edges or Radio Bandwidth edges.

For a IAB-DU operating in non-contiguous spectrum within any *operating band*, the narrowband intermodulation requirement applies in addition inside any sub-block gap in case the sub-block gap is at least as wide as the channel bandwidth of the NR interfering signal in table 7.7.5.1-2 or 7.7.5.1-4. The interfering signal offset is defined relative to the sub-block edges inside the sub-block gap.

For a *multi-band connectors*, the intermodulation requirement applies in addition inside any Inter RF Bandwidth gap, in case the gap size is at least twice as wide as the NR interfering signal centre frequency offset from the IAB-DU RF Bandwidth edge.

For a *multi-band connectors*, the narrowband intermodulation requirement applies in addition inside any Inter RF Bandwidth gap in case the gap size is at least as wide as the NR interfering signal in tables 7.7.5.1-2 and 7.7.5.1-4. The interfering signal offset is defined relative to the IAB-DU RF Bandwidth edges inside the Inter RF Bandwidth gap.

Table 7.7.5.1-1: General intermodulation requirement

|  |  |  |  |
| --- | --- | --- | --- |
| IAB-DU type | Wanted Signal mean power (dBm) | Mean power of interfering signals (dBm) | Type of interfering signals |
| Wide Area  | PREFSENS + 6 dB  | -52 |  |
| Medium Range  | PREFSENS + 6 dB  | -47 | See table 7.7.5.1-2 |
| Local Area | PREFSENS + 6 dB  | -44 |  |
| NOTE: PREFSENS depends on the RAT and the IAB class. For NR, PREFSENS depends also on the IAB-DU *channel bandwidth* as specified inTS 38.174 [x], section 7.2.1.2. |

Table 7.7.5.1-2: Interfering signals for intermodulation requirement

|  |  |  |
| --- | --- | --- |
| *IAB-DU channel bandwidth* of the lowest/highest carrier received (MHz) | Interfering signal centre frequency offset from the lower/upper IAB-DU RF Bandwidth edge (MHz) | Type of interfering signal (Note 3) |
| 5 | ±7.5 | CW |
|  | ±17.5 | 5 MHz DFT-s-OFDM NR signal, (Note 1) |
| 10 | ±7.465 | CW |
|  | ±17.5 | 5 MHz DFT-s-OFDM NR signal, (Note 1) |
| 15 | ±7.43 | CW |
|  | ±17.5 | 5 MHz DFT-s-OFDM NR signal, (Note 1) |
| 20 | ±7.395 | CW |
|  | ±17.5 | 5 MHz DFT-s-OFDM NR signal, (Note 1) |
| 25 | ±7.465 | CW |
|  | ±25 | 20MHz DFT-s-OFDM NR signal, (Note 2) |
| 30 | ±7.43 | CW |
|  | ±25 | 20 MHz DFT-s-OFDM NR signal, (Note 2) |
| 40 | ±7.45 | CW |
|  | ±25 | 20 MHz DFT-s-OFDM NR signal, (Note 2) |
| 50 | ±7.35 | CW |
|  | ±25 | 20 MHz DFT-s-OFDM NR signal, (Note 2) |
| 60 | ±7.49 | CW |
|  | ±25 | 20 MHz DFT-s-OFDM NR signal, (Note 2) |
| 70 | ±7.42 | CW |
|  | ±25 | 20 MHz DFT-s-OFDM NR signal, (Note 2) |
| 80 | ±7.44 | CW |
|  | ±25 | 20 MHz DFT-s-OFDM NR signal, (Note 2) |
| 90 | ±7.46 | CW |
|  | ±25 | 20 MHz DFT-s-OFDM NR signal, (Note 2) |
| 100 | ±7.48 | CW |
|  | ±25 | 20 MHz DFT-s-OFDM NR signal, (Note 2) |
| NOTE 1: For the 15 kHz subcarrier spacing, the number of RB is 25. For the 30 kHz subcarrier spacing, the number of RB is 10.NOTE 2: For the 15 kHz subcarrier spacing, the number of RB is 100. For the 30 kHz subcarrier spacing, the number of RB is 50. For the 60 kHz subcarrier spacing, the number of RB is 24. NOTE 3: The RBs shall be placed adjacent to the transmission bandwidth configuration edge which is closer to the *IAB-DU RF Bandwidth* edge. |

Table 7.7.5.1-3: Narrowband intermodulation performance requirement in FR1

|  |  |  |  |
| --- | --- | --- | --- |
| IAB-DU type | Wanted signal mean power (dBm)(Note 1) | Mean power of interfering signals (dBm) | Type of interfering signal |
| Wide Area  | PREFSENS + 6 dB | -52 |  |
| Medium Range  | PREFSENS + 6 dB | -47 | See table 7.7.5.1-4 |
| Local Area  | PREFSENS + 6 dB | -44 |  |
| NOTE: PREFSENS depends on the RAT. For NR, PREFSENS depends also on the *IAB-DU channel bandwidth* as specified in TS 38.174 [x], section 7.2.1.2. |

Table 7.7.5.1-4: Interfering signals for narrowband intermodulation requirement in FR1

|  |  |  |
| --- | --- | --- |
| *IAB-DU channel bandwidth* of the lowest/highest carrier received (MHz) | Interfering RB centre frequency offset from the lower/upper IAB-DU RF Bandwidth edge or sub-block edge inside a sub-block gap (kHz) (Note 3) | Type of interfering signals |
| 5 | ±360 | CW |
|  | ±1420 | 5 MHz DFT-s-OFDM NR signal, 1 RB (Note 1) |
| 10 | ±370 | CW |
|  | ±1960 | 5 MHz DFT-s-OFDM NR signal, 1 RB (Note 1) |
| 15 (Note 2) | ±380 | CW |
|  | ±1960 | 5 MHz DFT-s-OFDM NR signal, 1 RB (Note 1) |
| 20 (Note 2) | ±390 | CW |
|  | ±2320 | 5 MHz DFT-s-OFDM NR signal, 1 RB (Note 1) |
| 25 (Note 2) | ±325 | CW |
|  | ±2350 | 20 MHz DFT-s-OFDM NR signal, 1 RB (Note 1) |
| 30 (Note 2) | ±335 | CW |
|  | ±2350 | 20 MHz DFT-s-OFDM NR signal, 1 RB (Note 1) |
| 40 (Note 2) | ±355 | CW |
|  | ±2710 | 20 MHz DFT-s-OFDM NR signal, 1 RB (Note 1) |
| 50 (Note 2) | ±375 | CW |
|  | ±2710 | 20 MHz DFT-s-OFDM NR signal, 1 RB (Note 1) |
| 60 (Note 2) | ±395 | CW |
|  | ±2710 | 20 MHz DFT-s-OFDM NR signal, 1 RB (Note 1) |
| 70 (Note 2) | ±415 | CW |
|  | ±2710 | 20 MHz DFT-s-OFDM NR signal, 1 RB (Note 1) |
| 80 (Note 2) | ±435 | CW |
|  | ±2710 | 20 MHz DFT-s-OFDM NR signal, 1 RB (Note 1) |
| 90 (Note 2) | ±365 | CW |
|  | ±2530 | 20 MHz DFT-s-OFDM NR signal, 1 RB (Note 1) |
| 100 (Note 2) | ±385 | CW |
|  | ±2530 | 20 MHz DFT-s-OFDM NR signal, 1 RB (Note 1) |
| NOTE 1: Interfering signal consisting of one resource block positioned at the stated offset, the *IAB-DU channel bandwidth* of the interfering signal is located adjacently to the lower/upper IAB-DU RF Bandwidth edge or sub-block edge inside a sub-block gap.NOTE 2: This requirement shall apply only for a G-FRC mapped to the frequency range at the channel edge adjacent to the interfering signals.NOTE 3: The centre of the interfering RB refers to the frequency location between the two central subcarriers. |

#### 7.7.5.2 *IAB-MT type 1-H*

The throughputshall be ≥ 95% of the maximum throughput of the reference measurement channel, with a wanted signal at the assigned channel frequency and two interfering signals coupled to the *IAB-MT type 1-H* *TAB connector*, with the conditions specified in tables 7.7.5.2-1 and 7.7.5.2-2 for intermodulation performance and in tables 7.7.5.2-3, and 7.7.5.2-4 for narrowband intermodulation performance. The reference measurement channel for the wanted signal is identified in tables 7.2.5-1 to 7.2.5-3 for each channel bandwidth and further specified in annex A.1. The characteristics of the interfering signal is further specified in annex E.

The subcarrier spacing for the modulated interfering signal shall in general be the same as the subcarrier spacing for the wanted signal, except for the case of wanted signal subcarrier spacing 60 kHz and BS channel bandwidth <=20MHz, for which the subcarrier spacing of the interfering signal should be 30 kHz.

The receiver intermodulation requirement is applicable outside the IAB-MT RF Bandwidth or Radio Bandwidth edges. The interfering signal offset is defined relative to the IAB-MT RF Bandwidth edges or Radio Bandwidth edges.

For a IAB-MT operating in non-contiguous spectrum within any *operating band*, the narrowband intermodulation requirement applies in addition inside any sub-block gap in case the sub-block gap is at least as wide as the channel bandwidth of the NR interfering signal in table 7.7.5.2-2 or 7.7.5.2-4. The interfering signal offset is defined relative to the sub-block edges inside the sub-block gap.

For a *multi-band connectors*, the intermodulation requirement applies in addition inside any Inter RF Bandwidth gap, in case the gap size is at least twice as wide as the NR interfering signal centre frequency offset from the IAB-MT RF Bandwidth edge.

For a *multi-band connectors*, the narrowband intermodulation requirement applies in addition inside any Inter RF Bandwidth gap in case the gap size is at least as wide as the NR interfering signal in tables 7.7.5.2-2 and 7.7.5.2-4. The interfering signal offset is defined relative to the IAB-MT RF Bandwidth edges inside the Inter RF Bandwidth gap.

Table 7.7.5.2-1: General intermodulation requirement

|  |  |  |  |
| --- | --- | --- | --- |
| IAB-MT type | Wanted Signal mean power (dBm) | Mean power of interfering signals (dBm) | Type of interfering signals |
| Wide Area  | PREFSENS + 6 dB  | -52 | See table 7.7.5.2-2 |
| Local Area | PREFSENS + 6 dB  | -44 |  |
| NOTE: PREFSENS depends on the RAT and the IAB class. For NR, PREFSENS depends also on the IAB-MT *channel bandwidth* as specified inTS 38.174 [x], section 7.2.2.2. |

Table 7.7.5.2-2: Interfering signals for intermodulation requirement

|  |  |  |
| --- | --- | --- |
| *IAB-MT channel bandwidth* of the lowest/highest carrier received (MHz) | Interfering signal centre frequency offset from the lower/upper IAB-MT RF Bandwidth edge (MHz) | Type of interfering signal (Note 3) |
| 10 | ±7.465 | CW |
|  | ±17.5 | 5 MHz CP-OFDM NR signal, (Note 1) |
| 15 | ±7.43 | CW |
|  | ±17.5 | 5 MHz CP-OFDM NR signal, (Note 1) |
| 20 | ±7.395 | CW |
|  | ±17.5 | 5 MHz CP-OFDM NR signal, (Note 1) |
| 25 | ±7.465 | CW |
|  | ±25 | 20MHz CP-OFDM NR signal, (Note 2) |
| 30 | ±7.43 | CW |
|  | ±25 | 20 MHz CP-OFDM NR signal, (Note 2) |
| 40 | ±7.45 | CW |
|  | ±25 | 20 MHz CP-OFDM NR signal, (Note 2) |
| 50 | ±7.35 | CW |
|  | ±25 | 20 MHz CP-OFDM NR signal, (Note 2) |
| 60 | ±7.49 | CW |
|  | ±25 | 20 MHz CP-OFDM NR signal, (Note 2) |
| 70 | ±7.42 | CW |
|  | ±25 | 20 MHz CP-OFDM NR signal, (Note 2) |
| 80 | ±7.44 | CW |
|  | ±25 | 20 MHz CP-OFDM NR signal, (Note 2) |
| 90 | ±7.46 | CW |
|  | ±25 | 20 MHz CP-OFDM NR signal, (Note 2) |
| 100 | ±7.48 | CW |
|  | ±25 | 20 MHz CP-OFDM NR signal, (Note 2) |
| NOTE 1: For the 15 kHz subcarrier spacing, the number of RB is 25. For the 30 kHz subcarrier spacing, the number of RB is 10.NOTE 2: For the 15 kHz subcarrier spacing, the number of RB is 100. For the 30 kHz subcarrier spacing, the number of RB is 50. For the 60 kHz subcarrier spacing, the number of RB is 24. NOTE 3: The RBs shall be placed adjacent to the transmission bandwidth configuration edge which is closer to the *IAB-MT RF Bandwidth* edge. |

Table 7.7.5.2-3: Narrowband intermodulation performance requirement in FR1

|  |  |  |  |
| --- | --- | --- | --- |
| IAB-MT type | Wanted signal mean power (dBm)(Note 1) | Mean power of interfering signals (dBm) | Type of interfering signal |
| Wide Area  | PREFSENS + 6 dB | -52 | See table 7.7.5.2-4 |
| Local Area  | PREFSENS + 6 dB | -44 |  |
| NOTE: PREFSENS depends on the RAT. For NR, PREFSENS depends also on the *IAB-DU channel bandwidth* as specified in TS 38.174 [x], section 7.2.2.2. |

Table 7.7.5.2-4: Interfering signals for narrowband intermodulation requirement in FR1

|  |  |  |
| --- | --- | --- |
| *IAB-MT channel bandwidth* of the lowest/highest carrier received (MHz) | Interfering RB centre frequency offset from the lower/upper IAB-MT RF Bandwidth edge or sub-block edge inside a sub-block gap (kHz) (Note 3) | Type of interfering signals |
| 10 | ±370 | CW |
|  | ±1960 | 5 MHz CP-OFDM NR signal, 1 RB (Note 1) |
| 15 (Note 2) | ±380 | CW |
|  | ±1960 | 5 MHz CP-OFDM NR signal, 1 RB (Note 1) |
| 20 (Note 2) | ±390 | CW |
|  | ±2320 | 5 MHz CP-OFDM NR signal, 1 RB (Note 1) |
| 25 (Note 2) | ±325 | CW |
|  | ±2350 | 20 MHz CP-OFDM NR signal, 1 RB (Note 1) |
| 30 (Note 2) | ±335 | CW |
|  | ±2350 | 20 MHz CP-OFDM NR signal, 1 RB (Note 1) |
| 40 (Note 2) | ±355 | CW |
|  | ±2710 | 20 MHz CP-OFDM NR signal, 1 RB (Note 1) |
| 50 (Note 2) | ±375 | CW |
|  | ±2710 | 20 MHz CP-OFDM NR signal, 1 RB (Note 1) |
| 60 (Note 2) | ±395 | CW |
|  | ±2710 | 20 MHz CP-OFDM NR signal, 1 RB (Note 1) |
| 70 (Note 2) | ±415 | CW |
|  | ±2710 | 20 MHz CP-OFDM NR signal, 1 RB (Note 1) |
| 80 (Note 2) | ±435 | CW |
|  | ±2710 | 20 MHz CP-OFDM NR signal, 1 RB (Note 1) |
| 90 (Note 2) | ±365 | CW |
|  | ±2530 | 20 MHz CP-OFDM NR signal, 1 RB (Note 1) |
| 100 (Note 2) | ±385 | CW |
|  | ±2530 | 20 MHz CP-OFDM NR signal, 1 RB (Note 1) |
| NOTE 1: Interfering signal consisting of one resource block positioned at the stated offset, the *IAB-MT channel bandwidth* of the interfering signal is located adjacently to the lower/upper IAB-MT RF Bandwidth edge or sub-block edge inside a sub-block gap.NOTE 2: This requirement shall apply only for a G-FRC mapped to the frequency range at the channel edge adjacent to the interfering signals.NOTE 3: The centre of the interfering RB refers to the frequency location between the two central subcarriers. |

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