**3GPP TSG-RAN WG4 Meeting # 116 draft R4-2511800**

**Bengaluru, India,** **25th -29th August, 2025**

**Agenda item:** 7.26.1

**Source:** Moderator (Huawei)

**Title:** WF on requirements for A-IoT BS and CW

**Document for:** Approval

# Introduction

This document captures the agreements about the RF requirements for A-IoT BS and CW on Rel-19 WI solutions for Ambient IoT in NR (RP-243326). The topic summaries are R4-2500687 (RAN4#114), R4-2504688 (RAN4#114bis) , R4-2507574 (RAN4#115) and R4-2509102 (RAN4#116). The previous WFs are R4-2502859 (RAN4 #114), R4-2505097 (RAN4 #114bis) and R4-2508101 (RAN4#115).

# Topic #1: A-IoT BS TX

### Issue 1-1: Modulation quality

* Agreement:
  + **Parameters definition:**
    - An is measured peak high level for the nth chip, in units of V/m or A/m
    - Bn is measured peak low level for the nth chip, in units of V/m or A/m
    - Anavg is the measured average high level for the nth chip during 1/2 duration above 90%An, in units of V/m or A/m
    - Bnavg is the measured average low level for the nth chip during 1/2 duration below 10%An, in units of V/m or A/m
  + **Modulation Depth:**
    - For each chip, Modulation depth =(Anavg-Bnavg)/Anavg
    - (Anavg–Bnavg)/Anavg>=80%
  + **RF Envelope Ripple**
    - Ripple\_high (%) = ((An − Anavg) / (Anag-Bnavg)) × 100% <=±15%
    - Ripple\_low (%) = ((Bn − Bnavg) / (Anavg-Bnavg)) × 100%<=±15%
  + **RF Envelope Rise/Fall Time:**
    - RF Envelop Rise Time: The time from 0.1 ×(Anavg-Bnavg) +Bnavg to 0.9 ×(Anavg-Bnavg)+Bnavg <=0.66Tc
    - RF Envelop Fall Time: The time from 0.9 ×(Anavg-Bnavg) +Bnavg to 0.1 ×(Anavg-Bnavg)+Bnavg <=0.66Tc
  + **RF Pulsewidth:** 
    - The pulse width is the time between two points on the pulse where the signal reaches 50% of (Anavg-Bnavg)+Bnavg, PW <=1.3 Tc
* Table 1: A-IoT BS RF envelope parameters

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **R2D Chip duration：Tc** | **Parameter** | **Symbol** | **Value** | **Units** |
| M∈ {2,6,12,24} | Modulation Depth | (A–B)/A | 80 | % |
| RF Envelope Ripple | Ripple\_high  Ripple\_low | <=±15 | % |
| RF Envelop Rise Time | Tr,10-90 | <=0.66Tc | µs |
| RF Envelop Fall Time | Tf,10-90 | <=0.66Tc | µs |
| RF Pulsewidth | PW | Option 1:<=1.3 Tc | µs |

Note: Modulation quality requirements can be further updated in the maintenance phase up to companies check.

### Issue 1-2: ACLR

* Agreement:
  + 100kHz offset, 40/45dB

### Issue 1-3: OBUE

* Agreement:
  + For 200 kHz R2D CBW, reuses the operating band unwanted emissions requirements of standalone NB-IoT Medium Range BS for A-IoT micro BS.
  + For 400/600/800kHz R2D CBW, use the operating band unwanted emissions requirements in Table 2 and 3.

Table 2 A-IoT medium range BS operating band unwanted emission limits, BS maximum output power 31 < Prated,c ≤ 38 dBm , for 400/600/800kHz R2D CBW

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **R2D CBW** | **Frequency offset of measurement filter ‑3dB point, Δf** | **Frequency offset of measurement filter centre frequency, f\_offset** | **Minimum requirement** | **Measurement bandwidth** |
| 400kHz | 0 MHz ≤ Δf < 0.4 MHz | 0.015 MHz ≤ f\_offset < 0.415 MHz | Prated,c -40dB - (- 0.015) dB | 30 kHz |
| 0.4 MHz ≤ Δf < 0.8 MHz | 0.415 MHz ≤ f\_offset < 0.815 MHz | Prated,c - 51dB- (-0.415) dB | 30 kHz |
| 0.8 MHz ≤ Δf < 1.6 MHz | 0.815 MHz ≤ f\_offset < 1.6 MHz | Prated,c - 56dB | 30 kHz |
| 1.6 MHz ≤ Δf < Δfmax | 1.6 MHz ≤ f\_offset < f\_offsetmax | -25dBm | 100kHz |
| 600kHz | 0 MHz ≤ Δf < 0.6 MHz | 0.015 MHz ≤ f\_offset < 0.615 MHz | Prated,c – 40dB - (-0.015) dB | 30 kHz |
| 0.6 MHz ≤ Δf < 1.2 MHz | 0.615 MHz ≤ f\_offset < 1.2 MHz | Prated,c – 53dB - (-0.615) dB | 30 kHz |
| 1.2 MHz ≤ Δf < 1.8 MHz | 1.2 MHz ≤ f\_offset < 1.8 MHz | Prated,c - 58dB | 30 kHz |
| 1.8 MHz ≤ Δf < Δfmax | 1.8 MHz ≤ f\_offset < f\_offsetmax | -25dBm | 100K |
| 800kHz | 0 MHz ≤ Δf < 0.8 MHz | 0.015 MHz ≤ f\_offset < 0.815 MHz | Prated,c – 40dB- (-0.015) dB | 30 kHz |
| 0.8 MHz ≤ Δf < 1.6 MHz | 0.815 MHz ≤ f\_offset < 1.6 MHz | Prated,c – 54dB- (-0.815) dB | 30 kHz |
| 1.6 MHz ≤ Δf < 2.4 MHz | 1.6 MHz ≤ f\_offset < 2.4 MHz | Prated,c - 59dB | 30 kHz |
| 2.4 MHz ≤ Δf < Δfmax | 2.4 MHz ≤ f\_offset < f\_offsetmax | -25dBm | 100K |

Table 3 A-IoT medium range BS operating band unwanted emission limits, BS maximum output power Prated,c ≤ 31 dBm , for 400/600/800kHz R2D CBW

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **R2D CBW** | **Frequency offset of measurement filter ‑3dB point, Δf** | **Frequency offset of measurement filter centre frequency, f\_offset** | **Minimum requirement** | **Measurement bandwidth** |
| 400kHz | 0 MHz ≤ Δf < 0.4 MHz | 0.015 MHz ≤ f\_offset < 0.415 MHz | -9dBm - (- 0.015) dB | 30 kHz |
| 0.4 MHz ≤ Δf < 0.8 MHz | 0.415 MHz ≤ f\_offset < 0.815 MHz | -20dBm- (-0.415) dB | 30 kHz |
| 0.8 MHz ≤ Δf < 1.6 MHz | 0.815 MHz ≤ f\_offset < 1.6 MHz | -25dBm | 30 kHz |
| 1.6 MHz ≤ Δf < Δfmax | 1.6 MHz ≤ f\_offset < f\_offsetmax | -25dBm | 100kHz |
| 600kHz | 0 MHz ≤ Δf < 0.6 MHz | 0.015 MHz ≤ f\_offset < 0.615 MHz | -9dBm - (-0.015) dB | 30 kHz |
| 0.6 MHz ≤ Δf < 1.2 MHz | 0.615 MHz ≤ f\_offset < 1.2 MHz | -22dBm - (-0.615) dB | 30 kHz |
| 1.2 MHz ≤ Δf < 1.8 MHz | 1.2 MHz ≤ f\_offset < 1.8 MHz | -27dBm | 30 kHz |
| 1.8 MHz ≤ Δf < Δfmax | 1.8 MHz ≤ f\_offset < f\_offsetmax | -25dBm | 100K |
| 800kHz | 0 MHz ≤ Δf < 0.8 MHz | 0.015 MHz ≤ f\_offset < 0.815 MHz | -9dBm - (-0.015) dB | 30 kHz |
| 0.8 MHz ≤ Δf < 1.6 MHz | 0.815 MHz ≤ f\_offset < 1.6 MHz | -23dBm - (-0.815) dB | 30 kHz |
| 1.6 MHz ≤ Δf < 2.4 MHz | 1.6 MHz ≤ f\_offset < 2.4 MHz | -28dBm | 30 kHz |
| 2.4 MHz ≤ Δf < Δfmax | 2.4 MHz ≤ f\_offset < f\_offsetmax | -25dBm | 100K |

Note: OBUE requirements can be further updated in the maintenance phase up to companies check.

# Topic #2: A-IoT BS RX

### Issue 2-1: Reference sensitivity level

* Agreement:
  + CW testing signal source: real CW node
  + CW input level to BS Antenna: -38dBm
  + Desens target 30dB
  + Note： The reference sensitivity power level is derived based on single RX and CW phase noise cancellation is not included.

### Issue 2-2: SNR value

* Agreement:
  + SNR for BPSK is -5dB
  + If BPSK reference sensitivity is X dBm，at the same other side condition, OOK sensitivity is X+3dB

### Issue 2-3: Dynamic range

* Agreement:
  + No need to define the dynamic range requirement

### Issue 2-4: ACS

* Agreement:
* Table 4: Adjacent channel selectivity for A-IoT Medium Range BS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| A-IoT  channel bandwidth of the lowest/highest carrier received [kHz] | Wanted signal mean power [dBm] | Interfering signal mean power [dBm] | Interfering signal centre frequency offset to the lower/upper Base Station RF Bandwidth edge [kHz] | Type of interfering signal |
| 200 | PREFSENS + 6dB (Note) | -53 | ±100 | 3 MHz DFT-s-OFDM NR signal, 15 kHz SCS, 1 RB，closest to wanted signal |
| 3520 | PREFSENS + 6dB (Note) | -53 | ±100 | 3 MHz DFT-s-OFDM NR signal |
| Note: PREFSENS depends on the sub-carrier spacing as specified in Table X | | | | |

### Issue 2-6: General intermodulation

* Agreement:
  + No need.

### Issue 2-7: Narrowband intermodulation

* Agreement:
  + Adopt the following narrow band IMD requirements.

Table 5-1: Narrowband blocking requirement for A-IoT Medium Range BS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | NB-IoT  channel bandwidth of the lowest/highest carrier received [kHz] | Wanted signal mean power [dBm] (Note) | Interfering signal mean power [dBm] | Type of interfering signal |
| Medium Range BS | 200 | PREFSENS + 6dB | -53 | See Table 7.5.1-2a |
|  | 3520 | PREFSENS + 6 dB | -53 | 3 MHz DFT-s-OFDM NR signal |
| Note : PREFSENS depends on the sub-carrier spacing as specified in Table | | | | |

Table 5-2: Interfering signal for Narrowband blocking requirement for A-IoT Medium Range BS

|  |  |  |
| --- | --- | --- |
| NB-IoT  channel bandwidth of the lowest/highest carrier received [kHz] | Interfering RB centre frequency offset to the lower/upper Base Station RF Bandwidth edge [kHz] | Type of interfering signal |
| 200 | ±(240 +m\*180),  m=0, 1, 2, 3, 4, 9, 14 | 3 MHz DFT-s-OFDM NR signal, 15 kHz SCS, 1 RB |
| 3520 | ±(240 +m\*180),  m=0, 1, 2, 3, 4, 9, 14 | 3 MHz DFT-s-OFDM NR signal |
| Note\*: Interfering signal consisting of one resource block is positioned at the stated offset, the channel bandwidth of the interfering signal is located adjacently to the lower/upper Base Station RF Bandwidth edge. | | |

# Topic #3: CW

### Issue 3-1: OFF power MBW

* Agreement:
  + OFF power MBW is 1MHz

### Issue 3-2: Phase noise

* Agreement:

**Table 6 Phase noise requirement for the CW node**

|  |  |
| --- | --- |
| **Frequency distance toward the CW centre** | **Phase noise (dBc/Hz)** |
| 7.5kHz | -97 |
| 120kHz | -102 |

### Issue 3-3: Unwanted emission

* Agreement:
  + Adopt the following proposal for CW node.
* **Table 7: CW node spectrum emission mask**

|  |  |  |
| --- | --- | --- |
| **Δf (kHz)** | **Emission limit (dBm)** | **Measurement bandwidth** |
| ± 200 | -18 | 30 kHz |
| ± 250 | -20 | 30 kHz |
| ± 350 | -25 | 30 kHz |
| ± 800 | -26 | 30 kHz |
| ± 1200 | -19 | 1 MHz |
| ± 5200~Δfmax | -23 | 1 MHz |

### Issue 3-4: CW channel bandwidth

* Agreement:
  + No need to define.

### Issue 3-6: CW others

* Agreement:
  + No need to specify the timing requirement for CW node in RF spec. It can be discussed under RRM.
  + Discuss how to capture “CW transmission and A-IoT BS downlink data transmission are non-concurrent”.

# Topic #4: draft TP to TS38.914

* Agreement:
  + Endorse the revised TPs.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Section in TS38914 | Volunteer company | RAN4#116 TPs submitted | Revised to |
| 1 | 5.3 BS channel bandwidth 5.4 Channel arrangement | CMCC | R4-2509717, CMCC（submitted in 7.22.2） |  |
| 2 | 6.1 General 6.2 Base station output power 6.3 Transmit ON/OFF power | CATT, LGE | R4-2509330，CATT  R4-2510079, LGE |  |
| 3 | 6.4 Transmitted signal quality | Huawei，ZTE | R4-2509884，Huawei |  |
| 4 | 6.5 Unwanted emissions 6.6 Transmitter intermodulation | CMCC，CATT | R4-2509331，CATT  R4-2509718，CMCC |  |
| 5 | 7.1 General 7.2 Reference sensitivity level 7.3 Dynamic range | ZTE, Huawei | R4-2511127，ZTE  R4-2509885，Huawei |  |
| 6 | 7.4 In-band selectivity and blocking 7.5 Out-of-band blocking | Ericsson | R4-2511433, Ericsson |  |
| 7 | 7.6 Receiver spurious emissions 7.7 Receiver intermodulation 7.8 In-channel selectivity | Ericsson, ZTE | R4-2511433, Ericsson |  |
| 8 | 8.1 General 8.2 CW Output power | Huawei, OPPO | R4-2511290, Huawei |  |
| 9 | 8.3 Frequency error 8.4 Unwanted emission | Vivo，ZTE | R4-2510252, Vivo |  |