**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** |
| $$Tc=\frac{10^{3}}{M\*15}(us)$$M∈ {2,6,12,24} | Modulation Depth | (A–B)/A | 80  | % |
| RF Envelope Ripple  | Ripple\_highRipple\_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 during the maintenance phase based on 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 - $\frac{11}{0.4}$ ($\frac{f\\_offset}{MHz} $- 0.015) dB | 30 kHz  |
| 0.4 MHz ≤ Δf < 0.8 MHz | 0.415 MHz ≤ f\_offset < 0.815 MHz | Prated,c - 51dB- $\frac{5}{0.4}$ ($\frac{f\\_offset}{MHz}$-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 - $\frac{13}{0.6}$ ($\frac{f\\_offset}{MHz}$-0.015) dB | 30 kHz  |
| 0.6 MHz ≤ Δf < 1.2 MHz | 0.615 MHz ≤ f\_offset < 1.2 MHz | Prated,c – 53dB - $\frac{5}{0.6} $($\frac{f\\_offset}{MHz}$-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- $\frac{14}{0.8}$ ($\frac{f\\_offset}{MHz}$-0.015) dB | 30 kHz  |
| 0.8 MHz ≤ Δf < 1.6 MHz | 0.815 MHz ≤ f\_offset < 1.6 MHz | Prated,c – 54dB- $\frac{5}{0.8}$ ($\frac{f\\_offset}{MHz}$-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 - $\frac{11}{0.4}$ ($\frac{f\\_offset}{MHz} $- 0.015) dB | 30 kHz  |
| 0.4 MHz ≤ Δf < 0.8 MHz | 0.415 MHz ≤ f\_offset < 0.815 MHz | -20dBm- $\frac{5}{0.4}$ ($\frac{f\\_offset}{MHz}$-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 - $\frac{13}{0.6}$ ($\frac{f\\_offset}{MHz}$-0.015) dB | 30 kHz  |
| 0.6 MHz ≤ Δf < 1.2 MHz | 0.615 MHz ≤ f\_offset < 1.2 MHz | -22dBm - $\frac{5}{0.6} $($\frac{f\\_offset}{MHz}$-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 - $\frac{14}{0.8}$ ($\frac{f\\_offset}{MHz}$-0.015) dB | 30 kHz  |
| 0.8 MHz ≤ Δf < 1.6 MHz | 0.815 MHz ≤ f\_offset < 1.6 MHz | -23dBm - $\frac{5}{0.8}$ ($\frac{f\\_offset}{MHz}$-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 during the maintenance phase based on 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 XdBm+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-IoTchannel 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: Narrowband intermodulation performance requirement for A-IoT Medium Range BS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel bandwidth of the lowest/highest carrier received [kHz] | Wanted signal mean power [dBm] | Interfering signal mean power [dBm] | Interfering RB centre frequency offset from the lower/upper Base Station RF Bandwidth edge or sub-block edge inside a sub-block gap [kHz] | Type of interfering signal |
| 200 | PREFSENS + 6dB\* | -53 | ±340 | CW |
| -53 | ±880 | 5MHz E-UTRA signal, 1 RB\*\* |
| 3520 | PREFSENS + 6dB\* | -53 | ±270 | CW |
|  |  | -53 | ±780 | 3.0 MHz E-UTRA signal, 1 RB\*\* |
| Note\*: PREFSENS depends on the sub-carrier spacing as specified in Table 7.2.1-5c.Note\*\*: Interfering signal consisting of one resource block positioned at the stated offset, the channel bandwidth of the interfering signal is located adjacently to the lower/upper Base Station RF Bandwidth edge. |

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# 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.

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| --- | --- | --- | --- | --- |
| No. | Section in TS38914 | Volunteer company | RAN4#116 TPs submitted  | Revised to |
| 1 | 5.3 BS channel bandwidth5.4 Channel arrangement | CMCC | R4-2509717, CMCC（submitted in 7.22.2） | Revised to R4-2511722 (from R4-2509717). |
| 2 | 6.1 General6.2 Base station output power6.3 Transmit ON/OFF power | CATT, LGE | R4-2509330，CATTR4-2510079, LGE | Revised to R4-2511725 (from R4-2509330).Revised to R4-2511730 (from R4-2510079) |
| 3 | 6.4 Transmitted signal quality | Huawei，ZTE | R4-2509884，Huawei | Revised to R4-2511728 (from R4-2509884) |
| 4 | 6.5 Unwanted emissions6.6 Transmitter intermodulation | CMCC，CATT | R4-2509331，CATTR4-2509718，CMCC | Revised to R4-2511726 (from R4-2509331)——no need this TP because it is agreed no need to define RX IMD in RAN4#115Revised to R4-2511727 (from R4-2509718) |
| 5 | 7.1 General7.2 Reference sensitivity level7.3 Dynamic range | ZTE, Huawei | R4-2511127，ZTER4-2509885，Huawei | Revised to R4-2511731 (from R4-2511127). |
| 6 | 7.4 In-band selectivity and blocking7.5 Out-of-band blocking | Ericsson | R4-2511433, Ericsson | Revised to R4-2511732 (from R4-2511433) |
| 7 | 7.6 Receiver spurious emissions7.7 Receiver intermodulation7.8 In-channel selectivity | Ericsson, ZTE | R4-2511433, Ericsson | Revised to R4-2511732 (from R4-2511433) |
| 8 | 8.1 General8.2 CW Output power | Huawei, OPPO | R4-2511290, Huawei | Revised to R4-2511743 (from R4-2511290) |
| 9 | 8.3 Frequency error8.4 Unwanted emission | Vivo，ZTE | R4-2510252, Vivo | Revised to R4-2511742 (from R4-2510252) |