**3GPP TSG-RAN WG4 Meeting # 112 R4-2414305**

Maastricht, Netherlands,19 – 23 Aug, 2024

**Agenda item:** 8.20.4

**Source:** Moderator (Huawei)

**Title:** WF on impacts of A-IoT on RF requirements

**Document for:** Approval

# Introduction

This document captures the agreements about the impacts of Ambient IoT on RF requirements for R19 SI（RP-240826）. The topic summary in RAN4#114 is R4-2412834. The WF in RAN4#111 is R4-2410597.

# Topic #1: A-IoT System Parameters

### Issue 1-1: System parameter

Agreement in RAN4#111:

* RAN4 will define the D2R and/or R2D channel bandwidth and operating bands for A-IoT
	+ Wait for the conclusions from other WGs to discuss the detailed parameters.
	+ FFS on whether to have the same or different channel bandwidths for devices, BS and intermediate node

**Agreement in RAN4#112:**

* Requirements needed:
	+ channel bandwidth
* FFS whether requirements are needed or not:
	+ Transmission bandwidth configuration;
	+ Channel spacing
	+ Channel raster

Note: The system parameters are defined from the network perspective. Some of them might not be needed for devices.

* Requirements not needed:
	+ Synchronization raster
	+ Guard band/Guard RB

Note: Guard band/RB can be considered as part of RF requirements and/or test cases.

# Topic #2: A-IoT BS

### Issue 2-1: start point

Agreement in RAN4#111:

* The existing NR BS RF requirement framework can be used as starting point for A-IoT BS.
	+ FFS on the detailed requirements.

### Issue 2-2: A-IoT BS class and BS type

**Agreement in RAN4#112:**

* + BS class: Use Micro-BS as baseline in SI stage (reference to SID RP-240826).
	+ BS type: Priority A-IoT BS type 1-C, FFS for 1-H.

### Issue 2-4: TX

Agreement in RAN4#111:

* Use the following table as starting point for RF requirements impact study. The table is for information.

|  |
| --- |
| **RF Requirement for A-IoT BS- TX part** |
| TX requirement  | Transmit output power | Maximum output power |  |
| Output power dynamic |  |
| Transmit ON/OFF power |  |
| Transmission times |  |
| Transmit signal quality | Frequency error |  |
| EVM |  |
| TAE |  |
| Unwanted emissions | Occupied bandwidth |  |
| SEM |  |
| ACLR |  |
| Operating band unwanted emissions |  |
| Transmitter spurious emissions |  |
| Transmitter intermodulation |  |

**Agreement in RAN4#112:**

* Requirements needed:
	+ Base station output power: reuse current requirements of 1-C Micro NR BS.
	+ Frequency error: Transmit signal quality: such as modulation depth, RF envelop ripple, RF plusewidth, RF envelope mask,
	+ Unwanted emissions (including Occupied bandwidth, ACLR, IBE, Operating band unwanted emissions, Transmitter spurious emissions)
* FFS whether requirements are needed or not:
	+ Output power dynamic (RE power control dynamic range, Total power dynamic range)
	+ Some requirements like Transmit ON/OFF power
	+ Transmitter transient period
	+ IBE
	+ Transmitter intermodulation
* Requirements not needed:
	+ Transmission times (requirements from RF ID reader)
	+ TAE

### Issue 2-5: RX

Agreement in RAN4#111:

* Use the following table as starting point for RF requirements impact study. The table is for information.

|  |
| --- |
| **RF Requirement for A-IoT BS- RX part** |
| RX requirement | Reference sensitivity  |  |
| Dynamic range  |  |
| In-channel selectivity |  |
| Adjacent Channel Selectivity |  |
| In-band blocking |  |
| Out-of-band blocking |  |
| Receiver intermodulation |  |
| Narrowband intermodulation |  |
| Rx spurious emission |  |
| Receiver intermodulation |  |

**Agreement in RAN4#112:**

* Requirements needed:
	+ Reference sensitivity level
	+ Adjacent Channel Selectivity
	+ Blocking requirement
	+ Rx spurious emission
* FFS whether requirements are needed or not:
	+ Dynamic range
	+ In-channel selectivity
	+ In-band blocking
	+ Narrow-band blocking
	+ Out-of-band blocking
	+ Receiver intermodulation
	+ Narrowband intermodulation
	+ Receiver intermodulation

### Issue 2-6: CW for D1T1

Agreement in RAN4#111:

* To further investigate output power, emission requirements for CW node
	+ FFS for other requirements.

# Topic #3: A-IoT device

### Issue 3-1: General

**Agreement in RAN4#112:**

* Different RF requirement for Ambient IoT Device 1, Device 2a and Device 2b can be specified

### Issue 3-3: TX(D2R)

Agreement in RAN4#111:

* Use the following table as starting point for RF requirements impact study. The table is for information.
	+ Encourage companies to provide views on RF requirements impact for different device types.

|  |
| --- |
| **RF Requirement for A-IoT device- TX part** |
| Tx requirement  | Transmit output power | Maximum output power |  |
| Output power dynamic | Transmit OFF power |  |
| Transmit time mask |  |
| Minimum output power |  |
| Power control requirement |  |
| Transmit ON/OFF power | Transmit OFF power |  |
| ON/OFF time mask |  |
| Transmit signal quality | Frequency error |  |
| EVM |  |
| In band emissions  |  |
| Carrier leakage |  |
| Output RF spectrum emissions | Occupied bandwidth |  |
| SEM |  |
| ACLR |  |
| Spurious emissions |  |
| Transmit intermodulation |  |

**Agreement in RAN4#112:**

* Requirements needed:
	+ Transmit OFF power for device 2b
	+ Power control requirement for device 2b
	+ ON/OFF time mask for device 2b
	+ Frequency error for device 2b
	+ In band emissions (IBE) for device 2b
	+ Carrier leakage for device 2b
	+ SEM
	+ ACLR
	+ Spurious emissions
	+ Unwanted emissions
* FFS whether requirements are needed or not:
	+ Maximum output power
	+ EVM
	+ Transmit OFF power for device 1/2a
	+ Transmit time mask
	+ Minimum output power
	+ Frequency error for device 2a
	+ In band emissions (IBE) for device 2a
	+ Carrier leakage for device 2a
	+ Occupied bandwidth
	+ Transmit intermodulation
* Requirements not needed:
	+ Power control requirement for device 1/2a
	+ ON/OFF time mask for device 1/2a
	+ Frequency error for device 1
	+ In band emissions (IBE) for device 1
	+ Carrier leakage for device 1

### Issue 3-4: RX(R2D)

Agreement in RAN4#111:

* Use the following table as starting point for RF requirements impact study. The table is for information.
	+ Encourage companies to provide views on RF requirements impact for different device types.

|  |
| --- |
| **RF Requirement for A-IoT device- RX part** |
| RX requirement | Reference sensitivity |  |
| Maximum input power |  |
| ACS |  |
| ASCS |  |
| In-band blocking |  |
| Out-of-band blocking |  |
| Receiver intermodulation |  |
| Rx spurious emission |  |

**Agreement in RAN4#112:**

* Requirements needed:
	+ Reference sensitivity
	+ Maximum input power
* FFS whether requirements are needed or not:
	+ Receiver intermodulation
	+ Rx spurious emission
	+ ACS
	+ ACSC
	+ In-band blocking
	+ Out-of-band blocking
* Requirements not needed:
	+ Spurious response

### Issue 3-5: testability

Agreement: in RAN4#111:

* FFS on whether conducted conformance test is feasible for AIOT devices.
* FFS on OTA test method, performance metric, etc.

**Agreement in RAN4#112:**

* Take OTA test as the baseline for at least Devices 1 and 2a

# Topic #4: Intermediate node (iUE)

### Issue 4-2: TX

Agreement:

* Use the following table as starting point for RF requirements impact study. The table is for information.

|  |
| --- |
| **RF Requirement for A-IoT intermediate UE- TX part** |
| TX requirement | Maximum output power  |  |
| Output power dynamics |  |
| Transmit ON/OFF power |  |
| Transmitted signal quality |  |
| Transmission times |  |
| Occupied bandwidth |  |
| Tx intermodulation |  |
| ACLR |  |
| Operating band unwanted emissions  |  |
| Transmitter spurious emissions |  |

**Agreement in RAN4#112:**

* Requirements needed:
	+ Maximum output power
	+ Transmitted signal quality (Frequency error, EVM)
	+ Occupied bandwidth
	+ Spectrum emission mask
	+ Transmitter
	+ Intermodulation
	+ ACLR
	+ Operating band unwanted emissions
	+ Transmitter spurious emissions
* FFS whether requirements are needed or not:
	+ Output power dynamics
	+ Transmit ON/OFF power
	+ Transmit ON/OFF time mask
	+ IBE
* Requirements not needed:
	+ Transmission times

### Issue 4-3: RX

Agreement:

* Use the following table as starting point for RF requirements impact study. The table is for information.

|  |
| --- |
| **RF Requirement for A-IoT intermediate UE- RX part** |
| RX requirement | Reference sensitivity |  |
| Maximum input power |  |
| ICS |  |
| ACS |  |
| In-band blocking |  |
| Out-of-band blocking |  |
| Receiver intermodulation |  |
| Rx spurious emission |  |

**Agreement in RAN4#112:**

* Requirements needed:
	+ Reference sensitivity power level
	+ Maximum input power
	+ Receiver intermodulation
* FFS whether requirements are needed or not:
	+ ACS
	+ In-band blocking
	+ Out-of-band blocking
	+ Narrow band blocking
	+ Receiver spurious response
	+ Rx spurious emission
	+ Requirements not needed:
	+ ICS

### Issue 4-4: CW for D2T2

Agreement in RAN4#111:

* To further investigate output power, emission requirements for CW node
	+ FFS for other requirements.

**Agreement in RAN4#112:**

* Requirements needed:
	+ Output power
	+ RF spectrum emission
* FFS whether requirements are needed or not:
	+ Operation bands
	+ Channel bandwidth related requirements
	+ Channel arrangement related
	+ Transmit signal quality
* Requirements not needed:
	+ Output power dynamic range