**3GPP TSG-RAN WG4 Meeting #116 R4-25xxxxx**

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

**Agenda item:** 7.22.1

**Source:** Moderator (CMCC)

**Title:** WF on A-IoT device RF requirements and OTA test methods

**Document for:** Approval

1. System parameters

Topic 2-1: R2D bandwidth

**Issue 2-1-1: R2D transmission bandwidth**

**Agreement:**

Define asymmetric guard band as below

**Table : Minimum guardband (kHz)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **R2D CBW** | **200kHz** | **400kHz** | **600kHz** | **800kHz** |
| Minimum guardband(kHz) | 2.5 | 12.5 | 22.5 | 32.5 |

Topic 2-2: D2R bandwidth

**Issue 2-2-1: D2R bandwidth**

**Agreement:**

* Following equations will be captured as informative Annex in TS.

|  |
| --- |
| For BS D2R CBW:D2R CBW for BS (kHz)= ceiling ((2SB Transmission BW\_without SFO× (1/2) +2× Small frequency shift\_without SFO)/0.9)=ceiling ( (2+2R)/Tb × (1+∣SFO∣)/0.9)=ceiling ( (1+R)/ (Tc ×R) × (1+∣SFO∣)/0.9) (Eq. 4)The 0.9 divisor presents the 90% BS filter spectrum utility (10% guard band). |
| For device D2R CBW D2R CBW for device (kHz)=ceiling (2SB Transmission BW\_without SFO× (1/2) +2× Small frequency shift\_without SFO)=ceiling ( (2+2R)/Tb × (1+∣SFO∣))=ceiling ( (1+R)/ (Tc ×R) × (1+∣SFO∣)) (Eq. x) |

* + Capture the following channel bandwidth tables in TS:

|  |
| --- |
| **Device D2R channel bandwidth (kHz)**  |
| **Norminal D2R transmission** **Bandwidth without SFO(kHz)** | **Norminal Small frequency shift without SFO(kHz)** |
| **3.75**  | **7.5**  | **15**  | **30**  | **60** | **120**  | **240** | **480** | **720**  |
| **15** | 17 | 25 | 42 | 75 | 141 | 273 | 534 | 1065 |  |
| **30** | 　 | 33 | 50 | 83 | 149 | 281 | 545 | 1073 |  |
| **60** | 　 | 　 | 66 | 99 | 165 | 297 | 561 | 1089 |  |
| **120** | 　 | 　 |  | *132* | *198* | *330* | *594* | *1122* |  |
| **240** | 　 | 　 | 　 |  | *264* | *396* | *660* | *1188* |  |
| **480** | 　 | 　 | 　 | 　 |  | *528* | *792* | *1320* |  |
| **960** | 　 | 　 | 　 | 　 | 　 |  | *1056* | *1584* |  |
| **2880** | 　 | 　 | 　 | 　 | 　 | 　 | 　 |  | *3168* |

|  |
| --- |
| **BS D2R channel bandwidth (kHz)**  |
| **Norminal D2R transmission** **Bandwidth without SFO (kHz)** | **Norminal Small frequency shift without SFO(kHz)** |
| **3.75**  | **7.5**  | **15**  | **30**  | **60** | **120**  | **240** | **480** | **720**  |
| **15** | 19 | 28 | 46 | 83 | 156 | 303 | 596 | 1183 |  |
| **30** | 　 | 37 | 55 | 92 | 165 | 312 | 605 | 1192 |  |
| **60** | 　 | 　 | 74 | 110 | 184 | 330 | 624 | 1210 |  |
| **120** | 　 | 　 |  | 147 | 220 | 367 | 660 | 1247 |  |
| **240** | 　 | 　 | 　 |  | 294 | 440 | 734 | 1320 |  |
| **480** | 　 | 　 | 　 | 　 |  | 587 | 880 | 1467 |  |
| **960** | 　 | 　 | 　 | 　 | 　 |  | 1174 | 1760 |  |
| **2880** | 　 | 　 | 　 | 　 | 　 | 　 | 　 |  | 3520 |

Topic 2-3: Channel raster

**Issue 2-3-1: R2D channel raster**

**Agreement:**

* Define 10kHz channel raster for both D2R and R2D.
	+ Note: channel raster for D2R will only be captured into BS spec 38.194
* No channel raster offset

Topic 2-4: Others

**Issue 2-4-1: whether channel spacing is needed or not**

**Agreement:**

* No channel spacing.

**Issue 2-4-2: maximum number of devices allowed to communicate simultaneously with one A-IoT BS**

**Agreement:**

* No discussion is needed.
1. Device RF requirements

Topic 3-1: Transmit output power

**Issue 3-1-1: Transmit output power**

**Agreement:**

* Define requirements only at the peak antenna gain direction.
	+ When input CW level is -27dBm, the backscatter loss<=10dB for OOK and <=6dB for BPSK
	+ When input CW level is-10dBm, the backscatter power is larger than -25dBm for OOK, and -21dBm for BPSK respectively.

Topic 3-2: Modulation quality

**Issue 3-2-1: SFO requirement**

**Agreement:**

No explicitly define SFO requirement in RF spec. Define D2R CBW bandwidth calculation equations in Annex.

Topic 3-3: Emission requirements

**Issue 3-3-1: SEM requirements**

**Agreement:**

Define flat SEM requirements, i.e. 10dBc, The RBW is 1SB

* + The carrier power includes the two sidebands centred at +/-SFS, but excludes the spectrum around the carrier frequency.

**Issue 3-3-1: spurious emission requirements**

**Agreement:**

**Table 3: Requirement for general spurious emissions limits**

|  |  |  |  |
| --- | --- | --- | --- |
| **Frequency Range** | **Maximum Level** | **Measurement bandwidth** | **NOTE** |
| 30 MHz ≤ f < 1000 MHz | -36 dBm | 100 kHz |  |
| 1 GHz ≤ f < 5 GHz | -30 dBm | 1 MHz |  |
| 5 GHz ≤ f < 12.75 GHz | -30 dBm | 1 MHz | 1 |
| NOTE 1: Applies for Band for which the upper frequency edge of the UL Band is greater than 1 GHz and less than or equal to 2.55 GHz. |

* OOB boundary:
	+ For CBW<1.4 MHz: max of 500kHz and 10 times NB where NB equals to D2R CBW
		- For CBW>=1.4 MHz: 7.5MHz assuming 3M CBW
* For testing:
	+ Only using limited DSB and SFS combination for testing with -5 dBm CW input power.
		- SFS = 480kHz with 15kHz, 2SB transmission bandwidth need to be tested

Topic 3-4: Reference sensitivity

**Issue 3-4-1: Reference sensitivity**

**Agreement:**

* EIS at peak antenna gain direction is -34dBm. Additional peak EIS levels can be added in the future if needed
* EIS spherical coverage requirement is defined as sensitivity over partial sphere, i.e. XdBm at Y solid angle range partial sphere . Y is suggested to be +-45 degree with respect to the bore sight direction (or UE declared direction), X is suggested to be 5.5dB worse than peak EIS.
	+ For testing
		- 90% success rate.
		- Use CFRA for REFSENS test procedure
		- Allow set time + SFO for the device response time.
		- Leave number of repeats to reach 90% success rate for the RAN5 to determine.
		- Further discuss if false alarm test can be considered in demod.
* FRC is listed as below (note: it does not mean UE should be tested for all specified FRC)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | SCS | 15 | 15 | 15 | 15 |
|  | PRB | 1 | 2 | 3 | 4 |
| SIP | Bit length | 8 | 8 | 8 | 8 |
|  | M\_SIP | 4 | 4 | 4 | 4 |
|  | OOK |  |  |  |  |
|  | OFDM | 2 | 2 | 2 | 2 |
| CAP | Bit length | 4 | 4 | 4 | 4 |
|  | M | 2 | 2 | 2 | 2 |
|  | OOK |  |  |  |  |
|  | OFDM | 2  | 2  | 2  | 2  |
| PRDCH | TBS | Depending on the size of the MAC PDU of A-IoT paging message indicating CFA |
|  | CRC | 16 | 16 | 16 | 16 |
|  | Line encoding |  |  |  |  |
|  | OOK |  |  |  |  |
|  | M | 6 | 6 | 6 | 6 |
| postamble | Bit length | 4 | 4 | 4 | 4 |
|  | M | 6 | 12 | 2 | 2 |
| chip number except for SIP, padding |  | 228 | 228 | 228 | 228 |
| Padding |  | 6 | 12 | 2 | 2 |

Topic 3-5: Others

**Issue 3-5-1: Maximum input power**

**Agreement:**

Max input level is 30dB higher than peak EIS, detailed value is based on conclusion of min sensitivity.

1. OTA

**Performance metric**

**Agreement:**

* Performance metric of Tx requirements:

$$EIRP\left(θ,ϕ\right)=EIRP\_{θ}\left(θ,ϕ\right)|\_{cw\_{θ}\left(θ,ϕ\right)}+EIRP\_{ϕ}\left(θ,ϕ\right)|\_{cw\_{θ}\left(θ,ϕ\right)}+EIRP\_{θ}\left(θ,ϕ\right)|\_{cw\_{ϕ}\left(θ,ϕ\right)}+EIRP\_{ϕ}\left(θ,ϕ\right)|\_{cw\_{ϕ}\left(θ,ϕ\right)}$$

* + Where $EIRP\_{θ}$ and $EIRP\_{ϕ}$ are the EIRP in the corresponding θ and ϕ polarizations, $CW\_{θ}$ and $CW\_{ϕ}$ are the incident CW in the corresponding θ and ϕ polarizations,
	+ For backscatter power measurement, the EIRP only contains the power of 1st sidebands within D2R channel bandwidth and excludes power of CW.
* Performance metric of Rx requirements

$$EIS\left(θ,ϕ\right)=\frac{1}{(\frac{1}{EIS\_{θ}\left(θ,ϕ\right)}+\frac{1}{EIS\_{ϕ}\left(θ,ϕ\right)})}$$

* + Where EISθ and EISϕ are the EIS in the corresponding θ and ϕ polarizations.
	+ The EIS partial sphere coverage metric is defined as the maximum R2D EIS radiated in the Theta and Phi range from partial surface within ±45° angular width degrees.



Visualization of Partial sphere within ±45° angular range

**Device positioning guidelines**

**Agreement:**

|  |  |  |
| --- | --- | --- |
| **Test condition** | **DUTorientation** | **Diagram** |
| Free spaceDUT | α = 0º;β = -90º;γ = 0º |  |