**3GPP TSG RAN Meeting #104**  **RP-24XXXX**

**Shanghai, China, June 17-20, 2024**

## Status Report to TSG

**Agenda item:** 9.2.2

|  |  |
| --- | --- |
| **WI / SI Name** | New SID: Study on solutions for Ambient IoT (Internet of Things) in NR |
| included in this status report | Study Item: Yes | Core part: | Performance part: | Testing part: |
| **Acronym** | FS\_Ambient\_IoT\_solutions |
| **Unique ID** | 1020085 |
| **TSG Tdoc of latest approved WI/SI description (if any)** | RP-234058 |
| **Target Completion Date****(indicate if changed)** | Study Item: 12/2024(No change) | Core part:  | Performance part:  | Testing part:  |
| **Overall** **Completion level** | Study Item: 40 % | Core part:  | Performance Part:  | Testing part:  |

Note: Overall completion level percentage numbers should use one of the colors below:

* xx%: Normal progress, no RAN plenary action needed
* xx%: Progress behind schedule, may need RAN plenary intervention. If so, SR should clearly define requested action
* xx%: Progress critically behind, RAN plenary shall intervene. SR should define requested action

**Source:**

|  |  |
| --- | --- |
| **Leading WG** | RAN1 |
| **Rapporteur** | **Name** | Xiaodong Shen |
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## 1 Work plan related evaluation

|  |  |
| --- | --- |
| **Do you want to modify the time budget for this WI/SI compared to what was endorsed at the last RAN meeting?** | No |

*If you answered No: Then please remove the Excel file from the zip file of this status report.*

*If you answered Yes: Then please fill out the attached Excel template to request a modification of the time budgets for your WI /SI. The Excel table has to be filled out for all affected RAN WGs and up to the target date of the WI/SI. The basis are the endorsed time budgets of the last RAN meeting. Please highlight all changes of the values.
 One time unit (TU) corresponds to ~ 2 hours in the meeting.
 If this status report covers a WI with Core and Performance part, then please have one line for each in the attached Excel table.
 Note: If no Excel table is attached, then this means no time budget change.*

**Additional explanations/motivations for the time budget changes in the attached Excel table:**

## 2. Detailed progress in RAN WGs since last TSG meeting (for all involved WGs)

 NOTE: Agreements and Open issues impacted cross-TSG aspects shall be explicitly highlighted

## 2.1 RAN1

#### 2.1.1 Agreements

Agreement

The Skeleton for TR 38.769 in R1-2401795 is endorsed.

##### 2.1.1.1 Evaluation assumptions and results

**RAN1#116bis**

Agreement

For R2D link in the coverage evaluation, for device 1

* *Budget-Alt1* is used (note: receiver architecture is RF ED)

For D2R link in the coverage evaluation,

* *Budget-Alt2* is used.

Agreement

The following scenarios are defined,

* FFS: which of these scenarios will be evaluated.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Scenario** | **CW Inside/outside topology** | **Diagram of the scenario** | **Description of the scenario** | **Device 1/2a/2b**  | **CW spectrum** | **D2R spectrum** | **R2D spectrum** |
| **D1T1-A1** | CW inside topology | 形状  中度可信度描述已自动生成 | * CW node inside topology 1
* ‘CW’ in CW2D and ‘R2’ in D2R are different
* ‘CW’ in CW2D and ‘R1’ in R2D are same
* ‘R1’ in R2D and ‘R2’ in D2R are different
 | Device 1, 2a | Case 1-1 (inside topology, DL)Case 1-2 (inside topology, UL) | Same as CW |  |
| **D1T1-A2** | A black background with a black square  Description automatically generated with medium confidence | * CW node inside topology 1
* same ‘CW’ and ‘R’ node for CW2D, D2R and R2D
 | Same as D1T1-A1 | Same as CW |  |
| **D1T1-B** | CW outside topology | A black background with a black square  Description automatically generated with medium confidence | * CW node outside topology 1
* ‘CW’ in CW2D and ‘R’ in D2R are different
* ‘CW’ in CW2D and ‘R’ in R2D are different
* ‘R’ in R2D and ‘R’ in D2R are same
 | Case 1-4 (outside topology, UL) | Same as CW |  |
| **D1T1-C** | No CW | 形状  中度可信度描述已自动生成 | * No CW Node.
 | Device 2b | N/A | UL |  |
| **D2T2-A1** | CW inside topology | A black background with a black square  Description automatically generated with medium confidence | * CW node inside topology 2
* ‘CW’ in CW2D and ‘R2’ in D2R are different
* ‘CW’ in CW2D and ‘R1’ in R2D are same
* ‘R1’ in R2D and ‘R2’ in D2R are different
* BS communicates with R1 and R2
 | Device 1, 2a | Case 2-2 (inside topology, UL) | Same as CW |  |
| **D2T2-A2** | A black background with a black square  Description automatically generated with medium confidence | * CW node inside topology 2
* same ‘CW’ and ‘R’ node for CW2D, D2R and R2D
* BS communicates with R
 | Same as D2T2-A1 | Same as CW |  |
| **D2T2-B** | CW outside topology | A black background with a black square  Description automatically generated with medium confidence | * CW node outside topology 2
* ‘CW’ in CW2D and ‘R’ in D2R are different
* ‘CW’ in CW2D and ‘R’ in R2D are different
* ‘R’ in R2D and ‘R’ in D2R are same
* BS communicates with R
 | Case 2-3 (outside topology, DL)Case 2-4 (outside topology, UL) | Same as CW |  |
| **D2T2-C** | No CW | 形状  中度可信度描述已自动生成 | * No CW Node.
* BS communicates with R
 | Device 2b | N/A | FFS |  |
| Note: this table is for the case where D2R is in the same spectrum as CW2D. |

Agreement

For D1T1,

* InF-DH NLOS model defined in TR38.901 is used for D2R and R2D links as pathloss model in coverage evaluation.

For D2T2,

* InF-DL and InH-Office model defined in TR38.901is used as pathloss model in coverage evaluation,
	+ NLOS for D2R and R2D links if InF-DL is used
	+ LOS for D2R and R2D links if InH-Office is used

Agreement

The following layout is used for evaluation purpose,

* FFS: CW distribution for D1T1-B and D2T2-B

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Assumptions for D1T1** | **Assumptions for D2T2** |
| Scenario | InF-DH | InH-office | InF-DL |
| Hall size | 120x60 m | 120 x50 m | 300x150 m |
| Room height | 10 m | 3m | 10 m |
| Sectorization | None |
| BS deployment / Intermediate UE dropping | 18 BSs on a square lattice with spacing D, located D/2 from the walls.* L=120m x W=60m; D=20m
* BS height = 8 m

A black dots on a white background  Description automatically generated | * L=120m x W=50m;
* Intermediate UE height = 1.5 m

FFS: Intermediate UE dropping | * L=300m x W=150m;
* Intermediate UE height = 1.5 m

FFS: Intermediate UE dropping |
| Device distribution  | Device Height= 1.5 mAIoT devices drop uniformly distributed over the horizontal area | Device Height= 1.5 mAIoT devices drop uniformly distributed over the horizontal areaFFS: which devices are involved in the evaluations | Device Height= 1.5mAIoT devices drop uniformly distributed over the horizontal areaFFS: which devices are involved in the evaluations |
| Device mobility (horizontal plane only) | 3 kph | 3 kph | 3 kph |

Agreement

In the link level simulation, considering the following channel model,

* For D1T1, TDL-A channel model is used for R2D link and for D2R link for InF-DH scenario.
* For D2T2,
	+ TDL-A channel model is used for R2D link and for D2R link if InF scenario is considered
	+ TDL-D channel model is used for R2D link and for D2R link if InH-Office scenario is considered
* FFS delay spread for each case.

Agreement

For coverage evaluation, subject to further discussion on which scenarios to evaluate,

* In the case of CW inside topology with ’A2’ scenarios
	+ The digital baseband processing of CW self-interference handling is not modelled in link level simulation (LLS). It is included in the link budget analysis by reporting the CW cancellation capability value.
* FFS: In the case of CW outside topology with ‘B’ scenarios or CW inside topology with ’A1’ scenarios

Agreement

The maximum distance targets are set separately for device 1, device 2a, device 2b, respectively

* FFS detailed values and RAN1 can further decide the target within in the range of 10m to 50m after link budget study.
* FFS whether to set different values for different scenarios

Agreement

The table below is agreed (except for the yellow part)

|  |  |  |  |
| --- | --- | --- | --- |
| **No.** | **Item** | **Reader-to-Device** | **Device-to-Reader** |
| **(0) System configuration** |
| [0A] | Scenarios | D1T1-A1/A2/B/CD2T2-A1/A2/B/C | D1T1-A1/A2/B/CD2T2-A1/A2/B/C |
| [0A1] | CW case | N/A | 1-1/1-2/1-4/2-2/2-3/2-4 |
| [0B] | Device 1/2a/2b | Device 1/2a/2b | Device 1/2a/2b |
| [0C] | Center frequency (MHz) | 900MHz (M), 2GHz (O) | 900MHz (M), 2GHz (O) |
| **(1) Transmitter** |
| [1D] | Number of Tx antenna elements / TxRU/ Tx chains modelled in LLS | For BS:- 2(M) or 4(O) antenna elements for 0.9 GHzFor Intermediate UE:- 1(M) or 2(O)  |  1 |
| [1E] | Total Tx Power (dBm)  | * For BS in DL spectrum for indoor
	+ 33dBm(M), FFS: 38dBm(O), one smaller value [FFS: 23 or 26] dBm(M)
	+ FFS: additional constraints on PSD
* FFS: For UE in DL spectrum for indoor
* For UL spectrum for indoor,
	+ 23dBm (M)
	+ FFS: 26dBm(O)

Other valuesare NOT precluded subject to future discussion. | * For device 1/2a:
	+ D2R-CWRxPower-Alt1:
		- Company to report CW Tx/Rx power together with CW2D distance (see [1E1]~[1E5])
	+ D2R-CWRxPower-Alt2:
		- Balanced MPL/distance (see [1E1]~[1E5], ~~and subject to [1E3] = = [4B])~~
* For device 2b:
	+ D2R-dev2bTxPower-Alt1: -10 dBm(O)
	+ D2R-dev2bTxPower-Alt2: -20 dBm(M)

Other values are NOT precluded subject to future discussion. |
| [1E1] | CW Tx power (dBm) | N/A | * 23dBm for UL spectrum, FFS 26dBm
* 33dBm(M), 38dBm (O) for DL spectrum

Note: only applicable for device 1/2a |
| [1E2] | CW Tx antenna gain (dBi) | N/A | * Company to report, the value equals to
	+ UE Tx ant gain, or
	+ BS Tx ant gain

Note: only applicable for device 1/2a |
| [1E3] | CW2D distance (m) | N/A | * For D2R-CWRxPower-Alt1:
	+ [Company to report]
* For D2R-CWRxPower-Alt2:
	+ Calculated

Note: only applicable for device 1/2a |
| [1E4] | CW2D pathloss (dB) | N/A | CalculatedNote: only applicable for device 1/2a |
| [1E5] | CW received power (dBm) | N/A | CalculatedNote: only applicable for device 1/2a |
| [1F] | Transmission Bandwidth used for the evaluated channel (Hz) | 180k(M), 360k(O), 1.08MHz(O) | UL data rate: xx bpsFFS: data rate for each case |
| [1G] | Tx antenna gain (dBi) | * For BS for indoor, 6 dBi(M), 2dBi(M)
* For intermediate UE, 0 dBi
 | * For A-IoT device, 0dBi (M), -3dBi (O)
 |
| [1H] | Ambient IoT backscatter loss (dB)Note: due to, e.g., * impedance mismatch
* Modulation factor
 | N/A | * OOK: Y dB
* PSK: X dB

Note: Only for device 1FFS: for device 2a |
| [1J] | FFS: Ambient IoT on-object antenna penalty | * 0.9dB or 10.4
 | * 0.9dB or 10.4
 |
| [1K] | Ambient IoT backscatter amplifier gain (dB) | N/A | * 10 dB (M)
* 15 dB (O)

Note: Only for device 2a |
| [1N] | FFS: Cable, connector, combiner, body losses, etc. (dB) | FFS | N/A |
| [1M] | EIRP (dBm) | CalculatedFFS: any limitation of the EIRP subject to future discussion | Calculated |
| **(2) Receiver** |
| [2A] | Number of receive antenna elements / TxRU / chains modelled in LLS | Same as [1D]-D2R | Same as [1D]-R2D |
| [2B] | Bandwidth used for the evaluated channel (Hz) | FFS: relation with the transmission bandwidth used for the evaluated channel | * FFS: whether the values are single side-band or double side-band
* Note: The value is used for calculating the noise power

FFS: relation with the transmission bandwidth used for the evaluated channel |
| [2B1] | FFS: RF CBW (Hz) | FFS:* 10MHz
* 20MHz
* Other values

Note: The value is used for calculating the noise power  | N/A |
| [2C] | Receiver antenna gain (dBi) | same as [1G]-D2R | Same as [1G]-R2D |
| [2X] | FFS: Cable, connector, combiner, body losses, etc. (dB) | N/A | FFS |
| [2D] | Receiver Noise Figure (dB) | FFS: 20dB or 24dB or 30dB for *Budget-Alt2*FFS: different values for device architecture | For BS as reader* 5dB

For UE as reader* 7dB
 |
| [2E] | Thermal Noise power spectrum density (dBm/Hz) | -174 | -174 |
| [2F] | Noise Power (dBm) | Calculated | Calculated |
| [2G] | Required SNR | Reported by company | Reported by company |
| [2H] | FFS: Ambient IoT on-object antenna penalty | * 0.9dB or 10.4
 | * 0.9dB or 10.4
 |
| [2J] | Budget-Alt1/ Budget-Alt2 | For R2D link in the coverage evaluation, for device 1* *Budget-Alt1* is used (note: receiver architecture is RF ED)

FFS: device 2 | Budget-Alt2 |
| [2K] | CW cancellation (dB) | N/A | For [monostatic backscatter], FFS* [140dB for BS]
* [120dB for UE]

For [bistatic backscatter]* Assuming CW has no impact to the receiver sensitivity loss.
 |
| [2K1] | Remaining CW interference (dB) | N/A | Calculated |
| [2K2] | Receiver sensitivity loss(dB) | N/A | Calculated |
| [2L] | Receiver Sensitivity (dBm) | For Budget-Alt1, * For device 1 (RF-ED),
	+ FFS:{-30dBm ~ -36dBm}
* For device 2 if RF-ED is used
	+ FFS
* For device 2 if RF-ED is not used
	+ N/A

For Budget-Alt2, * Calculated
 | CalculatedNote: the receiver sensitivity includes the receiver sensitivity loss [2K2], i.e. after CW cancellation at least if ‘A2’ scenario is used |
| **(3) System margins** |
| [3A] | Shadow fading margin (function of the cell area reliability and lognormal shadow fading std deviation) (dB) | TBD | TBD |
| [3B] | polarization mismatching loss (dB) | 3 dB | 3 dB |
| [3C] | BS selection/macro-diversity gain (dB) | 0 dB FFS: other values are not precluded | 0 dBFFS: other values are not precluded |
| [3D] | Other gains (dB) (if any please specify) | Reported by companies with justification | Reported by companies with justification |
| **(4) MPL / distance** |
| 4A | MPL (dB) | Calculated | Calculated |
| 4B | Distance (m) | Calculated | Calculated |

*<Editor Notes: Note 1 will be updated once the table has stabilized >*

Note1: calculated values in the Table XXXX are derived according to the followings,

* 1E
	+ For D2R, and device 1/2(backscatter), whether this value is need (not regarded as an input variable but regarded as indirect variable), or based on backscatter activation power threshold
* 1M
	+ For R2D,
	+ For D2R,
		- Device 1:
		- Device 2a:
		- Device 2b:
* 2F:
* 2L
	+ For R2D and Budget-Alt1, [2L] = [2H]
	+ For R2D and Budget-Alt2, [2L] = [2G]+[2F]
	+ For D2R and Budget-Alt2, Refer to section [xxx] (Proposal [P4-3])
* 4A
* 4B is derived from pathloss model
	+ Refer to section [XXX] (Proposal [P4-3-2])

Note2: (M) denotes the value is mandatory to be evaluated. (O) denotes the value can be optionally evaluated.

Agreement

For coverage evaluation purpose,

* For scenarios ‘A1’ and ‘A2’,
	+ The Device Tx Power is calculated by assuming CW2D pathloss = D2R pathloss.
* For scenarios ‘B’,
	+ The Device Tx Power is calculated by CW received power which can be derived by at least CW2D distance (m) value.
		- FFS: CW2D distance (m) value(s)

[**R1-2403769**](file:///C%3A%5CUsers%5Czhang%5CDocuments%5CWeChat%20Files%5Cwxid_6027540262111%5CFileStorage%5CFile%5CDocs%5CR1-2403769.zip) **[draft] LS on Ambient-IoT evaluation scenarios and assumptions CMCC, [RAN1]**

**Decision:** The draft LS in [R1-2403769](file:///C%3A%5CUsers%5Czhang%5CDocuments%5CWeChat%20Files%5Cwxid_6027540262111%5CFileStorage%5CFile%5CDocs%5CR1-2403769.zip) is endorsed with the following changes:

* For the last agreement copied in the LS, remove the green highlight in the second column and delete “note 1” with its yellow highlights.
* Revise the first sentence in the LS as follows:
	+ RAN1 has discussed and agreed the following aspects. RAN1 would like to clarify that parts highlighted in yellow are not yet agreed by RAN1.
* Revise the action to RAN4 as follows:
	+ RAN1 respectfully asks RAN4 to take the above information into account for coexistence studies and to provide a response if needed.

Final LS is approved in [R1-2403782](file:///C%3A%5CUsers%5Czhang%5CDocuments%5CWeChat%20Files%5Cwxid_6027540262111%5CFileStorage%5CFile%5CDocs%5CR1-2403782.zip). Note the above additional agreement reached on Friday is added in the LS compare to the endorsed draft LS in [R1-2403769](file:///C%3A%5CUsers%5Czhang%5CDocuments%5CWeChat%20Files%5Cwxid_6027540262111%5CFileStorage%5CFile%5CDocs%5CR1-2403769.zip).

[Post-116bis-AIoT] Email discussion on Ambient IoT evaluation assumptions from April 23 until April 26 – Xiaodong (CMCC)

* focus on proposals P3.7.1-v1, P3.5.8-v2, P3.2.1-(1)-v2 and P3.5.5-v1 in section 2 of [R1-2403768](file:///C%3A%5CUsers%5Czhang%5CDocuments%5CWeChat%20Files%5Cwxid_6027540262111%5CFileStorage%5CFile%5CDocs%5CR1-2403768.zip).

**Friday decision:** Focus on proposal P3.2.4-v1 in section 2 of [R1-2403768](file:///C%3A%5CUsers%5Czhang%5CDocuments%5CWeChat%20Files%5Cwxid_6027540262111%5CFileStorage%5CFile%5CDocs%5CR1-2403768.zip) is added to the post email discussion.

Proposal#5 (V05r1)

For the R2D LLS for ED, ~~the following is considered as start point,~~ report followings (as start point).

* CINR/CNR~~in LLS~~, where CINR/CNR is defined as the ratio of signal power spectral density in the transmission bandwidth to the noise and~~/or~~ interference (if any) power spectral density in the device ED channel bandwidth.
* signal transmission bandwidth
* ED channel bandwidth

FFS: exact definition of ED channel bandwidth for RF-ED, IF, ~~ZIF~~ receiver

FFS: which and how to report for R2D ZIF receiver and D2R

Proposal#2 (V05r1)

The following table of coverage evaluation assumptions in link level simulation is considered as start point.

-  Other values/options are not precluded and subject to future discussion.

 Table: Coverage evaluation assumptions

|  |  |
| --- | --- |
| **Parameters** | **Assumptions** |
| **R2D/D2R common parameters** |
| Carrier frequency | Refer to link budget template |
| SCS | 15 kHz as baseline |
| Block structure | ~~Preamble + payload + CRC,~~ ~~to be reported by companies~~Blocks as agreed in 9.4.2.3, or other blocks reported by companies |
| Channel model | *<Editor’s Note: ~~Refer to Proposals in section 3.5.3~~will be updated according to the agreements made for channel model>* |
| Delay spread | [30, 150] ns  |
| Device velocity | 3 km/h |
| Number of Tx/Rx chains for Ambient IoT device | 1 |
| BS | Number of antenna elements | ~~[2 or 4]~~2 or 4 |
| Number of TXRUs | ~~[2 or 4]~~2 or 4 |
| Intermediate UE | Number of antenna elements | ~~[1 or 2]~~ 1 or 2 |
| Number of TXRUs | ~~[1 or 2]~~ 1 or 2 |
| Reference data rate | [0.1, 1, 5] kbps |
| Message size | * D2R:
	+ [FFS: 16, 96, 400 bits]
* R2D:
	+ [FFS: 16, 32, 64, 400bits]
 |
| BLER target | 1%, 10% |
| Sampling frequency | *<Editor’s Note:~~Refer to Proposals in section 3.5.3~~will be updated according to the agreements made for ~~channel model~~* *Sampling frequency >* |
| Device 1/2a/2b | Options are as follows,-          Device 1, RF-ED-          Device 2a, RF-ED-          Device 2b, RF-ED/IF-ED/ZIF*<Editor’s Note: will be updated according to agreements from 9.4.1.2>* |
| **R2D specific parameters** |
| Transmission bandwidth | 180 kHz as baseline |
| FFS: ~~RF-~~ED bandwidth | [X MHz] |
| FFS: BB LPF | [X]-order Butterworth filter with cutoff frequency at [Y] kHz |
| Waveform | OOK waveform generated by OFDM modulator |
| Modulation | OOKCompanies to report, e.g., OOK-1, OOK-4 with M chips per OFDM symbol |
| Line code | Companies to report, e.g., Manchester, PIE |
| FEC | No FEC as baseline |
| ADC bit width | 1-bit for device 14-bit for device 2 |
| Detection/decoding method for Line code | Companies to report |
| **D2R specific parameters** |
| Transmission bandwidth(w.r.t. D2R data rate) | ~~15 kHz as baseline~~~~For Device 1 and 2a, 15 kHz as baseline~~~~For Device 2b, [180] kHz as baseline~~[FFS: 15kHz, 180kHz] |
| Waveform (CW) | Companies to report waveform, e.g., unmodulated single tone, multi-tone(multiple unmodulated single tone) |
| Modulation | Companies to report modulation, e.g., OOK, BPSK, BFSK |
| Line code | Companies to report, e.g., Manchester encoding, FM0 encoding, Miller encoding, no line coding |
| FEC | Companies to report, e.g., CC, No FEC |
| ADC bit width | Companies to report, e.g., 11-bit |
| D2R receiver  | FFS: Reader receiver, e.g., coherent receiver / non-coherent receiver |
| **Other assumptions** |
| Other assumptions | To be reported by company |
| Note:  -           Companies to report required SINR according to BLER target. |

**RAN1#117**

Agreement

In the link level simulation, coherent and non-coherent receiver can be evaluated for D2R receiver.

Agreement

For CW2D pathloss model applied to the D1T1-A1/A2/B and D2T2-A1/A2/B scenarios, using the same pathloss model defined in TR38.901 as used for R2D/D2R.

Agreement

Add Row [0D] in the link budget table as follows,

|  |  |  |  |
| --- | --- | --- | --- |
| **No.** | **Item** | **Reader-to-Device** | **Device-to-Reader** |
| [0D] | Topology/Pathloss model | For D2T2:[0D]-Alt1: InF-DL NLOS [0D]-Alt2: InH-Office LOSFor D1T1:[0D] InF-DH NLOS | For D2T2:[0D]-Alt1: InF-DL NLOS [0D]-Alt2: InH-Office LOSFor D1T1:[0D] InF-DH NLOS |

Agreement

Update the link budget table Row [0C] as follows,

|  |  |  |  |
| --- | --- | --- | --- |
| **No.** | **Item** | **Reader-to-Device** | **Device-to-Reader** |
| [0C] | Center frequency (MHz) | [0C]-Alt1: 900MHz (M), [0C]-Alt2: 2GHz (O) | [0C]-Alt1: 900MHz (M), [0C]-Alt2: 2GHz (O) |

Agreement

* For R2D link in the coverage evaluation for device 2,
	+ *Budget-Alt2* is used if receiver architecture is IF/ZIF ED is used

Agreement

Update the link budget table Row [1G] as follows,

|  |  |  |  |
| --- | --- | --- | --- |
| **No.** | **Item** | **Reader-to-Device** | **Device-to-Reader** |
| [1G] | Tx antenna gain (dBi) | * For BS for indoor, 6 dBi(M), 2dBi(M)
* For intermediate UE, 0 dBi
 | For A-IoT device, 0dBi ~~(M), -3dBi (O)~~ |

Agreement

For the link level simulation,

* An RMS delay spread of 30 ns and [150] ns is considered for TDL-A channel model.
* An RMS delay spread of 30 ns is considered for TDL-D channel model.

Agreement

For the link level simulation in coverage evaluation, {20 bits, 96 bits, 400 bits} are considered for message size.

* Note: companies to report the M value and chip length used for each message size

Agreement

For coverage evaluation,

* In the case of CW outside topology with ‘B’ scenarios or CW inside topology with ’A1’ scenarios
	+ The digital baseband processing of CW interference handling is not modelled in link level simulation (LLS). It is included in the link budget analysis by reporting the CW cancellation capability value(s) ([2K] in link budget table).
	+ Note1: ’A2’ scenarios have already been agreed.
	+ Note2: The study of CW interference cancellation capability value(s) at D2R receiver to be discussed in 9.4.2.4 for all scenarios (and if necessary ask RAN4 about the feasibility)
	+ Note3: which scenarios to be evaluated is subject to other discussion.

Agreement

* For R2D link in the coverage evaluation for device 2,
	+ *Budget-Alt1* is used if receiver architecture is RF ED
	+ *Budget-Alt2* is used if receiver architecture is IF/ZIF ED
* Note1: this does not preclude to have LLS for device 1 and 2 R2D link with RF-ED if needed.
* Note1b: For device 2 R2D link with RF-ED, *Budget-Alt1* is mandatory, *Budget-Alt2* is optional.
* Note2: this does not imply all M values are achievable with the sensitivity given by *Budget-Alt1* for RF ED
* Note3: For device 2 with an RF ED-based receiver on the R2D link, if the receiver sensitivity derived from *Budget-Alt2*, assuming a noise figure of [X dB], exceeds the receiver sensitivity based on *Budget-Alt1*, then *Budget-Alt2* is applied.

Agreement

Update the link budget table Row [3A] as follows,

|  |  |  |  |
| --- | --- | --- | --- |
| **No.** | **Item** | **Reader-to-Device** | **Device-to-Reader** |
| [3A] | Shadow fading margin (dB) | For D1T1: 4 dBFor D2T2: 3dB for InH-LOS7.2dB for InF-DL-NLOS | For D1T1: 4 dBFor D2T2: 3dB for InH-LOS7.2dB for InF-DL-NLOS |

Agreement

Update the ED bandwidth parameter in link level simulation table as follows:

|  |
| --- |
| R2D specific parameters |
| ED bandwidth | The ED bandwidth is the bandwidth for calculating the noise/interference (if any) power:For evaluations, the value(s) of ED bandwidth is 20 MHz for RF-ED, [180] kHz for IF/ZIF receiver. Note: this does not imply that a A-IoT device supports sampling clock rate as large as RF ED bandwidth. |

Working assumption:

* For the D2R LLS, the SINR/SNR is reported and it is defined as the ratio of signal power to noise and interference (if any) power in the receiver bandwidth.
* FFS: receiver bandwidth
* On/off keying backscatter loss is not taken into account in the LLS and is included in link budget table [1H].

Agreement

For R2D ZIF receiver, report the same metrics (i.e., CNR/CINR, signal transmission bandwidth, ED bandwidth) as agreed for RF-ED/IF receiver.

Agreement

The link budget table is updated as follows (the yellow parts are not agreed and will be discussed by email),

|  |  |  |  |
| --- | --- | --- | --- |
| **No.** | **Item** | **Reader-to-Device** | **Device-to-Reader** |
| **(0) System configuration** |
| [0A] | Scenarios | D1T1-A1/A2/B/CD2T2-A1/A2/B/C | D1T1-A1/A2/B/CD2T2-A1/A2/B/C |
| [0A1] | CW case | N/A | 1-1/1-2/1-4/2-2/2-3/2-4 |
| [0B] | Device 1/2a/2b | Device 1/2a/2b | Device 1/2a/2b |
| [0C] | Center frequency (MHz) | 900MHz (M), 2GHz (O) | 900MHz (M), 2GHz (O) |
| [0D] | Topology/Pathloss model | For D2T2:* [0D]-Alt1: InF-DL NLOS
* [0D]-Alt2: InH-Office LOS

For D1T1:* InF-DH NLOS
 | For D2T2:* [0D]-Alt1: InF-DL NLOS
* [0D]-Alt2: InH-Office LOS

For D1T1:* InF-DH NLOS
 |
| **(1) Transmitter** |
| [1D] | Number of Tx antenna elements / TxRU/ Tx chains modelled in LLS | For BS:- 2(M) or 4(O) antenna elements for 0.9 GHzFor Intermediate UE:- 1(M) or 2(O)  |  1 |
| [1E] | Total Tx Power (dBm)  | * For BS in DL spectrum for indoor
	+ [1E]-R2D-Alt1: 33dBm(M),
	+ [1E]-R2D-Alt2: 38dBm(O),
	+ [1E]-R2D-Alt3: 24dBm(M)
	+ Companies to report if PSD constraints are imposed (company to report the condition for applying PSD constraints in Row [5A]: Other notes)
* For UL spectrum for indoor,
	+ [1E]-R2D-Alt4:23dBm (M)
	+ [1E]-R2D-Alt5:26dBm(O)
 | * For device 1/2a:
	+ [1E]-D2R-Alt1: (For scenarios ‘B’)
		- The Device Tx Power is calculated by CW received power which can be derived by at least CW2D distance (m) value and other related factors.
	+ [1E]-D2R-Alt2: (For scenarios ‘A1’ and ‘A2’)
		- The Device Tx Power is calculated by assuming CW2D pathloss = D2R pathloss.
* For device 2b: (For scenarios ‘C’)
	+ [1E]-D2R-Alt3: -20 dBm(M)
	+ [1E]-D2R-Alt4: -10 dBm(O)
 |
| [1E1] | CW Tx power (dBm) | N/A | For scenario ‘A1’, ‘A2’ and ‘B’* Report a value from the candidate values [1E]-R2D-Alt1/[1E]-R2D-Alt2/[1E]-R2D-Alt3 from [1E]-R2D if CW in DL spectrum
* Report a value from the candidate values [1E]-R2D-Alt4/[1E]-R2D-Alt5 from [1E]-R2D if CW in UL spectrum.

Note: only applicable for device 1/2a |
| [1E2] | CW Tx antenna gain (dBi) | N/A | * Company to report, the value equals to
	+ UE Tx ant gain, or
	+ BS Tx ant gain

Note: only applicable for device 1/2a |
| [1E3] | CW2D distance (m) | N/A | For scenarios ‘B’* + D1T1-B:
		- 5m,
		- 10m,
		- 20m
		- CW2D distance is derived assuming CW node is located with the same position as ‘R1’ in ‘A1’ scenario
	+ D2T2-B:
		- 5m,
		- 10m,
	+ FFS other values

For scenarios ‘A1’ and ‘A2’* + Calculated (see note 1), (i.e., CW2D distance is calculated by assuming CW2D pathloss = D2R pathloss)

Note: only applicable for device 1/2aNote: companies to report which value(s) are evaluated. |
| [1E4] | CW2D pathloss (dB) | N/A | Calculated (see note1)Note: only applicable for device 1/2a |
| [1E5] | CW received power (dBm) | N/A | Calculated (see note1)Note: only applicable for device 1/2a |
| [1F] | Transmission Bandwidth used for the evaluated channel (Hz) | 180kHz(M), 360kHz(O), 1.08MHz(O) | Refer to LLS table [1a] |
| [1G] | Tx antenna gain (dBi) | * For BS for indoor, 6 dBi(M), 2dBi(M)
* For intermediate UE, 0 dBi
 | * For A-IoT device, 0dBi
 |
| [1H] | Ambient IoT backscatter loss (dB) due to Modulation factor  | N/A | * OOK: 6 dB
* PSK: 0 dB
* FSK: Y dB

It is applicable for device 1 and 2aCompanies to report and justify their assumptions for Y.Companies to report in row 3D if they assume any additional related loss. |
| [1J] | Ambient IoT on-object antenna penalty | Not applicable | 0.9dB or 4.7dB |
| [1K] | Ambient IoT backscatter amplifier gain (dB) | N/A | * 10 dB (M)
* 15 dB (O)

Note: Only for device 2a |
| [1N] | Cable, connector, combiner, body losses, etc. (dB) | * For BS, X dB, X <=3 to be reported by companies with justification provided in row 5A
* For intermediate UE, 1 dB
 | N/A |
| [1M] | EIRP (dBm) | Calculated (see Note 1)FFS: any limitation of the EIRP subject to future discussion | Calculated (see Note 1) |
| **(2) Receiver** |
| [2A] | Number of receive antenna elements / TxRU / chains modelled in LLS | Same as [1D]-D2R | Same as [1D]-R2D |
| [2B] | Bandwidth used for the evaluated channel (Hz) | Refer to LLS table [1b] ED bandwidth | Refer to LLS table [2a] [receiver bandwidth?] |
| [2C] | Receiver antenna gain (dBi) | same as [1G]-D2R | Same as [1G]-R2D |
| [2X] | Cable, connector, combiner, body losses, etc. (dB) | N/A | Same as [1N]-R2D |
| [2D] | Receiver Noise Figure (dB) | For RF-ED receiver* 20dB, Device 2
	+ FFS other values

For IF/ZIF receiver* 15dB, Device 2
 | For BS as reader* 5dB

For intermediate UE as reader* 7dB
 |
| [2E] | Thermal Noise power spectrum density (dBm/Hz) | -174 | -174 |
| [2F] | Noise Power (dBm) | Calculated (see Note 1) | Calculated (see Note 1) |
| [2G] | Required SNR/CNR | Reported by companies for Budget-Alt2 | Reported by companies for Budget-Alt2 |
| [2H] | Ambient IoT on-object antenna penalty | 0.9dB or 4.7dB | Not applicable |
| [2J] | Budget-Alt1/ Budget-Alt2 | Budget-Alt1/ Budget-Alt2 (see note1) | Budget-Alt2 |
| [2K] | CW cancellation (dB) | N/A | Companies to report for scenario A2/A1/B for BS and intermediate UE.Note: * Only applicable for device 1/2a
* The value provided is for the unmodulated single-tone CW. The impact of a multi-tone CW, e.g., assuming an [X] dB difference, is FFS
 |
| [2K1] | Remaining CW interference (dB) | N/A | Calculated (see Note 1)Note: only applicable for device 1/2a |
| [2K2] | Receiver sensitivity loss(dB) | N/A | Calculated (see Note 1)Note: only applicable for device 1/2a |
| [2L] | Receiver Sensitivity (dBm) | For Budget-Alt1, * For device 1 (RF-ED), for example:
	+ {-30dBm, -36dBm, -40dBm, etc}
* For device 2 (RF-ED), for example:
	+ {-40dBm, -45dBm, etc}

For Budget-Alt2,* Calculated (see note1)
 | Calculated (see Note 1)Note: the receiver sensitivity includes the receiver sensitivity loss [2K2], i.e. after CW cancellation at least if ‘A2’ scenario is used |
| **(3) System margins** |
| [3A] | Shadow fading margin (dB) | For D1T1: 4 dBFor D2T2: 3dB for InH-LOS7.2dB for InF-DL-NLOS | For D1T1: 4 dBFor D2T2: 3dB for InH-LOS7.2dB for InF-DL-NLOS |
| [3B] | polarization mismatching loss (dB) | 3 dB | 3 dB |
| [3C] | BS selection/macro-diversity gain (dB) | 0 dB FFS: other values are not precluded | 0 dBFFS: other values are not precluded |
| [3D] | Other gains (dB) (if any please specify) | Reported by companies with justification | Reported by companies with justification |
| **(4) MPL / distance** |
| [4A] | MPL (dB) | Calculated (see Note 1) | Calculated (see Note 1) |
| [4B] | Distance (m) | Calculated (see Note 1) | Calculated (see Note 1) |
| **（5）Other**  |
| [5A] | Other notes | Companies to report | Companies to report |

*<Editor Notes: Note 1 will be updated once the table has stabilized >*

Note1 (for email discussion): calculated values in the Table XXXX are derived according to the followings,

[1M]:

* For R2D,
	+ [1M] = [1E] + [1G] - [1N] - FFS: [1J]
* For D2R
	+ Device 1:
		- [1M] = [1E] + [1G] - [1H] - [1J]
	+ Device 2a:
		- [1M] = [1E] + [1G] + [1K] - [1H] - [1J]
	+ Device 2b:
		- [1M] = [1E] + [1G] - [1J]

[2F]:

* [2F] = [2D] + [2E] +*lin2dB*([2B])

[2G]

* For the R2D LLS for ED, CINR/CNR is reported, where CINR/CNR is defined as the ratio of signal power spectral density in the transmission bandwidth to the noise and interference (if any) power spectral density in the device ED channel bandwidth.

[2J]

* For R2D link in the coverage evaluation, for device 1
	+ Budget-Alt1 is used (note: receiver architecture is RF ED)
* For R2D link in the coverage evaluation for device 2,
	+ *Budget-Alt1* is used if receiver architecture is RF ED
	+ *Budget-Alt2* is used if receiver architecture is IF/ZIF ED
* Note1a: this does not preclude to have LLS for device 1 and 2 R2D link with RF-ED if needed.
* Note1b: For device 2 R2D link with RF-ED, *Budget-Alt1* is mandatory, *Budget-Alt2* is optional.
* Note1c: this does not imply all M values are achievable with the sensitivity given by *Budget-Alt1* for RF ED
* Note1d: For device 2 with an RF ED-based receiver on the R2D link, if the receiver sensitivity derived from *Budget-Alt2*, assuming a noise figure of [X dB], exceeds the receiver sensitivity based on *Budget-Alt1*, then *Budget-Alt2* is applied.

[2K1]:

* FFS:
	+ Alt1: [2K1] = [1E1] + [1E2] - [2K] or
	+ Alt2: [2K1] = [1E1] + [1E2] + [2C] - [2K]

[2K2]:

[2L]:

* For R2D and *Budget-Alt2*,
	+ [2L] = [2G] - *lin2dB*([2B] / [1F]) + [2F]
	+ Note 1e: the term ‘*lin2dB*([2B] / [1F])’ is applied due to scaling from CNR/CINR to SNR/SINR.
* For D2R,
	+ [2L] = [2G] + [2F] + [2K2], device 1/2a
	+ [2L] = [2G] + [2F], device 2b

[4A]

* [4A]=[1M]+[2C]-[2L]-[3A]-[3B]+[3C]+[3D]
* Note 1f: For scenarios ‘A1’ and ‘A2’, The Device Tx Power is calculated by assuming CW2D pathloss = D2R pathloss. i.e.,
	+ TBC: [4A] = 0.5\*([1E1]+[1E2]-2\*[3A]-2\*[3B]-[1J]-[2L]+[2C]-[1H]) for device 1,
	+ TBC: [4A] = 0.5\*([1E1]+[1E2]-2\*[3A]-2\*[3B]-[1J]-[2L]+[2C]+[1K]) for device 2

Note2: (M) denotes the value is mandatory to be evaluated. (O) denotes the value can be optionally evaluated.

**Proposal (for email discussion)**

The link level simulation table is updated as follows,

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Parameters** | **Assumptions** | **Company result1** | **Company result 2** |
|  | **R2D/D2R common parameters** |  |  |
| **[0a]** | Carrier frequency | Refer to link budget template |  |  |
| **[0b]** | SCS | 15 kHz as baseline |  |  |
| **[0c]** | Block structure | Blocks as agreed in 9.4.2.3, or other blocks reported by companies |  |  |
| **[0d]** | Channel model | *<Editor’s Note: will be updated according to the agreements made for channel model>* |  |  |
| **[0e]** | Delay spread | * An RMS delay spread of 30 ns and [150] ns is considered for TDL-A channel model.
* An RMS delay spread of 30 ns is considered for TDL-D channel model.
 |  |  |
| **[0f]** | Device velocity | 3 km/h |  |  |
| **[0g]** | Number of Tx/Rx chains for Ambient IoT device | 1 |  |  |
| **[0h1]** | BS | Number of antenna elements | 2 or 4 |  |  |
| **[0h2]** | Number of TXRUs | 2 or 4 |  |  |
| **[0j1]** | Intermediate UE | Number of antenna elements | 1 or 2 |  |  |
| **[0j2]** | Number of TXRUs | 1 or 2 |  |  |
| **[0m]** | Reference data rate | ~~[0.1, 1, 5] kbps~~[0.1] kbps (M), [1] kbps (M), [7] kbps (O), [large value] (O) |  |  |
| **[0n]** | Message size | {20 bits, 96 bits, 400 bits} are considered for message size.* Note: companies to report the M value and chip length used for each message size
 |  |  |
| **[0p]** | BLER target | 1%, 10% |  |  |
| **[0q]** | Sampling frequency | ~~<Editor’s Note: will be updated according to the agreements made for Sampling frequency >~~Sampling frequency is 1.92 Msps.Initial SFO (Sampling Frequency Offset) (Fe):* [0.1 ~ 1] \* 10^5 ppm ~~for device 1, reported by company~~
* ~~[0.1 ~ 1] \* 10^4 ppm for device 2, reported by company~~

The timing drift ΔT over a time T is modelled as ΔT = ±Fe \* T.FFS: Accuracy after clock calibration at least for device 2.FFS: CFO for device 2b.Note: the values are for coverage evaluation purpose. A harmonized design approach for all devices should be considered when utilizing these values in the design. |  |  |
| **[0r]** | Device 1/2a/2b | Options are as follows,* Device 1, RF-ED
* Device 2a, RF-ED
* Device 2b, RF-ED/IF-ED/ZIF

*<Editor’s Note: will be updated according to agreements from 9.4.1.2>* |  |  |
|  | **R2D specific parameters** |  |  |
| **[1a]** | Transmission bandwidth | 180 kHz as baseline |  |  |
| **[1b]** | ED bandwidth | The ED bandwidth is the bandwidth for calculating the noise/interference (if any) power:For evaluations, the value(s) of ED bandwidth is 20 MHz for RF-ED, [180] kHz for IF/ZIF receiver. Note: this does not imply that a A-IoT device supports sampling clock rate as large as RF ED bandwidth. |  |  |
| **[1c]** | BB LPF | [X]-order Butterworth/RC filter with cutoff frequency at half of R2D transmission bandwidth.Companies to report X = {3, 5}. |  |  |
| **[1d]** | Waveform | OOK waveform generated by OFDM modulator |  |  |
| **[1e]** | Modulation | OOKCompanies to report, e.g., OOK-1, OOK-4 with M chips per OFDM symbol |  |  |
| **[1f]** | Line code | Companies to report, e.g., Manchester, PIE |  |  |
| **[1g]** | FEC | No FEC as baseline |  |  |
| **[1h]** | ADC bit width | 1-bit for device 14-bit for device 2 |  |  |
| **[1j]** | Detection/decoding method for Line code | Companies to report |  |  |
|  | **D2R specific parameters** |  |  |
| **[2a1]** | Transmission bandwidth ~~(w.r.t. D2R data rate)~~ | ~~[FFS: 15kHz, 180kHz]~~* **[2a1]-Alt1:**
	+ DSB
	+ X kHz ~~(M) and Y kHz (O)~~ is considered for D2R transmission bandwidth.
	+ The value is for two sidebands, i.e., the total transmission bandwidth for DSB is X kHz ~~(M) and Y kHz (O)~~.
* **[2a1]-Alt2:**
	+ SSB
	+ X kHz ~~(M) and Y kHz (O)~~ is considered for D2R transmission bandwidth.
	+ The value is for one sideband, i.e., the total transmission bandwidth for DSB is X kHz ~~(M) and Y kHz (O)~~.
* The value of X ~~and Y~~ is as follows, to be down-select from alternative 1 and 2
	+ Alternative 1:
		- X = {15 (M), 180 (O)}
		- ~~Y =180~~
	+ Alternative 2:
		- X ~~and Y~~ reported by companies,
			* the value may be related to, e.g.,
				+ Reference data rate
				+ Coding scheme
				+ Repetition
				+ With or without SFS
				+ SSB or DSB
 |  |  |
| **[2a2]** | [OOK/BPSK/BFSK chip rate]  | Companies to report  |  |  |
| **[2a3]** | Receiver bandwidth | D2R receiver bandwidth is the bandwidth used at the reader side to filter out the D2R signals for calculating noise and interference (if any) power. * Assume the receiver matches the transmitter's modulation, i.e., to receiver uses SSB when transmitter uses SSB, receiver uses DSB when transmitter uses DSB.

Companies to report the value. |  |  |
| **[2b]** | Waveform (CW) | Companies to report waveform, e.g., unmodulated single tone, multi-tone(multiple unmodulated single tone) |  |  |
| **[2d]** | Modulation | Companies to report modulation, e.g., OOK, BPSK, BFSK |  |  |
| **[2e]** | Line code | Companies to report, e.g., Manchester encoding, FM0 encoding, Miller encoding, no line coding |  |  |
| **[2g]** | FEC | Companies to report, e.g., CC, No FEC |  |  |
| **[2h]** | ADC bit width | Companies to report, e.g., 11-bit |  |  |
| **[2j]** | D2R receiver  | ~~FFS: Reader receiver, e.g., coherent receiver / non-coherent receiver~~Companies to report, e.g., coherent receiver / non-coherent receiver |  |  |
|  | **Other assumptions** |  |  |
| **[3a]** | Other assumptions | To be reported by company |  |  |
| **[3b]** | Note: Companies to report required SINR/SNR/CINR/CNR according to BLER target. |  |  |

##### 2.1.1.2 Ambient IoT device architectures

**RAN1#116bis**

Agreement

Study device 2b architecture w/ RF-ED receiver with following blocks.

* **Antenna** could be either shared or separate for RF energy harvester (if present) and receiver/transmitter.
* **Matching network** is to match impedance between antenna and other components (including RF energy harvester (if present) and receiver related blocks).
* **Energy harvester** for harvesting energyfrom e.g., RF signal, solar, vibration/movement, temperature difference, etc
* **Energy storage** (e.g., capacitor) stores harvested energy from energy harvester.
* **Power management unit (PMU)** manages storing energy to energy storage from energy harvester and suppling power to active component blocks which needs power supply.
* **Digital BB logic** includes functional blocks like encoder, decoder, controller, etc.
* **Memory** caninclude two types of memory: 1) Non-Volatile Memory (NVM) such as EEPROM for permanently storing device ID, etc, and 2) registers for temporarily keeping any information required for its operation only while energy is available in energy storage.
* **Clock generator** provides required clock signal(s).
* **Reception related blocks**
	+ **RF BPF** filter for improving selectivity.
		- Depending on implementation, it may not exist. RAN4 RF requirement (if any, e.g., ACS) and peak power consumption target also need to be considered.
	+ FFS: **LNA** for improving signal strength and sensitivity of receiver, if present
	+ **RF envelope detector (RF-ED)** detects envelope from RF signal.
	+ **BB amplifier** amplifies BB signal to improve signal strength.
	+ **BB LPF** can filter out harmonics and high frequency components to improve input signal quality to comparator/ADC.
		- Depending on implementation, it may not exist.
	+ **Comparator or N-bit ADC**
* **Transmission related blocks**
* **Tx Modulator**: baseband bits are modulated according to modulation scheme. This block could be the part of BB logic.
* **Digital to Analog Converter (DAC)** converts digital signal to analog signal.
* **Low pass filter** for filtering out undesired signal
* **Mixer** performs up converting baseband signal to RF range.
* **Local oscillator (LO)** for carrier frequency generation
	+ FFS: PLL/FLL
* **FFS: Power amplifier (PA)** amplifies tx signal, if present
* Details on transmitter related blocks depends on tx waveform/modulation.



Agreement

Further study reflection amplifier for Device 2a, considering following aspects:

* Types of reflection amplifier
	+ Uni-directional/one-way (for D2R)
	+ Bi-directional/two-way (for both R2D and D2R)
		- FFS: switching loss (if applicable)
* One-way Amplification Gain
	+ E.g. [10, 15, 25] dB
	+ Considering stability, operating frequency, and power consumption characteristics
* Bandwidth

Agreement

Further study the feasibility of large frequency shift (large FS, i.e. between DL/UL spectrum of an FDD band) for device 2a considering at least following aspects.

* Power consumption characteristics
* Frequency shift range and granularity
* Image suppression or SSB backscatter for large FS
* IF carrier frequency accuracy
* Harmonics suppression

Note: the necessity (including applicable potential scenarios) of large FS can still be discussed in other agendas of the SI

Agreement

**Study device 2b architecture with ZIF receiver with following blocks.**

* **Antenna** could be either shared or separate for RF energy harvester (if present) and receiver/transmitter.
* **Matching network** is to match impedance between antenna and other components (including RF energy harvester (if present) and receiver related blocks).
* **Energy harvester** for harvesting energyfrom e.g., RF signal, solar, vibration/movement, temperature difference, etc
* **Energy storage** (e.g., capacitor) stores harvested energy from energy harvester.
* **Power management unit (PMU)** manages storing energy to energy storage from energy harvester and suppling power to active component blocks which needs power supply.
* **Digital BB logic** includes functional blocks like encoder, detector, decoder, controller, etc.
* **Memory** caninclude two types of memory: 1) Non-Volatile Memory (NVM) such as EEPROM for permanently storing device ID, etc, and 2) registers for temporarily keeping any information required for its operation only while energy is available in energy storage.
* **Clock generator** provides required clock signal(s).
* **Local oscillator (LO)** for generating carrier frequency for Tx and Rx
	+ **FFS: PLL/FLL**
	+ **FFS: one LO or separate LOs for Tx and Rx**
* **Reception related blocks**
	+ **RF BPF** filter for improving selectivity.
		- Depending on implementation, it may not exist. RAN4 RF requirement (if any, e.g., ACS) and peak power consumption target also need to be considered.
	+ FFS: **LNA** for improving signal strength and sensitivity of receiver.
	+ **Mixer** down converts RF signal to BB stage.
		- Depending on implementation, there could be one or two mixers for Rx and Tx
	+ **BB amplifier** amplifies BB signal
	+ **BB LPF** can filter out undesired frequency components to improve input signal quality to comparator/ADC.
		- Depending on implementation, it may not exist.
	+ **Comparator or N-bit ADC**
* **Transmission related blocks**
* **Tx Modulator**: baseband bits are modulated according to modulation scheme. This block could be the part of BB logic.
* **Digital to Analog Converter (DAC)** converts digital signal to analog signal.
* **Low pass filter** for filtering out undesired signal
* **Mixer** performs up converting baseband signal to RF range.
* **FFS: Power amplifier (PA)** amplifies tx signal, if present
* Details on transmitter related blocks depends on e.g., waveform/modulation, etc



Agreement

**Study device 2b architecture with IF-ED receiver with following blocks.**

* **Antenna** could be either shared or separate for RF energy harvester (if present) and receiver/transmitter.
* **Matching network** is to match impedance between antenna and other components (including RF energy harvester (if present) and receiver related blocks).
* **Energy harvester** for harvesting energyfrom e.g., RF signal, solar, vibration/movement, temperature difference, etc
* **Energy storage** (e.g., capacitor) stores harvested energy from energy harvester.
* **Power management unit (PMU)** manages storing energy to energy storage from energy harvester and suppling power to active component blocks which needs power supply.
* **Digital BB logic** includes functional blocks like encoder, decoder, controller, etc.
* **Memory** caninclude two types of memory: 1) Non-Volatile Memory (NVM) such as EEPROM for permanently storing device ID, etc, and 2) registers for temporarily keeping any information required for its operation only while energy is available in energy storage.
* **Clock generator** provides required clock signal(s).
* **Local oscillator (LO)** for generating carrier frequency for Tx, or for generating carrier frequency offset by the IF for Rx
	+ **FFS: PLL/FLL**
	+ **FFS: one LO or separate LOs for Tx and Rx**
* **Reception related blocks**
	+ **RF BPF** filter for improving selectivity.
		- Depending on implementation, it may not exist. RAN4 RF requirement (if any, e.g., ACS) and peak power consumption target also need to be considered.
	+ FFS: **LNA** for improving signal strength and sensitivity of receiver, if present
	+ **Mixer** down converts RF signal to IF stage.
		- Depending on implementation, there could be one or two mixers for Rx and Tx
	+ **IF amplifier** amplifies IF signal
	+ **IF filter** for filtering out unwanted RF and LO signals
	+ **IF envelope detector (IF-ED)** detects envelope from IF signal.
	+ **BB amplifier**
		- Depending on implementation, one or both of IF amplifier and BB amplifier may exist.
	+ **BB LPF** can filter out harmonics and high frequency components to improve input signal quality to comparator/ADC.
		- Depending on implementation, it may not exist.
	+ **Comparator or N-bit ADC**
	+ Note: image rejection is required
* **Transmission related blocks**
* **Tx Modulator**: baseband bits are modulated according to modulation scheme. This block could be the part of BB logic.
* **Digital to Analog Converter (DAC)** converts digital signal to analog signal.
* **Low pass filter** for filtering out undesired signal
* **Mixer** performs up converting baseband signal to RF range.
* **FFS: Power amplifier (PA)** amplifies tx signal, if present
* Details on transmitter related blocks depends on e.g., waveform/modulation, etc



**RAN1#117**

**Observation**

Reflection amplifier with following characteristics could be considered for device 2a.

* Direction of amplification
	+ Uni-directional reflection amplifier (baseline) can amplify backscattered signal in D2R which can improve D2R link budget.
	+ Bi-directional amplifier can amplify both signal in R2D and backscatter signal in D2R at least when R2D and D2R are in the same spectrum.
	+ Bi-directional amplifier has higher complexity, higher noise figure, and reduced isolation between tx and rx path.
* Amplification gain ranges from 10 to 20dB.
* Power consumption of reflection amplifier is in the range of a tens of uW to 100s of uW.
* Reflection amplifier can operate in FDD frequency bands.
* Reflection amplifier bandwidth can support 10s of MHz.
* Note: reflection amplifier can get unstable when the input power exceeds a certain value, which may be frequency-dependent.

**Observation**

For large frequency shift:

* Large frequency shift can be used in shifting reflected signal in tens of MHz, e.g., from FDD DL to FDD UL frequency or vice versa.
* Large frequency shift consumes 10s of uW to 100s of uW.
* Large frequency shift is not feasible for device 1.
* Large frequency shift requires a clock for IF generation which is accurate enough to avoid large guard band and interference to adjacent channels/bands.
* Large frequency shift requires image suppression and may require harmonics suppression
	+ Note: details of image suppression and harmonics suppression are not discussed in RAN1
* FFS: whether large frequency shift is necessary and feasible for device 2a

Agreement

For study purpose, assume that A-IoT device has a single antenna for both communication (tx/rx) and RF energy harvesting purposes.

Agreement

The following template is used for capturing descriptions on clock/LO.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Purpose | Applicabledevice types | Clockspeed | Power consumption | [Initial clockAccuracy] | [Accuracy after clock sync] | [Clock drift] |
| Purpose #1 of the clock |  |  |  |  |  |  |  |
| Purpose #N of the clock |  |  |  |  |  |  |  |
| Etc |  |  |  |  |  |  |  |
|  |  |

##### 2.1.1.3 General aspects of physical layer design

**RAN1#116bis**

Agreement

Study time-domain multiple access of D2R transmissions. Further details, including pros/cons, are FFS.

Agreement

Study frequency-domain multiple access of D2R transmissions, at least by utilizing a small frequency-shift in baseband. Further details, including pros/cons, are FFS.

Agreement

Whether code-domain multiple access is feasible and necessary for D2R transmissions for all devices is FFS.

Agreement

The following bandwidths for D2R are defined for the purpose of the study:

* Transmission bandwidth, *B*tx,D2R: The frequency resources scheduled by a reader for a D2R transmission from one device.
	+ FFS in agenda 9.4.2.3: how frequency resources scheduled by a reader are determined
* Occupied bandwidth, *B*occ,D2R: The transmission bandwidth plus the potential associated intra A-IoT guard-bands totalling *B*guard,D2R
	+ Note: this guard band is not for coexistence with NR/LTE
* If/how to define guard band for coexistence between A-IoT D2R and NR/LTE is up to RAN4.
* Bocc,D2R >= *B*tx,D2R
	+ Possible values of each bandwidth are FFS

Agreement

For D2R, study: Manchester encoding, FM0 encoding, Miller encoding, no line coding.

* FFS: Mapping(s) from bit(s) to line-code codewords
* FFS: How to achieve small frequency shift in baseband and/or FDM(A) among devices
* Aspects to study include:
	+ Spectrum shape
	+ Complexity
	+ Power consumption
	+ BER, BLER
	+ Resilience to SFO
	+ If there is any relation to CFO

Agreement

A-IoT D2R study of FEC includes at least convolutional codes.

* Comparisons are encouraged to compare to the case of no FEC
* FFS details of convolutional codes, such as polynomial(s), shift-register termination, etc.
* FFS if other FEC candidates/methods will be studied.

Agreement

Study

* baseline: using 6 bits and 16 bits CRC with polynomials from TS 38.212, or no CRC, for PRDCH
* baseline: using 6 bits and 16 bits CRC with polynomials from TS 38.212, or no CRC, for PDRCH
* FFS: details when different CRC lengths or no CRC may be used
* FFS: other 6 bits and 16 bits CRC with different polynomials than from TS 38.212

Agreement

Study D2R transmission in the physical layer using repetition

* Note: Discussions regarding higher-layer repetitions are up to RAN2.

Agreement

R2D study includes subcarrier spacing of 15 kHz, from the reader perspective, for OFDM-based waveform.

* Inclusion in the study of subcarrier spacing of 30 kHz is FFS.

Agreement

For R2D study OFDM-based waveform with subcarrier spacing of 15 kHz, *B*tx,R2D is ≤ [12] PRBs and is down-selected among:

* Alt 1: Including 180 kHz, 360 kHz, and FFS other values
* Alt 2: Integer multiple(s) of 180 kHz (FFS: what integer(s))
* Alt 3: Integer multiple(s) of the subcarrier spacing (FFS: what integer(s))

Agreement

For R2D CP handling for OFDM based OOK waveform:

* For potential down-selection, study among the following candidate methods
	+ Method Type 1: Removal of CP at device without specified transmit-side
		- FFS: How device determines the CP location
		- FFS: Impact on feasibility of device SFO
		- FFS: relation to M, if any
	+ Method Type 2: Ensure the CP insertion of OFDM-based waveform will not introduce false rising/falling edge between the last OOK chip in OFDM symbol (*n*-1) and the first OOK chip in OFDM symbol *n*.
		- FFS: Whether/how to arrange that OOK chips have equal length after CP insertion
		- FFS: relation to M, if any
		- FFS: Detail of relationship to line code codewords
		- FFS: Impact on feasibility of device SFO
	+ [Other method types are not precluded]
* Study of the methods should include e.g.:
	+ CP impact on R2D timing acquisition, and decoding & performance of PRDCH
	+ Reader and device implementation complexities
	+ Interference between R2D and NR DL/UL if in the same NR band
	+ Spectrum efficiency

Agreement

Study for all devices the following for D2R baseband modulation, for potential down-selection:

* OOK
* Binary PSK
* Binary FSK
	+ Strive to identify one variant of Binary FSK to study further

**RAN1#117**

Agreement

Study the following regarding CP location/length determination for Method Type 1:

* + Alt 1: Device assumes same CP length for each OFDM symbol, i.e. does not distinguish exact CP length among different OFDM symbols
	+ Alt 2: duration between transition edges is utilized by device to determine CP location/length, i.e. if the duration appears to be invalid based on known chip duration
* Companies are encouraged to clarify the CP removal method used and implementation aspects for the device
* Evaluations are encouraged to be performed for a small value of M, e.g. 4 and a large value of M, e.g. 24, at least by comparison to the case where the CP length of each OFDM symbol is known by device
* Companies should report the values of SFO, and SFO detection methods used in evaluations

Agreement

Study the following options regarding subcarrier orthogonality for Method Type 2:

* Alt 1: Method Type 2 retains subcarrier orthogonality (i.e. CP copied from the end of an OFDM symbol)
* Alt 1-1: The first OOK chip(s) and the last OOK chip(s) in an OFDM symbol are the same
	+ FFS: whether this alternative applies if CP length is longer than the chip duration
* Alt 1-2: Ensure a transition edge occurs only at the start or only at the end of the CP, and no transition edge occurs during the CP
* Other potential methods are not precluded
* Alt 2: Method Type 2 does not retain subcarrier orthogonality
* Proponents to bring further details to RAN1#118
* Evaluations and discussions are encouraged to be performed for a small value of *M*, e.g. *M* = 4 and a large value of *M*, e.g. *M* = 24.
* Companies should report the values of SFO, and SFO detection methods used in evaluations

Agreement

Define repetition types for study purposes as follows:

* Block level: All the bits received from higher layers and/or physical layer (according to what is present) after CRC attachment (if used) are blockwise repeated Rblock times
* Bit level type 1: Each bit after CRC attachment (if used) is repeated Rbit times
* Bit level type 2: Each bit after both CRC attachment (if used) and FEC (if used) is repeated Rbit times
* Chip level: Each chip after line coding (if used) or after square wave modulation (if used) is repeated Rchip times
	+ NOTE: Equivalent to extending the duration of each chip by Rchip times

Agreement

For D2R, study at least block-level and bit-level repetition type 1 and type 2.

Agreement

For R2D evaluation purposes, the R2D waveform for DFT-s-OFDM is generated as follows:

1. The time domain OOK signal is the M chips of one OFDM symbol.
2. A chip is represented (e.g. upsampled) by L samples
	* Companies to report L
3. An N’-points DFT is performed on the samples of one OFDM symbol to obtain the frequency domain signal.
	* Companies to report N’, e.g. N’=128 or equal to X
4. Map the frequency domain signal obtained by N’-points DFT to the X subcarriers of Btx,R2D.
	* Companies report how to map and report X
5. An N-points IDFT is performed to obtain the time domain signal.
	* Companies to report N, and how value was selected

Note: companies report whether/how CP samples are added.

Agreement

The study assumes the following bit to chip mapping for Manchester encoding:

* + bit 0→chips{10}, bit 1→chips{01}
* FFS: Variant of the above for CP handling

##### 2.1.1.4 Frame structure and timing aspects

**RAN1#116bis**

Agreement

For R2D transmission, if OFDM-based waveform is used, the start of R2D transmission from reader perspective is assumed to be aligned with the boundary of an NR OFDM symbol (including the CP) for in-band/guard-band operation.

Agreement

To determine or derive the end of PRDCH transmission, study at least following options:

* Option 1: R2D postamble immediately follows the PRDCH to indicate the end of the PRDCH.
* Option 2: Based on R2D control information.

Agreement

For the reader to acquire the end of PDRCH transmission, study at least following options:

* Option 1: D2R postamble immediately follows the PDRCH
* Option 2: Based on control information

Agreement

For D2R transmission, study the necessity of midamble at least for the purpose of performing timing/frequency tracking or channel estimation or interference estimation, considering at least the following:

* Modulation and Coding schemes, e.g., data modulation, line/channel coding
* Receiving methods, e.g., coherent or non-coherent
* D2R transmission length/packet size
* Midamble overhead
* Timing/frequency accuracy
* Phase accuracy

Agreement

RAN1 study the R2D transmission without midamble as the baseline if Manchester encoding is used.

* FFS the necessity for the R2D transmission with midamble if PIE is used.

**RAN1#117**

Agreement

Study whether/how an A-IoT device can count the time with sufficient accuracy (with a certain timing error due to SFO) at least for the purposes related to TDM(A) (if needed), and if so for how long after receiving an R2D transmission.

Agreement

Scheduling information of PDRCH transmission is provided by a corresponding PRDCH.

**Conclusion**

RAN1 discussion related to the potential impact of device unavailability due to charging by energy harvesting will occur in agenda item 9.4.2.2.

Agreement

Study the following options for the time interval between a R2D transmission and the corresponding D2R transmission following it:

* Option 1: Define a maximum time TR2D\_max between a R2D transmission and the corresponding D2R transmission following it, so that the device transmits D2R transmission within [TR2D\_min, TR2D\_max].
	+ FFS: maximum time is common or different for different A-IoT devices
	+ FFS: maximum time for different traffic types/command types (e.g. DT or DO-DTT) and/or different use case (e.g., Inventory or Command)
* Option 2: The corresponding D2R transmission timing TR2D following a R2D transmission is determined based on the control information in the R2D transmission, where TR2D ≥ TR2D\_min
	+ FFS the maximum value(s) for TR2D

##### 2.1.1.5 Downlink and uplink channel/signal aspects

**RAN1#116bis**

Agreement

For the R2D timing acquisition signal immediately preceding the transmission of a physical channel, study a preamble with at least two parts which includes a start-indicator part and a clock-acquisition part, where the start-indicator part immediately precedes the clock-acquisition part:

* Start-indicator part provides the start of the R2D transmission
	+ FFS: Details of start-indicator part
* Clock-acquisition part provides at least the chip synchronization of the subsequent physical channel transmission
	+ FFS: Details of clock-acquisition part, e.g. structure, encoding, length, etc.
	+ FFS: Methods to determine chip duration of the subsequent physical channel transmission
	+ FFS: Other functionalities
* Note: the preamble is considered not to be part of a physical channel
* FFS: other part(s) of the preamble, if any
* FFS: whether the above clock acquisition is sufficient for all devices
* FFS: how to make the preamble compact

Agreement

For D2R, a preamble preceding each PDRCH transmission is studied as the baseline at least for the D2R timing acquisition signal:

* Preamble is not part of PDRCH
* FFS: Other functionalities of the preamble

Agreement

For PRDCH generation at the reader, at least following blocks are studied as the baseline:

* CRC bits are appended if there is non-zero length CRC
	+ Note: CRC details discussed in agenda item 9.4.2.1
* Line coding block
* OOK-1/OOK-4 modulation with OFDM waveform generation, including resource mapping
	+ FFS details
* Note: Other blocks could be added if agreed



PRDCH generation

Agreement

For PDRCH generation at the device, at least following blocks are studied as the baseline:

* CRC bits are appended if there is non-zero length CRC
	+ Note: CRC details discussed in agenda item 9.4.2.1
* Coding
	+ Exact coding methods within the coding block, e.g. with/without line coding and/or FEC discussed under agenda 9.4.2.1
	+ Note: If no line coding is used, there may be an additional block (e.g. square wave generator) before/after modulation block
* Modulation
* Note: Other blocks could be added if agreed

 

PDRCH generation

Agreement

Reference signals including at least DMRS, PTRS, CSI-RS/TRS, are not further studied for R2D.

Agreement

Reference signals including DMRS, PTRS, SRS, are not further studied for D2R

* Note: This doesn’t preclude the possibility to study preamble, midamble, postamble for different purposes, e.g. channel/interference estimation and/or proximity determination

Agreement

Proximity determination based on device side measurements is not considered.

**RAN1#117**

Agreement

For R2D, the only physical channel is PRDCH.

* PRDCH carries any higher-layer payload
* PRDCH carries L1 R2D control information (if defined)
* FFS details of device behaviour(s) for receiving PRDCH

Agreement

For D2R

* PDRCH carries any higher-layer payload
* PDRCH carries L1 D2R control information (if defined)
* Note: PDRCH carries the response agreed at RAN1#116

Agreement

For L1 D2R control information (if defined), the following are not considered for further study:

* CSI feedback
* Autonomous SR
* FFS: Whether any other L1 D2R control information is needed or not

Agreement

Study the following schemes for proximity determination:

* Option 1: If reader receives D2R transmission from the device in response to R2D transmission, then device is determined as near
	+ - FFS: Details on reception criteria (e.g. either successful or not) at reader and device
* Option 2: Device is determined to be near the reader based on measurements at the reader side
	+ - FFS: Details on measurement methods
* FFS: Whether/how transmit power of R2D and/or D2R is considered for proximity determination

Agreement

For the start-indicator part of the R2D time acquisition signal, study the two options below:

* + Option 1: ON/OFF pattern i.e. high/low voltage transmission
	+ Option 2: OFF pattern, i.e. low voltage transmission

Agreement

For R2D, the clock-acquisition part of the R2D time acquisition signal is used to determine the OOK chip duration

* + FFS: Pattern design to support determination of chip duration

##### 2.1.1.6 Waveform characteristics of carrier-wave provided externally to the Ambient IoT device

**RAN1#116bis**

Agreement

For CW waveform for D2R backscattering, multiple unmodulated single-tone is studied compared to single-tone in R19 SI.

* Two unmodulated single-tones as a starting point
	+ FFS: Other number of tones
	+ FFS: how large gap is needed between tones

Agreement

For CW waveform for D2R backscattering, contiguous multi-tone OFDM signal is not studied in R19 SI.

Agreement

Study at least the following characteristics of unmodulated single-tone and multiple unmodulated single-tone CW waveforms for backscattering:

* For D2R
	+ Reception performance
	+ Spectrum utilization of backscattered signal corresponding to the CW waveforms
* CW interference suppression at D2R receiver
	+ Including complexity and CW cancellation capability value/range (if any)
	+ For scenarios ’A1’, ’A2’ and ’B’
* Relative complexity of CW generation

**RAN1#117**

Agreement

For the study of characteristics of CW waveforms, the following table is adopted as a template for capturing observations.

Note 1: Further row(s) can be added, if other CW waveform characteristic is agreed.

|  |  |  |
| --- | --- | --- |
| CW waveform characteristics | Observations and/or comparisons of single-tone unmodulated sinusoid waveform without frequency hopping and two unmodulated single-tones waveform for backscattering | … (if any) |
| D2R reception performance |  |  |
| Spectrum utilization of backscattered signal corresponding to the CW waveforms |  |  |
| CW interference suppression at D2R receiver |  |  |
| Relative complexity of CW generation |  |  |
|  | Note: For two unmodulated single-tones waveform, the two tones are transmitted from the same CW node. |  |

**Observation**

For D2R reception performance,

* Compared to single-tone unmodulated sinusoid waveform without frequency hopping, two unmodulated single-tones waveform provides [X Y] dB frequency diversity gain in a fading channel, at least depending on the gap between the two tones and the channel’s coherence bandwidth.
	+ Note: The total transmission power is assumed the same for single-tone unmodulated sinusoid waveform without frequency hopping and two unmodulated single-tones waveform.
	+ Note: For two unmodulated single-tones waveform, assume the two tones are transmitted from the same CW node.

**Observation**

For CW interference suppression at D2R receiver,

* Compared to single-tone unmodulated sinusoid waveform without frequency hopping, two unmodulated single-tones waveform:
	+ Requires additional complexity if RF interference cancellation is used at least with CW waveform reconstruction.
		- Note: RF interference cancellation is needed when the received CW interference power exceeds the blocking threshold of the receiver
	+ Note: For two unmodulated single-tones waveform, assume the two tones are transmitted from the same CW node.

Agreement

For multiple unmodulated single-tone transmitted by one CW node, other number of tones (i.e. >2) is deprioritized.

* Note: other number of tones (i.e. >2) is studied only when obvious gains are provided.

**Observation**

For relative complexity of CW generation

* Compared to single-tone unmodulated sinusoid waveform without frequency hopping, two unmodulated single-tones waveform:
	+ Leads to higher PAPR of the generated CW, which impacts the implementation of the power amplifier in the CW node.
	+ Note: For two unmodulated single-tones waveform, assume the two tones are transmitted from the same CW node.

#### 2.1.2 Remaining Open issues

The following opens need to be addressed in RAN1:

1. Evaluation assumptions
2. Conclude at least the following aspects of design targets left to WGs in Clause 5 (RAN design targets) of TR 38.848 [RAN1].
	* Clause 5.3: Applicable maximum distance target values(s)
	* Clause 5.6: Refine the definition of latency suitable for use in RAN WGs
	* Clause 5.8: 2D distribution of devices
3. Define necessary further evaluation assumptions of deployment scenarios for coverage and coexistence evaluations [RAN1, RAN4]
4. Identify basic blocks/components of possible Ambient IoT device architectures, taking into account state of the art implementations of low-power low-complexity devices which meet the RAN design target for power consumption and complexity. [RAN1]
5. Define link budget calculation for coverage, including whether/how to model carrier wave from node(s) inside or outside the connectivity topology.

NOTE: Assessment performance of the design targets is within the study of feasibility and necessity of proposals in the following objectives, e.g. by inspection of reference implementations in the field, simulations, analytically.

NOTE: strive to minimize evaluation cases in RAN1.

1. Study necessary and feasible solutions for Ambient IoT as prescribed in the General Scope, including decisions on which functions, procedures, etc. are needed and not needed, and ensuring at least the required functionalities in Section 6.2 of TR 38.848.

Study the feasibility and required functionalities for proximity determination (coordination with SA3 is required for privacy aspects).

* RAN1-led:

For the Ambient IoT DL and UL:

* + Frame structure, synchronization and timing, random access
	+ Numerologies, bandwidths, and multiple access
	+ Waveforms and modulations
	+ Channel coding
	+ Downlink channel/signal aspects
	+ Uplink channel/signal aspects
	+ Scheduling and timing relationships
	+ Study necessary characteristics of carrier-wave waveform for a carrier wave provided externally to the Ambient IoT device, including for interference handling at Ambient IoT UL receiver, and at NR basestation.

 For Topology 2, no difference in physical layer design from Topology 1.

## 2.2 RAN2

#### 2.2.1 Agreements

##### 2.2.1.1 Stage 2 General aspects

**RAN2#125bis**

**Agreements**

1. Unless explicitly stated all agreements apply to all device types and for both topologies.
2. From RAN2 perspective, the aim is that the design on the interface between reader and A-IoT device is common for topology 1 and topology 2.
3. RAN2 will support two use cases, “inventory” and “command”. The definition, detailed wording is FFS
4. Baseline procedure:

Step A: Based on the service request, the reader sends the Initial Trigger Message indicating device(s) that need to respond; Details FFS

Step B: Triggered device(s) performs the random access-like procedure, if needed; Details FFS

Step C: The device may perform the data communication with the reader as needed,: Details FFS

1. We will study the support of both “inventory” and “command” in the same procedure.
2. FFS if *Initial Trigger Message* can also include “command”.
3. RAN2 will continue the study of ambient IoT assuming no support of AS security until SA3 provides further input.

**RAN2#126**

**Agreements**

1 As baseline, the “inventory only” case is supported by the procedure:

- Step A: A-IoT paging;

- Step B: Device ID transmission (via Random Access or without using RA). Details are FFS

2 As baseline, the “inventory and command” case is supported by the procedure:

- Step A: A-IoT paging;

- Step B: Device ID transmission (via Random Access or without using RA). Details are FFS

- Step C: reader to device data transmission (e.g. the R2D command), and

- Step D: corresponding device to reader data transmission (e.g. the feedback). FFS whether this is optional, pending other WG discussions.

Clarify in TR that inventory and command doesn’t mean that AIoT paging includes both Inventory and Command in the same message. This doesn’t mean that inventory and command are received by the reader at the same time from upper layer.

3 From RAN2 point of view we will study “Command only” use case.

FFS the options on how to support it :

 Initial trigger message from the reader contains the command. Final feasibility depends on SA2 and SA3 work/conclusions.

 Use baseline procedure for “inventory and command”(i.e. first triggers inventory procedure and then sends command)

##### 2.2.1.2 Protocol and Functionality aspects

**RAN2#125bis**

**Agreements for control plane**

1 RRC connection management is not supported. FFS how the resource configuration is provided to the device (if needed based on RAN1 progress)

2 RRM L3 measurement reporting is not supported by Ambient IoT devices.

3 RAN2 assumes, AIoT devices are not required to support ASN.1 encoding/decoding.

4 Periodical System information and MIB are not supported by AIoT devices. This doesn’t preclude any RAN1 defined broadcast signals.

5 RAN2 assumes that RRC layer is not necessary between the reader and the device. RAN2 will continue to study the functionalities required and later discuss whether we will have: 1) a new AS protocol on top of A-IoT MAC layer; or 2) A-IoT MAC

**Agreements for user plane**

1 SDAP is not supported for UP protocol stack.

2 PDCP layer is not needed. FFS how to handle AS security (if needed pending SA3 dicsussion) and any other really needed functionalities.

3 RLC layer is not needed. FFS how to handle segmentation (if needed and depending on RAN1 design and upper layer packet size). RAN2 considers segmentation and reassembly would add complexity, however further discussions are needed.

4 No HARQ and RLC AM

5 FFS about the level of visibility required by the reader and what information is necessary for AS layer operations.

6 RAN2 assumes that no per-packet QoS and no per-QoS flow is supported at AS level (for both UL/DL). FFS how to handle the general QoS requirements from SA2

**RAN2#126**

**Agreements on functionality**

1 Multiple “AIoT logical channels” for upper layer data are not supported. FFS if AIoT logical channel concept is used depending on final modeling issue.

2 legacy NR BSR/SR is not needed for A-IoT communication.

3 FFS whether further indication of device message size/status is needed

4 AS-layer (above PHY layer) RLC-like sretransmission/repetition is not supported. This doesn’t preclude the reader and device sending the payload again as new transmission from MAC perspective. FFS how we handle segmentation case (if needed)

##### 2.2.1.3 Paging

**RAN2#125bis**

**Agreements**

1. Legacy paging message for device will not be supported.

2. Legacy paging occasion and legacy DRX for the device is not supported. This doesn’t preclude solutions that address device monitoring (taking into account discussions from RAN1 as well).

3. RAN2 assumes that the device will not support tracking/RAN area update procedure.

4. For the case of reaching single or group of devices, an identifier may be required to identify the device/group of devices in the trigger message. FFS pending the details from SA2

**RAN2#126**

**Agreements**

1 RAN2 will study the following cases for AIoT paging message:

* a message containing an ID of a single A-IoT device.
* a message containing a group ID that maps to multiple A-IoT devices.
* a message that does not contain an ID, i.e., addressed for all devices that can receive the AIoT message.
* a message containing multiple IDs of A-IoT devices. Need to confirm the need for this use case based on SA2 discussion.

 What device ID and group ID and scenarios is depending on SA2 discussion.

2 AIoT paging message indicate information from which the device can determine resources to be used for response (D2R message). FFS how (e.g. implicit/explicit/configured/preconfigured) and what resources (dedicated and/or shared) are provided to the device taking into account RAN1 discussion.

3 From RAN2 perspective, we assume the device can receive as long as there is enough energy. We will wait for RAN1 further progress on device monitoring details.

##### 2.2.1.3 Random Access

**RAN2#125bis**

**Agreement**

1 RAN2 confirms slotted-ALOHA is the baseline for Ambient IoT random access

2 We will study the support for access triggering for a single device, group of devices, or all devices. RAN2 to discuss the contention-based and contention-free access procedures and detailed solutions.

3 Random Access is triggered by the reader

4 Reader provides the information that the device needs to respond to the random access trigger. FFS what those parameters are

5 Study the solution and benefits of both 2-step like random access procedure and 4-step like random access procedure. FFS the details on each procedure and how we call it.

6 Handling of contention resolution failure and access failure at the device will be studied in RAN2, including failure detection and re-access. FFS details

7 For the very first access message from the device to reader in random access an ID is included. RAN2 to discuss whether a temporary identifier is included, or the permanent device ID is included (considering other WGs input as well).

**RAN2#126**

**Agreements on “4 step” RA**

1 A-IoT Msg1: the device sends an ID to the reader. ID is a random ID generated by device (FFS how it is generated, e.g. randomly generated or generated based on Device ID). FFS on ID size. This doesn’t preclude any other RAN1 agreed information

2 A-IoT Msg2: the reader echos the ID received in Msg1. Further information may be included in mgs2 based on RAN1 agreements

3 A-IoT Msg3: device sends Device ID and/or any other upper layer data (depending on upper layer request)

4 The device considers the contention resolution as successful, if the Msg2 including the same random ID in Msg1 is received. RAN2 assumes the size of random ID in Msg1 should be sufficient for contention resolution purpose.

5 “Msg4” (i.e. the subsequent R2D transmission after D2R transmission) does not need to be always sent in random access. “Msg4” can be considered to handle the Msg3 transmission failure (due to various reasons). “Msg4” usage/presence can be further discussed.

RAN2 will not use “Msg4” term for further discussion of the random access.

**Agreements on 2 step CB RA**

1 A-IoT Msg1: The device sends Device ID and/or any other upper layer data (depending on upper layer request). FFS what device ID is and whether an additional random ID is needed. This doesn’t preclude any other RAN1 agreed information

2 A-IoT Msg2: the reader may echo some information from Msg1. FFS what some information is. “Msg2” usage/presence can be further discussed

**Agreement**

- From reader perspective, contention-free access procedure we will study single and multi-device case (depending on RAN1 discussion).

#### 2.2.2 Remaining Open issues

* RAN2-led:
	+ Study and decide which functions are needed for an Ambient IoT compact protocol stack and lightweight signalling procedure to enable DO-DTT and DT data transmission, and study those functions.

For example:

* + - Paging
		- Random access
		- Data transmission, including necessary radio resource control aspects, respecting the limitation in the General Scope
		- Interactions with upper layers

For functionalities not listed above, they are studied only if found essential.

## 2.3 RAN3

#### 2.3.1 Agreements

##### 2.3.1.1 RAN Architecture

**RAN3#123bis**

RAN3 considers both Topologies at the same time looking whether commonalities are applicable.

[Topo1] AIoT RAN node:

Corresponds to the basestation in Figure 4.2.1.1-1 in TR 38.848;

A RAN node providing AIoT radio, and connecting with an AIoT-aware CN node via the XX interface. Details of the AIoT-aware CN node is subject to SA2.

[Topo2] UE Reader:

A UE (corresponds to the intermediate node in Figure 4.2.1.2-1 in TR 38.848);

Providing AIoT radio, and connecting with a gNB (may be an AIoT enhanced gNB, corresponds to the basestation in Figure 4.2.1.2-1 in TR 38.848) via NR Uu interface.

For Topology 1, RAN3 starts with AIoT RAN node being aggregated.

**RAN3#124**

Agreements of RAN Architecture in RAN3#124 meeting are captured in the following document:

* R3-243962 [TP for TR 38.769] CB:#AIoT1\_Architecture, Ericsson, Huawei

##### 2.3.1.2 RAN-CN Interface Impact

**RAN3#123bis**

AIoT Paging can be used to reach one or more devices for identified AIoT services (e.g., inventory, command).

**RAN3#124**

Agreements of signaling and procedures for CN-RAN interface in RAN3#124 meeting are captured in the following document:

* R3-243963 Inventory and Command between AIoT CN and AIoT RAS, Huawei, CMCC, Nokia, Ericsson, ZTE, Xiaomi, Qualcomm Incorporated, Samsung, CATT, Lenovo, LG Electronics, NEC

##### 2.3.1.3 Others

**RAN3#123bis**

Use cases for locating an AIoT device:

- Find an appropriate “reader” close to the A-IoT device;

- Find where the A-IoT device is.

Support locating the A-IoT device at “reader” granularity.

**RAN3#124**

Agreements of locating an Ambient IoT device in RAN3#124 meeting are captured in the following document:

* R3-243964 (TP for TR38.769) Locating Ambient-IoT device, CMCC, ZTE, CATT, Xiaomi, LGE, Huawei, Lenovo, NEC

2.3.2 Remaining Open issues

* RAN3-led:
	+ Identify necessary impacts on signaling and procedures for CN-RAN interface, to enable:
		- Paging
		- Device context management
		- Data transport
	+ Identify RAN architecture aspects.
	+ Identify potential solutions for locating an Ambient IoT device with no specification impact, e.g. reusing existing user location report, or minimal specification impact to convey location information to core network.

## 2.4 RAN4

#### 2.4.1 Agreements

Agreements in RAN4#110bis meeting are captured in the following document:

* R4-2406714 WF on Ambient IoT in NR, CMCC

Agreements in RAN4#111 meeting are captured in the following documents:

* R4-2410567 WF on co-existence study for ambient IoT and NR/LTE, CMCC
* R4-2410597 WF on impacts of A-IoT on RF requirements, Huawei
* R4-2410596 TP to TR38.769 skeleton for RF part, Huawei

#### 2.4.2 Remaining Open issues

* RAN4-led:
	+ Coexistence study of Ambient IoT and NR/LTE.
	+ RF requirements study for Ambient IoT:
		- Ambient IoT BS transmission and reception
		- Ambient IoT Device, as per the General Scope, transmission and reception
		- Intermediate node (UE), as per the General Scope, transmission and reception

## 2.5 RAN5

#### 2.5.1 Agreements

#### 2.5.2 Remaining Open issues

#### 2.5.3 Remaining Open issues with cross-WG dependencies

## 2.6 RAN6

#### 2.6.1 Agreements

#### 2.6.2 Remaining Open issues

## 3. Detailed progress in SA/CT WGs since last TSG meeting (for all involved WGs)

NOTE: This section only needs to be filled in for WI/SIs where there is a corresponding relevant WI/SI in SA/CT.

## 3.1 SAx/CTs

#### 3.1.1 Agreements with cross-TSG impacts

#### 3.1.2 Remaining Open issues with cross-TSG impacts

NOTE: This section should also flag any critical dependencies that need TSG attention.

## 4. References

NOTE: This can be e.g. a list of all related Tdocs in the affected WGs since last TSG, references to LSs, produced TRs/TSs, the work/study item description or status reports of previous TSGs.

1. R1-2400328 Ambient IoT Study Item work plan CMCC, Huawei, T-Mobile USA

**RAN1#116bis**

1. R1-2401970 Evaluation assumptions and results for Ambient IoT Ericsson
2. R1-2402011 Evaluation methodology and assumptions for Ambient IoT Huawei, HiSilicon
3. R1-2402040 Discussion on evaluation assumptions and results for Ambient IoT devices FUTUREWEI
4. R1-2402072 Evaluation assumptions and results for Ambient IoT Nokia
5. R1-2402105 Discussion on evaluation assumptions and results for Ambient IoT Spreadtrum Communications
6. R1-2402137 Discussions on deployment scenarios and evaluation assumptions for A-IoT Intel Corporation
7. R1-2402184 Discussion on Ambient IoT evaluations ZTE, Sanechips
8. R1-2402242 Evaluation methodologies assumptions and results for Ambient IoT vivo
9. R1-2402328 Discussion on evaluation assumptions and results for A-IoT OPPO
10. R1-2402383 The evaluation methodology and preliminary results of Ambient IoT CATT
11. R1-2402466 Considerations for evaluation assuptions and results Samsung
12. R1-2402510 Discussion on evaluation assumptions and results for Ambient IoT China Telecom
13. R1-2402565 Discussion on evaluation methodology and assumptions CMCC
14. R1-2402666 Evaluation methodology and assumptions for Ambient IoT Xiaomi
15. R1-2402826 Discussion on ambient IoT evaluation framework NEC
16. R1-2402857 Evaluation assumptions for Ambient IoT InterDigital, Inc.
17. R1-2402881 Views on evaluation assumptions and link budget analysis for AIoT Apple
18. R1-2402946 On evaluation assumptions and results for A-IoT MediaTek
19. R1-2402967 Evaluation assumptions and results for Ambient IoT Sony
20. R1-2403117 Discussion on Ambient IoT evaluation LG Electronics
21. R1-2403194 Evaluation Assumptions and Results Qualcomm Incorporated
22. R1-2403244 Study on evaluation assumptions for Ambient IoT NTT DOCOMO, INC.
23. R1-2403284 Evaluation assumptions for Ambient IoT Comba
24. R1-2403397 Discussion on Evaluation assumption and preliminary results for AIoT IIT Kanpur, Indian Institute of Technology Madras
25. R1-2401971 Ambient IoT device architectures Ericsson
26. R1-2401976 Discussion on ambient IoT device architectures TCL
27. R1-2402012 Ultra low power device architectures for Ambient IoT Huawei, HiSilicon
28. R1-2402041 Discussion on Ambient IoT device architectures FUTUREWEI
29. R1-2402073 Ambient IoT device architectures Nokia
30. R1-2402106 Discussion on Ambient IoT device architectures Spreadtrum Communications
31. R1-2402185 Discussion on Ambient IoT device architectures ZTE, Sanechips
32. R1-2402243 Discussion on Ambient IoT Device architectures vivo
33. R1-2402329 Discussion on device architecture for A-IoT device OPPO
34. R1-2402384 Study of the Ambient IoT devices architecture CATT
35. R1-2402467 Considerations for Ambient-IoT device architectures Samsung
36. R1-2402511 Discussion on Ambient IoT device architectures China Telecom
37. R1-2402566 Discussion on Ambient IoT device architectures CMCC
38. R1-2402667 Discussion on ambient IoT device architectures Xiaomi
39. R1-2402725 Discussion on Ambient IoT device architectures Honor
40. R1-2402827 Device architecture requirements for ambient IoT NEC
41. R1-2402858 Device architectures for Ambient IoT InterDigital, Inc.
42. R1-2402882 Views on device architecture for AIoT Apple
43. R1-2402947 On Ambient IoT device architectures MediaTek
44. R1-2402968 Ambient IoT device architectures Sony
45. R1-2403059 Discussion on Ambient IoT device architectures CEWiT
46. R1-2403102 Discussion on the Ambient IoT device architectures Lenovo
47. R1-2403118 Discussion on Ambient IoT device architectures LG Electronics
48. R1-2403195 Ambient IoT Device Architecture Qualcomm Incorporated
49. R1-2403245 Study on device archtectures for Ambient IoT NTT DOCOMO, INC.
50. R1-2403398 Views on Architecture of Ambient IoT IIT Kanpur, Indian Institute of Tech Madras
51. R1-2401972 General aspects of physical layer design for Ambient IoT Ericsson
52. R1-2401977 Discussion on general aspects of physical layer design for Ambient IoT TCL
53. R1-2402013 On general aspects of physical layer design for Ambient IoT Huawei, HiSilicon
54. R1-2402042 Discussion on physical layer design for Ambient IoT devices FUTUREWEI
55. R1-2402074 General aspects of physical layer design for Ambient IoT Nokia
56. R1-2402107 Discussion on general aspects of physical layer design for Ambient IoT Spreadtrum Communications
57. R1-2402186 Discussion on general aspects of physical layer design for Ambient IoT ZTE, Sanechips
58. R1-2402244 Discussion on General Aspects of Physical Layer Design vivo
59. R1-2402330 Discussion on general aspects of physical layer design of A-IoT communication OPPO
60. R1-2402385 Discussion on general aspects of physical layer design CATT
61. R1-2402468 Considerations on general aspects of Ambient IoT Samsung
62. R1-2402487 General aspects of physical layer design for Ambient IoT Panasonic
63. R1-2402512 Discussion on general aspects of physical layer design for Ambient IoT China Telecom
64. R1-2402547 Discussion on Physical Layer Design for Ambient-IoT EURECOM
65. R1-2402567 Discussion on general aspects of A-IoT physical layer design CMCC
66. R1-2402668 Discussion on physical layer design of Ambient IoT Xiaomi
67. R1-2402706 Considerations on Some Aspects of Physical Layer Design for Ambient IoT Continental Automotive
68. R1-2402720 Ambient IoT – General aspects of physical layer design, for uplink modulation Wiliot Ltd.
69. R1-2402736 Discussion on general aspects of physical layer design Sharp
70. R1-2402769 Discussion on general aspects of ambient IoT physical layer design NEC
71. R1-2402859 Discussion on general aspects of physical layer design for Ambient IoT InterDigital, Inc.
72. R1-2402883 Views on general physical layer design aspects for AIoT Apple
73. R1-2402948 On general aspects of physical layer design for A-IoT MediaTek
74. R1-2402969 General aspects of physical layer design for Ambient IoT Sony
75. R1-2403020 Discussion on general aspects of physical layer design ETRI
76. R1-2403060 Discussion on General aspects of physical layer design CEWiT
77. R1-2403069 Discussions on general aspects of physical layer design for Ambient IoT Ruijie Networks Co. Ltd
78. R1-2403090 Discussion on general aspects of physical layer design Google
79. R1-2403103 Discussion on the physical layer design aspects for Ambient IoT devices Lenovo
80. R1-2403119 General aspects of Ambient IoT physical layer design LG Electronics
81. R1-2403196 General aspects of physical layer design Qualcomm Incorporated
82. R1-2403246 Study on general aspects of physical layer design for Ambient IoT NTT DOCOMO, INC.
83. R1-2403281 Discussion on general aspects of physical layer design Comba
84. R1-2403309 General aspects of physical layer design for Ambient IoT ITL
85. R1-2403394 Discussion on general aspects of physical layer design for AIoT IIT Kanpur, Indian Institute of Technology Madras
86. R1-2401973 Frame structure and timing aspects for Ambient IoT Ericsson
87. R1-2402014 On frame structure and timing aspects of Ambient IoT Huawei, HiSilicon
88. R1-2402043 Discussion on Frame Structure and Timing Aspects for Ambient IoT FUTUREWEI
89. R1-2402075 Frame structure and timing aspects for Ambient IoT Nokia
90. R1-2402108 Discussion on frame structure and timing aspects for Ambient IoT Spreadtrum Communications
91. R1-2402134 Discussions on frame structure and timing aspects for A-IoT Intel Corporation
92. R1-2402154 Discussion on frame structre and timing aspects for Ambient IoT BUPT
93. Late submission
94. R1-2402187 Discussion on frame structure and physical layer procedure for Ambient IoT ZTE, Sanechips
95. R1-2402245 Discussion on Frame structure, random access, scheduling and timing aspects vivo
96. R1-2402331 Discussion on frame structure and timing aspects of A-IoT OPPO
97. R1-2402386 Study of Frame structure and timing aspects for Ambient IoT CATT
98. R1-2402469 Considerations for frame structure and timing aspects Samsung
99. R1-2402513 Discussion on frame structure and timing aspects for Ambient IoT China Telecom
100. R1-2402568 Discussion on frame structure and timing aspects for A-IoT CMCC
101. R1-2402585 Discussion on physical layer procedures for ambient IoT Lenovo
102. R1-2402615 Frame structure and timing aspects of Ambient IoT InterDigital, Inc.
103. R1-2402669 Discussion on frame structre and timing aspects for Ambient IoT Xiaomi
104. R1-2402737 Discussion on frame structure and timing aspects Sharp
105. R1-2402748 Discussion on A-IoT Frame Structure and Timing Aspects Panasonic
106. R1-2402770 Discussion on frame structure and timing for ambient IoT NEC
107. R1-2402796 Discussion on frame structure and timing aspects Fujitsu
108. R1-2402884 Frame structure and timing aspects for Ambient IoT Apple
109. R1-2402949 On frame structure and timing aspects for A-IoT MediaTek
110. R1-2402970 Frame structure and timing aspects for Ambient IoT Sony
111. R1-2403021 Discussion on frame structure and timing aspects ETRI
112. R1-2403038 Discussion on frame structure and timing aspects for AIoT TCL
113. R1-2403042 Discussion on frame structure and timing aspects for Ambient IoT Comba
114. R1-2403061 Discussion on Frame structure and timing aspects CEWiT
115. R1-2403091 Discussion on frame structure and timing aspects Google
116. R1-2403120 Frame structure and timing aspects for Ambient IoT LG Electronics
117. R1-2403197 Frame structure and timing aspects Qualcomm Incorporated
118. R1-2403247 Study on frame structure and timing aspects for Ambient IoT NTT DOCOMO, INC.
119. R1-2403373 Discussion on Frame structure and timing aspects for A-IoT China Unicom
120. R1-2403393 Discussion on Frame Structure and Timing Aspects for Ambient IoT Indian Institute of Tech (M), IIT Kanpur
121. R1-2403395 Discussion on Frame structure and timing aspects for AIoT IIT Kanpur, Indian Institute of Technology Madras
122. R1-2401974 Downlink and uplink channel/signal aspects for Ambient IoT Ericsson
123. R1-2401978 Discussion on downlink and uplink channel/signal aspects for Ambient IoT TCL
124. R1-2402015 Physical channels and signals for Ambient IoT Huawei, HiSilicon
125. R1-2402044 Discussion on D2R and R2D Channel/Signal Aspects for Ambient IoT FUTUREWEI
126. R1-2402076 R2D and D2R channel/signal aspects for Ambient IoT Nokia
127. R1-2402109 Discussion on downlink and uplink channel/signal aspects for Ambient IoT Spreadtrum Communications
128. R1-2402135 Discussions on physical channel and signals for A-IoT Intel Corporation
129. R1-2402188 Discussion on downlink/uplink channel/signal for Ambient IoT ZTE, Sanechips
130. R1-2402246 Discussion on Downlink and uplink channel/signal aspects vivo
131. R1-2402332 Discussion on downlink and uplink channel/signal aspects for A-IoT OPPO
132. R1-2402387 DL and UL Physical Channels/signals design in support of Ambient IoT devices CATT
133. R1-2402470 Considerations for downlink and uplink channel/signal aspect Samsung
134. R1-2402514 Discussion on downlink and uplink channel/signal aspects for Ambient IoT China Telecom
135. R1-2402569 Discussion on downlink and uplink channel/signal aspets CMCC
136. R1-2402586 Discussion on channel/signal aspects for ambient IoT Lenovo
137. R1-2402616 Downlink and uplink channels aspects of Ambient IoT InterDigital, Inc.
138. R1-2402670 Discussion on downlink and uplink channel\_signal aspects for Ambient IoT Xiaomi
139. R1-2402705 Considerations on downlink and uplink channels/signals for A-IoT Continental Automotive
140. R1-2402738 Discussion on downlink and uplink channel/signal aspects Sharp
141. R1-2402771 Discussion on downlink and uplink channel for ambient IoT NEC
142. R1-2402797 Discussion on downlink and uplink channel/signal aspects Fujitsu
143. R1-2402856 Discussion on downlink and uplink channels and signals for A-IoT Panasonic
144. R1-2402885 Views on physical channels/signals and proximity determination for AIoT Apple
145. R1-2402950 On downlink and uplink channel/signal aspects for A-IoT MediaTek
146. R1-2402971 Downlink and uplink physical channel for Ambient IoT Sony
147. R1-2403022 Discussion on downlink and uplink channel/signal aspects for A-IoT ETRI
148. R1-2403043 Discussion on downlink and uplink channel and signal for Ambient IoT Comba
149. R1-2403092 Discussion on downlink and uplink transmission aspects Google
150. R1-2403121 Downlink and uplink channel/signal aspects for Ambient IoT LG Electronics
151. R1-2403198 Downlink and uplink channel/signal aspects Qualcomm Incorporated
152. R1-2403248 Study on downlink and uplink channel/signal aspects for Ambient IoT NTT DOCOMO, INC.
153. R1-2403374 Discussion on downlink and uplink channel aspects for A-IoT China Unicom
154. R1-2403396 Discussion on Downlink and Uplink channel/signal aspects for AIoT IIT Kanpur, Indian Institute of Technology Madras
155. R1-2401975 Waveform characteristics of carrier wave provided externally to the Ambient IoT device Ericsson
156. R1-2401979 Discussion on waveform characteristics of external carrier-wave for Ambient IoT TCL
157. R1-2402016 On external carrier wave for backscattering based Ambient IoT device Huawei, HiSilicon
158. R1-2402045 Discussion on External Carrier Waveform Characteristics for Ambient IoT FUTUREWEI
159. R1-2402077 Waveform characteristics of carrier-wave provided externally to the Ambient IoT device Nokia
160. R1-2402110 Discussion on waveform characteristics of external carrier-wave for Ambient IoT Spreadtrum Communications
161. R1-2402136 Discussions on waveform characteristics of carrier-wave for A-IoT Intel Corporation
162. R1-2402189 Discussion on carrier wave for Ambient IoT ZTE, Sanechips
163. R1-2402247 Discussion on CW waveform and interference handling at AIoT UL receiver vivo
164. R1-2402333 Discussion on Waveform characteristics of carrier-wave provided externally to the A-IoT device OPPO
165. R1-2402388 Discussion on the waveform characteristics of carrier-wave for the Ambient IoT device CATT
166. R1-2402471 Considerations for waveform characteristics of carrier-wave Samsung
167. R1-2402515 Discussion on waveform characteristics of carrier-wave provided externally to the Ambient IoT device China Telecom
168. R1-2402570 Discussion on waveform characteristics of carrier-wave provided externally to the Ambient IoT device CMCC
169. R1-2402587 Discussion on external carrier wave for ambient IoT Lenovo
170. R1-2402671 Discussion on waveform characteristics of carrier-wave Xiaomi
171. R1-2402739 Discussion on waveform characteristics of externally provided carrier-wave Sharp
172. R1-2402860 Discussion on carrier-wave for Ambient IoT InterDigital, Inc.
173. R1-2402886 Views on carrier waveform and interference handling for AIoT Apple
174. R1-2402951 On carrier-wave waveform characteristics for A-IoT MediaTek
175. R1-2402972 External carrier wave for Ambient IoT Sony
176. R1-2403002 Discussion on waveform characteristics of carrier-wave for Ambient IoT device Panasonic
177. R1-2403023 Discussion on waveform characteristics of carrier-wave provided externally to the A-IoT device ETRI
178. R1-2403062 Discussion on Waveform characteristics of carrier-wave provided externally to the Ambient IoT device CEWiT
179. R1-2403093 Discussion on waveform characteristics of carrier-wave provided externally to the Ambient IoT device Google
180. R1-2403094 Considerations for waveform characteristics of carrier-wave Semtech Neuchatel SA
181. R1-2403122 Considerations on carrier-wave transmission for Ambient IoT LG Electronics
182. R1-2403199 Waveform characteristics of carrier-wave provided externally to the Ambient IoT device Qualcomm Incorporated
183. R1-2403249 Study on waveform characteristics of carrier-wave for Ambient IoT NTT DOCOMO, INC.
184. R1-2403399 Discussion on Carrier wave related aspects for AIoT IIT Kanpur, Indian Institute of Technology Madras

**RAN1#117**

1. R1-2403840 Evaluation assumptions and results for Ambient IoT Ericsson
2. R1-2403858 Discussion on evaluation assumptions and results for Ambient IoT devices FUTUREWEI
3. R1-2403885 Evaluation assumption and preliminary results for Ambient IoT Tejas Networks Limited
4. R1-2403886 Evaluation assumptions and results for Ambient IoT Nokia
5. R1-2403952 Evaluation methodology and assumptions for Ambient IoT Huawei, HiSilicon
6. R1-2404026 Discussion on evaluation assumptions and results for Ambient IoT Spreadtrum Communications
7. R1-2404115 Considerations for evaluation assumptions and results Samsung
8. R1-2404177 Evaluation methodologies assumptions and results for Ambient IoT vivo
9. R1-2404284 On evaluation assumptions and link budget analysis for AIoT Apple
10. R1-2404401 The evaluation methodology and preliminary results of Ambient IoT CATT
11. R1-2404427 Discussion on evaluation assumptions and results for Ambient IoT China Telecom
12. R1-2404456 Discussion on evaluation methodology and assumptions CMCC
13. R1-2404500 Initial evaluation results for Ambient IoT Sony
14. R1-2404554 Discussion on Ambient IoT evaluations ZTE, Sanechips
15. R1-2404618 Evaluation methodology and assumptions for Ambient IoT Xiaomi
16. R1-2404793 Discussion on ambient IoT evaluation framework NEC
17. R1-2404868 Discussion on evaluation assumptions and results for A-IoT OPPO
18. R1-2404888 Discussion on Ambient IoT evaluation LG Electronics
19. R1-2404939 Discussion on the evaluation assumptions for Ambient IoT devices Lenovo
20. R1-2404957 Evaluation assumptions for Ambient IoT InterDigital, Inc.
21. R1-2405042 Study on evaluation assumptions for Ambient IoT NTT DOCOMO, INC.
22. R1-2405076 Evaluation assumptions and results MediaTek Inc.
23. R1-2405155 Evaluation Assumptions and Results Qualcomm Incorporated
24. R1-2405214 Evaluation assumptions for Ambient IoT Comba
25. R1-2405296 Evaluation assumption and preliminary results for AIoT IIT Kanpur, Indian Institute of Tech (M)
26. R1-2403841 Ambient IoT device architectures Ericsson
27. R1-2403859 Discussion on Rel-19 Ambient IoT device architecture FUTUREWEI
28. R1-2403880 Discussion on ambient IoT device architectures TCL
29. R1-2403887 Ambient IoT device architectures Nokia
30. R1-2403953 Ultra low power device architectures for Ambient IoT Huawei, HiSilicon
31. R1-2404027 Discussion on Ambient IoT device architectures Spreadtrum Communications
32. R1-2404116 Considerations for Ambient-IoT device architectures Samsung
33. R1-2404178 Discussion on Ambient IoT Device architectures vivo
34. R1-2404285 On device architecture for AIoT Apple
35. R1-2404321 Discussion on Ambient-IoT Device Architecture Everactive
36. Late submission
37. R1-2404402 Study of the Ambient IoT devices architecture CATT
38. R1-2404428 Discussion on Ambient IoT device architectures China Telecom
39. R1-2404457 Discussion on Ambient IoT device architectures CMCC
40. R1-2404501 Ambient IoT device architectures Sony
41. R1-2404555 Discussion on Ambient IoT device architectures ZTE, Sanechips
42. R1-2404619 Discussion on ambient IoT device architectures Xiaomi
43. R1-2404794 Device architecture requirements for ambient IoT NEC
44. R1-2404869 Discussion on device architecture for A-IoT device OPPO
45. R1-2404889 Discussion on Ambient IoT device architectures LG Electronics
46. R1-2404940 Discussion on the Ambient IoT device architectures Lenovo
47. R1-2404958 Device architectures for Ambient IoT InterDigital, Inc.
48. R1-2405043 Study on device archtectures for Ambient IoT NTT DOCOMO, INC.
49. R1-2405077 Ambient IoT device architectures MediaTek Inc.
50. R1-2405156 Ambient IoT Device Architecture Qualcomm Incorporated
51. R1-2405215 Ambient IoT Device Architecture Comba
52. R1-2405297 Views on Architecture of Ambient IoT IIT Kanpur, Indian Institute of Tech (M)
53. R1-2403842 General aspects of physical layer design for Ambient IoT Ericsson
54. R1-2403860 Discussion on physical layer design for Rel-19 Ambient IoT devices FUTUREWEI
55. R1-2403881 Discussion on general aspects of physical layer design for Ambient IoT TCL
56. R1-2403888 General aspects of physical layer design for Ambient IoT Nokia
57. R1-2403954 On general aspects of physical layer design for Ambient IoT Huawei, HiSilicon
58. R1-2404005 Discussion on Physical Layer Design for Ambient-IoT EURECOM
59. R1-2404028 Discussion on general aspects of physical layer design for Ambient IoT Spreadtrum Communications
60. R1-2404117 Considerations on general aspects of Ambient IoT Samsung
61. R1-2404179 Discussion on General Aspects of Physical Layer Design vivo
62. R1-2404286 On general physical layer design aspects for AIoT Apple
63. R1-2404345 On General Physical Layer Design Considerations for Ambient IoT (internet of things) Applications Lekha Wireless Solutions
64. Late submission
65. R1-2404403 Discussion on general aspects of physical layer design CATT
66. R1-2404429 Discussion on general aspects of physical layer design for Ambient IoT China Telecom
67. R1-2404458 Discussion on general aspects of A-IoT physical layer design CMCC
68. R1-2404502 General aspects of physical layer design for Ambient IoT Sony
69. R1-2404556 Discussion on general aspects of physical layer design for Ambient IoT ZTE, Sanechips
70. R1-2404592 Consideration on general aspects of physical layer Fujitsu
71. R1-2404620 Discussion on physical layer design of Ambient IoT Xiaomi
72. R1-2404674 Discussion on general aspects of ambient IoT physical layer design NEC
73. R1-2404743 General aspects of physical layer design for Ambient IoT Panasonic
74. R1-2404775 Discussion on general aspects of physical layer design ETRI
75. R1-2404870 Discussion on general aspects of physical layer design of A-IoT communication OPPO
76. R1-2404890 General aspects of Ambient IoT physical layer design LG Electronics
77. R1-2404941 Discussion on the physical layer design aspects for Ambient IoT devices Lenovo
78. R1-2404959 Discussion on general aspects of physical layer design for Ambient IoT InterDigital, Inc.
79. R1-2404962 Discussion on general aspects of physical layer design Sharp
80. R1-2405044 Study on general aspects of physical layer design for Ambient IoT NTT DOCOMO, INC.
81. R1-2405078 General aspects of physical layer design MediaTek Inc.
82. R1-2405124 Discussions on general aspects of physical layer design for Ambient IoT Ruijie Networks Co. Ltd
83. R1-2405157 General aspects of physical layer design Qualcomm Incorporated
84. R1-2405216 Discussion on physical layer design for Ambient IoT Comba
85. R1-2405224 General aspects of physical layer design for Ambient IoT ITL
86. R1-2405242 Discussion on General aspects of physical layer design CEWiT
87. R1-2405269 Ambient IoT – General aspects of physical layer design, performance for uplink modulation Wiliot Ltd.
88. R1-2405298 Discussion on General aspects of physical layer design for AIoT IIT Kanpur, Indian Institute of Tech (M)
89. R1-2403843 Frame structure and timing aspects for Ambient IoT Ericsson
90. R1-2403861 Frame Structure and Timing Aspects for Ambient IoT FUTUREWEI
91. R1-2403889 Frame structure and timing aspects for Ambient IoT Nokia
92. R1-2403955 On frame structure and timing aspects of Ambient IoT Huawei, HiSilicon
93. R1-2403966 Discussions on frame structure and timing aspects for A-IoT Intel Corporation
94. R1-2404029 Discussion on frame structure and timing aspects for Ambient IoT Spreadtrum Communications
95. R1-2404118 Considerations for frame structure and timing aspects Samsung
96. R1-2404180 Discussion on Frame structure, random access, scheduling and timing aspects vivo
97. R1-2404219 Discussion on frame structure and physical layer procedures for Ambient IoT Lenovo
98. R1-2404287 Frame structure and timing aspects for Ambient IoT Apple
99. R1-2404329 Discussion on frame structure and timing aspects for Ambient IoT TCL
100. R1-2404404 Study of Frame structure and timing aspects for Ambient IoT CATT
101. R1-2404430 Discussion on frame structure and timing aspects for Ambient IoT China Telecom
102. R1-2404459 Discussion on frame structure and timing aspects for A-IoT CMCC
103. R1-2404503 Frame structure and timing aspects for Ambient IoT Sony
104. R1-2404519 Frame structure and timing aspects of Ambient IoT InterDigital, Inc.
105. R1-2404557 Discussion on frame structure and physical layer procedure for Ambient IoT ZTE, Sanechips
106. R1-2404593 Discussion on frame structure and timing aspects Fujitsu
107. R1-2404596 Discussion on A-IoT Frame Structure and Timing Aspects Panasonic
108. R1-2404621 Discussion on frame structure and timing aspects for Ambient IoT Xiaomi
109. R1-2404675 Discussion on frame structure and timing for ambient IoT NEC
110. R1-2404734 Discussion on frame structre and timing aspects for Ambient IoT BUPT
111. R1-2404776 Discussion on frame structure and timing aspects ETRI
112. R1-2404798 Some Considerations on Frame Structure and Timing Aspects for A-IoT Continental Automotive
113. R1-2404803 Discussion on Frame Structure and Timing Aspects for Ambient IoT IIT, Kharagpur
114. R1-2404871 Discussion on frame structure and timing aspects of A-IoT communication OPPO
115. R1-2404891 Frame structure and timing aspects for Ambient IoT LG Electronics
116. R1-2404963 Discussion on frame structure and timing aspects Sharp
117. R1-2405045 Study on frame structure and timing aspects for Ambient IoT NTT DOCOMO, INC.
118. R1-2405079 Frame structure and timing aspects MediaTek Inc.
119. R1-2405158 Frame structure and timing aspects Qualcomm Incorporated
120. R1-2405183 Discussion on Frame structure and timing aspects for A-IoT China Unicom
121. R1-2405208 Discussion on frame structure and timing aspect ASUSTeK
122. R1-2405217 Discussion on frame structure and timing aspects for Ambient IoT Comba
123. R1-2405243 Discussion on Frame structure and timing aspects CEWiT
124. R1-2405273 Discussion on frame structure and timing aspects Google
125. R1-2403844 Downlink and uplink channel/signal aspects for Ambient IoT Ericsson
126. R1-2403862 D2R and R2D Channel/Signal Aspects for Ambient IoT FUTUREWEI
127. R1-2403882 Discussion on downlink and uplink channel/signal aspects for Ambient IoT TCL
128. R1-2403890 R2D and D2R channel/signal aspects for Ambient IoT Nokia
129. R1-2403956 Physical channels and signals for Ambient IoT Huawei, HiSilicon
130. R1-2403967 Discussions on physical channel and signals for A-IoT Intel Corporation
131. R1-2404030 Discussion on downlink and uplink channel/signal aspects for Ambient IoT Spreadtrum Communications
132. R1-2404119 Considerations for downlink and uplink channel/signal aspect Samsung
133. R1-2404181 Discussion on Downlink and uplink channel/signal aspects vivo
134. R1-2404220 Discussion on channel/signal aspects for Ambient IoT Lenovo
135. R1-2404288 On physical channels/signals and proximity determination for AIoT Apple
136. R1-2404405 DL and UL Physical Channels/signals design in support of Ambient IoT devices CATT
137. R1-2404431 Discussion on downlink and uplink channel/signal aspects for Ambient IoT China Telecom
138. R1-2404460 Discussion on downlink and uplink channel/signal aspects CMCC
139. R1-2404504 Downlink and uplink physical channel for Ambient IoT Sony
140. R1-2404520 Downlink and uplink channels aspects of Ambient IoT InterDigital, Inc.
141. R1-2404558 Discussion on channel and signal for Ambient IoT ZTE, Sanechips
142. R1-2404576 Discussion on downlink and uplink channel/signal aspects for A-IoT HONOR
143. R1-2404594 Discussion on downlink and uplink channel/signal aspects Fujitsu
144. R1-2404622 Discussion on downlink and uplink channel\_signal aspects for Ambient IoT Xiaomi
145. R1-2404676 Discussion on downlink and uplink channel for ambient IoT NEC
146. R1-2404777 Downlink and uplink channel/signal aspects for A-IoT ETRI
147. R1-2404799 Considerations on Downlink and Uplink Channels/Signals for A-IoT Continental Automotive
148. R1-2404872 Discussion on downlink and uplink channel/signal aspects for A-IoT OPPO
149. R1-2404892 Downlink and uplink channel/signal aspects for Ambient IoT LG Electronics
150. R1-2404901 Discussion on downlink and uplink channels and signals for A-IoT Panasonic
151. R1-2404937 Considerations for downlink and uplink channel/signal aspects Semtech Neuchatel SA
152. R1-2404964 Discussion on downlink and uplink channel/signal aspects Sharp
153. R1-2405046 Study on downlink and uplink channel/signal aspects for Ambient IoT NTT DOCOMO, INC.
154. R1-2405080 Downlink and uplink channel/signal aspects MediaTek Inc.
155. R1-2405159 Downlink and uplink channel/signal aspects Qualcomm Incorporated
156. R1-2405184 Discussion on downlink and uplink channel aspects for A-IoT China Unicom
157. R1-2405218 Discussion on downlink and uplink channel and signal for Ambient IoT Comba
158. R1-2405244 Discussion on Downlink and Uplink channel/signal aspects CEWiT
159. R1-2405274 Discussion on downlink and uplink transmission aspects Google
160. R1-2405300 Discussion on Downlink and uplink channel signal aspects for AIoT IIT Kanpur, Indian Institute of Tech (M)
161. R1-2403845 Waveform characteristics of carrier wave provided externally to the Ambient IoT device Ericsson
162. R1-2403863 Discussion on External Carrier Waveform Characteristics for Rel-19 Ambient IoT devices FUTUREWEI
163. R1-2403883 Discussion on waveform characteristics of external carrier-wave for Ambient IoT TCL
164. R1-2403891 Waveform characteristics of carrier-wave provided externally to the Ambient IoT device Nokia
165. R1-2403957 On external carrier wave for backscattering based Ambient IoT device Huawei, HiSilicon
166. R1-2403968 Discussions on waveform characteristics of carrier-wave for A-IoT Intel Corporation
167. R1-2404031 Discussion on waveform characteristics of external carrier-wave for Ambient IoT Spreadtrum Communications
168. R1-2404120 Considerations for Waveform characteristics of carrier-wave Samsung
169. R1-2404182 Discussion on CW waveform and interference handling at AIoT UL receiver vivo
170. R1-2404221 Discussion on external carrier wave for Ambient IoT Lenovo
171. R1-2404289 On carrier waveform and interference handling for AIoT Apple
172. R1-2404406 Discussion on the waveform characteristics of carrier-wave for the Ambient IoT device CATT
173. R1-2404432 Discussion on waveform characteristics of carrier-wave provided externally to the Ambient IoT device China Telecom
174. R1-2404461 Discussion on waveform characteristics of carrier-wave provided externally to the Ambient IoT device CMCC
175. R1-2404505 External carrier wave for Ambient IoT Sony
176. R1-2404559 Discussion on carrier wave for Ambient IoT ZTE, Sanechips
177. R1-2404623 Discussion on waveform characteristics of carrier-wave Xiaomi
178. R1-2404778 Waveform characteristics of carrier-wave provided externally to the A-IoT device ETRI
179. R1-2404873 Discussion on Waveform characteristics of carrier-wave provided externally to the A-IoT device OPPO
180. R1-2404893 Considerations on carrier-wave transmission for Ambient IoT LG Electronics
181. R1-2404902 Discussion on waveform characteristics of carrier-wave for Ambient IoT device Panasonic
182. R1-2404938 Considerations for carrier-wave aspects Semtech Neuchatel SA
183. R1-2404960 Discussion on carrier-wave for Ambient IoT InterDigital, Inc.
184. R1-2404965 Discussion on waveform characteristics of externally provided carrier-wave Sharp
185. R1-2405006 Analyses on interference between AIoT and NR Fujitsu
186. R1-2405047 Study on waveform characteristics of carrier-wave for Ambient IoT NTT DOCOMO, INC.
187. R1-2405081 Waveform characteristics of carrier-wave provided externally to the Ambient IoT device MediaTek Inc.
188. R1-2405160 Waveform characteristics of carrier-wave provided externally to the Ambient IoT device Qualcomm Incorporated
189. R1-2405185 Discussion on waveform characteristics of carrier-wave provided externally to the Ambient IoT device China Unicom
190. R1-2405219 Discussion on waveform characteristics of carrier-wave for Ambient IoT Comba
191. R1-2405245 Discussion on Waveform characteristics of carrier-wave provided externally to the Ambient IoT device CEWiT
192. R1-2405275 Discussion on waveform characteristics of carrier-wave provided externally to the Ambient IoT device Google
193. R1-2405301 Discussion on Carrier wave related aspects for AIoT IIT Kanpur, Indian Institute of Tech (M)

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1. R2-2402156 Discussion on general aspects for Ambient IoT China Telecom
2. R2-2402157 Discussion on user plane for Ambient IoT China Telecom
3. R2-2402158 Discussion on random access for Ambient IoT China Telecom
4. R2-2402164 Discussion on access procedure for ambient IOT Xiaomi
5. R2-2402165 Discussion on protocol stack for ambient IOT Xiaomi
6. R2-2402178 Stage 2 overall procedures, baseline assumptions on security and use cases CATT
7. R2-2402179 Discussion on the Control Plane for Ambient IoT CATT
8. R2-2402180 Discussion on Data Transmission and Protocol Stack of A-IoT CATT
9. R2-2402181 Discussion on Paging Functionality of Ambient IoT CATT
10. R2-2402182 Discussion on the Random Access for Ambient IoT CATT
11. R2-2402191 General considerations on Ambient IoT OPPO
12. R2-2402192 Discussion on user-plane aspects for Ambient IoT OPPO
13. R2-2402197 Discussion on control-plane aspects for Ambient IoT OPPO
14. R2-2402198 Discussion on paging procedure for Ambient IoT OPPO
15. R2-2402200 Discussion on random access for Ambient IoT OPPO
16. R2-2402271 Discussions on General Aspect of Ambient IoT Fujitsu
17. R2-2402272 Discussions on User Plane Protocol Stacks Fujitsu
18. R2-2402273 Discussions on paging Fujitsu
19. R2-2402274 Discussions on Random Access Fujitsu
20. R2-2402289 Control Plane for Ambient-IoT NEC Corporation
21. R2-2402290 User Plane for Ambient-IoT NEC
22. R2-2402322 Considerations on the control plane aspects of the Ambient IOT Beijing Xiaomi Software Tech
23. R2-2402323 Considerations on the general aspects of the Ambient IOT Beijing Xiaomi Software Tech
24. R2-2402344 Discussion on control plane of Ambient IOT Spreadtrum Communications
25. R2-2402345 Discussion on user plane of Ambient IOT Spreadtrum Communications
26. R2-2402346 Discussion on random access of Ambient IOT Spreadtrum Communications
27. R2-2402349 Discussion on general aspects of A-IoT Spreadtrum Communications
28. R2-2402350 Discussion on paging functionality of A-IoT Spreadtrum Communications
29. R2-2402374 Consideration on general aspects for AIoT ZTE Corporation, Sanechips
30. R2-2402376 Consideration on CP functionality for AIoT ZTE Corporation, Sanechips
31. R2-2402377 Consideration on UP functionality for AIoT ZTE Corporation, Sanechips
32. R2-2402378 Consideration on Paging functionality for AIoT ZTE Corporation, Sanechips
33. R2-2402379 Consideration on Random Access procedure for AIoT ZTE Corporation, Sanechips
34. R2-2402392 Use Cases and Stage 2 Procedure Flow for Ambient IOT InterDigital
35. R2-2402393 Control Plane Aspects for Ambient IOT InterDigital
36. R2-2402394 User Plane Aspects for Ambient IOT InterDigital
37. R2-2402395 Paging for Ambient IOT InterDigital
38. R2-2402396 Random Access for Ambient IOT InterDigital
39. R2-2402422 General considerations for A-IoT Intel Corporation
40. R2-2402423 Required Control plane functions for A-IoT Intel Corporation
41. R2-2402424 Required User plane functions for A-IoT Intel Corporation
42. R2-2402425 Paging design for A-IoT Intel Corporation
43. R2-2402426 Random access aspects for A-IoT Intel Corporation
44. R2-2402434 Study on Paging for Ambient IoT SHARP Corporation
45. R2-2402435 Study on Random access for Ambient IoT SHARP Corporation
46. R2-2402490 General discussion on ambient IoT vivo
47. R2-2402491 Discussion on Control Plane Aspects for Ambient IoT vivo
48. R2-2402492 Discussion on User Plane Aspects for Ambient IoT vivo
49. R2-2402493 Discussion on the functionality of paging in ambient IoT vivo
50. R2-2402494 Initial Access Procedure for Ambient IoT vivo
51. R2-2402548 Discussion on random access for Ambient IoT CMCC
52. R2-2402604 Discussion on paging procedure for A-IOT Xiaomi
53. R2-2402608 Discussion on random access for Ambient IoT ETRI
54. R2-2402674 Initial Access procedure for Ambient IoT device NEC
55. R2-2402696 Overall procedure and related aspects on Ambient IoT HONOR
56. R2-2402725 Discussion on user plane for Ambient IoT Lenovo
57. R2-2402726 Discussion on paging procedure for Ambient IoT Lenovo
58. R2-2402727 Discussion on random access for Ambient IoT Lenovo
59. R2-2402786 Principles for RAN2 work on ambient IoT MediaTek Inc.
60. R2-2402793 Considerations on C-plane aspects for Ambient IoT Lenovo
61. R2-2402794 Considerations on general aspects for Ambient IoT Lenovo
62. R2-2402891 Discussion on Control plane for Ambient IoT Apple
63. R2-2402892 Discussion on User plane for Ambient IoT Apple
64. R2-2402893 Discussion on Paging for Ambient IoT Apple
65. R2-2402894 Discussion on Random Access for Ambient IoT Apple
66. R2-2402896 A-IoT device hardware capabilities Apple
67. R2-2402918 General aspects for AIoT Samsung
68. R2-2402919 Initial view on the user plane aspects of AIoT Samsung
69. R2-2402920 Initial considerations on the RACH procedure for AIoT Samsung
70. R2-2402928 Stage-2 and general aspects of Ambient IoT Qualcomm Incorporated
71. R2-2402929 Control plane aspects of Ambient IoT Qualcomm Incorporated
72. R2-2402930 Paging aspects of Ambient IoT Qualcomm Incorporated
73. R2-2402938 User plane aspects of Ambient IoT Qualcomm Incorporated
74. R2-2402939 Random access aspects of Ambient IoT Qualcomm Incorporated
75. R2-2402949 General aspects for Ambient IoT Ericsson
76. R2-2402950 UP protocol and data transmission options Ericsson
77. R2-2402951 Discussion on UL multiple access Ericsson
78. R2-2402970 Ambient-IoT General Aspects NEC
79. R2-2402971 Considerations on Ambient-IoT Paging NEC
80. R2-2402977 Discussion on ambient IoT control plane functionality LG Electronics Inc.
81. R2-2402978 Discussion on ambient IoT paging functionality LG Electronics Inc.
82. R2-2402997 General aspects of AIoT Nokia
83. R2-2403011 General considerations on A-IOT CMCC
84. R2-2403012 Discussion on User Plane of A-IoT CMCC
85. R2-2403025 Discussion on A-IoT paging CMCC
86. R2-2403026 Discussion on control plane functions and signalling for Ambient IoT CMCC
87. R2-2403027 Work plan for Ambient IoT CMCC, Huawei, T-Mobile
88. R2-2403031 Considerations on random access in AIoT Nokia
89. R2-2403055 Considerations on various aspects for Ambient IoT Sony
90. R2-2403078 Discussion on random access aspects for Ambient-IoT Continental Automotive
91. R2-2403097 General aspects, high-level procedure and security aspects for Ambient IoT Huawei, HiSilicon, China Telecom, China Unicom, LG Electronics Inc., ZTE Corporation, Sanechips, Apple, NEC
92. R2-2403098 Other control plane aspects for Ambient IoT Huawei, HiSilicon
93. R2-2403099 Data transmission and protocol stack for A-IoT Huawei, HiSilicon
94. R2-2403100 Discussion on paging-like functionality design Huawei, HiSilicon
95. R2-2403113 TP for TR 38.769 update (RAN2 sub-clause skeleton) Huawei, CMCC, T-Mobile USA
96. R2-2403114 Random access-like procedure for Ambient IoT Huawei, HiSilicon
97. R2-2403115 Discussion on paging for Ambient IoT China Telecom
98. R2-2403117 Discussion on CP aspects of Ambient-IoT China Telecom
99. R2-2403149 Consideration on paging in AIoT Nokia
100. R2-2403257 Ambient IoT Paging Method Wiliot Ltd.
101. R2-2403259 Considerations of the data transmission in AIoT Nokia
102. R2-2403260 Energy-aware design for AIoT daa transmissions Nokia
103. R2-2403348 Discussion on contention-based access LG Electronics Inc.
104. R2-2403349 Discussion on user plane protocl stack and data transmission for A-IOT LG Electronics Inc.
105. R2-2403372 Considerations on protocol architecture for ambient IoT KT Corp.
106. R2-2403405 Discussion on DL reachability for Ambient IoT Ericsson
107. R2-2403406 Overview of CP protocols for Ambient IoT Ericsson
108. R2-2403421 Initial consideration of Ambient IoT Kyocera
109. R2-2403506 Initial considerations on the paging for AIoT Samsung
110. R2-2403516 Initial views on the control plane aspects of AIoT Samsung Electronics Czech
111. R2-2403561 Design Targets for Ambient IoT T-Mobile USA Inc.
112. R2-2403563 LS on Security Requirements for Ambient IoT T-Mobile USA Inc.
113. R2-2403609 Discussion on general aspects of Ambient IoT Futurewei
114. R2-2403610 Discussion on user plane aspects for Ambient IoT Futurewei
115. R2-2403611 Discussion on Control Plane for Ambient IoT NTT DOCOMO INC.
116. R2-2403612 Discussion on paging functions for Ambient IoT Futurewei
117. R2-2403613 Discussion on random access for Ambient IoT Futurewei
118. R2-2403616 Discussion on User Plane for Ambient IoT NTT DOCOMO INC.
119. R2-2403618 Discussion on user plane functionalities in A-IOT LG Electronics Inc.
120. R2-2403620 Discussion on random access for Ambient IoT LG Electronics Inc.
121. R2-2403645 Discussion on random access for ambient IoT Google Inc.
122. R2-2403676 General considerations on Ambient IoT Philips International B.V.
123. R2-2403677 Discussion on general aspects of ambient IoT LG Electronics Inc.
124. R2-2403679 Stage 2 overall procedures, baseline assumptions on security and use cases CATT, CEPRI
125. R2-2403680 Discussion on the Control Plane for Ambient IoT CATT, CEPRI
126. R2-2403681 Discussion on Data Transmission and Protocol Stack of Ambient IoT CATT, CEPRI
127. R2-2403682 Discussion on Paging Functionality of Ambient IoT CATT, CEPRI
128. R2-2403683 Discussion on the Random Access for Ambient IoT CATT, CEPRI

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1. R2-2404154 Discussion on access procedure for ambient IOT Xiaomi
2. R2-2404155 Discussion on functions in protocol stack for ambient IOT Xiaomi
3. R2-2404192 Overall procedures for Inventory and Command use cases Intel Corporation
4. R2-2404193 Required functions for A-IoT Intel Corporation
5. R2-2404194 Consideration on initial trigger message Intel Corporation
6. R2-2404195 Consideration on contention based and contention free based Access Intel Corporation
7. R2-2404224 Initial Access procedure for Ambient IoT device NEC
8. R2-2404231 Discussion on stage 2 overall procedures for Ambient IoT CATT, CEPRI
9. R2-2404232 Discussion on the Functionality Aspects for Ambient IoT CATT, CEPRI
10. R2-2404233 Discussion on Paging for Ambient IoT CATT, CEPRI
11. R2-2404234 Discussion on the Random Access for Ambient IoT CATT, CEPRI
12. R2-2404243 A-IoT random access procedure Huawei, HiSilicon
13. R2-2404344 Discussions on General Aspect of Ambient IoT Fujitsu
14. R2-2404345 Discussions on AIoT Functionalities Fujitsu
15. R2-2404346 Discussions on AIoT paging Fujitsu
16. R2-2404347 Discussions on AIoT Random Access Fujitsu
17. R2-2404369 Ambient IoT device paging TCL
18. R2-2404373 Random Access for Ambient IOT TCL
19. R2-2404381 Discussion on general aspects of AIoT Futurewei
20. R2-2404382 On not supporting segmentation and reassembly in Layer 2 for AIoT Futurewei
21. R2-2404383 Discussion on AIoT paging Futurewei
22. R2-2404384 Discussion on AIoT random access Futurewei
23. R2-2404394 General discussion on ambient IoT vivo
24. R2-2404395 Discussion on functionality aspects for Ambient IoT vivo
25. R2-2404396 Discussion on AIoT Paging vivo
26. R2-2404397 Random Access Procedure for A-IoT Device vivo
27. R2-2404398 Discussion on Paging Design for Ambient IoT China Telecom
28. R2-2404498 General aspects for Ambient IoT Ericsson
29. R2-2404499 Discussion on UL multiple access Ericsson
30. R2-2404500 Ambient IoT identifiers and "paging" procedure MediaTek Inc.
31. R2-2404501 AIoT read and write operations MediaTek Inc.
32. R2-2404507 Control and user plane modelling for ambient IoT interface MediaTek Inc.
33. R2-2404508 Transfer of upper-layer AIoT information MediaTek Inc.
34. R2-2404521 Considerations on functionality aspects for Ambient IoT Lenovo
35. R2-2404533 General Aspects on Ambient IOT InterDigital
36. R2-2404534 Functions for Ambient IOT InterDigital
37. R2-2404535 Paging for Ambient IOT InterDigital
38. R2-2404536 Access Procedure for Ambient IOT InterDigital
39. R2-2404538 A-IoT Functionality ZTE Corporation, Sanechips
40. R2-2404539 Random Access procedure for A-IoT ZTE Corporation, Sanechips
41. R2-2404569 Ambient-IoT General Aspects NEC
42. R2-2404570 Ambient-IoT Paging NEC
43. R2-2404571 Discussion on the Random Access for Ambient IoT LG Uplus
44. R2-2404578 Discussion on A-IOT paging procedure Xiaomi
45. R2-2404579 Discussion on paging procedure for Ambient IoT OPPO
46. R2-2404585 Discussion on random access for Ambient IoT OPPO
47. R2-2404586 Discussion on needed functionalities for Ambient IoT communication OPPO
48. R2-2404587 Stage 2 overall procedure flow OPPO
49. R2-2404628 Outstanding stage-2 issues of Ambient IoT design Apple
50. R2-2404659 Disucssion on functional aspects for Ambient IoT Apple
51. R2-2404660 Discussion on Ambient IoT Paging Apple
52. R2-2404661 Discussion on Ambient IoT Random Access Apple
53. R2-2404689 Discussion on A-IoT paging functionality LG Electronics Inc.
54. R2-2404795 Functionality aspects for A-IoT Ericsson
55. R2-2404809 Considerations on general aspects for Ambient IoT Lenovo
56. R2-2404810 Discussion on paging procedure for Ambient IoT Lenovo
57. R2-2404811 Discussion on random access for Ambient IoT Lenovo
58. R2-2404864 Discussion on A-IoT random access procedure ETRI
59. R2-2404873 Considerations on the general aspects of the Ambient IOT Beijing Xiaomi Software Tech
60. R2-2404876 Further consideration on general aspects for AIoT ZTE Corporation, Sanechips
61. R2-2404879 Ambient-IoT Functionality Aspects NEC
62. R2-2404881 Discussion on paging-like procedure for AIoT ZTE Corporation, Sanechips
63. R2-2404891 Ambient IoT Paging Method Wiliot Ltd.
64. R2-2404903 Considerations on paging for Ambient IoT Sony
65. R2-2404904 Considerations on random access aspects for Ambient IoT Sony
66. R2-2404925 Discussion on the functionalities required for Ambient IOT Spreadtrum Communications
67. R2-2404926 Discussion on random access of Ambient IOT Spreadtrum Communications
68. R2-2404929 Discussion on general aspects of A-IoT Spreadtrum Communications
69. R2-2404930 Discussion on paging functionality of A-IoT Spreadtrum Communications
70. R2-2404956 Discussion on random access aspects for Ambient-IoT Continental Automotive
71. R2-2404981 Discussion on functionality aspects of ambient IoT KT Corp.
72. R2-2404983 Discussion on general aspects for Ambient IoT HONOR
73. R2-2405015 Further discussion on random access for Ambient IoT CMCC
74. R2-2405030 Discussion on A-IoT paging CMCC
75. R2-2405039 General considerations on A-IoT CMCC
76. R2-2405040 Discussion on protocol stack of A-IoT CMCC
77. R2-2405041 General aspects and overall procedure Huawei, HiSilicon, Wiliot Ltd., Orange, LG Uplus, NTT DOCOMO, INC.
78. R2-2405042 A-IoT functionalities Huawei, HiSilicon
79. R2-2405043 A-IoT paging functionality Huawei, HiSilicon
80. R2-2405107 Further on AIoT random access Nokia
81. R2-2405140 Random access aspects of Ambient IoT Qualcomm Incorporated
82. R2-2405194 On Paging procedure for Ambient IoT Nokia
83. R2-2405212 General aspects of Ambient IoT Qualcomm Incorporated
84. R2-2405214 Views on Functionality Aspects of Ambient IoT Qualcomm Incorporated
85. R2-2405215 Views on Paging for Ambient IoT Qualcomm Incorporated
86. R2-2405227 Discussion on DL messages for Ambient IoT UEs Ericsson
87. R2-2405233 On AIoT functionality aspect Nokia
88. R2-2405244 Further on general aspects of AIoT Nokia
89. R2-2405269 Considerations for functionality aspects Semtech Neuchatel SA
90. R2-2405270 Considerations for Random Access Semtech Neuchatel SA
91. R2-2405291 Discussion on general aspects of ambient IoT LG Electronics Inc.
92. R2-2405305 Discussion on stage-2 aspects for Ambient IoT China Telecom
93. R2-2405306 Discussion on functionalities required for A-IoT devices China Telecom
94. R2-2405307 Discussion on random access for Ambient IoT China Telecom
95. R2-2405358 Discussion on random access for ambient IoT Google Inc.
96. R2-2405383 Overall procedures for Ambient IoT Kyocera
97. R2-2405384 Functionalities for Ambient IoT Kyocera
98. R2-2405427 Discussion on Ambient IoT random access conditions ASUSTeK
99. R2-2405465 General aspects for AIoT Samsung
100. R2-2405466 Discussions on functionalities required for AIoT Samsung
101. R2-2405495 Discussion on A-IoT paging Samsung
102. R2-2405496 Discussion on A-IoT random access Samsung
103. R2-2405518 Discussion on random access aspects for Ambient IoT LG Electronics Inc.
104. R2-2405520 Discussion on user plane aspects for Ambient IoT LG Electronics Inc.
105. R2-2405550 Discussion on random access for Ambient IoT CEWiT
106. R2-2405598 Discussion on Stage 2 aspects for Ambient IoT NTT DOCOMO, INC.
107. R2-2405603 Discussion on initial trigger message (paging-like message) on Ambient IoT NTT DOCOMO, INC.
108. R2-2405604 Discussion on random access-like procedure for Ambient IoT NTT DOCOMO INC.
109. R2-2405615 TP for TR 38.769 update and terminologies Huawei, CMCC, T-Mobile USA
110. R2-2405688 On Random Access for Ambient IoT Philips International B.V.
111. R2-2405691 Discussion on functionality aspects for Ambient IoT Philips International B.V.
112. R2-2405697 Functions for Ambient IOT InterDigital
113. R2-2405950 Report of [AT126][022][AIoT] CB on 4 step RA Huawei

**RAN3#123bis**

1. R3-241570 Initial views on RAN architecture for Ambient IoT China Telecommunication
2. R3-241583 Discussion on A-IoT RAN architecture NEC
3. R3-241584 Discussion on A-IoT NG RAN interface impact NEC
4. R3-241635 On Requirements and Use Cases in Ambient IoT study in 3GPP Rel-19 Ericsson
5. R3-241636 On Use Cases for Ambient IoT work in 3GPP Rel-19 and related functions Ericsson
6. R3-241637 RAN-CN Protocol Aspects for Ambient IoT study in 3GPP Rel-19 Ericsson
7. R3-241638 Flows and Time Lines for Ambient IoT study in 3GPP Rel-19 Ericsson
8. R3-241679 TR 38.769 skeleton for Study on solutions for Ambient IoT (Internet of Things) in NR Huawei, CMCC
9. R3-241680 RAN architecture aspects for Ambient IoT Huawei
10. R3-241681 Inventory over CN-RAN interface Huawei
11. R3-241682 Data Transport and Device context management over CN-RAN interface Huawei
12. R3-241683 Location report of Ambient IoT devices Huawei
13. R3-241746 Discussion on AIoT RAN architecture Xiaomi
14. R3-241747 (TP for TR 38.769) AIoT interface impacts between RAN and CN Xiaomi
15. R3-241748 (TP for TR 38.796) AIoT device localization Xiaomi
16. R3-241807 RAN architecture considerations of ambient IoT Lenovo
17. R3-241808 Paging considerations of ambient IoT Lenovo
18. R3-241809 Device context management considerations of ambient IoT Lenovo
19. R3-241810 Data transport considerations of ambient IoT Lenovo
20. R3-241836 [TP for TR 38.769] Architecture Requirements for Supporting Ambient AIoT Devices Nokia
21. R3-241837 [TP for TR 38.769] RAN Architecture and Protocol Stack for AIoT Nokia
22. R3-241838 Paging Signalling Impacts for AIoT Nokia
23. R3-241839 [TP for TR 38.769] Paging Signalling Impacts for AIoT Nokia
24. R3-241850 Architecture aspects and Protocol stack for Ambient IoT Qualcomm Incorporated
25. R3-241851 Paging and device context management for Ambient IoT Qualcomm Incorporated
26. R3-241852 Ambient IoT positioning Qualcomm Incorporated
27. R3-241905 Discussion on NG Interface Signalling for Ambient IoT China Telecom
28. R3-241933 Consideration on A-IoT architecture aspects CATT
29. R3-241934 Discussion on Paging for A-IoT CATT
30. R3-241935 Discussion on UE context management and Data transport for A-IoT CATT
31. R3-241936 Consideration on positioning aspects for A-IoT CATT
32. R3-241957 Work Plan for Ambient IoT SI CMCC, Huawei, T-Mobile USA
33. R3-241958 Discussion on RAN Architecture for Ambient IoT CMCC
34. R3-241959 Discussion on paging for Ambient IoT CMCC
35. R3-241960 Discussion on Device Context Management and Data Transfer CMCC
36. R3-241961 Discussion on locating Ambient IoT device CMCC
37. R3-241981 Discussion on RAN architecture for Ambient IoT LG Electronics
38. R3-242038 Discussion on RAN architecture for Ambient IoT Samsung
39. R3-242039 Discussion on RAN-CN interface impact for Ambient IoT Samsung
40. R3-242087 Discussion on RAN architecture for Ambient-IOT ZTE
41. R3-242088 Discussion on NG interface impact for Ambient-IOT ZTE
42. R3-242089 Discussion on overall procedure for Ambient-IOT ZTE
43. R3-242090 Discussion on position for Ambient-IOT ZTE
44. R3-242148 TR 38.769 skeleton for Study on solutions for Ambient IoT (Internet of Things) in NR Huawei, CMCC
45. R3-242149 CB:#AIoT1\_General Huawei
46. R3-242153 CB:#AIoT2\_Locating CMCC

**RAN3#124**

1. R3-243103 TR 38.769 skeleton for Study on solutions for Ambient IoT in NR Huawei, CMCC
2. R3-243128 [TP for TR 38.769] RAN Architecture and Protocol Stack for AIoT Nokia
3. R3-243129 Paging Signalling Impacts for AIoT Nokia
4. R3-243130 [TP for TR 38.769] Paging Signalling Impacts for AIoT Nokia
5. R3-243131 [TP for TR 38.769] Data Transport and Context Management for AIoT Nokia
6. R3-243133 (TP for TR38.769) RAN architecture for Ambient-IoT ZTE
7. R3-243134 [Draft] LS on CN-RAN interface design for Ambient-IoT ZTE
8. R3-243135 (TP for TR38.769) NG interface impact for Ambient-IoT ZTE
9. R3-243136 (TP for TR38.769) Locating Ambient-IoT device ZTE
10. R3-243191 Architecture aspects and Protocol stack for Ambient IoT Qualcomm Incorporated
11. R3-243192 Paging, device context management and data transport for Ambient IoT Qualcomm Incorporated
12. R3-243193 Methods for locating an Ambient IoT device Qualcomm Incorporated
13. R3-243233 Consideration on RAN architecture aspects Huawei
14. R3-243234 Inventory over CN-RAN interface Huawei
15. R3-243235 Command and Context management over CN-RAN interface Huawei
16. R3-243236 Location report of Ambient IoT devices Huawei
17. R3-243244 RAN architecture discussion on ambient IoT NEC
18. R3-243245 RAN-CN interface impact on ambient IoT NEC
19. R3-243246 Further discussion on ambient IoT locating NEC
20. R3-243295 AIoT RAN architecture Xiaomi
21. R3-243296 AIoT interface impacts between RAN and CN Xiaomi
22. R3-243297 Locating AIoT device Xiaomi
23. R3-243400 [TP for TR 38.769] RAN architecture considerations of Ambient IoT Lenovo
24. R3-243401 [TP for TR 38.769] Paging considerations of Ambient IoT Lenovo
25. R3-243402 [TP for TR 38.769] Device context management considerations of Ambient IoT Lenovo
26. R3-243403 [TP for TR 38.769] Data transport considerations of Ambient IoT Lenovo
27. R3-243549 On functional split between RAN and CN Ericsson
28. R3-243550 Nature and Content of Information exchanged between RAN and CN for Ambient IoT Ericsson
29. R3-243551 [DRAFT] LS on AIoT - RAN3 assumptions on functional split between RAN and CN Ericsson
30. R3-243552 On locating AIoT devices Ericsson
31. R3-243609 Discussion on Paging and Context Management for Ambient IoT China Telecom
32. R3-243619 Further discussion on RAN architecture for Ambient IoT Samsung
33. R3-243620 Further discussion on RAN-CN interface impact for Ambient IoT Samsung
34. R3-243630 Discussion on AIoT RAN architecture China Telecommunication
35. R3-243674 (TP for TR 38.769) Consideration on A-IoT architecture aspects CATT
36. R3-243675 (TP for TR 38.769) On A-IoT Inventory and Command services CATT
37. R3-243676 (TP for TR 38.769) A-IoT device context management and Data transport CATT
38. R3-243677 Consideration on locating of A-IoT device CATT
39. R3-243736 Work Plan for Ambient IoT SI CMCC, Huawei, T-Mobile USA
40. R3-243737 Discussion on RAN Architecture for Ambient IoT CMCC
41. R3-243738 Discussion on paging for Ambient IoT CMCC
42. R3-243739 Discussion on Device Context Management and Data Transfer CMCC
43. R3-243740 Discussion on locating Ambient IoT device CMCC
44. R3-243769 Discussion on NG impact for Ambient IoT LG Electronics
45. R3-243807 [TP for TR 38.769] CB:#AIoT1\_Architecture Ericsson, Huawei
46. R3-243808 Summary of Offline Discussion – CB: # AIoT2\_CNRANinterface Huawei
47. R3-243810 CB:#AIoT3\_Location CMCC
48. R3-243872 Inventory and Command between AIoT CN amd AIoT RAS Huawei, CMCC, Nokia, Ericsson, ZTE, Xiaomi, Qualcomm Incorporated, Samsung, CATT, Lenovo, LG Electronics, NEC
49. R3-243950 (TP for TR38.769) Locating Ambient-IoT device CMCC, ZTE, CATT, Xiaomi, LGE, Huawei, Lenovo, NEC
50. R3-243962 [TP for TR 38.769] CB:#AIoT1\_Architecture Ericsson, Huawei
51. R3-243963 Inventory and Command between AIoT CN amd AIoT RAS Huawei, CMCC, Nokia, Ericsson, ZTE, Xiaomi, Qualcomm Incorporated, Samsung, CATT, Lenovo, LG Electronics, NEC Electronics, NEC
52. R3-243964 (TP for TR38.769) Locating Ambient-IoT device CMCC, ZTE, CATT, Xiaomi, LGE, Huawei, Lenovo, NEC
53. R3-243972 TR 38.769 skeleton for Study on solutions for Ambient IoT in NR Huawei, CMCC

**RAN4#110bis**

1. R4-2404459 Discussion on the general issues for AIoT CATT
2. R4-2404867 A-IoT general overview Ericsson
3. R4-2405298 A-IoT TR skeleton for RF part Huawei
4. R4-2407299 On coexistence between ambient IoT and NR/LTE Apple
5. R4-2407410 AIoT deployment scenario and impact on co-existence analysis Sony
6. R4-2405379 General consideration for A-IOT OPPO
7. R4-2405891 UE implementation aspects impacting work planning and study areas in RAN4 Qualcomm
8. R4-2405304 A-IoT workplan CMCC Huawei T-Mobile
9. R4-2404251 Preliminary considerations on the ambient IoT device implementation and the co-existence analysis Sony
10. R4-2404355 On coexistence between ambient IoT and NR/LTE Apple
11. R4-2404438 Discussion on co-existence simulation methodology and scenarios for ambient IoT CATT
12. R4-2404549 Discussion on the coexistence study of Ambient IoT and NR/LTE Xiaomi
13. R4-2404586 Discussion on co-existence evaluation for A-IoT and NR/LTE Spreadtrum
14. R4-2404671 Discussion on the co-existence of the AIoT vivo
15. R4-2404868 Coexisting study simulation assumptions for A-IoT Ericsson
16. R4-2404985 Views on coexistence of Ambient IoT and NRLTE Samsung
17. R4-2405299 General discussion on A-IoT coexistence scenarios Huawei
18. R4-2405305 Discussion on A-IoT co-existence evaluation CMCC
19. R4-2405376 Consideration on ambient IoT coexistence with NR/LTE China Telecom
20. R4-2405392 Discussion on the Ambient IoT coexistence for NR Qualcomm
21. R4-2405620 Discussion on co-existence study for ambient IoT and NR/LTE ZTE
22. R4-2405289 Topic summary for [110bis][136] FS\_Ambient\_IoT\_solutions Moderator (CMCC)
23. R4-2406618 WF on Ambient IoT in NR, CMCC
24. R4-2406714 WF on Ambient IoT in NR, CMCC

**RAN4#111**

1. R4-2409095 A-IoT general overview Ericsson
2. R4-2407917 TP to TR38.769 skeleton for RF part Huawei
3. R4-2410596 TP to TR38.769 skeleton for RF part Huawei
4. R4-2407299 On coexistence between ambient IoT and NR/LTE Apple
5. R4-2407410 AIoT deployment scenario and impact on co-existence analysis Sony
6. R4-2407525 Discussion on deployment scenarios and spectrum usage for A-IoT CATT
7. R4-2407715 Discussion on deployment scenarios and spectrum usage for ambient IoT Spreadtrum
8. R4-2407918 Discussion on A-IoT deployment scenarios and spectrum usage Huawei
9. R4-2408091 Discussion on the deployment scenarios and spectrum usage for AIoT vivo
10. R4-2408219 Discussion on A-IoT deployment scenario and spectrum usage CMCC
11. R4-2408820 on deployment scenarios and spectrum usage for A-IoT OPPO
12. R4-2409094 A-IoT deployment scenario and spectrum usage Ericsson
13. R4-2409426 Discussion on deployment and spectrum usage Qualcomm
14. R4-2409573 Discussion on spectrum usage for Ambient-IoT LGE
15. R4-2409596 Discussion on deployment scenarios and spectrum usage ZTE
16. R4-2407478 Discussion on co-existence evaluation for ambient-IoT CATT
17. R4-2407716 Discussion on co-existence evaluation for ambient IoT and NR-LTE Spreadtrum
18. R4-2407821 Discussion on the coexistence study of Ambient IoT and NR Xiaomi
19. R4-2407919 A-IoT co-existence evaluations Huawei
20. R4-2408092 Preliminary co-existence evaluation for AIoT vivo
21. R4-2408218 Discussion on A-IoT co-existence evaluation CMCC
22. R4-2408236 Consideration on co-existence evaluations China Telecom
23. R4-2408819 on co-existence evaluations for A-IoT OPPO
24. R4-2409098 Coexisting study simulation assumptions Ericsson
25. R4-2409427 Discussion on Ambient IoT co-existence evaluation Qualcomm
26. R4-2409595 Discussion on Co-existence evaluations ZTE
27. R4-2407522 Discussion on RF requirements of A-IoT BS CATT
28. R4-2407822 Discussion on the RF impact of Ambient IoT BS Xiaomi
29. R4-2408093 Discussion on the RF requirement for AIoT BS vivo
30. R4-2408217 Discussion on A-IoT BS RF requirements CMCC
31. R4-2408237 Consideration on RF requirements for Ambient IoT BS China Telecom
32. R4-2409093 A-IoT BS RF overview Ericsson
33. R4-2409407 RF requirements for Ambient IoT BS Huawei
34. R4-2409597 Discussion on RF requirement of Ambient IoT BS ZTE
35. R4-2407411 Preliminary considerations on the ambient IoT device implementation and RF aspect Sony
36. R4-2407523 Discussion on RF requirements of A-IoT device CATT
37. R4-2407588 A-IoT device study and RF requirements aspects Qualcomm
38. R4-2407717 Discussion on RF requirements impact for ambient IoT device Spreadtrum
39. R4-2407823 Discussion on the RF impact of Ambient IoT device Xiaomi
40. R4-2408094 Discussion on the RF requirement for AIoT device vivo
41. R4-2408220 Discussion on A-IoT device RF requirements CMCC
42. R4-2408238 Consideration on RF requirements for Ambient IoT device China Telecom
43. R4-2408817 further discussion on the regulation and Device requirements OPPO
44. R4-2409097 A-IoT UE RF overview Ericsson
45. R4-2409598 Discussion on RF requirement of Ambient IoT device ZTE
46. R4-2409646 Discussion on RF requirements for Ambient IoT devices Huawei
47. R4-2407524 Discussion on RF requirements of A-IoT intermediate node CATT
48. R4-2407587 Intermediate node role in A-IoT system and study considerations Qualcomm
49. R4-2407718 Discussion on RF requirements impact for intermediate node (UE) Spreadtrum
50. R4-2407824 Discussion on the RF impact of intermediate UE Xiaomi
51. R4-2408095 Discussion on the RF requirement for intermediate UE vivo
52. R4-2408221 Discussion on A-IoT intermediate UE RF requirements CMCC
53. R4-2408239 Consideration on RF requirements for Intermediate Node China Telecom
54. R4-2408818 further discussion on the regulation and UE requirements OPPO
55. R4-2409096 A-IoT UE as intermediate node RF overview Ericsson
56. R4-2409599 Discussion on RF requirement of Intermediate node (UE) ZTE
57. R4-2409647 Discussion on RF requirements for intermediate UE Huawei
58. R4-2408945 Topic summary for [111][134] FS\_Ambient\_IoT\_solutions\_part1 Moderator (CMCC)
59. R4-2410567 WF on co-existence study for ambient IoT and NR/LTE CMCC
60. R4-2408946 Topic summary for [111][135] FS\_Ambient\_IoT\_solutions\_part2 Moderator (Huawei)
61. R4-2410597 WF on impacts of A-IoT on RF requirements Huawei

 10.01.2022 minor adaptations for RAN #95e

 04.10.2021 minor adaptations for RAN #94e

 08.08.2021 minor adaptations for RAN #93e

 17.05.2021 minor adaptations for RAN #92e

 28.01.2021 minor adaptations for RAN #91e

 09.11.2020 minor adaptations for RAN #90e

 31.08.2020 minor adaptations for RAN #89e

 20.04.2020 minor adaptations for RAN #88e

 18.02.2020 minor adaptations for RAN #87e

 14.11.2019 minor adaptations for RAN #86

 18.08.2019 minor adaptations for RAN #85

 12.05.2019 minor adaptations for RAN #84

 27.02.2019 minor adaptations for RAN #83

 21.11.2018 completion levels with colours added (for RAN #82)

v04.81 31.07.2018 simplification of template and addition of cross-TSG aspects (for RAN #81)

v04.80 21.05.2018 minor adaptations for RAN #80

v04.79 26.02.2018 minor adaptations for RAN #79

v04.78 18.11.2017 minor adaptations for RAN #78

v04.77 06.08.2017 minor adaptations for RAN #77

v04.76 15.05.2017 minor adaptations for RAN #76

v04.75 31.01.2017 minor adaptations for RAN #75

v04.74 28.10.2016 minor adaptations for RAN #74

v04.73 01.09.2016 adaptations for RAN #73 (time units in extra Excel table, RAN6 reporting included)

v04.72 26.05.2016 adaptations for RAN #72 (introduction of NR & GERAN TUs)

v04.71 10.02.2016 minor adaptations for RAN #71

v04.70 30.10.2015 minor adaptations for RAN #70

v04.69 12.08.2015 minor adaptations for RAN #69

v04.68 21.05.2015 minor adaptations for RAN #68

v04.67 01.02.2015 minor adaptations for RAN #67

v04.66 16.11.2014 minor adaptations for RAN #66

v04.65 16.08.2014 minor adaptations for RAN #65

v04.64 22.05.2014 minor adaptations for RAN #64

v04.63 24.01.2014 restructuring for RAN #63 to cover Core & Perf. in one doc file

v03.62 11.11.2013 section 1.2.3 adapted for RAN #62

v03 11.08.2013 section 1.2.3 added on time budget

v02 07.05.2010 history added, some spelling corrections

v01 13.11.2009 First version of the template