3GPP TSG-RAN WG4 Meeting #112 R4-2414304

Maastricht, Netherlands,19 – 23 Aug, 2024

**Agenda item:** 8.20.4

**Source:** CMCC

**Title:** WF on Co-existence study for ambient IoT

**Document for:** Approval

# Introduction

This way forward captures the agreements for co-existence evaluation for Rel-19 ambient IOT study item.

The summary in RAN4#112 is R4-2412833. The way forward agreed in previous RAN4 meetings are R4-2406714 and R4-2410567.

# Deployment scenarios and spectrum usage

## Topic 2-1: Deployment scenario

**Issue 2-1-1: deployment scenarios for D1T1**

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| **Agreement in RAN4#110bis:****Issue 2-1-1: deployment scenarios for D1T1**Option 1-1: Legacy NR gNB are outdoor macro gNB while AIoT reader/CW/devices are all indoors. Legacy NR UE is only allowed outdoors.Option 1-2: Legacy NR gNB are outdoor macro gNB while AIoT reader/CW/devices are all indoors. Legacy NR UE is indoor accessing to outdoor NR marco gNBOption 2-1: Legacy NR gNB are co-located with AIoT reader and CW. All of NR and AIoT BS/UE/Reader/Device/CW are indoors. AIoT reader /CW and Legacy gNB share same hardwareOption 2-2: Legacy NR gNB are co-located with AIoT reader and CW. All of NR and AIoT BS/UE/Reader/Device/CW are indoors. AIoT reader /CW and Legacy NR gNB do not share same hardware. (less limitation on the power boosting)**Agreement:*** RAN4 to first evaluate co-existence for deployment scenario of option 1-1 and 1-2, and further study option 2-1 and 2-2.

**Issue 2-3-2: Priorities of spectrum deployment mode for co-existence evaluation****Agreement:*** Prioritize the following spectrum deployment mode for RAN4 co-existence evaluation
	+ A-IoT is located within a NR transmission bandwidth configuration
	+ A-IoT which is operating indoor shares in-band spectrum with outdoor macro BS

**Agreement in RAN4#111:** * Consider only adjacent RB/channel co-existence evaluation for in-band deployment scenario for NR and AIOT
* Encourage companies to provide the simulation results for option 1-1 and 1-2
	+ FFS on co-site scenario (option 2-1 and 2-2)

瀑布图  低可信度描述已自动生成 |

**Agreement in RAN4#112:**

* Feasibility of option 2-1/2-2 for device 1 and 2a should be evaluated with LLS simulation. Parameters for LLS are based on company report.
	+ Encourage companies to provide the co-existence simulation results.

## Topic 2-2: Spectrum usage

**Issue 2-2-1: Spectrum usage for R2D in D1T1**

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| **Agreement in RAN4#110bis:*** FFS on whether to prioritize FDD DL spectrum for R2D for D1T1 for co-existence evaluation.

**Agreement in RAN4#111:** * Use FDD DL as starting point for co-existence evaluation for R2D in D1T1
	+ FFS on FDD UL spectrum.
 |

**Agreement in RAN4#112:**

* Use FDD DL as baseline for co-existence evaluation for R2D in D1T1, FDD UL can be considered as optional

**Issue 2-2-2: CW spectrum for D2T2**

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| For the case that D2R backscattering is transmitted in the same carrier as CW for D2R backscattering, and for topology 2, the following cases for CW transmission are studied.· Case 2-2: CW is transmitted from inside the topology (i.e., intermediate UE), transmitted in UL spectrum· Case 2-3: CW is transmitted from outside the topology, transmitted in DL spectrum · Case 2-4: CW is transmitted from outside the topology, transmitted in UL spectrum**Agreement in RAN4#111:*** Use case 2-2 as starting point for co-existence evaluation for calibration.
* FFS on case 2-3
* Further discuss the difference of outside topology (case2-4) from co-existence study perspective.
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**Agreement in RAN4#112:**

* For D2T2, CW transmitted in UL is baseline for co-existence evaluation, CW transmitted in DL (i.e. case 2-3) can be considered once RAN4 agreed on the CW distribution for outside topology.

# Evaluation methodology and cases

## Topic 3-1: Evaluation methodology

**Issue 3-1-1: LLS to derive guard RBs**

**Agreement:**

* perform the study within the scope of the feasibility study in issue 2-1-1.

**Issue 3-1-2: SINR vs BLER**

**Agreement:**

* RAN4 does not perform LLS to derive SINR values for R2D and D2R.
* RAN4 can take RAN1 LLS as the reference to derive SINR values for R2D and D2R

**Issue 3-1-3: Assumption of R2D transmission and CW transmission for evaluation**

**Agreement:**

* Assume transmission timeline for R2D and CW signal among different A-IoT BS/CW node transmission are aligned for co-existence evaluation.



**Issue 3-1-4: Assumption of R2D and NR UL for D2T2**

**Agreement:**

* Assume intermediate UE in D2T2 transmit R2D and NR intermediate UE UL in TDM manner for co-existence evaluation.

**Issue 3-1-5: whether to study interference mitigation scheme for scenario option 1-2**

**Agreement:**

* RAN4 focus on the co-existence evaluation in this study item.

## Topic 3-2: Performance metric and SINR definition

**Issue 3-2-1: Performance metric for AIOT**

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| **Agreement in RAN4#110bis:*** For NR system, use 5% throughput loss as performance metric as legacy.
* For AIOT system, including reader, device, intermediate UE, further discuss the performance metric:
	+ Option 1: [10%] BLER, [Rx power]
	+ Option 2: SINR degradation
	+ Other options are precluded

**Agreement in RAN4#111:** * Use SINR for calibration purpose
* FFS on performance metric for co-existence evaluation and requirements definition.
 |

**Agreement in RAN4#112:**

For inter-system interference (between AIOT and NR):

* If SINR degradation is smaller than [1]dB, it can be considered that no impact for the inter-system interference
* If SINR degradation is lager than [1]dB, consider following criteria:
	+ Outage percentage consider SINR level with [10%] BLER

For intra-system interference (between AIOT and AIOT), following criteria can be considered:

* + Outage percentage consider SINR level with [10%] BLER

For SINR degradation, SINR refers to the 5% and 50% CDF SINR

**Issue 3-2-2: SINR definition for D2R**

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| **Agreement in RAN4#111:**Do not consider CW interference for calibration purpose for D1T1-A2 and D2T2-A2FFS on how to consider CW cancellation capability in formal simulation |

**Agreement in RAN4#112:**

* SINR includes CW interference is used as the baseline reference for co-existence evaluation for CW reader.
* SINR is calculated as total power ratio:

**Issue 3-2-3: SINR definition for R2D**

|  |
| --- |
| **Agreement in RAN4#111:**SINR for R2D for calibration purposes* signal power of device to the noise and interference within 10MHz
	+ Assume interference NR BW is 10MHz
* FFS on BB LPF
 |

**Agreement in RAN4#112:**

* signal power of device to the noise and interference within 10MHz is baseline assumption
* Consider [180KHz] noise and interference bandwidth as optional

## Topic 3-3: CW considerations

**Issue 3-3-1: Layout of CW for outside topology**

* Option 1 (Huawei): assume that CW node is co-located with the neighbouring A-IoT Reader.
* Option 2 (vivo):



* Option 3 (Ericsson): Model a dedicated CWT node layer with a grid shift to the network layer.

**Agreement in RAN4#112:**

* Simulate CW outside topology case, FFS on the layout of CW
* For the CW outside topology layout:
	+ For every reader, the outside topology CW node is always located at the nearest neighboring reader location. If the CW node is co-located with other readers, CW node and reader are not transmitted simultaneously.
	+ Note: This proposal is based on some further offline discussion. Companies please further check

**Issue 3-3-2: CW cancellation capability**

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| --- |
| **Agreement in RAN4#111:**Do not consider CW interference for calibration purpose for D1T1-A2 and D2T2-A2FFS on how to consider CW cancellation capability in formal simulation |

**Agreement in RAN4#112:**

* Companies to report the CW cancellation capability used for co-existence evaluation, CW cancellation capability for inside topology and outside topology can be different.
	+ total interference cancellation capability = spatial isolation + RF cancellation + digital cancellation
	+ CW transmission impact on the received SINR, e.g. degradation

**Issue 3-3-3: CW unwanted emissions**

**Agreement:**

* FFS on how to model CW unwanted emissions.

## Topic 3-4: Evaluation cases

**Issue 3-4-1: Evaluation cases**

For the case that D2R backscattering is transmitted in the same carrier as CW for D2R backscattering, and for topology 1, the following cases for CW transmission are studied.

· Case 1-1: CW is transmitted from inside the topology, transmitted in DL spectrum

· Case 1-2: CW is transmitted from inside the topology, transmitted in UL spectrum

· Case 1-4: CW is transmitted from outside the topology, transmitted in UL spectrum

For the case that D2R backscattering is transmitted in the same carrier as CW for D2R backscattering, and for topology 2, the following cases for CW transmission are studied.

· Case 2-2: CW is transmitted from inside the topology (i.e., intermediate UE), transmitted in UL spectrum

· Case 2-3: CW is transmitted from outside the topology, transmitted in DL spectrum

· Case 2-4: CW is transmitted from outside the topology, transmitted in UL spectrum

|  |  |  |  |
| --- | --- | --- | --- |
| **Deployment scenario and topology** | **spectrum**  | **aggressor** | **victim** |
| 图示  描述已自动生成· Case 1-1: CW is transmitted from inside the topology, transmitted in DL spectrum· Case 1-2: CW is transmitted from inside the topology, transmitted in UL spectrum | R2D: DLCW2D and D2R: UL | CW and/or device | NR UL |
| NR UL | device and/or reader |
| reader | NR DL |
| NR DL | device |
| R2D: DLCW2D and D2R: DL | CW and/or device | NR DL |
| NR DL | device and/or reader |
| R2D: ULCW2D and D2R: UL | Reader | NR UL |
| NR UL | reader |
| 图示  描述已自动生成Self interference cancelation is needed for reader· Case 1-1: CW is transmitted from inside the topology, transmitted in DL spectrum· Case 1-2: CW is transmitted from inside the topology, transmitted in UL spectrum | R2D: DLCW2D and D2R: UL | CW and/or device | NR UL |
| NR UL | device and/or reader |
| reader | NR DL |
| NR DL | device |
| R2D: DLCW2D and D2R: DL | CW and/or device | NR DL |
| NR DL | device and/or reader |
| R2D: ULCW2D and D2R: UL | reader | NR UL |
| NR UL | reader |
| 图示  描述已自动生成Self interference cancellation is needed for reader· Case 1-4: CW is transmitted from outside the topology, transmitted in UL spectrum | R2D: DLCW2D and D2R: UL | CW and/or device | NR UL |
| NR UL | device and/or reader |
| reader | NR DL |
| NR DL | device |
| R2D: ULCW2D and D2R: UL | reader | NR UL |
| NR UL | reader |

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| --- | --- | --- | --- |
| **Deployment scenario and topology** | **spectrum**  | **aggressor** | **victim** |
| 图示  描述已自动生成Case 2-2: CW is transmitted from inside the topology (i.e., intermediate UE), transmitted in UL spectrum | R2D: ULCW2D and D2R: UL | CW and/or device | NR UL |
| NR UL | Device and/or reader |
| reader | NR UL |
| NR UL | device |
| 图示  描述已自动生成\Case 2-2: CW is transmitted from inside the topology (i.e., intermediate UE), transmitted in UL spectrumSelf interference cancelation is needed for reader | R2D: ULCW2D and D2R: UL | CW and/or device | NR UL |
| NR UL | Device and/or reader |
| reader | NR UL |
| NR UL | device |
| 图示  描述已自动生成Case 2-3: CW is transmitted from outside the topology, transmitted in DL spectrum Case 2-4: CW is transmitted from outside the topology, transmitted in UL spectrumSelf interference cancelation is needed for reader | R2D: ULCW2D and D2R: UL | CW and/or device | NR UL |
| NR UL | Device and/or reader |
| reader | NR UL |
| NR UL | device |
| R2D: ULCW2D and D2R: DL | CW and/or device | NR DL |
| NR DL | device and/or reader |

**Issue 3-4-1: Simplification of evaluation cases**

Proposal 1 (Huawei): Remove redundant case 7, 10, 12, 17, and 19 from Table 6-1, since they share the same result with case 1, 4, 6, 13, and 15, respectively.

Proposal 2 (Huawei): No need to distinguish -A1, -A2 and -B for simulation. One case can be applied to all D1T1-A1, D1T1-A2 and D1T1-B (or D2T2-A1, D2T2-A2 and D2T2-B)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Deployment scenario and topology | 　　 | Evaluation case No. | Note | (Aggressor -> Victim) | spectrum |
| 1-1 | D1T1-legacy UE only outdoor | D1T1 option1-1， | 1 |  | device -> NR UL | R2D: DLCW2D and D2R: UL |
| 2 |  | NR UL -> reader |
| 3 |  | reader -> NR DL |
| 4 |  | NR DL -> device |
| 5 |  | device -> NR DL | R2D: DLCW2D and D2R: DL |
| 6 |  | NR DL -> reader |
| 1-2 | D1T1-legacy UE indoor | D1T1 option1-2 | 7 | Redundant,same with case 1 | device -> NR UL | R2D: DLCW2D and D2R: UL |
| 8 |  | NR UL -> reader |
| 9 |  | reader -> NR DL |
| 10 | Redundant,Same with case 4 | NR DL -> device |
| 11 | 　 | device -> NR DL | R2D: DLCW2D and D2R: DL |
| 12 | Redundant,Same with case 6 | NR DL -> reader |
| 2-3 | D2T2-A2-legacy UE only outdoor | D2T2 option1-1 | 13 |  | device -> NR UL | R2D: ULCW2D and D2R: UL |
|  | 14 |  | NR UL -> reader |
| 15 |  | reader -> NR UL |
| 　 | 16 |  | NR UL -> device |
| 2-4 | D2T2-A2-legacy UE indoor | D2T2 option1-2 | 17 | Redundant,Same with case 13 | device -> NR UL | R2D: ULCW2D and D2R: UL |
| 18 | 　 | NR UL -> reader |
| 19 | Redundant,Same with case 15 | reader -> NR UL |
| 20 | 　 | NR UL -> device |

**Recommended WF:**

From moderator perspective, even though the interference direction is the same for some cases, however, since option 1-1 and 1-2 has different NR legacy UE locations, the baseline SINR can be different. Not sure whether the cases can be removed.

**Issue 3-4-2: Whether to skip some cases that inter-system interference can be ignored for formal simulation**

According to calibration results, some companies propose that for the cases that inter-system interference can be ignored, formal simulation can be skipped:

* Proposal 1 (Xiaomi): for both D1T1 and D2T2, only simulating the legacy UE indoor scenarios is enough to research the inter-system interference.
	+ For D1T1, case 1 2 3 4 5 6 7 10 12 can be considered as no co-existence issue
	+ For D2T2, case 13 14 16 17 can be considered as no co-existence issue
* Proposal 2 (vivo): To save efforts, for D2T2, the following cases of D2T2 can be marked as no co-existence issue and no need to further evaluate

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 3 | **D2T2-A2-legacy UE only outdoor** | 13 | device -> NR UL | R2D: ULCW2D and D2R: UL | High | D2R |
| 14 | NR UL -> reader | D2R |
| 15 | reader -> NR UL | R2D |
| 16 | NR UL -> device | R2D |
| 4 | **D2T2-A2-legacy UE indoor** | 17 | device -> NR UL | R2D: ULCW2D and D2R: UL | High | D2R |
| 19 | reader -> NR UL | R2D |

**Recommended WF:**

From moderator perspective, since some parameters are still under discusison for formal simulation, it may not easy to draw conclusion based on initial calibration results.

**Issue 3-4-3: Device type**

**Agreement:**

* Prioritize device 1 and 2a without a frequency shifter for coexistence evaluation.

**Issue 3-4-4: Multi-operator scenario**

**Agreement:**

* Focus on the co-existence study between A-IoT and NR in this study item.
* The scenario of multiple A-IOT operators in the same band can be considered in the WI phase or in the study of the future release.

# Evaluation parameters

## Topic 4-1: Adjacent RB Tx and Rx characteristics

**Issue 4-1-1: A-IOT reader and NR BS**

**Agreement:**

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| --- | --- |
|  | In-band |
| Tx | Rx |
| NR UE/A-IOT Intermediate UE | Legacy UE IBE | ACS |
| NR BS | Option 1: ACLR of legacy gNB (45dB)Option 2: 40dBOption 3: 17dB or other values | ACS of legacy gNB |
| A-IOT BS | ACLR of legacy NB -IOT gNB (i.e. ACLR1:40dB，ACLR2:50dB) | ACS of legacy gNB |

**Issue 4-1-2: Tx for device 1 and 2a**

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| **Agreement in RAN4#111:**For device 1 and 2a, 25dBc is used for calibration purposes **图表, 直方图  描述已自动生成** |

Proposal 1(CMCC): for device 1 and 2a, it’s suggested to use following value for IBE with assuming 7kbps D2R date rate, Manchester code, 1/3 code rate convolution code, BPSK modulation scheme. Following assumes that Tx signal is at frequency center

• 16dBc at the edge of center 1PRB, i.e. 90kHz offset from frequency center

**Agreement in RAN4#112:**

* Discuss which one or both should be used for formal simulation
	+ Option 1: 25dBc (based on 5kbps, Manchester code)
	+ Option 2: 16dBc (based on 7kbps, Manchester code, 1/3 code rate convolution code)

**Issue 4-1-3: Rx for device 1 and 2a**

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| **Agreement in RAN4#111:**Assume no frequency selectivity for co-existence evaluation for calibration purposes for device 1 and 2a. |

**Agreement in RAN4#112:**

* + Use R2D without LPF as baseline for co-existence evaluation
	+ R2D with LPF as optional.

|  |  |
| --- | --- |
| SINR | R2D with LPF |
| Interference from NR | Frequency selectivity: [4.3 dB] |
| Noise bandwidth | [180kHz] |

**Issue 4-1-4: Scaling factor**

Proposal (Ericsson):

Interference for case 1 and 7: CW node aggressor ACLR scaling factor: ACLR\_e\_AIOT\_xx = ACLR – 10\*log10((9MHz/(# of NR users))/180kHz)

Interference for case 3 and 9: AIoT-BS aggressor ACLR scaling factor: tACLR\_e\_AIOT\_BS = ACLR – 10\*log10((9MHz/(# of NR users))/180kHz)

**Recommended WF:**

Discuss the above proposal.

In SBFD study, for the case where the aggressor’s bandwidth is narrower that the victims bandwidth, no scaling factor is applied. For the cases where the aggressor’s bandwidth is wider than the victim’s bandwidth, a bandwidth compensation factor is applied

Following scaling factor is used for calibration, it is recommended to also use this for formal simulation.

* when A-IoT reader as victim, the scaling factor is suggested as below to compensate different aggressor and victim bandwidth when calculating inter-system interference.
* Scaling factor =

FFS on whether to evaluate individual RB.

## Topic 4-2: General parameters and layout

**Issue 4-2-1: Active rate of reader for D1T1 and D2T2**

It has been observed that the intra-system interference is very high for the 18 BS layout of D1T1. Some companies propose to reduce the number of active BS and the proposals are:

* Proposal 1 (Qualcomm): 50% active rate (9 reader)
* Proposal 2 (Huawei): For D1T1, Readers transmit round-robin as the baseline, and concurrent transmission is not considered for co-existence simulation. (1 reader)
* Proposal 3 (ZTE): further study the assumption of A-IoT BS activation within the indoor factory in D1T1 scenario.
* Proposal 4 (vivo): For D1T1, at least 1/3 readers are activated in one snapshot is assumed. (6 reader)
* Proposal 5 (Xiaomi): For D1T1, adopting 2 readers are activated in one drop as the starting point to reduce the inter-system interference due to all reader are activated. (2 reader)
* Proposal 6 (CMCC): the activation ratio of topology 1 reader is suggested as below:
	+ Divide all 18 readers into X blocks, 1 reader per block are activated simultaneously. Noted: we need to order the reader in each block, the reader that is located in the same relative location in each block would be blocked as the same index. only the reader with the same order index will be activated simultaneously.
	+ X could be 1, 2, 3, if there is no consensus of X value, X could be based on companies report.

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**Recommended WF:**

**Tentative agreement for D1T1 and D2T2:**

* Minimum distance between active readers: 60m, other values can be reported by other companies.

- 2 readers are activated in one drop, companies can use larger values

**~~Issue 4-2-2: Active rate of reader for D2T2~~**

~~The similar observation of intra-system interference as issue X-X-X is also observed for D2T2. The proposed active rate for intermediate UE for D2T2 are:~~

* ~~Proposal 1 (Qualcomm): 1 or 2 UE at each drop should be used for the D2T2 coexistence study.~~
* ~~Proposal 2 (Xiaomi, vivo, CMCC): For D2T2, adopting Option 1 (2 UE at one drop) as the starting point for the later simulation.~~

**~~Recommended WF:~~**

~~It is recommended that:~~

* ~~Randomly choose 2 intermediate UEs simultaneously for D2T2 for formal simulation.~~

**Issue 4-2-3: Indoor UE percentage for scenario option 1-2**

**Agreements in RAN4#111:**

For scenario option 1-2, uniformly distributed, 80% indoor, 20% outdoor

**Agreements in RAN4#112:**

Choose two options for co-existence evaluation for NR UE indoor ratio:

* + Option 1: 10% as baseline
	+ Option 2: 100% as optional

**Issue 4-2-4: transmission bandwidth of R2D**

**Agreements in RAN4#111:**

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| --- | --- |
| Channel BW for AIOT | DL: 180kHz with 15KHz SCSUL: 15KHz or 180KHz |

**Proposals in RAN4#112:**

Proposal 1 (Huawei): 180KHz

Proposal 2 (ZTE): for the transmission bandwidth of R2D signal, propose to use 720KHz transmission bandwidth for formal evaluation.

**Recommended WF:**

Keep 180KHz for formal simulation.

**Issue 4-2-5: Minimum NR BS-NR UE distance (2D)**

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| **Agreements in RAN4#111:**Minimum NR BS – NR UE distance (2D): 35 m |

**Agreements in RAN4#112:**

For formal simulation:

* Use MCL of 70 dB for Minimum NR BS – NR UE distance

**Issue 4-2-6: Minimum distance between device and reader for D1T1 and D2T2**

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| **Agreements in RAN4#111:**For D1T1: MCL between device and reader is 45dB for calibration.For D2T2: Minimum distance between reader and device is 1m |

**Agreements in RAN4#112:**

Minimum distance between reader and device is 1m.

**Issue 4-2-7: NR RB allocation**

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| **Agreements in RAN4#111:**NR UE number:- DL active UE: 1 UE per cell - UL active UE: 3UE per cell |

**Agreements in RAN4#112**

For formal simulation.

* For RB allocation, each UE is scheduled with 17PRB and A-IoT using 1PRB is located between the most two UEs. Detailed illustration is listed as below:



**Issue 4-2-7: Penetration loss for O2I**

**Agreement:**

* Use the equation of 7.4-2 in 38.901
* PLin = 0.5 \* d2D-in where d2D-in is the distance to nearest factory/office boundary on the line between Tx and Rx point.
* Check whether to set maximum value of d2D-in as [25m]



**Issue 4-2-8: Pathloss**

**Agreement:**

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|  | **D1T1** | **D2T2** |
| Indoor legacy UE <-> indoor device | Indoor office |
|  |  |
| Indoor legacy UE <-> indoor reader | Indoor factory DH | Indoor office |
| Outdoor macro gNB <-> indoor device/indoor reader | PLb: Uma |
| Outdoor UE <-> indoor device/ D2T2 UE, i.e. UE<->UE | PLb: Umi |
| Outdoor UE <-> indoor D1T1 reader, i.e. UE<-> reader | PLb: UMi |
| Note: For other indoor factory related parameters that are not listed, it’s suggested to refer to 7.8.4 of TR 38.901. |

 **Issue 4-2-9: Other general parameters**

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| --- | --- |
| **General Parameter** | **D1T1&D2T2****Values for calibration purposes** |
| Carrier frequency | 900MHz |
| BW for NR | 10MHz with 15KHz SCS |
| BW for AIOT system | 180KHz for transmission90KHz for reception |
| Waveform (CW) | CW: Unmodulated single tone |
| Waveform (R2D) | OOK waveform generated by OFDM modulator |
| A-IoT DL power control | No |
| A-IoT UL power control | No |
| Traffic model | Full buffer |
| Frequency reuse | 1 |

## Topic 4-3: Parameters for AIOT BS/intermedaite UE and device

**Issue 4-3-1: AIOT micro-BS parameters for D1T1**

**Agreement:**

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| **A-IoT micro BS parameters** | **Values for calibration purposes** |
| A-IoT micro-BS total Tx power | 33dBm |
| A-IoT micro-BS receiver Noise Figure（dB） | 10 |
| A-IoT micro-BS antenna gain (dBi) |  6 dBi |
| Antenna pattern | Antenna Array Geometry：* 1\*1\*1 antenna element
* equals to omni-directional antenna pattern in GCG in horizontal

图示, 示意图  描述已自动生成

|  |  |
| --- | --- |
| **Parameter** | **Assumption** |
| Antenna pattern (horizontal) | ,  = 90°, *Am* = 15 dB  |
| Antenna pattern (vertical) | ,  = 90°, *SLAv* = 15 dB |
| Combining method in 3D antenna pattern |  |
| BS antenna gain (dBi) (including feeder loss) | 6 |

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**Issue 4-3-2: Intermediate UE parameters for D2T2**

**Agreement:**

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| **intermediate UE parameters** | **Values for calibration purposes** |
| intermediate UE total Tx power（dBm） | 23dBm |
| gain of antenna intermediate UE (dBi) | 0 |
| intermediate UE receiver Noise Figure（dB） | 9 |
| Antenna configuration | Omni direction antenna |

**Issue 4-3-3: AIOT device parameters**

**Recommended WF:**

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| **A-IoT device parameters** | **Device 1****Values used for calibration**  | **Device 2a** | **~~RAN1 assumption~~****~~(R1-2406752)~~** |
| A-IoT device effective antenna gain per Tx or Rx branch (dBi) | 0  | [0] | ~~For A-IoT device, 0dBi~~ |
| A-IoT device reflection （backscatter）loss (dB)~~Note: due to, e.g., impedance mismatch~~ | OOK: -6 dB | OOK: -6 dB | ~~OOK: 6 dB~~~~PSK: 0 dB~~~~FSK: Y dB~~~~It is applicable for device 1 and 2a.~~~~Companies to report and justify their assumptions for Y.~~~~Companies to report in row 3D if they assume any additional related loss.~~ |
| A-IoT device power gain of reflection amplifier (dB) | N/A | 10(M),15(O) | ~~10 dB (M)~~~~15 dB (O)~~~~Note: Only for device 2a~~ |
| A-IoT Device receiver sensitivity (dBm)Use this value to determine whether device can camp on the cell. | -36 | [-45] | ~~For Budget-Alt1~~~~For device 1 (RF-ED), for example:~~~~{‑30 dBm, ‑36 dBm, ‑40 dBm, etc}~~~~For device 2 (RF-ED), for example:~~~~{-40 dBm, -45 dBm, etc}~~~~For Budget-Alt2~~~~Calculated (see note1)~~ |
| A-IoT device noise figure (dB) | 24 | [20] | ~~For RF-ED receiver~~* ~~20dB, Device 2~~
* ~~FFS other values~~
 |
| Guard band | 0PRB | 0PRB |  |

## Topic 4-4: Paramters for legacy NR

**Issue 4-4-1: NR macro BS parameters**

**Agreement:**

|  |  |
| --- | --- |
| **NR macro-BS Parameter** | **Values for calibration purposes** |
| Macro-BS Tx power (dBm) | 46 |
| BS antenna gain (dBi) and antenna pattern | Antenna Array Geometry：* 1\*1\*1 antenna element
* BS point at fixed beam direction
	+ vertical: θtilt + 90°
	+ horizontal: 0, 120, 240 °

图示, 示意图  描述已自动生成

|  |  |
| --- | --- |
| **Parameter** | **Assumption** |
| Antenna pattern (horizontal)(For 3-sector cell sites with fixed antenna patterns) |  = 65 degrees, *Am* = 25 dB  |
| Antenna pattern (vertical)(For 3-sector cell sites with fixed antenna patterns) |  = 10 degrees, *SLAv* = 25 dB, = 9 degrees |
| Combining method in 3D antenna pattern |  |
| BS antenna gain (dBi) (including feeder loss) | 15 |

 |
| Height of macro NR BS (m) | 25 |
| NR Macro-BS Noise Figure(dB) | 5 |
| Network location | outdoor |

**Issue 4-4-2: NR UE parameters**

**Agreement:**

|  |  |
| --- | --- |
| **NR UE Parameter** | **Values for calibration purposes** |
| UE TX power in dBm | -40 to 23 |
| NR UE Antenna gain (dBi) | 0 |
| Height of UE antenna (m) | 1.5  |
| NR UE ACLR（dB） | 30 |
| NR UE Noise Figure（dB） | 9 |
| Antenna configuration | Omni direction antenna |

## Topic 4-5: Paramters for CW

**Issue 4-5-1: Other CW parameters**

**Agreement:**

|  |  |  |
| --- | --- | --- |
| **CW parameters** | **D1T1** | **D2T2**  |
| Tx power（dBm） | If UL spectrum is used, UE Tx power is assumed, i.e. 23dBIf DL spectrum is used, AIOT micro-BS Tx power is assumed. | Inter-mediate UE Tx power is assumed. |
| Antenna gain | Same as AIOT reader | Same as inter-mediate UE |

## Topic 4-6: Parameters for collocated scenario (option 2-1 and 2-2)

**Issue 4-6-1: Simulation assumptions for collocated scenario**

**Agreement:**

Reuse the evaluation parameters of scenario option1-1 and 1-2, additionally use following parameters.

1) NR BS indoor gNB deployed co-site with A-IoT indoor reader;

2) ISD as 20m;

3) Min BS-UE distance: 0m;

4) NR indoor UE uniformly distributed.