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**Source:** Huawei, Hisilicon, CMCC, Qualcomm, vivo

**Title:** TP to TR38.769 Co-existence simulation

**Agenda Item:** 7.21.2.2

**Document for:** Approval

# Introduction

In the last two meetings, the formal co-existence simulation assumptions for Rel-19 Ambient IoT were approved in [1][2]. Companies provided the co-existence evaluation results this meeting.

In this contribution, we provide the draft TP to TR 38.769 for Co-existence evaluation based on [3][4].

# Reference

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[2] R4-2417196, WF on co-existence study for A-IOT, CMCC, RAN4#112bis, October 2024

[3] R4-2414306, TP to TR38.769 for Co-existence evaluation assumptions, Huawei, Hisilicon, RAN4#112, August 2024

[4] R4-2416356, TP to TR38.769 Co-existence simulation, Huawei, Hisilicon, RAN4#112bis, October 2024

# Text Proposal to TR 38.769

***------------Start of the Change-------------***

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TR 38.848: "Study on Ambient IoT (Internet of Things) in RAN".

[R1-1] RP-240826: "Revised SID: Study on solutions for Ambient IoT (Internet of Things) in NR".

[R1-2] 3GPP TR 38.869: "Study on low-power Wake-up Signal and Receiver for NR".

[R1-3] 3GPP TS 38.212: "NR; Multiplexing and channel coding".

[R1-4] EPC Radio-Frequency Identity Protocols Class-1 Generation-2 UHF RFID Protocol for Communications at 860 MHz – 960 MHz.

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## 6.6 Coexistence of ambient IoT and NR/LTE

6.6.1 Co-existence scenarios and cases

The coexistence evaluation is conducted considering the different scenarios listed in Table 6.6.1-1

**Table 6.6.1-1: Co-existence scenarios**

|  |  |  |
| --- | --- | --- |
| **Deployment scenario No. (Case No.)** | **Topology** | **Spectrum** |
| **1-1(a/b/c/d)** | D1T1-A2- NR UE only outdoor | R2D: DL CW2D and D2R: DL |
| **1-2(a/b/c/d)** | D1T1-A2- NR UE indoor | R2D: DL CW2D and D2R: DL |
| **2-1(e/f/c/d)** | D1T1-B- NR UE only outdoor | R2D: DL CW2D and D2R: UL |
| **2-2(e/f/c/d)** | D1T1-B- NR UE indoor | R2D: DL CW2D and D2R: UL |
| **3 (Optional)(a/b/g/h)** | D1T1-A2- NR UE indoor | R2D: UL CW2D and D2R: UL |
| **5-1(e/f/g/h)** | D2T2-A2- NR UE only outdoor | R2D: UL  CW2D and D2R: UL |
| **5-2(e/f/g/h)** | D2T2-A2- NR UE indoor | R2D: UL  CW2D and D2R: UL |
| **6-1(Optional)(a/b/g/h)** | D2T2-B- NR UE only outdoor | R2D: UL  CW2D and D2R: DL |
| **6-2(Optional)(a/b/g/h)** | D2T2-B- NR UE indoor | R2D: UL  CW2D and D2R: DL |

The main co-existence scenario considered for ambient IoT is D1T1 and D2T2. The deployment parameters are described in Table 6.6.2.1-1.

The co-existence evaluation captures cases where NR and A-IoT (Reader/device) are both victim and aggressor networks. It is to evaluate impact on legacy NR networks if A-IoT is introduced in indoor scenario, also to understand impact of the legacy NR network on A-IoT system. The co-existence cases are listed in Table 6.6.1-2.

**Table 6.6.1-2: Co-existence cases**

|  |  |  |  |
| --- | --- | --- | --- |
| **Case No.** | **Aggressor** | **Victim** | **note** |
| **a** | Device | NR DL | D2R |
| **b** | NR DL | reader | D2R |
| **c** | Reader | NR DL | R2D |
| **d** | NR DL | device | R2D |
| **e** | Device | NR UL | D2R |
| **f** | NR UL | reader | D2R |
| **g** | Reader | NR UL | R2D |
| **h** | NR UL | device | R2D |

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6.6.2 Co-existence evaluation assumptions

#### 6.6.2.1 Deployment

Simulation assumptions related to network layout is captured for D1T1 and D2T2 in Table 6.6.2.1-1.

Table 6.6.2.1-1. Deployment parameters for D1T1 and D2T2

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **D1T1** | **D2T2** | |
| **Carrier frequency** | 900 MHz (Band n8) | | |
| **BW for NR** | 10MHz with 15KHz SCS | | |
| **BW for A-IOT system** | 180kHz, for 15kHz SCS | | |
| **Waveform (R2D)** | OOK waveform generated by OFDM modulator | | |
| **Waveform (CW)** | Unmodulated single tone | | |
| **A-IoT DL power control** | No | | |
| **A-IoT UL power control** | No | | |
| **Traffic model** | Full buffer | | |
| **Frequency reuse** | 1 | | |
| **NR BS deployment (outdoor), i.e. scenario 1-1 and 1-2** | Hexagonal grid, 19 macro sites, 3 sectors per site with wrap around, 1 A-IOT indoor scenario per sector  the minimum 2D distance between macro BS and indoor factory center is set as 100m.  Inter-NR BS distance: 750m  NR BS height: 25m | | |
| **NR BS deployment (indoor), i.e. scenario 2-1 and 2-2** | NR indoor BS deployed co-site with A-IoT indoor reader;  NR indoor BS ISD as 20m;  NR indoor Min BS-UE distance: 0m;  NR indoor UE uniformly distributed.  NR indoor BS Tx power assumed [24] dBm  Antenna pattern of A-IoT reader is reused.  The self-interference cancellation of R2D in UL for co-located scenario can be reported by interested company. | | |
| **A-IoT reader deployment / Intermediate UE dropping** | For D1T1-A2 and D1T1-B:  18 A-IoT readers on a square lattice with spacing D, located D/2 from the walls.  L=120m x W=60m; D=20m  Reader height = 8 m  Room height = 10m  2 A-IoT readers are activated in one drop as baseline. Minimum distance between active readers: 60m as baseline | For D2T2-A2 and D2T2-B:  The intermediate UEs selected from the fixed positions.  L=120m x W=50m; D=20m  Intermediate UE height = 1.5 m  Room height = 3m  Number of intermediate UE for simulation: 2 UE at one drop. Minimum distance between intermediate UEs: 60m as baseline | |
| **CW deployment** | For D1T1-A2 and D2T2-A2, CW and A-IoT reader are collocated.  For D1T1-B and D2T2-B, CW topology layout is the same as A-IoT reader. For each device, the nearest CW node will be activated during the simulation, and CW node is not co-located with any activated reader | | |
| **Device distribution** | Device Height= 1.5 m  A-IoT devices drop uniformly distributed over the horizontal area  Number of A-IoTs = Total area × activated density (1.5 A-IOT devices/m²)  1 active A-IoT device under one reader at one drop  Minimum distance between reader and device is 1m | | |
| **NR UE dropping** | For NR UE only outdoor, uniformly distributed outdoor.  For NR UE indoor, uniformly distributed, Option1: 10% indoor, 90% outdoor, Option2: 100% indoor  UE number:  - DL active UE: 1 UE per cell  - UL active UE: 3 UE per cell | | |
| **NR BS Inter-site distance** | MCL of 70 dB | | |
| **Pathloss model** | - PLin = 0.5 \* d2D-in where d2D-in is the distance to nearest factory/office boundary on the line between Tx and Rx point. Set maximum value of d2D-in as [25m] as optional | | |
| PLb :  NLOS and LOS in TR38.901  NR BS – NR UE: Uma  Outdoor NR UE – A-IoT reader/ device: Umi  Device – A-IoT reader: InF-DH  Indoor NR UE – device: InH-Office  Indoor NR UE –A-IoT reader: InF-DH | | PLb :  NLOS and LOS in TR38.901  NR BS – NR UE: Uma  Outdoor NR UE – intermediate UE/ device: Umi  Device – Intermediate UE: InH-Office  Indoor NR UE – device: InH-Office  Indoor NR UE – intermediate UE: InH-Office |
| **O2I penetration loss** | High penetration loss as in TR 38.901 | | |

6.6.2.2 NR BS/ A-IoT reader/ intermediate UE/ CW RF characteristics

The NR BS and A-IoT reader are defined for two different antenna configurations as illustrated in Table 6.6.2.2-1 and Table 6.6.2.2-2. Assumptions related to CW RF characteristics relevant for different deployment scenarios are captured in Table 6.6.2.2-4.

**Table 6.6.2.2-1: NR BS RF parameters**

|  |  |
| --- | --- |
| **NR BS Parameter** | **Values for evaluation** |
| **Macro-BS Tx power (dBm)** | 46 |
| **BS antenna gain (dBi) and antenna pattern** | Antenna Array Geometry：BS point at fixed beam direction: vertical: θtilt + 90°, horizontal: 0, 120, 240 °  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 |
| **ACLR** | Option 1: 30dBc, Option 2: 17dBc |

**Table 6.6.2.2-2: A-IoT reader RF parameters**

|  |  |
| --- | --- |
| **A-IoT reader parameters** | **Values for evaluation** |
| **A-IoT reader total Tx power** | 33 dBm |
| **A-IoT reader receiver Noise Figure (dB)** | 10 |
| **A-IoT reader antenna gain (dBi)** | 6 |
| **ACLR** | ACLR of legacy NB -IOT gNB (i.e. ACLR1:40dB，ACLR2:50dB) |
| **ACS** | Same as legacy NR BS |
| **Antenna configuration** | Antenna Array Geometry：equals to omni-directional antenna pattern in GCG in horizontal  Antenna pattern (horizontal): , = 90°, *Am* = 15 dB  Antenna pattern (horizontal):, = 90°, *SLAv* = 15 dB  Combining method in 3D antenna pattern:  BS antenna gain (dBi) (including feeder loss): 6 |

**Table 6.6.2.2-3: Intermediate UE RF parameters**

|  |  |
| --- | --- |
| **intermediate UE parameters** | **Values for evaluation** |
| **Intermediate UE total Tx power (dBm)** | Baseline: 23  Optional: Tx power control is allowed |
| **Gain of antenna intermediate UE (dBi)** | 0 |
| **Intermediate UE receiver Noise Figure (dB)** | 9 |
| **Antenna configuration** | Omni directional antenna |

**Table 6.6.2.2-4: CW RF parameters**

|  |  |  |
| --- | --- | --- |
| **CW parameters** | **D1T1** | **D2T2** |
| **Tx power (dBm)** | If UL spectrum is used, UE Tx power is assumed, i.e. 23dB  If DL spectrum is used, A-IoT reader Tx power is assumed, i.e. 33 dBm | Intermediate UE Tx power is assumed. |
| **Antenna gain** | Same as A-IoT reader | Same as intermediate UE |

#### 6.6.2.3 NR UE/ A-IoT device RF characteristics

Assumptions relevant for modelling the NR UE and A-IoT device RF characteristics are captured in Table 6.6.2.3-1 and Table 6.6.2.3-2.

Table 6.6.2.3-1: NR UE RF parameters

|  |  |
| --- | --- |
| **NR UE Parameter** | **Values for evaluation** |
| **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 |

Table 6.6.2.3-2: A-IoT device RF parameters

|  |  |  |
| --- | --- | --- |
| **A-IoT device parameters** | **Device 1** | **Device 2a** |
| **A-IoT device effective antenna gain per Tx or Rx branch (dBi)** | 0 | [0] |
| **A-IoT device reflection （backscatter）loss (dB)** | OOK: -6 dB | OOK: -6 dB |
| **A-IoT device power gain of reflection amplifier (dB)** | N/A | 10(M) |
| **A-IoT Device receiver sensitivity (dBm)**  **Use this value to determine whether device can camp on the cell.** | -36 | [-45] |
| **A-IoT device noise figure (dB)** | 24 | [20] |
| **Guard band** | 0PRB | 0PRB |

6.6.3 Co-existence simulation methodology

6.6.3.1 Coexistence evaluation methodology

The coexistence evaluation methodology can be summarized as:

1) Aggressor and victim network are generated. NR UEs and A-IoT devices are distributed as described by parameter assumptions.

2) UEs are associated to BS based on coupling loss, and A-IoT devices are associated to A-IoT reader or intermediate UE based on coupling.

- NOTE: For A-IoT devices are associated to A-IoT reader or intermediate UE, there are two ways applied by companies:

(a) The device access to the reader is randomly selected from candidate devices whose R2D receiving power/coupling from one reader is higher than the other. The receiving power of device meets the device receiver sensitivity.

(b) The device can access the reader with best receiving power among of 12 or 18 total readers in one building. The receiving power of device meets the device receiver sensitivity.

3) Once association is done, round robin scheduling is used.

4) For inter-system interference (between A-IoT and NR):

- If SINR degradation is smaller than and equal to 1 dB, it can be considered that inter-system interference is negligible.

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

6.6.3.2. SINR definition

For D1T1-A1and -B /D2T2-A1and -B

SINR definition for D2R:

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

For the CW outside scenarios (D1T1-B and D2T2-B), the impact to SINR due to phase noise are also evaluated. The baseline D2R SNR for CW outside can be calculated by

Phase noise can be modelled as XdBc/Hz, e.g., -112dBc/Hz compared to the received power for D2R.

The noise and intra-system interference are within total receiver bandwidth, and the residual CW interference after cancellation is in linear scale.

SINR definition for R2D:

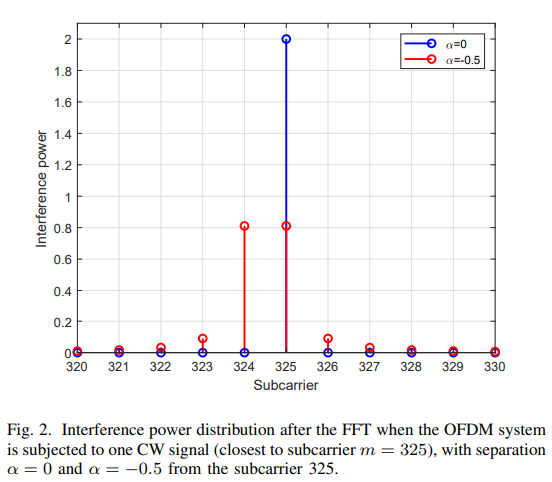
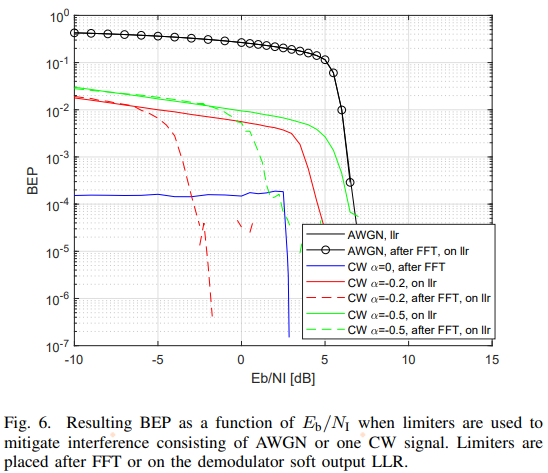
* signal power of device to the noise and interference within 10MHz is baseline assumption
* Consider [180KHz] noise and interference bandwidth after BB LPF as optional

#### 6.6.3.3 Coupling loss

The Coupling Loss (CL) is defined as the loss in signal between NR BS-to- NR UE, A-IoT reader -to- A-IoT device and intermediate UE -to- A-IoT device. CL is defined as the loss including propagation loss and antenna gains.

#### 6.6.3.4 Impact from CW to NR

In 6.6.3.2, the SINR definition includes the impact from CW to D2R which is treat as intra-system interference. However, Whether and how the CW will influence the NR system also needs to be studied. In [R4-2], the impact of CW signal under different assumptions are investigated and the evaluation results are shown in figure 6.6.3.4-1.

**Figure 6.6.3.4-1 Impact from CW to NR system [****R4-2]**

The results shows that when the CW is orthogonal with NR subcarrier, i.e., α=0, the influence of interference is much lower and also easier to be removed after FFT, only if the power of CW interference does not exceed the dynamic range of receiver.

Based on the analysis above, the impact from CW to NR is not modelled in the co-existence evaluation for simplicity.

### 6.6.4 Co-existence evaluation results

The simulation results submitted for the ambient IoT and NR co-existence study from all contributing companies in RAN4 were summarized into three attached files in [R4-1] to this report.

6.6.5 Summary of co-existence evaluation

The sub-clause captures the co-existence simulation results for ambient IoT categorized by scenarios and cases. The conclusions below are derived from the coexistence results.

6.6.5.1 Scenario 1-1: D1T1-A2- NR UE only outdoors (R2D/ CW2D/ D2R: DL)

Scenario 1-1 considers D1T1 topology, all the NR UE outdoors and Readers/CW collocated, with DL spectrum applying to reader-to-device link. The conclusions of each cases are listed per scenario in Table 6.6.5.1-1.

Table 6.6.5.1-1: Scenario 1-1 co-existence conclusions

|  |  |  |  |
| --- | --- | --- | --- |
| **Case No.** | **Aggressor** | **Victim** | **Co-existence conclusion** |
| a | Device | NR DL | Negligible NR DL throughput degradation for both average throughput and cell edge throughput is observed |
| b | NR DL | reader | SINR degradation is less than 1dB under the assumption of 30dBc inband leakage for legacy NR gNB. Inter-system interference is negligible.  2 companies observed some SINR degradation under the assumption of 17dBc inband leakage for legacy NR gNB. |
| c | Reader | NR DL | Negligible NR DL throughput degradation for both average throughput and cell edge throughput is observed |
| d | NR DL | device | SINR degradation is less than 1dB. Inter-system interference is negligible. |

6.6.5.2 Scenario 1-2: D1T1-A2- NR UE indoor (R2D/ CW2D/ D2R: DL)

Scenario 1-2 considers D1T1 topology, 10% and 100%(Optional)of the NR UE indoors and Reader/CW collocated, with DL spectrum applying to reader-to-device link. The conclusions of each cases are listed per scenario in Table 6.6.5.2-1.

Table 6.6.5.2-1: Scenario 1-2 co-existence conclusions

|  |  |  |  |
| --- | --- | --- | --- |
| **Case No.** | **Aggressor** | **Victim** | **Co-existence conclusion** |
| a | Device | NR DL | Negligible NR DL throughput degradation for both average throughput and cell edge throughput is observed |
| b | NR DL | reader | SINR degradation is less than 1dB under the assumption of 30dBc inband leakage for legacy NR gNB. Inter-system interference is negligible.  1 company observed some SINR degradation under the assumption of 17dBc inband leakage for legacy NR gNB. |
| c | Reader | NR DL | Under the assumption of 10% NR UE indoor, NR DL throughput degradation is observed.  Under the assumption of 100% NR UE indoor, significant NR DL throughput degradation is observed. |
| d | NR DL | device | SINR degradation is less than 1dB. Inter-system interference is negligible. |

6.6.5.3 Scenario 2-1: D1T1-B- NR UE only outdoor (R2D: DL, CW2D/ D2R: UL)

Scenario 2-1 considers D1T1 topology, all the NR UE outdoors and Readers/CW non-collocated, with DL spectrum applying to reader-to-device link. The conclusions of each cases are listed per scenario in Table 6.6.5.3-1.

Table 6.6.5.3-1: Scenario 2-1 co-existence conclusions

|  |  |  |  |
| --- | --- | --- | --- |
| **Case No.** | **Aggressor** | **Victim** | **Co-existence conclusion** |
| e | Device | NR UL | Negligible NR UL throughput degradation for both average throughput and cell edge throughput is observed. |
| f | NR UL | reader | SINR degradation is less than 1dB. Inter-system interference is negligible. |
| c | Reader | NR DL | Negligible NR DL throughput degradation for both average throughput and cell edge throughput is observed. |
| d | NR DL | device | SINR degradation is less than 1dB. Inter-system interference is negligible. |

6.6.5.4 Scenario 2-2: D1T1-B- NR UE indoor (R2D: DL, CW2D/ D2R: UL)

Scenario 2-2 considers D1T1 topology, 10% and 100%(Optional)of the NR UE indoors and Readers/CW non-collocated, with DL spectrum applying to reader-to-device link. The conclusions of each cases are listed per scenario in Table 6.6.5.4-1.

Table 6.6.5.4-1: Scenario 2-2 co-existence conclusions

|  |  |  |  |
| --- | --- | --- | --- |
| **Case No.** | **Aggressor** | **Victim** | **Co-existence conclusion** |
| e | Device | NR UL | Negligible NR UL throughput degradation for both average throughput and cell edge throughput is observed. |
| f | NR UL | reader | Under the assumption of 10% and 100% NR UE indoor, significant SINR degradation is observed |
| c | Reader | NR DL | Under the assumption of 10% and 100% NR UE indoor, NR DL throughput degradation is observed. |
| d | NR DL | device | SINR degradation is less than 1dB. Inter-system interference is negligible. |

6.6.5.5 Scenario 5-1: D2T2-A2- NR UE only outdoor (R2D/ CW2D/ D2R: UL)

Scenario 5-1 considers D2T2 topology, all the NR UE outdoors and Readers/CW collocated, with UL spectrum applying to reader-to-device link. The conclusions of each cases are listed per scenario in Table 6.6.5.5-1.

Table 6.6.5.5-1: Scenario 5-1 co-existence conclusions

|  |  |  |  |
| --- | --- | --- | --- |
| **Case No.** | **Aggressor** | **Victim** | **Co-existence conclusion** |
| e | Device | NR UL | Negligible NR UL throughput degradation for both average throughput and cell edge throughput is observed |
| f | NR UL | reader | SINR degradation is less than 1dB. Inter-system interference is negligible~~.~~ |
| g | Reader | NR UL | NR UL throughput degradation is observed |
| h | NR UL | device | SINR degradation is less than 1dB. Inter-system interference is negligible. |

6.6.5.6 Scenario 5-2: D2T2-A2- NR UE indoor (R2D/ CW2D/ D2R: UL)

Scenario 5-2 considers D2T2 topology, 10% and 100%(Optional)of the NR UE indoors and Readers/CW collocated, with UL spectrum applying to reader-to-device link. The conclusions of each cases are listed per scenario in Table 6.6.5.6-1.

Table 6.6.5.6-1: Scenario 5-2 co-existence conclusions

|  |  |  |  |
| --- | --- | --- | --- |
| **Case No.** | **Aggressor** | **Victim** | **Co-existence conclusion** |
| e | Device | NR UL | Negligible NR UL throughput degradation for both average throughput and cell edge throughput is observed |
| f | NR UL | reader | Significant SINR degradation is observed for both 10% NR indoor UE and 100% NR indoor UE assumption. |
| g | Reader | NR UL | NR UL throughput degradation is observed |
| h | NR UL | device | Under the assumption of 10% NR UE indoor, SINR degradation is larger than 1dB.  Under the assumption of 100% NR UE indoor, significant SINR degradation is observed. |

6.6.5.7 Scenario 6-1 (Optional): D2T2-B- NR UE only outdoor (R2D: UL, CW2D/ D2R: DL)

Scenario 6-1 considers D2T2 topology, all the NR UE outdoors and Readers/CW non-collocated, with UL spectrum applying to reader-to-device link. The conclusions of each cases are listed per scenario in Table 6.6.5.7-1.

Table 6.6.5.7-1: Scenario 6-1 co-existence conclusions

|  |  |  |  |
| --- | --- | --- | --- |
| **Case No.** | **Aggressor** | **Victim** | **Co-existence conclusion** |
| a | Device | NR DL | Negligible NR DL throughput degradation for both average throughput and cell edge throughput is observed. |
| b | NR DL | reader | SINR degradation is less than 1dB under the assumption of 30dBc inband leakage for legacy NR gNB. Inter-system interference is negligible. |
| g | Reader | NR UL | NR UL throughput degradation is observed. |
| h | NR UL | device | SINR degradation is less than 1dB. Inter-system interference is negligible. |

6.6.5.8 Scenario 6-2 (Optional): D2T2-B- NR UE indoor (R2D: UL, CW2D/ D2R: DL)

Scenario 6-2 considers D2T2 topology, 10% and 100%(Optional)of the NR UE indoors and Readers/CW non-collocated, with UL spectrum applying to reader-to-device link. The conclusions of each cases are listed per scenario in Table 6.6.5.8-1.

Table 6.6.5.8-1: Scenario 6-2 co-existence conclusions

|  |  |  |  |
| --- | --- | --- | --- |
| **Case No.** | **Aggressor** | **Victim** | **Co-existence conclusion** |
| a | Device | NR DL | Negligible NR DL throughput degradation for both average throughput and cell edge throughput is observed |
| b | NR DL | reader | SINR degradation is less than 1dB under the assumption of 30dBc inband leakage for legacy NR gNB. Inter-system interference is negligible. 1 company observed some SINR degradation under the assumption of 17dBc inband leakage for legacy NR gNB |
| g | Reader | NR UL | NR UL throughput degradation is observed. |
| h | NR UL | device | Under the assumption of 10% NR UE indoor, SINR degradation is larger than 1dB.  Under the assumption of 100% NR UE indoor, significant SINR degradation is observed. |

6.6.5.9 Scenario 3 (Optional): D1T1-A2- NR UE indoor (R2D: UL, CW2D/ D2R: DL)

Scenario 3 optionally considers D1T1 topology, 10% and 100%(Optional)of the NR UE indoors and Readers/CW collocated, with UL spectrum applying to reader-to-device link. The conclusions of each cases are listed per scenario in Table 6.6.5.9-1.

Table 6.6.5.9-1: Scenario 3 co-existence conclusions

|  |  |  |  |
| --- | --- | --- | --- |
| **Case No.** | **Aggressor** | **Victim** | **Co-existence conclusion** |
| a | Device | NR DL | Negligible NR DL throughput degradation for both average throughput and cell edge throughput is observed |
| b | NR DL | reader | 1 company provides simulation results based on assumption of 30dBc NR gNB inband leakage and observed less than 1dB SINR degradation.  1 company provides simulation results based on assumption of 17dBc NR gNB inband leakage and observed larger than 1 dB SINR degradation. |
| g | Reader | NR UL | NR UL throughput degradation is observed. |
| h | NR UL | device | 1 company provides simulation results based on assumption of 10% NR UE indoor and observed less than 1dB SINR degradation  1 company provides simulation results based on assumption of 100% NR UE indoor and observed larger than 1 dB SINR degradation. |



6.6.5.10 General remarks on coexistence findings

For D1T1 deployment scenario 1-1 (R2D, CW2D/D2R: DL) and scenario 2-1(R2D: DL, CW2D/D2R: UL), which has no legacy NR UE indoor, the performance degradation for NR system and inter-system interference is negligible. Co-existence between ambient IOT and NR is feasible based performance metrics of throughput degradation for NR and SINR degradation for Ambient IoT, no additional coexistence measures are required.

For the deployment scenarios with legacy NR UE indoor (scenario 1-2, 2-2, 5-2, 6-2), which either significant NR throughput degradation or significant SINR degradation for ambient IOT system is observed, some existing mechanisms based on gNB implementation can be considered to avoid/mitigate the interference. For example, for RRC idle mode, NR UEs can camp on a frequency different from ambient IOT system based on frequency priority configured by network; for RRC connected mode, network can handover NR UEs to a different cell (e.g. indoor gNB on a different frequency) based on existing measurement report triggering and event. Besides, other interference management solutions to reduce the inter-system interference from ambient IOT to proximity NR UE and vice versa can also be considered.

For the D2T2 deployment scenarios (scenario 5-1, 5-2, 6-1, 6-2), NR UL throughput degradation is observed. The mechanisms to mitigate the interference can be considered. For example, enhanced emission requirements for intermediate UE or power control for intermediate UE [R4-3] [R4-4].

Additionally, RAN4 has also considered using guard band to solve the interference issue between ambient system and NR system.

***------------End of the Change-------------***