**3GPP TSG-RAN WG4 Meeting #110bis R4-2406618**

**Changsha, China, 15th – 19th April, 2024**

**Agenda item:** 9.13.3

**Source:** CMCC

**Title:** WF on Ambient IoT in NR

**Document for:** Approval

# Introduction

This way forward captures agreements on ambient IOT co-existence evaluation aspects in RAN4#110bis meeting.

The summary for ambient IOT is in R4-2405289 for information.

# Way forward for co-existence evaluation

## Topic 2-1: Deployment scenario

**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 gNB

Option 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 hardware

Option 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 2-1-2: deployment scenarios for D2T2**

Option 1-1: Legacy NR gNB are outdoor macro gNB, AIoT intermediate UE/CW/devices are all indoors. Legacy NR UE is only allowed outdoor.

Option 1-2: Legacy NR gNB are outdoor macro gNB, AIoT intermediate UE/CW/devices are all indoors. Legacy NR UE is indoor.

**Agreement:**

* For D2T2 co-existence evaluation, Legacy NR gNB are outdoor macro gNB, AIoT intermediate UE/CW/devices are all indoors.
	+ Consider option 1-1 and option 1-2 as the starting point

## Topic 2-2: Spectrum usage

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

Option 1: FDD DL spectrum for R2D

Option 2: FDD UL spectrum for R2D

**Agreement:**

* FFS on whether to prioritize FDD DL spectrum for R2D for D1T1 for co-existence evaluation.

**Issue 2-2-2: Spectrum usage for CW transmission in D1T1 for the case that D2R backscattering is transmitted in the same carrier as CW for D2R backscattering**

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

**Agreement:**

* For the case that D2R backscattering is transmitted in the same carrier as CW for D2R backscattering, consider the following for co-existence evaluation
	+ CW transmits in either UL or DL spectrum
	+ FFS on inside topology and outside topology.

**Issue 2-2-4: Spectrum usage for R2D in D2T2**

**Agreement:**

* Use FDD UL spectrum for R2D in D2T2.

**Issue 2-2-5: Spectrum usage for CW transmission in D2T2 for the case that D2R backscattering is transmitted in the same carrier as CW for D2R backscattering**

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:**

* For the case that D2R backscattering is transmitted in the same carrier as CW for D2R backscattering
	+ Use UL spectrum as the starting point for co-existence evaluation.
		- It won’t preclude the use of DL for backscattering transmission.
		- FFS on the minimum distance between the intermediate UE and A-IoT device

## Topic 2-3: Spectrum deployment mode

**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

## Topic 2-4: Evaluation methodology

**Issue 2-4-1: Evaluation methodology**

**Agreement:**

* Use the Monte-Carlo method as baseline for co-existence evaluation, i.e. Section 5.3 in TR38.803
* Depending on the discussion on deployment scenarios, for some cases, calculation for the worst interference link may be enough.
* FFS on whether RAN4 needs to perform link level simulation

**Issue 2-4-2: Performance metric for AIOT**

**Agreement:**

* 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

## Topic 2-5: Evaluation cases

**Issue 2-5-1: device type**

**Agreement:**

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

**Issue 2-5-2: Evaluation cases for D1T1 for device 1 and 2a between NR and AIOT**

**Agreement:**

* FFS on evaluation cases for D1T1 for device 1 and 2a between NR and AIOT. Corresponding evaluation cases are listed for information. Note that some duplicated cases are omitted in the table.

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| **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 |

**Issue 2-5-3: Evaluation cases for D2T2 for device 1 and 2a between NR and AIOT**

**Agreement:**

* FFS on evaluation cases for D2T2 for device 1 and 2a between NR and AIOT. Corresponding evaluation cases are listed for information. Note that some duplicated cases are omitted in the table.

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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 2-5-4: Evaluation cases for device 2b between AIOT and NR**

**Agreement:**

* FFS for evaluation cases for device 2b

**Issue 2-5-5: Interference between AIOT systems**

**Agreement:**

* RAN4 to first evaluate interference between AIOT and NR.
* FFS on interference between AIOT and AIOT

## Topic 2-6: Evaluation parameters

There are no agreements on detailed parameters in RAN4#110bis meeting. Deatiled parameters for information can be found in summary document R4-2405289 and will be further discussed in next meeting.

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**Issue 2-6-2 and 2-6-3: Layout for D1T1 and D2T2**

**Agreement:**

Use RAN1 agreements in RAN1#116bis meeting as baseline (copied as below).

* FFS on whether any updates are needed for RAN4 co-existence evaluation.
* FFS on other parameters.

**RAN1 agreements:**

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

The following layout is used for evaluation purpose,

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

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| **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

 | * 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 |

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