**3GPP TSG-RAN WG4 Meeting # 112-bis R4-2415217**

**Hefei, China, April 14 - 18, 2024**

**Agenda item:** 5.21

**Source:** Moderator (China Unicom)

**Title:** Topic summary for [112bis][113] NR\_mmWave\_protect

**Document for:** Information

# Introduction

*In RAN-105 meeting, new WID on mmWave UE spurious emission was approved to work on necessary UE and BS requirements to meet the latest regulation requirements on EESS protection from mmwave emissions. This summary covers the A.I.5.21 with following parts:*

*- General issues*

*- UE RF requirements*

*- BS RF requirements*

# Topic #1: General Issues

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2415262 | China Unicom, Huawei, HiSilicon | The work plan for WI NR\_mmWave\_protect. |
| R4-2416354 | Huawei, HiSilicon | TR skeleton for Protection of Earth Exploration Satellite Service (EESS) |

## Open issues summary

*Before Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 1-1 Work plan

*Sub-topic description:*

*Open issues and candidate options before meeting:*

**Issue 1-1: Work plan**

* Proposal: The work plan proposed in R4-2415262 (China Unicom, Huawei, HiSilicon)
* Recommended WF
  + Agree on the work plan.

### Sub-topic 1-2 TR skeleton

*Sub-topic description*

*Open issues and candidate options before meeting:*

**Issue 1-2: TR skeleton**

* Proposal: The TR skeleton proposed in R4-2416354 (Huawei, HiSilicon)
* Recommended WF
  + Agree on the TR skeleton

# Topic #2: UE RF requirements

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2415083 | CATT | **Observation 1:** For Network Signaling(s) and associated A-MPR(s), the introduction of additional spurious emission requirements of -5dBm/200Mz for 23.6-24 GHz frequency range for n257 and n258 will impact the following parts in TS 38.101-2:   * 6.2.3 UE maximum output power with additional requirements * 6.2A.3 UE maximum output power with additional requirements for CA * H.1 Indication of modified MPR behavior   **Observation 2:** For additional spurious emission requirement, the introduction of additional spurious emission requirements of -5dBm/200Mz for 23.6-24 GHz frequency range for n257 and n258 will impact the following parts in TS 38.101-2:   * 6.5.3.1 Spurious emission band UE co-existence * 6.5.3.2 Additional spurious emissions * 6.5A.3.1 Spurious emission band UE co-existence for UL CA * 6.5A.3.2 Additional spurious emissions   **Observation 3:** Use the Note 4 and Note 5 in the following table to specify 1dBm/200MHz(Note 4) and -5dBm/200MHz(Note 5) spurious emission for EESS protection. |
| R4-2415329 | Apple | **Observation:** Initial simulation of a 400MHz channel placed at the lower band edge of n258 indicates that at least 1dB power back-off might be required for a fully allocated channel. Further analysis is needed to obtain a full picture for the protection of EESS. |
| R4-2415726 | Qualcomm | **Observation 1:** The EESS phase 2 emissions requirements require a bespoke solution, independent of NS\_203  **Proposal 1:** RAN4 to create a new NS to support UE compliance of EESS phase 2 requirements.  **Observation 2:** PC1 UEs in n257/n261 will also need backoff due to first order spurs (despite the large frequency distance from the EESS protected band).  **Observation 3:** NS\_203 A-MPR does not account separately for non-contiguous RBs in contiguous CA and will need to be revisited separately for completeness  **Proposal 2:** For [NS\_205], frequency distance to protected band edge (rather than frequency distance to band edge) is adopted as frequency offset criterion. This is because n257 and n261 are projected to need A-MPR allowance. |
| R4-2415908 | ZTE Corporation, Sanechips | **Observation 1:** The existing NS\_202/CA\_NS\_202 A-MPR requirements can met the -5dBm/200MHz (or -35 dBW/200 MHz) requirements in 23.6 - 24.0 GHz ranges.  **Proposal 1.** It is proposed to introduce NS\_204 (for single CC) and CA\_NS\_204 (for CA) for the emissions limit of -5dBm/200MHz (or -35 dBW/200 MHz) in the frequency range 23.6 - 24.0 GHz and -10 dBm/100 MHz in the frequency range 7.25 GHz ≤ f ≤ 2nd harmonic (for EU), where the A-MPR defined in NS\_202 (for single CC) and CA\_NS\_202 (for CA) can be applied, respectively.  **Proposal 2.** To met the -5 dBm/200 MHz (or -35 dBW/200 MHz) emission limit in 23.6 - 24.0 GHz, it is proposed to introduce NS\_205 (for single CC) with the A-MPR requirements defined in TS38.817-01, which are:   * PC1: 7.0 if Offset frequency < BWchannel, 6.0 otherwise * PC2~7: 1.0 if Offset frequency < BWchannel, 0.0 otherwise   The Offset frequency is defined as the frequency from 24.25 GHz to the lower edge of the channel bandwidth.  **Proposal 3.** For the requirement applying UE brought into use for -5 dBm/200 MHz (or -35 dBW/200 MHz) limits, applying different changeover dates for different countries/regions.  **Proposal 4.** The new NS values are mandatory for UE brought into use at least after the changeover dates.  **Proposal 5:** The same approach with introduction of NS\_203, i.e. modifiedMPRbehavior indication, should apply to the NS\_204, NS\_205 and CA\_NS\_204, CA\_NS\_205 for band n257 and n258, respectively.  **Proposal 6:** It is proposed to introduce 23.6GHz-24GHz protection of -5dBm/200MHz for n257 and n258 into general spurious emission band UE co-existence requirements. |
| R4-2416065 | Nokia | **Observation/Proposal:** In this contribution we have discussed the A-MPR need for additional spurious emission requirements of -5dBm/200Mz for 23.6-24 GHz frequency range for n257 and n258 that has become a regulatory requirement and concluded that there seems not to be a need for A-MPR definition. |
| R4-2416161 | Ericsson | **Observation:** TS 38.101-2 only captures the first stage limit from WRC-19 Resolution 750 (valid until 1 September 2027 when following ITU-R RR).  **Proposal 1:** Update NS\_202 (and CA\_NS\_202) changing the 1dBm/200MHz limit to -5dBm/200MHz.  **Proposal 2:** Specify a new NS\_205 to manage the second stage limit of -5dBm/200 MHz in the 23.6-24.0 GHz frequency range. This NS CA\_NS\_205 should only be used from 1 September 2027. A corresponding new NS for CA should also be specified. |
| R4-2416163 | Ericsson | Draft CR to TS 38.101-2 – EES protection – UE RF impacts |
| R4-2416194 | NTT Docomo | **Observation 1:** The EESS protection of -5dBm/200MHz are already in place in Japanese regulation which will start to be applied from September 2027.  **Observation 2:** The relaxed EESS protection of 1dBm/200MHz is already specified in UE coexistence table as general requirement for n257 in current TS 38.101-2.  **Observation 3:** If the severe EESS protection of -5dBm/200MHz is specified under new NS for n257, it requires additional UE and NW implementation to set an appropriate NS to the legacy and new UE, since the legacy UE does not understand the new NS and considers the cell as barred.  **Observation 4:** NS\_203 requires no A-MPR when the frequency offset from 24.25MHz to lowest edge of channel bandwidth is larger than or equal to its channel bandwidth for both PC3 and PC1.  **Proposal:** RAN4 evaluates the condition where A-MPR is not needed for n257 to meet EESS protection of -5dBm/200MHz, and specify it in general requirement (i.e., UE coexistence table).   * Especially for UE transmitting at 27.4-27.8GHz with 100MHz x 4CC. |
| R4-2416353 | Huawei, HiSilicon | **Observation 1:** NS\_202 and NS\_203 with +1dBm/200MHz do not meet the latest demand of regulation.  **Observation 2:** To analyse how to introduce A-MPR for Rel-19 EESS, evaluation is essential, especially to identify the frequency range that is not impacted in the case.  **Proposal 1:** Rel-19 should introduce new NS values considering all the power classes and analyse the A-MPR requirements based on evaluations to meet EESS passive services protection in the 23.6GHz-24GHz region for band n258 and n257.  **Proposal 2:** The evaluation assumptions for A-MPR should be captured in the TR for Rel-19 EESS. |

## Open issues summary

*Before Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 2-1 Network Signalling

*Sub-topic description:*

*Open issues and candidate options before meeting:*

**Issue 2-1-1: Necessity of New NS signalling**

* Proposals
  + Option 1: Defining new NS values (i.e. NS\_205) considering all the power classes to meet -5 dBm/200 MHz (or -35 dBW/200 MHz) EESS passive services protection in the 23.6GHz-24GHz for band n258 and n257. (Qualcomm, ZTE, Ericsson, Huawei, HiSilicon)
    - Option 1-1: A corresponding new NS for CA (i.e. CA\_NS\_205) should also be specified. (Ericsson)
  + Option 2: No need for A-MPR definition. (Nokia)
* Recommended WF
  + It is recommended to check whether Option 1/1-1 is agreeable.

**Issue 2-1-2: Applicability for the new NS**

* Proposal 1: For the requirement applying UE brought into use for -5 dBm/200 MHz (or -35 dBW/200 MHz) limits, applying different changeover dates for different countries/regions. The new NS values are mandatory for UE brought into use at least after the changeover dates. (ZTE)
* Proposal 2: The new NS should only be used from 1 September 2027. (Ericsson)
* Recommended WF
  + TBA

**Issue 2-1-3: Updating of existing NSs**

* Proposal 1: Introduce NS\_204 (for single CC) and CA\_NS\_204 (for CA) for the emissions limit of -5dBm/200MHz (or -35 dBW/200 MHz) in the frequency range 23.6 - 24.0 GHz and -10 dBm/100 MHz in the frequency range 7.25 GHz ≤ f ≤ 2nd harmonic (for EU), where the A-MPR defined in NS\_202 (for single CC) and CA\_NS\_202 (for CA) can be applied, respectively. (ZTE)
* Proposal 2: Update NS\_202 (and CA\_NS\_202) changing the 1dBm/200MHz limit to -5dBm/200MHz. (Ericsson)
* Recommended WF
  + TBA

### Sub-topic 2-2 A-MPR evaluation

*Sub-topic description*

*Open issues and candidate options before meeting:*

**Issue 2-2-1: Definition of A-MPR frequency offset**

* Proposals
  + Option 1: The Offset frequency is defined as the frequency from 24.25 GHz to the lower edge of the channel bandwidth. (ZTE)
  + Option 2: For [NS\_205], frequency distance to protected band edge (rather than frequency distance to band edge) is adopted as frequency offset criterion. This is because n257 and n261 are projected to need A-MPR allowance. (Qualcomm)
* Recommended WF
  + Agree on the definition of frequency offset.

**Issue 2-2-2: Applicability of the A-MPR frequency offset**

* Proposal: RAN4 evaluates the condition where A-MPR is not needed for n257 to meet EESS protection of -5dBm/200MHz, and specify it in general requirement (i.e., UE coexistence table). Especially for UE transmitting at 27.4-27.8GHz with 100MHz x 4CC. (NTT Docomo)
* Recommended WF
  + To find a frequency offset point where there is no A-MPR needed. Further evaluations could be carried out.

**Issue 2-2-3: A-MPR values**

* Proposals
  + Option 1: (ZTE) Introduce NS\_205 (for single CC) with the A-MPR requirements defined in TS38.817-01, which are:
    - -PC1: 7.0 if Offset frequency < BWchannel, 6.0 otherwise
    - -PC2~7: 1.0 if Offset frequency < BWchannel, 0.0 otherwise
  + Option 2: Initial simulation of a 400MHz channel placed at the lower band edge of n258 indicates that at least 1dB power back-off might be required for a fully allocated channel. Further analysis is needed to obtain a full picture for the protection of EESS. (Apple)
  + Option 3: No need for A-MPR definition. (Nokia)
* Recommended WF
  + Taking inputs from this meeting as starting point, further evaluate the A-MPR values once the evaluation assumptions are agreed.

### Sub-topic 2-3 Specification Impact(s)

*Sub-topic description*

*Open issues and candidate options before meeting:*

**Issue 2-3-1: Impacts to TS38.101-2**

* Proposal 1: (CATT, R4-2415083) Following clauses would be impacted:
  + -6.2.3 UE maximum output power with additional requirements
  + -6.2A.3 UE maximum output power with additional requirements for CA
  + -H.1 Indication of modified MPR behavior
  + -6.5.3.1 Spurious emission band UE co-existence
  + -6.5.3.2 Additional spurious emissions
  + -6.5A.3.1 Spurious emission band UE co-existence for UL CA
  + -6.5A.3.2 Additional spurious emissions
  + Adding “***Note 4:*** *This limit applies to UE brought into use on or before 1 September 2027 except in China and European Union. And this limit applies to UE brought into use on or before 1 January 2024 in European Union.* ***Note 5:*** *This limit applies to UE brought into use after 1 September 2027 except in China and European Union. This limit applies to UE brought into use on in China. And this limit applies to UE brought into use after 1 January 2024 in European Union*.” in Spurious emission table.
* Proposal 2: Draft CR to TS 38.101-2 – EESS protection – UE RF impacts (Ericsson, R4-2416163)
* Proposal 3: Introduce 23.6GHz-24GHz protection of -5dBm/200MHz for n257 and n258 into general spurious emission band UE co-existence requirements. (ZTE)
* Recommended WF
  + Identify all the potential impacted clauses for TS38.101-2 to make sure all necessary changes would be included for this WI.

**Issue 2-3-2: Impacts to the EESS TR**

* Proposal: The evaluation assumptions for A-MPR should be captured in the TR for Rel-19 EESS. (Huawei, HiSilicon)
* Recommended WF
  + Agree with the proposal.

# Topic #3: BS RF requirements

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2415084 | CATT | **Observation 1:** Add the additional OBUE limits for EESS protection in European Union as following table.  **Observation 2:** Add additional spurious limits for EESS protection in European Union as following table. |
| R4-2415477 | Nokia | **Proposal:** This contribution provides the necessary changes of the BS RF requirements in TS 38.104 and TS 38.141-2 on mmWave UE spurious emission. The necessary changes are provided. |
| R4-2415909 | ZTE Corporation, Sanechips | **Observation 1.** For BS study, there were no consensus for EESS protection at 36 - 37 GHz in previous meetings.  **Proposal 1:** To clarify the scope for BS study is only for 23.6-24 GHz frequency range in this WID.  **Observation 2.** Except additional OTA OBUE and Tx/Rx spurious emissions requirements, there are no other BS RF requirements impacted.  **Proposal 2.** For the requirement applying BS brought into use for -9 dBm/200 MHz limits, applying different changeover dates for different countries/regions. |
| R4-2416160 | Ericsson | **Observation:** TS 38.104 was not updated to consider Chinese and European regulations related to the EESS protection in the 23.6-24.0 GHz frequency range.  **Proposal:** Endorse our companion draft CR R4-2416162, TS 38.141-2 should be updated accordingly. |
| R4-2416162 | Ericsson | Draft CR to TS 38.104 – EES protection – BS RF impacts |

## Open issues summary

*Before Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 3-1 General proposals

*Sub-topic description*

*Open issues and candidate options before meeting:*

**Issue 3-1:**

* Proposal 1: To clarify the scope for BS study is only for 23.6-24 GHz frequency range in this WID.
* Proposal 2: For the requirement applying BS brought into use for -9 dBm/200 MHz limits, applying different changeover dates for different countries/regions. (*Moderator: It seems that the discussion of proposal 2 could be merged with sub-topic 3-2*)
* Recommended WF
  + The scope for BS study is only for 23.6-24 GHz frequency range in this WID.

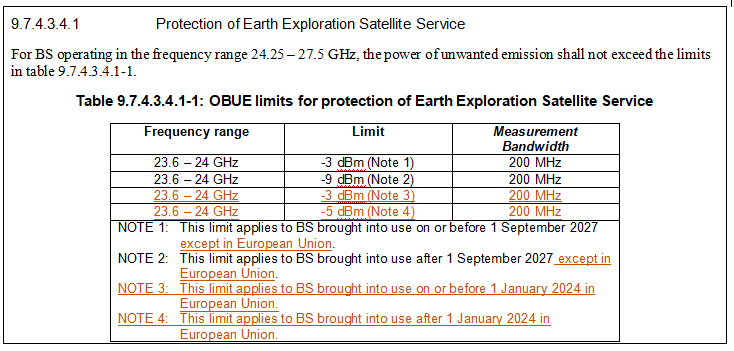
### Sub-topic 3-2 Specification updates

*Sub-topic description:*

*Open issues and candidate options before meeting:*

**Issue 3-2-1: OBUE limits (TS 38.104 Table 9.7.4.3.4.1-1)**

* Proposals
  + Option 1: (CATT)



* + Option 2: (Nokia)

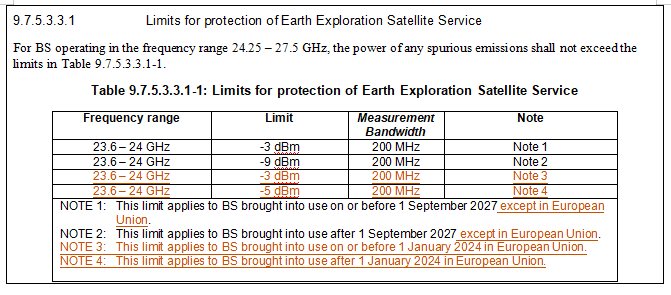
Table 9.7.4.3.4.1-1: OBUE limits for protection of Earth Exploration Satellite Service

|  |  |  |
| --- | --- | --- |
| Frequency range | Limit | *Measurement Bandwidth* |
| 23.6 – 24 GHz | -3 dBm (Note 1) | 200 MHz |
| 23.6 – 24 GHz | -9 dBm (Note 2) | 200 MHz |
| NOTE 1: This limit applies to BS brought into use on or before 1 January 2024 in countries following EU Decision 2020-590 and applies to BS brought into use on or before 1 September 2027 inr other countries.  NOTE 2: This limit applies to BS brought into use after 1 January 2024 in countries following EU Decision 2020-590 and applies to BS brought into use after 1 September 2027 in other countries. | | |

* Recommended WF
  + TBA

**Issue 3-2-2: Spurious limits (TS38.104 Table 9.7.5.3.3.1-1)**

* Proposals
  + Option 1: (CATT)



* + Option 2: (Nokia)

Table 9.7.5.3.3.1-1: Limits for protection of Earth Exploration Satellite Service

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency range | Limit | *Measurement Bandwidth* | Note |
| 23.6 – 24 GHz | -3 dBm | 200 MHz | Note 1 |
| 23.6 – 24 GHz | -9 dBm | 200 MHz | Note 2 |
| NOTE 1: This limit applies to BS brought into use on or before 1 January 2024 in countries following EU Decision 2020-590 and applies to BS brought into use on or before 1 September 2027 inr other countries.  NOTE 2: This limit applies to BS brought into use after 1 January 2024 in countries following EU Decision 2020-590 and applies to BS brought into use after 1 September 2027 in other countries. | | | |

* + Option 3: (Ericsson)

9.7.5.3.3.1 Limits for protection of Earth Exploration Satellite Service

For BS operating in the frequency range 24.25 – 27.5 GHz, the power of any spurious emissions shall not exceed the limits in Table 9.7.5.3.3.1-1.

Table 9.7.5.3.3.1-1: Limits for protection of Earth Exploration Satellite Service

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency range | Limit | *Measurement Bandwidth* | Note |
| 23.6 – 24 GHz | -3 dBm | 200 MHz | Note 1 |
| 23.6 – 24 GHz | -9 dBm | 200 MHz | Note 2 |
| NOTE 1: This limit applies to BS brought into use on or before 1 September 2027 in some countries.  NOTE 2: This limit applies to BS brought into use after 1 September 2027 in the countries where note 1 applies, while this limit applies already in this version of the specification in the other countries. | | | |

* Recommended WF
  + TBA

**Issue 3-2-3: TS38.141-2**

* Proposal: (Nokia)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Table 6.7.4.5.2.4.1-1: BS radiated limits for protection of EESS   |  |  |  |  | | --- | --- | --- | --- | | Frequency range | Measurement filter centre frequency range | Limit | Measurement Bandwidth | | 23.6 – 24 GHz | 23.7 – 23.9 GHz | -3 dBm (Note 1) | 200 MHz | | 23.6 – 24 GHz | 23.7 – 23.9 GHz | -9 dBm (Note 2) | 200 MHz | | NOTE 1: This limit applies to BS brought into use on or before 1 January 2024 in countries following EU Decision 2020-590 and applies to BS brought into use on or before 1 September 2027 inr other countries.  NOTE 2: This limit applies to BS brought into use after 1 January 2024 in countries following EU Decision 2020-590 and applies to BS brought into use after 1 September 2027 in other countries. | | | |   Table 6.7.5.4.5.2-1: BS spurious emissions test limits for protection of Earth Exploration Satellite Service   |  |  |  |  | | --- | --- | --- | --- | | Frequency range | Limit | Measurement Bandwidth | Note | | 23.6 – 24 GHz | -3 dBm | 200 MHz | Note 1 | | 23.6 – 24 GHz | -9 dBm | 200 MHz | Note 2 | | NOTE 1: This limit applies to BS brought into use on or before 1 January 2024 in countries following EU Decision 2020-590 and applies to BS brought into use on or before 1 September 2027 inr other countries.  NOTE 2: This limit applies to BS brought into use after 1 January 2024 in countries following EU Decision 2020-590 and applies to BS brought into use after 1 September 2027 in other countries. | | | |   Table 7.7.5.2-3: Limits for protection of Earth Exploration Satellite Service   |  |  |  |  | | --- | --- | --- | --- | | Frequency range | Limit | Measurement Bandwidth | Note | | 23.6 – 24 GHz | -3 dBm | 200 MHz | Note 1 | | 23.6 – 24 GHz | -9 dBm | 200 MHz | Note 2 | | NOTE 1: This limit applies to BS brought into use on or before 1 January 2024 in countries following EU Decision 2020-590 and applies to BS brought into use on or before 1 September 2027 inr other countries.  NOTE 2: This limit applies to BS brought into use after 1 January 2024 in countries following EU Decision 2020-590 and applies to BS brought into use after 1 September 2027 in other countries. | | | | |

* Recommended WF
  + TBA