**3GPP TSG-RAN WG4 Meeting#111 R4-2410106**

**Fukuoka City, Fukuoka , Japan, 20th – 24th May, 2024**

**Agenda item:**  10.2.4

**Source:** Moderator (ZTE)

**Title:** Topic summary for [111][311] NR\_BS\_RF

**Document for:** Information

# Introduction

*Briefly introduce background, the scope of this email discussion (e.g. list of treated agenda items) and provide some guidelines for email discussion if necessary.*

*List of candidate target of email discussion for 1st round and 2nd round*

* 1st round: TBA
* 2nd round: TBA

It is appreciated that the delegates for this topic put their contact information in the table below.

Note:

1. Please add your contact information in above table once you make comments on this email thread.
2. If multiple delegates from the same company make comments on single email thread, please add you name as suffix after company name when make comments i.e. Company A (XX, XX)

# Topic #1: General

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| **[R4-2409545](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2409545.zip)** | Huawei, HiSilicon | Information on developments of ETSI TR 103 974 on the equivalence of measurement results with different OTA test methods |

## Open issues summary

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

### Sub-topic 1-1 ETSI related information

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 1-1: ETSI related information**

* Information on developments of ETSI TR 103 974 on the equivalence of measurement results with different OTA test methods [Huawei, **[R4-2409545](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2409545.zip)**].
* Recommended WF:
	+ No discussions are needed.

# Topic #2: BS EIRP mask for U6GHz

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| **[R4-2407020](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2407020.zip)** | Spark NZ Ltd | Validation of EIRP**Observation 1**: The calculation of confidence intervals on the mean requires the knowledge of standard deviations. as this is not specified, we could estimate the standard deviation from that of the given samples.**Observation 2** : The calculation of confidence intervals also requires the knowledge of the underlying distribution type. As this is not specified, we have two choices: (1) Either to assume that the distribution of EIRP is Normal, or (2) a students *t* distribution.**Observation 3**: The calculation of CIs assume the N samples are unbiased.A 95% confidence interval on the population mean (per-bin) with *unknown standard deviation* *for a normal distribution* is then given by:*Lower limit*= * Mean- 1.96. *s*/$√N$

*Upper limit* = * Mean + 1.96.*s*/$√N$

A 95% confidence interval on the population mean (per bin) with *unknown standard deviation for a students t* distribution is then given by [ Chapter 9, 2]:*Lower limit*= * Mean- 2.04. *s*/$√N$

*Upper limit* =* Mean +2.04. *s*/$√N$
* In both cases, we can think of *s*/$√N$as an error in the estimated mean.

**Observation 4:** For both types of distribution choices above, the number of samples ( in this case the beams) N, and the accuracy of samples will significantly influence the upper and lower bounds.**Observation 5:** As the distribution of EIRP is not specified, students t distribution may be preferable to estimate the CI.**Proposal** 1: RAN 4 should decide if equation (7) or (8) should be used in the mean value estimation. If equation (8) is to be used then the issues of a 3 sector site and radiation outside the steering range need to be clarified . RAN 4 should also confirm the number of quantisation points.**Proposal 2:**Assuming the students t distribution and estimating the standard deviation s of the population from the samples, the upper and lower CI for the mean per elevation angular bin are:*Lower limit*= * Mean- 1.7. s/sqrt(N)

*Upper limit* =* Mean + 1.7. s/sqrt(N)

**Proposal 3:** Capture all of the above text in sections 2 and 3 in TR (section 5) for upper 6 GHz- skeleton agreed during RAN4 110bis. |
| **[R4-2407555](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2407555.zip)** | CATT | Discussion on the remaining issues for expected EIRP mask for upper 6GHz**Proposal 1: The EIRP emission measurement frequency range is defined up to 7075MHz.****Proposal 2: The following name can be a candidate for discussion,****OTA spatial emission limit for protection of fixed-satellite service.****Proposal 3: A new clause 9.9.1 to be added to introduce the requirement to allow some flexibility for the specification.**We also drafted specification wording for reference in 2.4. |
| **[R4-2408215](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408215.zip)** | NEC | Discussion on the sub-clause to capture the EIRP mask requirement**Proposal:****To add new clause for EIRP emission mask, unless there is a concrete rule that regional requirements shall be additional requirements.** |
| **[R4-2408401](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408401.zip)** | Qualcomm Germany | Views on Expected EIRP mask for upper 6GHz**Observation 1: BS type 1-H and BS type 1-O are the BS types that should comply to the expected EIRP mask requirement.****Proposal 1: RAN4 to consider the EIRP mask requirement applicable to the whole n104 (6 425 – 7 125MHz) band.** **Proposal 2: RAN4 to add a new clause in Section 9 (i.e., Radiated Transmitter Requirements) of TS 38.104 to include the EIRP mask requirement.****Proposal 3: Prior to specifying the conformance procedures and requirements of how to capture the EIRP mask, RAN4 to study the impact of different parameters (e.g., number of beamforming directions, number of elevation bins, etc.) that constitutes the evaluation of the average EIRP mask as a function of the elevation angle.** **Proposal 4: RAN4 to discuss the impact of the expected EIRP evaluation framework on the test accuracy and complexity.** **Proposal 5: RAN4 to discuss how to ensure that the expected EIRP is accurately evaluated at each given direction of the N beamforming directions assumed.**  |
| **[R4-2409073](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2409073.zip)** | Nokia | Discussion on expected EIRP mask above horizon**Proposal 1: It is proposed to include the range 6425 – 7125 MHz which is full band n104 range.****Proposal 2: To consider during conformance testing exclusion of range 7075- 7125 MHz if any part of respective channel bandwidth doesn’t fall to band below 7075 MHz.** **Proposal 3: It is proposed to use name “OTA average spatial emission above horizon” for new requirement.** **Proposal 4: It is proposed to introduce new sub-clause “9.9 OTA average spatial emission above horizon” for new requirement.****Observation 1: The number of beamforming directions defined will impact test effort and increasing the number of these beams will increase the time it takes to test.****Proposal 5: RAN4 to consider appropriate values of beamforming directions taking into account all aspects.****Observation 2: The angular steps size both in horizontal and vertical should be sufficient to capture the e.i.r.p. variations of the AAS beam.** **Observation 3: Step sizes of 5° / 5° (vertical / horizontal angular step size) is unlikely to be adequate to capture the e.i.r.p. variations of the AAS beam correctly.****Observation 4: Incorrectly determining the angular step can increase measurement effort substantially without material improvement to the actual e.i.r.p. of the AAS beam.****Observation 5: Choosing appropriate angular step between the horizontal and vertical domain can capture the e.i.r.p. of the AAS beam while keeping the number of measurement points to a minimum.****Proposal 6: RAN4 to consider the number of measurement points (or vertical/horizontal angular step size) when defining the calculation methodology, aiming to minimize the measurement complexity or effort while assuring a high level of accuracy.****Observation 6: Number of frequencies to measure in operating band will impact test effort.****Proposal 7: RAN4 to consider the number of frequencies to measure when defining the calculation methodology.** |
| **[R4-2409074](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2409074.zip)** | Nokia | CR to TS 38.104 with OTA spatial emission above horizon requirement introduction |
| **[R4-2409118](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2409118.zip)** | Ericsson | On introduction of OTA spatial emission above the horizon requirement for band n104**Proposal 1:** Add a new section in subclause 9 with the heading “9.9 OTA spatial emission”.**Proposal 2:** Define OTA spatial emission requirement for NR band n104 within the frequency range 6425 to 7075 MHz.**Proposal 3:** The requirement is applicable for AAS BS type 1-H and BS type 1-O.**Proposal 4:** It is proposed to use the draft requirement text in section 5 as baseline for further discussions.**Proposal 5:** RAN4 should define a concept where the test beam directions are related to the declared Coverage Angular Range (CAR) and the number of test beam directions are specified.**Proposal 6:** RAN4 need to develop a concept where the test beams are distributed within the whole coverage angular range with specified beam weight factor vector.  |
| **[R4-2409401](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2409401.zip)** | Huawei, HiSilicon | Expected EIRP requirements**Proposal 1:** It is not necessary to define the horizon or a coordinate system relative to it in the core specification.**Proposal 2:** The statement covering all foreseen modes of operation could be strengthened to better cover the installation parameters to:**Observation 1:** θ=0 is NOT the horizon in our coordinate system**Proposal 3:** The coordinate system diagram and the geographical (horizon) diagram should be combined to make it clear the reference points for θ and ϕ.**Proposal 4:** in the EEIRP requirement table use θHL andθHH and define the symbols in clause 3 as above the horizon.**Proposal 5:** Option 3: add new clause for EIRP emission mask**Proposal 6:** to define the expected EIRP to be applied to up to 7075 MHz**Proposal 7:** to endorse the draft CR to 38.104 as proposed in annex**Proposal 8:** Spatial declarations for Expected EIRP are made in the conformance requirement, no need for formal definitions in the core specification.**Proposal 9:** A means to identify a means to test the quality of potential conformance directional test vectors must be derived.**Observation 1:** a suitable summation Error for the Expected EIRP MU calculation should be derived based on step size and averaging uncertainty.**Observation 2:** A test equipment MU analysis is required but MU value per directional point may be closer to the unwanted emissions level accuracy rather than the wanted signal TRP accuracy. |
| **[R4-2409604](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2409604.zip)** | ZTE Corporation, Sanechips | Further discussion on Expected EIRP mask for upper 6GHz**Proposal 1:** the expected EIRP mask requirement apply for whole frequency range of band n104.**Proposal 2:** use the OTA spatial emission above horizon as the name of the expected EIRP mask requirement. **Proposal 3:** define the reference coordinate system for OTA spatial emission over the horizon as followingThe coordinate system for OTA spatial emission over horizon is created of a Cartesian coordinate system with rectangular axis (x***,*** y***,*** z) and spherical angles () irrespective of BS mechanical down-tilt as showed in figure 3.IMG_256Figure 3: Reference coordinate system for OTA spatial emission above horizon******is the angle in the x/y plane, between the x-axis and the projection of the radiating vector onto the x/y plane and is defined between -180° and +180°, inclusive. ****** is the angle between the projection of the vector in the x***/***y plane and the radiating vector and is defined between 0 and +90°, inclusive. Note that  is defined as positive along the up-tilt angle.**Proposal 4:**To ensure protection for the FSS (Earth-to-space), the Expected EIRP of NR BS operating in band n104 shall not exceed the limits in Table 9.9-1.Table 9.9-1: Expected EIRP limits.

|  |  |
| --- | --- |
| Vertical angle rangeθL ≤ θ < θH(vertical angle θ above the horizon) | Expected e.i.r.p. (dBm/MHz) |
| 0° ≤ θ < 5° | 27 |
| 5° ≤ θ < 10° | 23 |
| 10° ≤ θ < 15° | 19 |
| 15° ≤ θ < 20° | 18 |
| 20° ≤ θ < 30° | 16 |
| 30° ≤ θ < 60° | 15 |
| 60° ≤ θ ≤ 90° | 15 |
| Note 1: The reference coordinate system for OTA spatial emission requirement is defined in clause 4. 10.Note 2: The requirement is defined within specific vertical angle range above the horizon and over horizontal angles from −180° to +180 °.Note 3: NR BS shall comply with the specified limits on expected e.i.r.p. spectral density for all mechanical tilts with which it can be deployed |

In addition, in last RAN4 meeting, there were some discussions where to capture the core requirement for OTA spatial emission requirements. From our understanding, Unwanted emissions consisting of so-called out-of-band emissions and spurious emissions according to ITU definitions ITU-R SM.329 might be not appropriate place to put this requirement since this clause is targeted for out of band emissions instead of within wanted carriers. In other words, to have new clause e.g. Clause 9.9 OTA spatial emission above the horizon should be one better structure for it. **Proposal 5:** have new clause 9.9 for OTA spatial emission above the horizon for band n104.**Proposal 6**: use the legacy measurement grid with updated maximum step size for elevation angle 0 to 20 degree at least for EIRP measurement on upper hemisphere or above the horizon, then use these measured spatial EIRP value to calculate the EEIRP mask.  $Δϕ\_{ref}= min⁡(\frac{180^{∘}}{π}\frac{λ}{D\_{cyl}},5^{∘})$ $Δθ\_{ref}=⁡min(\frac{180^{∘}}{π}\frac{λ}{D},5^{∘})$or$$∆θ\_{ref}=min(\frac{180^{°}}{π}arcsin⁡(\frac{λ}{D\_{z}}),5^{°})$$ $Δϕ\_{ref}=min(\frac{180^{°}}{π}arcsin⁡(\frac{λ}{D\_{y}}),5^{°})$**Proposal 7:**$EEIRP\left(θ\_{L} , θ\_{H}\right)=\frac{π}{MN\left(sinθ\_{H}−sinθ\_{L}\right)}\sum\_{n=n\_{L}}^{n\_{H}}\sum\_{m=1}^{M}EIRP\left(θ\_{n},φ\_{m}\right) cos\left(θ\_{n}\right)$ ,where$θ\_{n}$ is the discrete elevation sampling angles between the elevation bins$φ\_{m}$ is the discrete azimuth sampling angles ranging from −180° to +180 °$n\_{L}$ is the lowest elevation sampling angles within the $\left(θ\_{L} , θ\_{H}\right)$ bounding range$n\_{H}$ is the highest elevation sampling angles within the $\left(θ\_{L} , θ\_{H}\right)$ bounding range**Proposal 8:** to consider the manufacture declarations in Table 2.4-1 for different mechanical down-tilt and its the corresponding coverage angular range.  |
| **[R4-2409766](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2409766.zip)** | Samsung | Discussion on expected EIRP mask for upper 6GHz**Observation 1**: Based on Resolution 220 (WRC-23), the expected EIRP spectral density limit is introduced to ensure protection for the FSS (Earth-to-space), which operates within the frequency band 6 425-7 075 MHz. **Proposal 1**: The requirement of OTA spatial emission above horizon to be introduced by RAN4 is applicable on the frequency band 6 425-7 075 MHz.**Observation 2**: Based on Resolution 220 (WRC-23), the expected EIRP spectral density limit is a spatial mask, defined as a function of the vertical angle θ (defined as the vertical angle above the horizon). **Proposal 2:** OTA spatial emission above horizon can be implemented, by only considering Option 2 and 3: - Option 2: a subclause of “9.7 OTA unwanted emissions”, i.e., “9.7.x OTA spatial emission above horizon” - Option 3: an independent new requirement clause, i.e., “9.x OTA spatial emission above horizon”**Proposal 3**: The Option 3 (An independent new requirement clause, i.e., “9.x OTA spatial emission above horizon”), is slightly preferred. The Option 2 can be adopted if we extend the definition of “OTA unwanted emission” by include “spatial emission above horizon” in addition to out-of-band emissions and spurious emission. **Observation 3**: Based on Resolution 220 (WRC-23), the level of expected EIRP spectral density limit shall be complied for all mechanical tilts with which BS can be deployed. **Proposal 4**: The OTA EIRP mask requirement shall be applicable to all BS supported mechanical tilts, while the BS supported mechanical tilts shall be based upon BS vendor declaration. **Proposal 5**: For OTA EIRP mask requirement, the following text proposal for general description (for NR BS as example) is initially given for discussion:  |

## Open issues summary

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

### Sub-topic 2 BS EIRP mask requirement for U6GHz

*Sub-topic description:*

*Open issues and candidate options before e-meeting:.*

**Issue 2-1 The applicability of frequency range within band n104.**

* Option 1: 6425-7075MHz (CATT, Huawei, Ericsson, Samsung)
* Option 2: 6425-7125MHz (Qualcomm, ZTE)
* Option 3: for core part, applicable for 6425-7175MHz, consider the testing exclusion of range 7075- 7125 MHz in conformance testing spec.
* Recommended for further discussion:
	+ **Need further discussions**
* Option 1: n104 only
* Option 2: 6425-7 075 MHz

Offline agreement:

Option 1 is agreeable.

**Issue 2-2 The naming for this requirement**

* Option 1: OTA spatial emission above horizon [Huawei, ZTE, Samsung]
* Option 2: OTA spatial emission limit for protection of fixed-satellite service [CATT]
* Option 3: OTA spatial emission [Ericsson]
* Option 4: OTA average spatial emission above horizon [Nokia]
* Recommended for further discussion:
	+ Need further discussions

Offline agreement:

OTA spatial emission

**Issue 2-3 Which sub-clause to capture the requirement**

* Option 1: new clause 9.9 [CATT, NEC,Qualcomm, Nokia, Ericsson, Huawei, ZTE, Samsung]
* Recommended WF:
	+ Use the new clause 9.9 to capture the requirement

Offline agreement:

* + Use the new clause 9.9 to capture the requirement

**Issue 2-4 The applicable BS types to fulfill the Expected EIRP requirements**

* Option 1: BS type 1-H and BS type 1-O [Qualcomm, Ericsson, ZTE, Samsung]
* Option 1: BS type 1-O [Huawei]
* Recommended WF:
	+ BS type 1-H and BS type 1-O

Offline agreement:

BS type 1-H and BS type 1-O

**Issue 2-5 The coordinate system for Expected EIRP requirement**

* Option 1: not necessary to define the horizon or a coordinate system relative to it in the core specification [Huawei]
* Option 2: The coordinate system diagram and the geographical (horizon) diagram should be combined to make it clear the reference points for θ and ϕ.[Huawei]
* Option 3: define the reference coordinate system for OTA spatial emission over the horizon as following [ZTE]



Figure 3: Reference coordinate system for OTA spatial emission above horizon

* Option 4: [Nokia]



Figure 9.9.1-1: Definitions of θL and θH angles.

* Recommended for further discussion:
	+ Need further discussions

Offline agreement:



**Issue 2-6 Mechanical tilts related**

* Proposal 1: The OTA EIRP mask requirement shall be applicable to all BS supported mechanical tilts, while the BS supported mechanical tilts shall be based upon BS vendor declaration. [Samsung]
* Proposal 2: to consider the manufacture declarations in Table 2.4-1 for different mechanical down-tilt and its the corresponding coverage angular range [ZTE]
* Proposal 3: The statement covering all foreseen modes of operation could be strengthened to better cover the installation parameters to [Huawei]
* Recommended for further discussion:
	+ Proposal 1 is agreeable.
	+ Further discuss the wording on the mechanical downtilt in the core specification;
	+ Further discuss how to capture the mechanical downtilt in the conformance testing specification;

Offline agreement:

NOTE 2: An IMT base station shall comply with the specified limits on expected e.i.r.p. spectral density

for all declared mechanical tilts.

Offline agreement:

**Table 2.2.2-1: [CAR] declarations**

| **Parameter** | **Description** |
| --- | --- |
| Qmin  | Minimum angle along q axis |
| qmax | Maximum angle along q axis |
| jmin | Minimum angle along j axis |
| jmax | Maximum angle along j axis |

NOTE 1: further discuss the definition of Qmin qmax jmin jmax

NOTE 2: reusing the existing declaration is not precluded.

**Issue 2-7 Expected EIRP calculation in discrete spatial sampling grid**

* Proposal 1: RAN 4 should decide if equation (7) or (8) should be used in the mean value estimation. If equation (8) is to be used then the issues of a 3 sector site and radiation outside the steering range need to be clarified . RAN 4 should also confirm the number of quantisation points. [Spark]

$$ EIRP\left(θ\_{L} , θ\_{H}\right)=\frac{π}{2δ\left(sinθ\_{H}−sinθ\_{L}\right)}\sum\_{n=n\_{L}}^{n\_{H}}\_{ave}\left(θ\_{n}\right) cos\left(θ\_{n}\right) \left(7\right)$$

$$ EIRP\left(θ\_{L} , θ\_{H}\right)=\frac{π}{2Mδ\left(sinθ\_{H}−sinθ\_{L}\right)}\sum\_{n=n\_{L}}^{n\_{H}}\sum\_{m=1}^{M}\_{ave}\left(θ\_{n},φ\_{m}\right) cos\left(θ\_{n}\right), (8)$$

* Proposal 2: [ZTE]

$EEIRP\left(θ\_{L} , θ\_{H}\right)=\frac{π}{MN\left(sinθ\_{H}−sinθ\_{L}\right)}\sum\_{n=n\_{L}}^{n\_{H}}\sum\_{m=1}^{M}EIRP\left(θ\_{n},φ\_{m}\right) cos\left(θ\_{n}\right)$ ,

where

$θ\_{n}$ is the discrete elevation sampling angles between the elevation bins

$φ\_{m}$ is the discrete azimuth sampling angles ranging from −180° to +180 °

$n\_{L}$ is the lowest elevation sampling angles within the $\left(θ\_{L} , θ\_{H}\right)$ bounding range

$n\_{H}$ is the highest elevation sampling angles within the $\left(θ\_{L} , θ\_{H}\right)$ bounding range

* Proposal 3: [Nokia]

$$EIRP\left(θ\_{L} , θ\_{H}\right)=\frac{π}{2MN\left(sinθ\_{H}−sinθ\_{L}\right)}\sum\_{n=n\_{L}}^{n\_{H}}\sum\_{m=1}^{M}EIRP\left(θ\_{n},φ\_{m}\right) cos\left(θ\_{n}\right) , (5)$$

* Proposal 4: Others
* Recommended for further discussion:
	+ Need further discussions

Offline agreement:

P$\left(\_{}\_{}\right)\frac{}{\left(\_{}\_{}\right)}\sum\_{\_{}}^{\_{}}\sum\_{}^{}\left(\_{}\_{}\right)\left(\_{}\right)$

M is the number of sampling points in the azimuth range;

[N is the number of sampling points over upper hemisphere in the elevation range ]

$\_{}$ is the lowest elevation sampling angles within the $\left(\_{}\_{}\right)$ bounding range

$\_{}$ is the highest elevation sampling angles within the $\left(\_{}\_{}\right)$ bounding range]

$\sum\_{}^{}\left(\_{}\_{}\right)$ is to produce the global sum over the whole azimuth ranges for EIRP above the horizon in a given bin.

**Issue 2-8 Expected EIRP sampling grid for average EIRP**

* Proposal 1: use the legacy measurement grid with updated maximum step size for elevation angle 0 to 20 degree at least for EIRP measurement on upper hemisphere or above the horizon, then use these measured spatial EIRP value to calculate the EEIRP mask. [ZTE]

 $Δϕ\_{ref}= min⁡(\frac{180^{∘}}{π}\frac{λ}{D\_{cyl}},5^{∘})$

 $Δθ\_{ref}=⁡min(\frac{180^{∘}}{π}\frac{λ}{D},5^{∘})$

or

$$∆θ\_{ref}=min(\frac{180^{°}}{π}arcsin⁡(\frac{λ}{D\_{z}}),5^{°})$$

 $Δϕ\_{ref}=min(\frac{180^{°}}{π}arcsin⁡(\frac{λ}{D\_{y}}),5^{°})$

* Proposal 2: RAN4 to consider the number of measurement points (or vertical/horizontal angular step size) when defining the calculation methodology, aiming to minimize the measurement complexity or effort while assuring a high level of accuracy. [Nokia]
* Proposal 3: Prior to specifying the conformance procedures and requirements of how to capture the EIRP mask, RAN4 to study the impact of different parameters (e.g., number of beamforming directions, number of elevation bins, etc.) that constitutes the evaluation of the average EIRP mask as a function of the elevation angle. [Qualcomm]
* Recommended for further discussion:
	+ Need further discussions

**Issue 2-9 Other related with conformance testing declaration and RF channels**

* Proposal 1: RAN4 should define a concept where the test beam directions are related to the declared Coverage Angular Range (CAR) and the number of test beam directions are specified. [Ericsson]
* Proposal 2: RAN4 need to develop a concept where the test beams are distributed within the whole coverage angular range with specified beam weight factor vector. [Ericsson]
* Proposal 3: RAN4 to consider appropriate values of beamforming directions taking into account all aspects. [Nokia]
* Proposal 4: Spatial declarations for Expected EIRP are made in the conformance requirement, no need for formal definitions in the core specification. [Huawei]
* Proposal 5: A means to identify a means to test the quality of potential conformance directional, test vectors must be derived. [Huawei]
* Proposal 6: Prior to specifying the conformance procedures and requirements of how to capture the EIRP mask, RAN4 to study the impact of different parameters (e.g., number of beamforming directions, number of elevation bins, etc.) that constitutes the evaluation of the average EIRP mask as a function of the elevation angle. [Qualcomm]
* Proposal 7: RAN4 to discuss the impact of the expected EIRP evaluation framework on the test accuracy and complexity. [Qualcomm]
* Proposal 8: RAN4 to discuss how to ensure that the expected EIRP is accurately evaluated at each given direction of the N beamforming directions assumed. [Qualcomm]
* Proposal 9: to consider the manufacture declarations in Table 2.4-1 for different mechanical down-tilt and its the corresponding coverage angular range.
* Recommended for further discussion:
	+ The following issues to be considered:
* the number of mechanical down-tilt and its corresponding angular coverage range;
* For each angular coverage range, the number of beams for conformance testing and its corresponding weighting factor;
* To balance the number for beams for conformance testing/complexity and test accuracy;
* The impacts of potential factors (measurement sampling grid for summation error etc) on EIRP accuracy.

**Issue 2-10 Other related with RF channels**

* Proposal 1: RAN4 to consider the number of frequencies to measure when defining the calculation methodology. [Nokia]
* Recommended for further discussion:
	+ Need further discussions

**Issue 2-11 Other related with confidence intervals**

* Proposal 1: Assuming the students t distribution and estimating the standard deviation s of the population from the samples, the upper and lower CI for the mean per elevation angular bin are: [Spark]

*Lower limit*=

* Mean- 1.7. s/sqrt(N)

*Upper limit* =

* Mean+ 1.7. s/sqrt(N)
* Recommended for further discussion:
	+ Need further discussions

**Issue 2-12 draft CRs**

 CATT version:

## 9.9 Additional OTA transmitter requirements

### 9.9.1 General

This clause captures the specific requirements which are not included in the clauses 9.2 - 9.8.

### 9.9.2 OTA spatial emission limit for protection of fixed-satellite service

For BS operating in band n104, the level of expected EIRP spectral density emitted by an base station as a function of the vertical angle above the horizon shall not exceed the values in Table 9.9.2-1.

Table 9.9.2-1: OTA spatial emission limit for protection of fixed-satellite service

|  |  |
| --- | --- |
| Vertical angle rangeθ*L* ≤ θ < θ*H*(vertical angle θ above horizon) | Expected EIRP (dBm/MHz) (See NOTES 1, 2 and 3) |
| 0° ≤ θ < 5° | 27 |
| 5° ≤ θ < 10° | 23 |
| 10°≤ θ < 15° | 19 |
| 15°≤ θ < 20° | 18 |
| 20°≤ θ <30° | 16 |
| 30°≤ θ < 60° | 15 |
| 60°≤ θ ≤ 90° | 15 |
| NOTE 1: The expected EIRP is defined as the average value of the EIRP, with the averaging being performed:‒ over horizontal angles from −180° to +180°, with the base station beamforming in a specific direction within its horizontal and vertical steering range, ‒ over different beamforming directions within the base station horizontal and vertical steering range, and‒ over the specified vertical angle range θ*L* ≤ θ < θ*H*.NOTE 2: A base station shall comply with the specified limits on expected EIRP spectral density for all mechanical tilts with which it can be deployed.NOTE 3: See the Annex x for additional details on how the expected EIRP can be calculated. |

Nokia:

9.9 OTA average spatial emission above horizon

9.9.1 General

The OTA average spatial emission above horizon (EEIRP) is the requirement defined by ITU [20] for frequency range 6425 MHz to 7125 MHz. The maximum allowed EEIRP level for a BS as function of the vertical angle above the horizon shall not exceed the values defined in table 9.9.1-1.

This requirement shall apply for band n104 only.

**Table 9.9.1-1: OTA average spatial emission above horizon (EEIRP) requirement**

|  |  |
| --- | --- |
| **Vertical angle range θ*L* ≤ θ < θ*H*****(vertical angle θ above horizon)** | **Expected e.i.r.p. (dBm/MHz)****(See NOTES 1, 2)** |
| 0° ≤ θ < 5° | 27 |
| 5° ≤ θ < 10° | 23 |
| 10°≤ θ < 15° | 19 |
| 15°≤ θ < 20° | 18 |
| 20°≤ θ <30° | 16 |
| 30°≤ θ < 60° | 15 |
| 60°≤ θ ≤ 90° | 15 |
| NOTE 1: The expected e.i.r.p. is defined as the average value of the e.i.r.p., with the averaging being performed.‒ over horizontal angles from −180º to +180º, with the IMT base station beamforming in a specific direction within its horizontal and vertical steering range,‒ over different beamforming directions within the IMT base station horizontal and vertical steering range, and‒ over the specified vertical angle range θL ≤ θ < θH.NOTE 2: An IMT base station shall comply with the specified limits on expected e.i.r.p. spectral density for all mechanical tilts with which it can be deployed). |

The angles which are used in table 9.9.1-1 are defined as described on figure 9.9.1-1.



**Figure 9.9.1-1: Definitions of θL and θH angles.**

Ericsson:

## 9.9 OTA spatial emission

### 9.9.1 General

OTA spatial emission requirements are defined to set requirement on emission in unintended directions.

### 9.9.2 Protection of FSS UL

The requirement is defined to protect FSS UL receiver from interference.

#### 9.9.2.1 Minimum requirement for BS type 1-H and BS type 1-O

For BS type 1-H and BS type 1-O operating within band n104, within the frequency range 6425 to 7075 MHz the requirement is defined as a maximum allowed EEIRP level profile above horizon for vertical angular ranges listed in Table 9.9.2.1-1.

**Table 9.9.2.1-1: Maximum allowed EEIRP level as function of elevation angular range**

| **Elevation angular ranges**$$α\_{i}\leq θ<β\_{i}$$**(Degrees)** | **EEIRP(dBm/MHz)** |
| --- | --- |
| 0<q<5 | 27 |
| 5<q<10 | 23 |
| 10<q<15 | 19 |
| 15<q<20 | 18 |
| 20<q<30 | 16 |
| 30<q<60 | 15 |
| 60<q<90 | 15 |
| Note 1 : the requirement is applicable for the frequency range 6425 to 7075 MHzNOTE 2: An IMT base station shall comply with the specified limits on expected e.i.r.p. spectral density for all mechanical tilts. |

### 9.9.3 Protection of FSS UL

Huawei:

## 9.9 OTA spatial emission above horizon

### 9.9.1 General

The OTA spatial emission above horizon requirement is a measure of the Expected EIRP radiated in ranges of vertical (perpendicular to the horizon) angles above the horizon. The OTA spatial emission above the horizon requirement is to ensure the protection of FSS (Earth-to-space) in the band 6425 – 7075MHz.

The requirement shall apply at each RIB supporting transmission in the appropriate frequency range of n104.

The requirement applies for all foreseen modes of operation and installation parameters.

NOTE: the OTA spatial emission above horizon requirement is specified with reference to the horizon, directional requirements are made with respect to the BS enclosures local coordinate system.

### 9.9.2 Minimum requirement for *BS type 1-O*

For BS type 1-O the Expected EIRP shall not exceed the levels shown in table 9.9.2-1.

Expected EIRP is defined as the average value of the EIRP, with the averaging being performed:

- Over horizontal angles from −180° to +180 ° and over the specified vertical angle range θHL ≤ θ < θHH in table 9.9.2-1

- With the BS randomly generating *beam peak directions* within the *OTA peak directions set*.

Table 9.9.2-1: Expected EIRP limits.

|  |  |
| --- | --- |
| Vertical angle range θHL ≤ θ < θHHNote 1. | Expected EIRP. (dBm/MHz) |
| 0° ≤ θ < 5° | 27 |
| 5° ≤ θ < 10° | 23 |
| 10° ≤ θ < 15° | 19 |
| 15° ≤ θ < 20° | 18 |
| 20° ≤ θ < 30° | 16 |
| 30° ≤ θ < 60° | 15 |
| 60° ≤ θ < 90° | 15 |
| Note1: Angles are specified with respect to the Horizon |

ZTE:

## 4.10 The reference coordinate system for OTA spatial emission above horizon

OTA spatial emission requirement over the horizon is defined in the elevation angle above the horizon towards the sky. To be able to meet the OTA spatial emission requirement over the horizon, the reference coordinate system for EEIRP is required.

The coordinate system for OTA spatial emission over horizon is created of a Cartesian coordinate system with rectangular axis (x***,*** y***,*** z) and spherical angles () irrespective of BS mechanical down-tilt as showed in figure 4.xxx-1.



Figure 3: Reference coordinate system for OTA spatial emission above horizon

******is the angle in the x/y plane, between the x-axis and the projection of the radiating vector onto the x/y plane and is defined between -180° and +180°, inclusive. ****** is the angle between the projection of the vector in the x***/***y plane and the radiating vector and is defined between 0 and +90°, inclusive. Note that  is defined as positive along the up-tilt angle.

## 9.9 OTA spatial emission above horizon

To ensure protection for the FSS (Earth-to-space), the Expected EIRP of NR BS operating in band n104 shall not exceed the limits in Table 9.9-1.

Table 99: Expected EIRP limits.

|  |  |
| --- | --- |
| Vertical angle rangeθL ≤ θ < θH(vertical angle θ above the horizon) | Expected e.i.r.p. (dBm/MHz) |
| 0° ≤ θ < 5° | 27 |
| 5° ≤ θ < 10° | 23 |
| 10° ≤ θ < 15° | 19 |
| 15° ≤ θ < 20° | 18 |
| 20° ≤ θ < 30° | 16 |
| 30° ≤ θ < 60° | 15 |
| 60° ≤ θ ≤ 90° | 15 |
| Note 1: The reference coordinate system for OTA spatial emission requirement is defined in clause 4. 10.Note 2: The requirement is defined within specific vertical angle range above the horizon and over horizontal angles from −180° to +180 °.Note 3: NR BS shall comply with the specified limits on expected e.i.r.p. spectral density for all mechanical tilts with which it can be deployed |

Samsung:

## 9.x OTA spatial emission above horizon

### 9.x.1 General

The OTA spatial emission above horizon is a limit of the level of expected EIRP emitted by a BS as a function of the vertical angle above the horizon.

The OTA spatial emission above horizon is applicable to BS operating within the frequency band 6 425-7 075 MHz.

The OTA spatial emission above horizon shall be applicable to all mechanical tilts declared to be supported.

### 9.x.2 Minimum requirements for BS type 1-H and BS type 1-O

For the OTA spatial emission above horizon requirement, the level of expected EIRP for certain vertical angle range shall not exceed the following values:

|  |  |
| --- | --- |
| Vertical angle rangeθL ≤ θ < θH(vertical angle θ above the horizon) | Expected EIRP (dBm/MHz) |
| 0° ≤ θ < 5° | 27 |
| 5° ≤ θ < 10° | 23 |
| 10° ≤ θ < 15° | 19 |
| 15° ≤ θ < 20° | 18 |
| 20° ≤ θ < 30° | 16 |
| 30° ≤ θ < 60° | 15 |
| 60° ≤ θ ≤ 90° | 15 |

The expected EIRP is defined as the average value of the EIRP, with the averaging being performed:

 ‒ over horizontal angles from −180° to +180°, with the base station beamforming in a specific direction within its horizontal and vertical steering range,

 ‒ over different beamforming directions within the base station horizontal and vertical steering range, and

 ‒ over the specified vertical angle range θL ≤ θ < θH.