**3GPP TSG-RAN WG4 Meeting #111 R4-2408701**

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

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| *CR-Form-v12.3* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **8.101-5** | **CR** |  | **rev** |  | **Current version:** | **18.5.0** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network |  | Core Network |  |

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|  | | | | | | | | | | |
| ***Title:*** | Draft CR to TS 38.101-5 on top of the running CR R4-2405085: Tx requirements | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Ericsson | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** |  | | | | |  | ***Date:*** | | | 2024-05-20 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-18 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)*  *Rel-20 (Release 20)* | |
| ***7*** |  | | | | | | | | | |
| ***Reason for change:*** | | This draft CR further updates the endorsed running CR R4-2405085 for Tx requirements. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Subclause 9.2.2 is clarified  Some typos are fixed  K factor was missing in the Off-axis EIRP requirement + Clarification on N factor declaration | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | The specification of NTN Ka-badn will contain some ambiguities | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 9.2.1, 9.2.2, 9.5.2.2.1, 9.5.3.2.3 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  | **X** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

*<Start of the change>*

## 9.2 Transmitter power

### 9.2.1 NTN VSAT maximum output power

#### 9.2.1.0 General

The NTN VSAT classes are specified based on the assumptions of certain NTN VSAT types with specific device architectures including antenna beam steering types. The requirements are specified for different NTN VSAT types. And for the hybrid beam steering capable NTN VSAT, which can adjust its antenna(s) or beam(s) in both electronic steering and mechanical steering ways, the applicable requirements should follow either electronic or mechanical beam steering requirements depending on the NTN VSAT type it declared. The NTN VSAT types can be found in Table 9.2.1.0-1 below.

Table 9.2.1.0-1: Assumptions of NTN VSAT Types

|  |  |  |
| --- | --- | --- |
| NTN VSAT class | NTN VSAT type | Type description |
| Fixed VSAT | 1 | Fixed VSAT communicating with GSO and LEO with mechanical steering antenna. |
|  | 2 | Fixed VSAT communicating with GSO and LEO with electronic steering antenna. |
|  | 3 | Fixed VSAT communicating with LEO only with electronic steering antenna. |
| Mobile VSAT | 4 | Mobile VSAT communicating with GSO with mechanical steering antenna. |
|  | 5 | Mobile VSAT communicating with GSO with electronic steering antenna. |
| Note 1: The NTN VSAT types are assuming NTN VSAT has only one antenna beam towards one satellite at a given time in this release. | | |

#### 9.2.1.1 Minimum requirements for Fixed VSAT

The following requirements define the maximum output power radiated by the Fixed VSAT for any transmission bandwidth within the channel bandwidth for non-CA configuration, unless otherwise stated. The period of measurement shall be at least one sub frame (1ms). The minimum output power values for EIRP are found in Table 9.2.1.1-1. The requirement is verified with the test metric of EIRP (Link=[Spherical coverage grid], Meas=Link angle).

[Note: FFS on VSAT spherical coverage grid definition.]

Table 9.2.1.1-1: Minimum peak EIRP for Fixed VSAT

|  |  |  |
| --- | --- | --- |
| Operating band | UE Type | Min peak EIRP (dBm) |
| n512, n511, n510 | 1 | 70 |
|  | 2 | 70 |
|  | 3 | 61 |
| Note: Minimum peak EIRP is defined as the lower limit without tolerance. | | |

The maximum output power values for TRP and EIRP are found in Table 9.2.1.1-2 below.

Table 9.2.1.1-2: Maximum output power limits for Fixed VSAT



|  |  |  |  |
| --- | --- | --- | --- |
| Operating band | UE Type | TRPMAX (dBm) | EIRPmax (dBm) |
| n512, n511, n510 | 1 | 35 | 76.2 |
| 2, 3 | TBD | 76.2 |

#### 9.2.1.2 Minimum requirements for Mobile VSAT

The following requirements define the maximum output power radiated by the Mobile VSAT for any transmission bandwidth within the channel bandwidth for non-CA configuration, unless otherwise stated. The period of measurement shall be at least one sub frame (1ms). The minimum output power values for EIRP are found in Table 9.2.1.2-1. The requirement is verified with the test metric of EIRP (Link=[Spherical coverage grid], Meas=Link angle).

Table 9.2.1.2-1: Minimum peak EIRP for Mobile VSAT

|  |  |  |
| --- | --- | --- |
| Operating band | UE Type | Min peak EIRP (dBm) |
| n512, n511 | 4 | 70 |
|  | 5 | 70 |
| Note: Minimum peak EIRP is defined as the lower limit without tolerance. | | |

The maximum output power values for TRP and EIRP are found in Table 9.2.1.2-2 below.

Table 9.2.1.2-2: Maximum output power limits for Mobile VSAT



|  |  |  |  |
| --- | --- | --- | --- |
| Operating band | UE Type | TRPMAX (dBm) | EIRPmax (dBm) |
| n512, n511, n510 | 4 | 35 | 76.2 |
| 5 | TBD | 76.2 |

### 9.2.2 Off-axis EIRP emission density limit

#### 9.2.2.1 General

The Off-axis EIRP density envelope is applicable within the band to NTN VSAT transmitting to a SAN.

#### 9.2.2.2 Minimum requirement for bands n510 and n511

For co-polarized transmissions in the plane tangent to the GSO arc, the requirements specified in table 9.2.2.2-1 apply to NTN VSAT.

Table 9.2.2.2-1: Off-axis EIRP density limits for co-polarized transmissions in the plane tangent to the GSO arc

|  |  |  |
| --- | --- | --- |
| θ value | Maximum Off-axis EIRP (dBm) | Measurement bandwidth (MHz) |
| 2.0° ≤ θ ≤ 7° | 62.5 – 25log(θ) | 1 |
| 7° ≤ θ ≤ 9.2° | 41.5 | 1 |
| 9.2° ≤ θ ≤ 19.1° | 65.5 – 25log(θ) | 1 |
| 19.1° < θ ≤ 180° | 33.5 | 1 |

For co-polarized transmissions in the plane perpendicular to the GSO arc, the requirements specified in table 9.2.2.2-2 apply to NTN VSAT.

Table 9.2.2.2-2: Off-axis EIRP density limits for co-polarized transmissions in the plane perpendicular to the GSO arc

|  |  |  |
| --- | --- | --- |
| θ value | Maximum Off-axis EIRP (dBm) | Measurement bandwidth (MHz) |
| 3.5° ≤ θ ≤ 7° | 65.5 – 25log(θ) | 1 |
| 7° ≤ θ ≤ 9.2° | 44.5 | 1 |
| 9.2° ≤ θ ≤ 19.1° | 68.5 – 25log(θ) | 1 |
| 19.1° < θ ≤ 180° | 36.5 | 1 |

The EIRP density levels specified in table 9.2.2.2-1 and table 9.2.2.2-2 may be exceeded by up to 3 dB, for values of θ > 7°, over 10% of the range of theta (θ) angles from 7–180° on each side of the line from the  NTN VSAT to the target SAN.

For cross-polarized transmissions in the plane tangent to the GSO arc and in the plane perpendicular to the GSO arc, the requirements specified in table 9.2.2.2-3 apply to NTN VSAT.

Table 9.2.2.2-2: Off-axis EIRP density limits for cross-polarized transmissions in the plane tangent to the GSO arc and in the plane perpendicular to the GSO arc

|  |  |  |
| --- | --- | --- |
| θ value | Maximum Off-axis EIRP (dBm) | Measurement bandwidth (MHz) |
| 2.0° ≤ θ ≤ 7° | 52.5 – 25log(θ) | 1 |

#### 9.2.2.3 Minimum requirement for band n512

##### 9.2.2.3.1 Fixed VSAT

For co-polarized transmissions, the requirements specified in table 9.2.2.3.1-1 apply to Fixed VSAT type 1 or 2.

Table 9.2.2.3.1-1: Off-axis EIRP density limits for co-polarized transmissions

|  |  |  |
| --- | --- | --- |
| θ value | Maximum Off-axis EIRP (dBm) | Measurement bandwidth (kHz) |
| 1.8° ≤ θ ≤ 7° | 49 – 25log(θ) – K | 40 |
| 7° ≤ θ ≤ 9.2° | 28– K | 40 |
| 9.2° ≤ θ ≤ 48° | 52 – 25log(θ) – K | 40 |
| 48° < θ ≤ | 20– K | 40 |
| Note: K=10log(N) with N the number of terminals simultaneously transmitting at the same EIRP on a given carrier frequency in the same measurement bandwidth. K = 0 if only one Fixed VSAT transmits at any one time on a given carrier frequency. See sub-clause 4.2.4.2 in [18]. The manufacturer shall declare the value N. | | |

For cross-polarized transmissions, the requirements specified in table 9.2.2.3.1-2 apply to Fixed VSAT.

Table 9.2.2.3.1-2: Off-axis EIRP density limits for cross-polarized transmissions

|  |  |  |
| --- | --- | --- |
| θ value | Maximum Off-axis EIRP (dBm) | Measurement bandwidth (kHz) |
| 1.8° ≤ θ ≤ 7° | 39 – 25log(θ) – K | 40 |
| 7° ≤ θ ≤ 9.2° | 18– K | 40 |
| Note: K=10log(N) with N the number of terminals simultaneously transmitting at the same EIRP on a given carrier frequency in the same measurement bandwidth. K = 0 if only one Fixed VSAT transmits at any one time on a given carrier frequency. See sub-clause 4.2.4.2 in [18]. ]. The manufacturer shall declare the value N. | | |

##### 9.2.2.3.2 Mobile VSAT

For co-polarized transmissions, the requirements specified in table 9.2.2.3.2-1 apply to Mobile VSAT.

Table 9.2.2.3.2-1: Off-axis EIRP density limits for co-polarized transmissions

|  |  |  |
| --- | --- | --- |
| θ value | Maximum Off-axis EIRP (dBm) | Measurement bandwidth (kHz) |
| 2.0° ≤ θ ≤ 7° | 49 – 25log(θ) – K | 40 |
| 7° ≤ θ ≤ 9.2° | 28– K | 40 |
| 9.2° ≤ θ ≤ 48° | 52 – 25log(θ) – K | 40 |
| 48° < θ ≤ 180° | 20– K | 40 |
| Note: K=10log(N) with N the number of terminals simultaneously transmitting at the same EIRP on a given carrier frequency in the same measurement bandwidth. K = 0 if only one Mobile VSAT transmits at any one time on a given carrier frequency. See sub-clause 4.2.2.2.1 in [17]. ]. The manufacturer shall declare the value N. | | |

Mobile VSAT with low elevation angles may exceed the limits specified in Table 9.2.2.3.2-1 by the amount specified in Table 9.2.2.3.2-2

**Table 9.2.2.3.2-2: Off-axis EIRP density limits for co-polarized transmissions**

|  |  |
| --- | --- |
| Elevation angle to Satellite (ε) | Increase in EIRP density (dB) |
| ε < 5o | 2.5 |
| 5o < ε < 30o | 3 – 0.1 \* ε |

For cross-polarized transmissions, the requirements specified in table 9.2.2.3.2-3 apply to Mobile VSAT.

Table 9.2.2.3.2-3: Off-axis EIRP density limits for cross-polarized transmissions

|  |  |  |
| --- | --- | --- |
| θ value | Maximum Off-axis EIRP (dBm) | Measurement bandwidth (kHz) |
| 2.0° ≤ θ ≤ 7° | 39 – 25log(θ) – K | 40 |
| 7° ≤ θ ≤ 9.2° | 18– K | 40 |
| Note: K=10log(N) with N the number of terminals simultaneously transmitting at the same EIRP on a given carrier frequency in the same measurement bandwidth. K = 0 if only one Mobile VSAT transmits at any one time on a given carrier frequency. See sub-clause 4.2.2.2.1 in [17]. The manufacturer shall declare the value N. | | |

##### 9.2.2.3.3 Additional Off-axis EIRP density requirements for protection of fixed services

For NTN VSAT], the requirements specified in table 9.2.2.3.3-1 apply.

Table 9.2.2.3.3-1: Off-axis EIRP density limits for protection of fixed services

|  |  |  |
| --- | --- | --- |
| Frequency Range (GHz) | Maximum Off-axis EIRP (dBm) | Measurement bandwidth (MHz) |
| 27.8285 – 28.4445 |  |  |
| 28.8365 – 28.9485 (NOTE1) | -5 | 1 |
| 28.9485 – 29.4525 |  |  |
| NOTE1: When applicable, if this frequency range is allocated to fixed service. | | |

*<End of the change>*

*<Start of the change>*

## 9.5 Output RF spectrum emissions

### 9.5.1 Occupied bandwidth

Occupied bandwidth is defined as the bandwidth containing 99 % of the total integrated mean power of the transmitted spectrum on the assigned channel. The occupied bandwidth for all transmission bandwidth configurations (Resources Blocks) shall be less than the channel bandwidth specified in Table 9.5.1-1.

The occupied bandwidth is defined as a directional requirement. The requirement is verified in beam locked mode with the test metric of OBW (Link=TX beam peak direction, Meas=Link angle).

**Table 9.5.1-1: Occupied channel bandwidth**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Occupied channel bandwidth / Channel bandwidth** | | | |
|  | **50**  **MHz** | **100**  **MHz** | **200**  **MHz** | **400**  **MHz** |
| **Channel bandwidth (MHz)** | 50 | 100 | 200 | 400 |

### 9.5.2 Out of Band Emissions

#### 9.5.2.1 General

The Out of band emissions are unwanted emissions immediately outside the assigned channel bandwidth resulting from the modulation process and non-linearity in the transmitter but excluding spurious emissions. This out of band emission limit is specified in terms of a spectrum emission mask and an adjacent channel leakage power ratio. Additional requirements to protect specific bands are also considered.

The requirements in clause 9.5.2.2 only apply when both UL and DL of a NTN VSAT are configured for single CC operation, and they are of the same bandwidth.

All out of band emissions for FR2-NTN are TRP.

The spectrum emission mask of the NTN VSAT applies to frequencies starting from the ± edge of the assigned NR channel bandwidth.

#### 9.5.2.2 Spectrum emission mask

##### 9.5.2.2.1 General NR spectrum emission mask

The power of any NTN VSAT emission shall not exceed the levels specified in Table 9.5.2.2-1 for the specified channel bandwidth. The requirement is verified in beam locked mode with the test metric of TRP (Link=TX beam peak direction, Meas=TRP grid).

Table 9.5.2.2.1-1: General NR spectrum emission mask for NTN-FR2

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency offset of measurement filter ‑3dB point, Δf | Frequency offset of measurement filter centre frequency, f\_offset | Basic limits  (dBm) | Measurement bandwidth |
| 0 MHz ≤ Δf < 2× BW | 0.5 MHz ≤ f\_offset < 2× BW + 0.5 MHz |  | 1 MHz |
| NOTE 1: Prated,UE is the VSAT maximum TRP declared by manufacturer with Prated,UE< TRPmax (specified in clause 9.2.1);  NOTE 2: Transmission BW is in the unit of MHz;  NOTE 3: The 11dBm/1MHz value corresponds to the spurious emission limit specified in spurious emission clause 9.5.3, and is converted from the SE limit requirement defined on 4 kHz to a value defined over 1 MHz;  NOTE 4: PSD attenuation as in ITU-R SM.1541-6 [6], Annex 5 OoB domain emission limits for earth stations. | | | |

##### 9.5.2.2.2 Additional spectrum emission mask

For bands n511 and n510 the mean power of emissions shall be attenuated below the mean output power of the transmitter (measured in dBm) in accordance with [FCC 25.202].

The power of any NTN VSAT emission shall not exceed the levels specified in Table 9.5.2.2.2-1 for the specified channel bandwidth. The requirement is verified in beam locked mode with the test metric of TRP (Link=TX beam peak direction, Meas=TRP grid).

**Table 9.5.2.2.2-1: Additional spectrum emission mask**

|  |  |  |
| --- | --- | --- |
| Frequency offset of measurement filter centre frequency, f\_offset | Basic limits  (dBm) | Measurement bandwidth |
| 0.002MHz+0.5xBW ≤ f\_offset < 1xBW-0.002MHz | Prated,UE - 25 dB | 4 kHz |
| 0.002MHz+1xBW ≤ f\_offset < 2.5xBW-0.002MHz | Prated,UE - 35 dB | 4 kHz |
| 0.002MHz+2.5xBW ≤ f\_offset < 2nd harmonic of the upper frequency edge of the UL operating band in GHz | -13 | 4 kHz |
| NOTE 1: Prated,UE is the VSAT maximum TRP declared by manufacturer with Prated,UE< TRPmax (specified in clause 9.2.1);  NOTE 2: Transmission BW is in the unit of MHz;  NOTE 3: *Measurement bandwidth*s as in ITU-R SM.329 [16], s4.1.  NOTE 4: Upper frequency as in ITU-R SM.329 [16], s2.5 table 1. | | |

*<End of the change>*

*<Start of the change>*

##### 9.5.3.2.3 “Carrier-on” state

The requirements specified in tables 9.5.3.2.3-1 and 9.5.3.2.3-2 apply to NTN VSAT in “Carrier-on”.

The requirement specified in table requirements specified in table 9.5.3.2.3-1 apply outside a bandwidth of 5 times the occupied bandwidth centred on the carrier centre frequency.

The requirement specified in table requirements specified in table 9.5.3.2.3-2 apply inside a bandwidth of 5 times the occupied bandwidth centred on the carrier centre frequency, and outside the transmission bandwidth.

Note: The on-axis spurious radiations, outside the frequency range 27,5 GHz to 30,0 GHz, are indirectly limited by subclause 9.5.3.3.

Table 9.5.5.2.2.3-1: On-axis spurious limits in “Carrier-on” state - outside

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency range  (GHz) | NTN VSAT type | EIRP Limit  (dBm) | Measurement bandwidth  (MHz) |
| 27.5 – 30.0 | 4, 5 | 44 - K (Note) | 1 |
| 1, 2, 3 | 4 - K (Note) | 1 |
| Note: K=10log(N) with N the number of terminals simultaneously transmitting at the same EIRP on a given carrier frequency in the same measurement bandwidth. K = 0 if only one NTN VSAT transmits at any one time on a given carrier frequency. See sub-clause 4.2.2.2.1 in [17] for Mobile VSAT or sub-clause 4.2.4.2 in [18] for Fixed VSAT. The manufacturer shall declare the value N. | | | |

Table 9.5.5.2.2.3-2: On-axis spurious limits in “Carrier-on” state - inside

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency range  (GHz) | NTN VSAT type | EIRP Limit  (dBm) | Measurement bandwidth  (MHz) |
| 27.5 – 30.0 | 4, 5 | 58 - K (Note) | 1 |
| 1, 2, 3 | 48 - K (Note) | 1 |
| Note: K=10log(N) with N the number of terminals simultaneously transmitting at the same EIRP on a given carrier frequency in the same measurement bandwidth. K = 0 if only one NTN VSAT transmits at any one time on a given carrier frequency. See sub-clause 4.2.2.2.1 in [17] for Mobile VSAT or sub-clause 4.2.4.2 in [19] for Fixed VSAT. The manufacturer shall declare the value N. | | | |

*<End of the change>*