**3GPP TSG-RAN WG4 Meeting # 111 *R4-2410581***

**Fukuoka, Japon, 20th May - 24th May, 2024 (revision of *)***

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| *CR-Form-v12.3* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.101-5** | **CR** | **draft 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:*** |  | | | | | | | | | |
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| ***Source to WG:*** |  | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
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| ***Work item code:*** |  | | | | |  | ***Date:*** | | |  |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **F** |  | | | | | ***Release:*** | | |  |
|  | *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-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)  Rel-20 (Release 20)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | The TSG-RAN WG4 Meeting#110bis has endorsed updates on terms and references, Tx requirements and Rx requirements for NTN VSAT UE. Some corrections are required. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Fixed typos/corrections. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Minor changes. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 9.2, 9.4 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | |  | | |
| ***affected:*** | |  | **X** | Test specifications | | | |  | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | |  | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

## **<Start of Change 1>**

# 9 Radiated transmitter characteristics

## 9.1 General

Unless otherwise stated, the transmitter characteristics are specified over the air (OTA) with a single or multiple transmit chains.

## 9.2 Transmitter power

## **<End of Change 1>**

## **<Start of Change 2>**

### 9.2.2 Off-axis EIRP emission density limit within the operating band

#### 9.2.2.1 General

The Off-axis EIRP density envelope is applicable within the band to NTN VSAT transmitting towards geostationary satellite orbit.

#### 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 when transmitting towards satellites in geostationary orbit.

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 of N. |

For cross-polarized transmissions, the requirements specified in table 9.2.2.3.1-2 apply to Fixed VSAT type 1 or 2 when transmitting towards satellites in geostationary orbit.

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 of 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 of N.  Note: The manufacturer shall declare the operational conditions of the system e.g. motion of the platform with 6 degrees of freedom and the duration for which the limits will not be exceeded for more than 0,01% of the time. |

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 of N.  Note: The manufacturer shall declare the operational conditions of the system e.g. motion of the platform with 6 degrees of freedom and the duration for which the requirement will not be exceeded for more than 0,01% of the time. |

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

For 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 Change 2>**

## **<Start of Change 3>**

## 9.4 Transmitter signal quality

### 9.4.1 Frequency Error

The NTN VSAT basic measurement interval of modulated carrier frequency is 1 UL slot. The NTN VSAT pre-compensates the uplink modulated carrier frequency by the estimated Doppler shift according to 3GPP TS 38.300 [9] clause 16.14.2. The mean value of basic measurements of NTN VSAT modulated carrier frequency shall be accurate to within ± 0.1 PPM observed over a period of 1 ms of cumulated measurement intervals compared to ideally pre-compensated reference uplink carrier frequency.

[NOTE: The ideally pre-compensated reference uplink carrier frequency consists of the UL carrier frequency signalled to the NTN VSAT by SAN and UL pre-compensated Doppler frequency shift. For the test case, the location of the NTN VSAT is explicitly provided to the NTN VSAT from the test equipment.]

Requirement will be verified for at least two cases of which one has zero Doppler conditions.

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

### 9.4.2 Transmit modulation quality

#### 9.4.2.1 General

Transmit modulation quality defines the modulation quality for expected in-channel RF transmissions from the NTN VSAT. The transmit modulation quality is specified in terms of:

- Error Vector Magnitude (EVM) for the allocated resource blocks (RBs)

All the parameters defined in clause 9.4.2 are defined using the measurement methodology specified in Annex F.

All the requirements in 9.4.2 are defined as directional requirement. The requirements are verified in beam locked mode on beam peak direction, with parameter *maxRank* (as defined in TS 38.331 [11]) set to 1. The requirements are applicable to UL transmission from each configurable antenna port (as defined in TS 38.331 [11]) of UE, enabled one at a time.

#### 9.4.2.2 Error vector magnitude

The Error Vector Magnitude is a measure of the difference between the reference waveform and the measured waveform. This difference is called the error vector. Before calculating the EVM, the measured waveform is corrected by the sample timing offset and RF frequency offset. Then the carrier leakage shall be removed from the measured waveform before calculating the EVM.

For DFT-s-OFDM waveforms, the EVM result is defined after the front-end FFT and IDFT as the square root of the ratio of the mean error vector power to the mean reference power expressed as a percentage value (%). For CP-OFDM waveforms, the EVM result is defined after the front-end FFT as the square root of the ratio of the mean error vector power to the mean reference power expressed as a percentage value (%).

The basic EVM measurement interval in the time domain is one preamble sequence for the PRACH and one slot for PUCCH and PUSCH in the time domain. The EVM measurement interval is reduced by any symbols that contains an allowable power transient in the measurement interval as as defined in clause 9.3.3.

The RMS average of the basic EVM measurements over 10 subframes for the average EVM case, and over 60 subframes for the reference signal EVM case, for the different modulation schemes shall not exceed the values specified in Table 9.4.2.2-1 for the parameters defined in Table 9.4.2.2-2. For EVM evaluation purposes, all 13 PRACH preamble formats and all 5 PUCCH formats are considered to have the same EVM requirement as QPSK modulated.

The requirement is verified with the test metric of EVM (Link=TX beam peak direction, Meas=Link angle).

Table 9.4.2.2-1: Minimum requirements for error vector magnitude

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Unit | Average EVM level | Reference signal EVM level |
| Pi/2 BPSK | % | 30.0 | 30.0 |
| QPSK | % | 17.5 | 17.5 |
| 16QAM | % | 12.5 | 12.5 |
| 64QAM | % | 8.0 | 8.0 |

Table 9.4.2.2-2: Parameters for Error Vector Magnitude

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Level |
| NTN VSAT EIRP | dBm | ≥ [Min peak EIRP] |
| NTN VSAT EIRP for UL 16QAM | dBm | ≥ [Min peak EIRP] |
| NTN VSAT EIRP for UL 64QAM | dBm | ≥ [Min peak EIRP] |
| Operating conditions |  | Normal conditions |

## 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 an 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: TRPrated isthe declared rated output power lower than 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 | TRPrated (dBm) - 25 dB | 4 kHz |
| 0.002MHz+1xBW ≤ f\_offset < 2.5xBW-0.002MHz | TRPrated (dBm) - 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 dBm | 4 kHz |
| NOTE 1: TRPrated isthe declared rated output power lower than 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 Change 3>**

## **<Start of Change 4>**

##### 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 of 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 [18] for Fixed VSAT. The manufacturer shall declare the value of N. | | | |

## **<End of Change 4>**