**3GPP TSG-RAN4 Meeting #110 *R4-2401116***

**Athens, Greece, 26th Feb 2024 - 1st Mar 2024**

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
|  |
|  | **38.101-5** | **CR** | **0060** | **rev** | **-** | **Current version:** | **18.4.0** |  |
|  |
| *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 |  | Radio Access Network |  | Core Network |  |

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|  |
| ***Title:***  | Big CR on TS38.101-5 for UE RF Requirements |
|  |  |
| ***Source to WG:*** | Samsung Electronics France SA |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_NTN\_enh-Core |  | ***Date:*** | 2024-02-19 |
|  |  |  |  |  |
| ***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 canbe 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)* |
|  |  |
| ***Reason for change:*** | This CR is a running CR to capture CRs on NTN UE requiements in Ka band endorsed by RAN4 meetings. |
|  |  |
| ***Summary of change:*** | Reference, Operating bands and channel arrangement, Clause 9 |
|  |  |
| ***Consequences if not approved:*** | Requirements for NTN in Ka band will be missing and thus NTN in Ka band won’t be supported |
|  |  |
| ***Clauses affected:*** | Clause 2, Clause 3, Clause 5 (5.1,5.2,5.3,5.4), Clause 6.4.2, Clause 9, Clause10, Annex A, Annex D |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** | **X** |  |  Test specifications | TS 38.521-5 |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

## *<Start of Change 1>*

# 2 References

……

[15] IEEE Std 149: "IEEE Standard Test Procedures for Antennas", IEEE.

[16] 3GPP TS 38.101-2: "NR; User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone"

[17] ITU-R Recommendation SM.329-10, "Unwanted emissions in the spurious domain"

[18] EN 303 979, Satellite Earth Stations and Systems (SES);Harmonised Standard for Earth Stations on Mobile Platforms (ESOMP) transmitting towards satellites in non-geostationary orbit, operating in the 27,5 GHz to 29,1 GHz and 29,5 GHz to 30,0 GHz frequency bands covering the essential requirements of article 3.2 of the Directive 2014/53/EU, v2.1.2, 2016-10

## *<End of Change 1>*

## *<Start of Change 2>*

# 3 Definitions of terms, symbols and abbreviations

## 3.1 Terms

For the purposes of the present document, the terms given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

**Co-polarized transmission:** when the DUT transmission antenna polarization is aligned with test antenna polarization.

**Cross-polarized transmission:** when the DUT transmission antenna polarization is aligned with the tangent of the test antenna polarization.

**Emissions disables state:** Radio state in which the ESOMP is not emitting (e.g. before system monitoring pass, before the control channel is received, when a failure is detected, when an ESOMP is commanded to disable, and

when the ESOMP is in a location requiring cessation of emissions).

**Enhanced channel raster**: channel raster with a 10 kHz granularity in bands with a 100 kHz channel raster.

…

**Non-terrestrial networks:** Networks, or segments of networks, using an airborne or space-borne vehicle to embark a transmission equipment relay node or base station.

**Plane perpendicular to the GSO arc:** The plane that is perpendicular to the “plane tangent to the GSO arc,” as defined below, and includes a line between the [earth station](https://www.law.cornell.edu/definitions/index.php?width=840&height=800&iframe=true&def_id=78b6a8b2410df19c2611058edc75e85f&term_occur=999&term_src=Title:47:Chapter:I:Subchapter:B:Part:25:Subpart:A:25.103) in question and the GSO [space station](https://www.law.cornell.edu/definitions/index.php?width=840&height=800&iframe=true&def_id=0b6c8478b2f4db9e2b4a8a65a86a965f&term_occur=999&term_src=Title:47:Chapter:I:Subchapter:B:Part:25:Subpart:A:25.103) that it is communicating with (FCC 47 CFR 25.103).

**Plane tangent to the GSO arc:** The plane defined by the location of an [earth station](https://www.law.cornell.edu/definitions/index.php?width=840&height=800&iframe=true&def_id=78b6a8b2410df19c2611058edc75e85f&term_occur=999&term_src=Title:47:Chapter:I:Subchapter:B:Part:25:Subpart:A:25.103)'s transmitting antenna and a line in the equatorial plane that is tangent to the GSO arc at the location of the GSO [space station](https://www.law.cornell.edu/definitions/index.php?width=840&height=800&iframe=true&def_id=0b6c8478b2f4db9e2b4a8a65a86a965f&term_occur=999&term_src=Title:47:Chapter:I:Subchapter:B:Part:25:Subpart:A:25.103) that the [earth station](https://www.law.cornell.edu/definitions/index.php?width=840&height=800&iframe=true&def_id=78b6a8b2410df19c2611058edc75e85f&term_occur=999&term_src=Title:47:Chapter:I:Subchapter:B:Part:25:Subpart:A:25.103) is communicating with (FCC 47 CFR 25.103).

**Satellite:** A space-borne vehicle embarking a bent pipe payload or a regenerative payload telecommunication transmitter, placed into Low-Earth Orbit (LEO), Medium-Earth Orbit (MEO), or Geostationary Earth Orbit (GEO).

## 3.2 Symbols

For the purposes of the present document, the following symbols apply:

ΔFGlobal Granularity of the global frequency raster

ΔFRaster Band dependent channel raster granularity

BWChannel Channel bandwidth

BWinterferer Bandwidth of the interferer

FDL\_low The lowest frequency of the downlink *operating band*

FDL\_high The highest frequency of the downlink *operating band*

FUL\_low The lowest frequency of the uplink *operating band*

FUL\_high The highest frequency of the uplink *operating band*

FInterferer Frequency of the interferer

FInterferer (offset) Frequency offset of the interferer (between the center frequency of the interferer and the carrier frequency of the carrier measured)

FIoffset Frequency offset of the interferer (between the center frequency of the interferer and the closest edge of the carrier measured)

FOOB The boundary between the NR out of band emission and spurious emission domains

FREF RF reference frequency

FREF-Offs Offset used for calculating FREF

Fuw (offset) The frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the interferer

NRB Transmission bandwidth configuration, expressed in units of resource blocks

NREF NR Absolute Radio Frequency Channel Number (NR-ARFCN)

NREF-Offs Offset used for calculating NREF

PInterferer Modulated mean power of the interferer

PUEType Minimum UE type peak EIPR (i.e. no tolerance) as specified in sub-clause 9.2.1

Puw Power of an unwanted DL signal

θ Angle in degrees from a line from the [earth station](https://www.law.cornell.edu/definitions/index.php?width=840&height=800&iframe=true&def_id=78b6a8b2410df19c2611058edc75e85f&term_occur=999&term_src=Title:47:Chapter:I:Subchapter:B:Part:25:Subpart:C:25.218) antenna to the assigned orbital location of the target satellite

## *<End of Change 2>*

## *<Start of Change 3>*

# 5 Operating bands and channel arrangement

## 5.1 General

The channel arrangements presented in this clause are based on the operating bands and channel bandwidths defined in the present Release of specifications.

NOTE: Other operating bands and channel bandwidths may be considered in future Releases.

Requirements throughout the RF specifications are in many cases defined separately for different frequency ranges (FR). The frequency ranges in which NTN satellite can operate according to this version of the specification are identified as described in Table 5.1-1.

Table 5.1-1: Definition of NTN frequency ranges

|  |  |
| --- | --- |
| Frequency range designation | Corresponding frequency range  |
| FR1-NTN1 | 410 MHz – 7125 MHz |
| FR2-NTN2 | 17300 MHz – 30000 MHz |
| NOTE 1: [NTN bands within this frequency range are regarded as a FR1 band when references from other specifications.]NOTE 2: [NTN bands within this frequency range are regarded as a FR2 band when references from other specifications.] |

## 5.2 Operating bands

### 5.2.1 General

NTN satellite covers FR1-NTN and FR2-NTN operating bands in the present specification.

### 5.2.2 Operating bands with conducted requirements

NTN satellite is designed to operate in the operating bands defined in Table 5.2.2-1.

Table 5.2.2-1: NTN satellite bands in FR1-NTN

|  |  |  |  |
| --- | --- | --- | --- |
| NTN satellite operating band | Uplink (UL) operating bandSatellite Access Node receive / UE transmitFUL,low – FUL,high | Downlink (DL) operating bandSatellite Access Node transmit / UE receiveFDL,low – FDL,high  | Duplex mode |
| n256 | 1980 MHz – 2010 MHz | 2170 MHz – 2200 MHz | FDD |
| n255 | 1626.5 MHz – 1660.5 MHz | 1525 MHz – 1559 MHz | FDD |
| NOTE: NTN satellite bands are numbered in descending order from n256. |

### 5.2.3 Operating bands with radiated requirements

NTN satellite is designed to operate in the operating bands defined in Table 5.2.3-1.

Table 5.2.3-1: Satellite *operating bands* in FR2-NTN

|  |  |  |  |
| --- | --- | --- | --- |
| **Satellite *operating band*** | Uplink (UL) *operating band*SAN receive / UE transmit**FUL,low – FUL,high** | Downlink (DL) *operating band*SAN transmit / UE receive**FDL,low – FDL,high** | **Duplex mode** |
| n5121 | 27500 MHz - 30000 MHz | 17300 MHz - 20200 MHz | FDD |
| n5112 | 28350 MHz - 30000 MHz | 17300 MHz - 20200 MHz | FDD |
| n5103 | 27500 MHz - 28350 MHz | 17300 MHz - 20200 MHz | FDD |
| NOTE 1: This band is applicable in the countries subject to CEPT ECC Decision(05)01 and ECC Decision (13)01. NOTE 2: This band is applicable in the USA subject to FCC 47 CFR part 25.NOTE 3: This band is applicable for Earth Station operations in the USA subject to FCC 47 CFR part 25. FCC rules currently do not include ESIM operations in this band (47 CFR 25.202). |

## 5.3 UE channel bandwidth

### 5.3.1 General

The UE channel bandwidth supports a single RF carrier in the uplink or downlink at the UE. From a SAN perspective, different UE channel bandwidths may be supported within the same spectrum for transmitting to and receiving from UEs connected to the SAN.

From a UE perspective, the UE is configured with one or more BWP / carriers, each with its own UE channel bandwidth. The UE does not need to be aware of the SAN channel bandwidth or how the SAN allocates bandwidth to different UEs.

The placement of the UE channel bandwidth for each UE carrier is flexible but can only be completely within the SAN channel bandwidth.

The relationship between the channel bandwidth, the guardband and the maximum transmission bandwidth configuration is shown in Figure 5.3.1-1.



Figure 5.3.1-1: Definition of the channel bandwidth and the maximum transmission bandwidth configuration for one channel

### 5.3.2 Maximum transmission bandwidth configuration

The maximum transmission bandwidth configuration NRB for each UE channel bandwidth and subcarrier spacing is specified in Table 5.3.2-1 for FR1-NTN and table 5.3.2-2 for FR2-NTN.

Table 5.3.2-1: Maximum transmission bandwidth configuration NRB for FR1-NTN

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| SCS (kHz) | 5MHz | 10MHz | 15MHz | 20MHz | **30**MHz |
| NRB | NRB | NRB | NRB | NRB |
| 15 | 25 | 52 | 79 | 106 | 160 |
| 30 | 11 | 24 | 38 | 51 | 78 |
| 60 | N/A | 11 | 18 | 24 | 38 |

Table 5.3.2-2: Maximum transmission bandwidth configuration NRB for FR2-NTN

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SCS (kHz) | 50 MHz | 100 MHz | 200 MHz | 400 MHz |
|  | NRB | NRB | NRB | NRB |
| 60 | 66 | 132 | 264 | N/A |
| 120 | 32 | 66 | 132 | 264 |

### 5.3.3 Minimum guardband and transmission bandwidth configuration

The minimum guardband for each UE channel bandwidth and SCS is specified in Table 5.3.3-1 for FR1-NTN and in table 5.3.3-2 for FR2-NTN.

Table 5.3.3-1: Minimum guardband for each UE channel bandwidth and SCS (kHz) for FR1-NTN

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| SCS (kHz) | 5MHz | 10MHz | 15MHz | 20MHz | **30**MHz |
| 15 | 242.5 | 312.5 | 382.5 | 452.5 | 592.5 |
| 30 | 505 | 665 | 645 | 805 | 945 |
| 60 | N/A | 1010 | 990 | 1330 | 1290 |

Table 5.3.3-2: Minimum guardband for each UE channel bandwidth and SCS (kHz) for FR2-NTN

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SCS (kHz) | 50 MHz | 100 MHz | 200 MHz | 400 MHz |
| 60 | 1210 | 2450 | 4930 | N/A |
| 120 | 1900 | 2420 | 4900 | 9860 |

NOTE: The minimum guardbands have been calculated using the following equation: (BWChannel x 1000 (kHz) - NRB x SCS x 12) / 2 - SCS/2, where NRB are from Table 5.3.2-1 and Table 5.3.2-2.

Figure 5.3.3-1: Void

The number of RBs configured in any channel bandwidth shall ensure that the minimum guardband specified in this clause is met.



Figure 5.3.3-2: UE PRB utilization

In the case that multiple numerologies are multiplexed in the same symbol, the minimum guard band on each side of the carrier is the guard band applied at the configured UE channel bandwidth for the numerology that is transmitted/received immediately adjacent to the guard band.



Figure 5.3.3-3: Guard band definition when transmitting multiple numerologies

NOTE: Figure 5.3.3-2 is not intended to imply the size of any guard between the two numerologies. Inter-numerology guard band within the carrier is implementation dependent.

### 5.3.4 RB alignment

The RB alignment for FR1-NTN refers to NR RB alignments as specified in 3GPP TS 38.101-1 [5] clause 5.3.4.

The RB alignment for FR2-NTN refers to NR RB alignments as specified in 3GPP TS 38.101-2 [15] clause 5.3.4.

### 5.3.5 UE channel bandwidth per operating band

The requirements in this specification apply to the combination of channel bandwidths, SCS and operating bands shown in Table 5.3.5-1 for FR1-NTN and table 5.3.5-2 for FR2-NTN. The transmission bandwidth configuration in Table 5.3.2-1 and Table 5.3.2-2 shall be supported for each of the specified channel bandwidths. The channel bandwidths are specified for both the Tx and Rx path.

Table 5.3.5-1: Channel bandwidths for each NTN satellite band in FR1-NTN

| NTN satellite band | SCSkHz | UE Channel bandwidth (MHz) |
| --- | --- | --- |
| 5 | 10 | 15 | 20 | **30****(NOTE)** |
|  | 15 | 5 | 10 | 15 | 20 |  |
| n256 | 30 |  | 10 | 15 | 20 |  |
|  | 60 |  | 10 | 15 | 20 |  |
|  | 15 | 5 | 10 | 15 | 20 |  |
| n255 | 30 |  | 10 | 15 | 20 |  |
|  | 60 |  | 10 | 15 | 20 |  |
| NOTE: Deployment of 30 MHz channel bandwidth for NTN SAN needs to be preceded by introduction of all applicable Tx RF, Rx RF, and demodulation requirements. |

Table 5.3.5-2: Channel bandwidths for each NTN satellite band in FR2-NTN

|  |  |  |
| --- | --- | --- |
| SAN Operating Band | SCS (kHz) | *SAN channel bandwidth* (MHz) |
| 50 | 100 | 200 | 400 |
| n512 | 60 | 50 | 100 | 200 |  |
|  | 120 | 50 | 100 | 200 | 400 |
| n511 | 60 | 50 | 100 | 200 |  |
|  | 120 | 50 | 100 | 200 | 400 |
| n510 | 60 | 50 | 100 | 200 |  |
|  | 120 | 50 | 100 | 200 | 400 |

## 5.4 Channel arrangement

### 5.4.1 Channel spacing

#### 5.4.1.1 Channel spacing for adjacent NTN satellite carriers

The channel spacing for adjacent NTN satellite carriers in FR1-NTN refers to the NR channel spacing as specified in 3GPP TS 38.101-1 [5] clause 5.4.1.1.

The channel spacing for adjacent NTN satellite carriers in FR2-NTN refers to the NR channel spacing as specified in 3GPP TS 38.101-2 [16] clause 5.4.1.1.

### 5.4.2 Channel raster

#### 5.4.2.1 NR-ARFCN and channel raster

The global frequency channel raster defines a set of RF reference frequencies FREF. The RF reference frequency is used in signalling to identify the position of RF channels, SS blocks and other elements.

The global frequency raster is defined for all frequencies from 0 to 100 GHz. The granularity of the global frequency raster is ΔFGlobal.

RF reference frequencies are designated by an NR Absolute Radio Frequency Channel Number (NR-ARFCN) in the range (0…2016666) on the global frequency raster. The relation between the NR-ARFCN and the RF reference frequency FREF in MHz is given by the following equation, where FREF-Offs and NREF-Offs are given in Table 5.4.2.1-1 and NREF is the NR-ARFCN.

 FREF = FREF-Offs + ΔFGlobal (NREF – NREF-Offs)

Table 5.4.2.1-1: NR-ARFCN parameters for the global frequency raster

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Frequency range (MHz) | ΔFGlobal (kHz) | FREF-Offs (MHz) | NREF-Offs | Range of NREF |
| 0 – 3000 | 5 | 0 | 0 | 0 – 599999 |
| 3000 – 24250 | 15 | 3000 | 600000 | 600000 – 2016666 |
| 24250 – 30000 | 60 | 24250.08 | 2016667 | 2016667 – 2112499 |

The channel raster defines a subset of RF reference frequencies that can be used to identify the RF channel position in the uplink and downlink. The RF reference frequency for an RF channel maps to a resource element on the carrier. For each operating band, a subset of frequencies from the global frequency raster are applicable for that band and forms a channel raster with a granularity ΔFRaster, which may be equal to or larger than ΔFGlobal.

The mapping between the channel raster and corresponding resource element is given in clause 5.4.2.2. The applicable entries for each operating band are defined in clause 5.4.2.3.

#### 5.4.2.2 Channel raster to resource element mapping

The mapping between the RF reference frequency on the channel raster and the corresponding resource element for FR1-NTN refers to the NR requirements specified in 3GPP TS 38.101-1 [5] clause 5.4.2.2.

The mapping between the RF reference frequency on the channel raster and the corresponding resource element for FR2-NTN refers to the NR requirements specified in 3GPP TS 38.101-2 [16] clause 5.4.2.2.

Table 5.4.2.3-1: Applicable NR-ARFCN per operating band in FR1-NTN

|  |  |  |  |
| --- | --- | --- | --- |
| NTN satellite operating band | ΔFRaster(kHz) | UplinkRange of NREF(First – <Step size> – Last) | DownlinkRange of NREF(First – <Step size> – Last) |
| n256 | 100 | 396000 – <20> – 402000 | 434000 – <20> – 440000 |
| n255 | 100 | 325300 – <20> – 332100 | 305000 – <20> – 311800 |
| NOTE : The channel numbers that designate carrier frequencies so close to the operating band edges that the carrier extends beyond the operating band edge shall not be used. |

Table 5.4.2.3-2: Applicable NR-ARFCN per operating band in FR2-NTN

|  |  |  |  |
| --- | --- | --- | --- |
| SAN operating band | ΔFRaster(kHz)  | Uplinkrange of NREF(First – <Step size> – Last) | Downlinkrange of NREF(First – <Step size> – Last) |
| n512 | 60 | 2070833 – <1> – 2112499 | 1553336 – <4> – 1746664 |
| 120 | 2070833 – <2> – 2112499 | 1553336 – <8> – 1746664 |
| n511 | 60 | 2084999 – <1> –2112499 | 1553336 – <4> – 1746664 |
| 120 | 2084999 – <2> –2112499 | 1553336 – <8> – 1746664 |
| n510 | 60 | 2070833 – <1> – 2084999 | 1553336 – <4> – 1746664 |
| 120 | 2070833 – <2> – 2084999 | 1553336 – <8> – 1746664 |

### 5.4.3 Synchronization raster

#### 5.4.3.1 Synchronization raster and numbering

The synchronization raster indicates the frequency positions of the synchronization block that can be used by the UE for system acquisition when explicit signalling of the synchronization block position is not present.

A global synchronization raster is defined for all frequencies. The frequency position of the SS block is defined as SSREF with corresponding number GSCN. The parameters defining the SSREF and GSCN for all the frequency ranges are in Table 5.4.3.1-1.

The resource element corresponding to the SS block reference frequency SSREF is given in clause 5.4.3.2. The synchronization raster and the subcarrier spacing of the synchronization block is defined separately for each band.

Table 5.4.3.1-1: GSCN parameters for the global frequency raster

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency range | SS Block frequency position SSREF | GSCN | Range of GSCN |
| 0 – 3000 MHz | N \* 1200kHz + M \* 50 kHz,N=1:2499, M ϵ {1,3,5}1 | 3N + (M-3)/2 | 2 – 7498 |
| 3000 – 24250 | 3000 MHz + N \* 1.44 MHz, N = 0:14756 | 7499 + N | 7499 – 22255 |
| NOTE: The default value for operating bands with which only support SCS spaced channel raster(s) is M=3. |

#### 5.4.3.2 Synchronization raster to synchronization block resource element mapping

The mapping between the synchronization raster and the corresponding resource element of the SS block in FR1-NTN refers to 3GPP TS 38.101-1 [5] clause 5.4.3.2.

The mapping between the synchronization raster and the corresponding resource element of the SS block in FR2-NTN refers to 3GPP TS 38.101-2 [16] clause 5.4.3.2.

#### 5.4.3.3 Synchronization raster entries for each operating band

The synchronization raster for each band is give in Table 5.4.3.3-1 and table 5.4.3.3-2. The distance between applicable GSCN entries is given by the <Step size> indicated in Table 5.4.3.3-1 for FR1-NTN and table 5.4.3.3-2 for FR2-NTN.

Table 5.4.3.3-1: Applicable SS raster entries per operating band (FR1-NTN)

|  |  |  |  |
| --- | --- | --- | --- |
| NTN satellite operating band | SS Block SCS | SS Block pattern1 | Range of GSCN(First – <Step size> – Last) |
| n256 | 15 kHz | Case A | 5429 – <1> – 5494 |
| n255 | 15 kHz | Case A | 3818 – <1> – 3892 |
|  | 30 kHz | Case B | 3824 – <1> – 3886 |
| NOTE : SS Block pattern is defined in clause 4.1 in 3GPP TS 38.213 [7]. |

Table 5.4.3.3-2: Applicable SS raster entries per operating band (FR2-NTN)

|  |  |  |  |
| --- | --- | --- | --- |
| **SAN operating band** | **SS Block SCS** | **SS Block pattern(NOTE)** | Range of GSCN**(First – <Step size> – Last)** |
| n512 | 120 kHz | Case D | 17448 – <12> – 19428 |
|  | 240 kHz | Case E | 17472 – <24> – 19416 |
| n511 | 120 kHz | Case D | 17448 – <12> – 19428 |
|  | 240 kHz | Case E | 17472 – <24> – 19416 |
| n510 | 120 kHz | Case D | 17448 – <12> – 19428 |
|  | 240 kHz | Case E | 17472 – <24> – 19416 |
| NOTE: SS Block pattern is defined in section 4.1 in TS 38.213 [7]. |

### 5.4.4 TX–RX frequency separation

The default TX channel (carrier centre frequency) to RX channel (carrier centre frequency) separation for operating bands is specified in Table 5.4.4-1 for FR1-NTN.

Table 5.4.4-1: UE TX-RX frequency separation (FR1-NTN)

| NTN Satellite Operating Band | TX – RX carrier centre frequencyseparation |
| --- | --- |
| n256 | 190 MHz |
| n255 | -101.5 MHz |

## *<End of Change 3>*

## *<Start of Change 4>*

### 6.4.2 Transmit modulation quality

#### 6.4.2.1 General

The requirements for transmit modulation quality defined in 3GPP TS 38.101-1 [5] clause 6.4.2 shall apply for NTN satellite UE except for clause 6.4.2.5.

#### 6.4.2.2 Phase continuity requirements for DMRS bundling

For bands that NTN UE indicates the support of DMRS bundling, when the NTN UE is configured with DMRS bundling, the maximum allowable difference between the measured phase value in any slot p-1 and slot p, or slot 0 and any slot p for each antenna connector shall satisfy the requirements as listed in Table 6.4.2.5-1 of TS 38.101-1 [5] for the measurement conditions defined in Table 6.4.2.5-2 of TS 38.101-1 [5], within a measurement time window limited by the UE capability of maximum duration for DMRS bundling [*maxDurationDMRS-Bundling-r17*] for GSO scenario and [*maxDurationDMRS-Bundling-NTN-NGSO-r18*] for NGSO scenario , and defined for each frequency band separately. The phase value for each slot is measured as shown in Annex F.9 of TS 38.101-1 [5]. These requirements apply to PUCCH and PUSCH transmissions with DFT-s-OFDM and CP-OFDM waveforms.

The above requirements are applicable when all the following conditions are met within the measurement time window:

- RB allocation in terms of length and frequency position does not change, and intra-slot and inter-slot frequency hopping is not activated.

- Modulation order does not change.

- No network commanded TA takes effect.

- The TPMI precoder does not change.

- There is no change in UE transmission power level, and no change in the level of P-MPR applied by the UE.

- UE is not scheduled with uplink transmission of other physical channel/signal in-between the PUSCH or PUCCH transmissions.

- Doppler conditions are set to zero and delay conditions are set to constant.

## *<End of Change 4>*

## *<Start of Change 5>*

# 9 Radiated transmitter characteristics

[Editor note: All the tables might be removed based on the conclusion how to capture the regulatory requirement for NTN VSAT.]

## 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

### 9.2.1 UE maximum output power

#### 9.2.1.0 General

The UE classes are specified based on the assumptions of certain UE types with specific device architectures including antenna beam steering types. The requirements are specified for different UE types. And for the the hybrid beam steering capable UE, 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 UE type it declared. The UE types can be found in Table 9.2.1.0-1 below.

Table 9.2.1.0-1: Assumptions of UE Types

|  |  |  |
| --- | --- | --- |
| **UE class** | **UE 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 UE types are assuming UE has only one antenna beam towards one satellite at a given time in this release.Note 2: The Mobile VSAT communicating with non-GSO is not considered in this release. |

#### 9.2.1.1 Minimum requirements for Fixed VSAT

The following requirements define the maximum output power radiated by the UE 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=TX beam peak direction, Meas=Link angle).

Table 9.2.1.1-1: UE 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 EIRP are found in Table 9.2.1.1-2 below.

Table 9.2.1.1-2: UE maximum output power limits for Fixed VSAT

|  |  |
| --- | --- |
| Operating band | Max EIRP (dBm) |
| n512, n511, n510 | 76.2 |

The maximum output power values for TRP are TBD, FFS how to specify them.

Note: The maximum TRP limit for UE should also follow the regulatory requirements, including both ECC and FCC requirements.

#### 9.2.1.2 Minimum requirements for Mobile VSAT

The following requirements define the maximum output power radiated by the UE 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=TX beam peak direction, Meas=Link angle).

Table 9.2.1.2-1: UE 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 EIRP are found in Table 9.2.1.2-2 below.

Table 9.2.1.2-2: UE maximum output power limits for Mobile VSAT

|  |  |
| --- | --- |
| Operating band | Max EIRP (dBm) |
| n512, n511 | 76.2 |

The maximum output power values for TRP are TBD, FFS how to specify them.

Note: The maximum TRP limit for UE should also follow the regulatory requirements, including both ECC and FCC requirements.

### 9.2.2 Off-axis EIRP limit

#### 9.2.2.1 General

The Off-axis EIRP density envelope is applicable within the band to FR2-NTN UE 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 fixed VSAT and mobile 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 fixed VSAT and mobile 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 UE 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 fixed VSAT and mobile 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.

**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) | 40 |
| 7° ≤ θ ≤ 9.2° | 28 | 40 |
| 9.2° ≤ θ ≤ 48° | 52 – 25log(θ) | 40 |
| 48° < θ ≤ 180° | 20 | 40 |

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) | 40 |
| 7° ≤ θ ≤ 9.2° | 18 | 40 |

##### 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) | 40 |
| 7° ≤ θ ≤ 9.2° | 28 | 40 |
| 9.2° ≤ θ ≤ 48° | 52 – 25log(θ) | 40 |
| 48° < θ ≤ 180° | 20 | 40 |

For cross-polarized transmissions, the requirements specified in table 9.2.2.3.2-2 apply to mobile VSAT.

**Table 9.2.2.3.2-2: 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) | 40 |
| 7° ≤ θ ≤ 9.2° | 18 | 40 |

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

For uncoordinated NTN fixed VSAT and for NTN mobile 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. |

9.2.3 Configured transmitted powerThe NTN UE can configure its maximum output power. The configured NTN UE maximum output power PCMAX,f,c for carrier f of a serving cell c is defined as that available to the reference point of a given transmitter branch that corresponds to the reference point of the higher-layer filtered RSRP measurement as specified in TS 38.215 [11].

The configured NTN UE maximum output power PCMAX,f,c for carrier *f* of a serving cell *c* shall be set such that the corresponding measured peak EIRP PUMAX,f,c is within the following bounds

PUEType ≤ PUMAX,f,c ≤ EIRPmax

while the corresponding measured total radiated power PTMAX,f,c is bounded by the maximum TRP limit for UE defined in sub-clause 9.2.1.

with PUEType is the NTN UE minimum peak EIRP as specified in sub-clause 9.2.1, EIRPmax the applicable maximum EIRP as specified in sub-clause 9.2.1. The requirement is verified in beam peak direction.

The tolerance T(∆P) for applicable values of ∆P (values in dB) is specified in Table 9.2.3-1.

Table 9.2.3-1: PUMAX,f,c tolerance for FR2-NTN

|  |  |  |
| --- | --- | --- |
| Operating Band | ∆P (dB) | Tolerance T(∆P)(dB) |
| n510, n511, n512 | P = 0] | [0] |
|  | [0 < P ≤ 2] | [1.5] |
|  | [2 < P ≤ 3] | [2.0] |
|  | [3 < P ≤ 4] | [3.0] |
|  | [4 < P ≤ 5] | [4.0] |
|  | [5 < P ≤ 10] | [5.0] |
|  | [10 < P ≤ 15] | [7.0] |
|  | [15 < P ≤ X] | [8.0] |
| NOTE: X is the value such that Pumax,f,c lower bound, PUEType - P – T(P) = minimum output power specified in clause 9.2.1 |

## 9.3 Output power dynamics

### 9.3.1 Minimum output power

#### 9.3.1.0 General

The minimum controlled output power of the VSAT is defined as the EIRP in the channel bandwidth for all transmit bandwidth configurations (resource blocks) when the power is set to a minimum value.

The minimum output power is defined as the mean power in at least one sub frame (1ms).

#### 9.3.1.1 Minimum output power for Mobile VSAT

For mobile VSAT, the minimum output power shall not exceed the values specified in Table 9.3.1.1-1 for each operating band supported. The minimum power is verified in beam locked mode with the test metric of EIRP (Link=TX beam peak direction, Meas=Link angle).

Table 9.3.1.1-1: Minimum output power for mobile VAST type 4 and type 5

|  |  |  |  |
| --- | --- | --- | --- |
| Operating band | Channel bandwidth(MHz) | Minimum output power(dBm) | Measurement bandwidth(MHz) |
| n512, n511 | 50 | [TBD] | 47.58 |
|  | 100 | [TBD] | 95.16 |
|  | 200 | [TBD] | 190.20 |
|  | 400 | [TBD] | 380.28 |

#### 9.3.1.2 Minimum output power for Fixed VSAT

For fixed VSAT, the minimum output power shall not exceed the values specified in Table 9.3.1.2-1 for each operating band supported. The minimum power is verified in beam locked mode with the test metric of EIRP (Link=TX beam peak direction, Meas=Link angle).

Table 9.3.1.2-1: Minimum output power for fixed VAST type 1, type 2 and type 3

|  |  |  |  |
| --- | --- | --- | --- |
| Operating band | Channel bandwidth(MHz) | Minimum output power(dBm) | Measurement bandwidth(MHz) |
| n512, n511, n510 | 50 | [TBD] | 47.58 |
|  | 100 | [TBD] | 95.16 |
|  | 200 | [TBD] | 190.20 |
|  | 400 | [TBD] | 380.28 |

### 9.3.2 Transmit OFF power

#### 9.3.2.1 General

The transmit OFF power is defined as the TRP in the channel bandwidth when the transmitter is OFF. The transmitter is considered OFF when the UE is not allowed to transmit on any of its ports.

#### 9.3.2.2 Minimum output power for Mobile VSAT

The transmit OFF power shall not exceed the values specified in Table 9.3.2.2-1 for each operating band supported. The requirement is verified with the test metric of TRP (Link=TX beam peak direction, Meas=TRP grid).

Table 9.3.2.2-1: Transmit OFF power

|  |  |
| --- | --- |
| Operating band | Channel bandwidth / Transmit OFF power (dBm) / measurement bandwidth |
|  | 50 MHz | 100 MHz | 200 MHz | 400 MHz |
| n512, n511 | [-35] | [-35] | [-35] | [-35] |
|  | 47.58 MHz | 95.16 MHz | 190.20 MHz | 380.28 MHz |

#### 9.3.2.3 Minimum output power for Fixed VSAT

The transmit OFF power shall not exceed the values specified in Table 9.3.2.2-1 for each operating band supported. The requirement is verified with the test metric of TRP (Link=TX beam peak direction, Meas=TRP grid).

Table 9.3.2.2-1: Transmit OFF power

|  |  |
| --- | --- |
| Operating band | Channel bandwidth / Transmit OFF power (dBm) / measurement bandwidth |
|  | 50 MHz | 100 MHz | 200 MHz | 400 MHz |
| n512, n511, n510 | [-35] | [-35] | [-35] | [-35] |
|  | 47.58 MHz | 95.16 MHz | 190.20 MHz | 380.28 MHz |

### [9.3.3 Transmit ON/OFF time mask

#### 9.3.3.1 General

The transmit ON/OFF time mask defines the transient period(s) allowed

- between transmit OFF power and transmit ON power symbols (transmit ON/OFF)

- between continuous ON-power transmissions when power change or RB hopping is applied.

In case of RB hopping, transition period is shared symmetrically.

Unless otherwise stated the minimum requirements in clause 9.5 apply also in transient periods.

The transmit ON/OFF time mask is defined as a directional requirement. The requirement is verified in beam locked mode at beam peak direction. The maximum allowed EIRP OFF power level is [-30dBm] at beam peak direction. The requirement is verified with the test metric of EIRP (Link=TX beam peak direction, Meas=Link angle).

In the following sub-clauses, following definitions apply:

- A slot transmission is a Type A transmission.

- A long subslot transmission is a Type B transmission with more than 2 symbols.

- A short subslot transmission is a Type B transmission with 1 or 2 symbols.

#### 9.3.3.2 General ON/OFF time mask

The general ON/OFF time mask defines the observation period allowed between transmit OFF and ON power. ON/OFF scenarios include: contiguous, and non-contiguous transmission, etc

The OFF power measurement period is defined in a duration of at least one slot excluding any transient periods. The ON power is defined as the mean power over one slot excluding any transient period.



Figure 9.3.3.2-1: General ON/OFF time mask for NR UL transmission in FR2-NTN

#### 9.3.3.3 Transmit power time mask for slot and short or long subslot boundaries

The transmit power time mask for slot and a long subslot transmission boundaries defines the transient periods allowed between slot and long subslot PUSCH transmissions. For PUSCH-PUCCH and PUSCH-SRS transitions and multiplexing the time masks in sub-clause 9.3.3.7 apply.

The transmit power time mask for slot or long subslot and short subslot transmission boundaries defines the transient periods allowed between slot or long subslot and short subslot transmissions. The time masks in sub-clause 9.3.3.8 apply.

The transmit power time mask for short subslot transmissiona boundaries defines the transient periods allowed between short subslot transmissions. The time masks in sub-clause 9.3.3.9 apply.

#### 9.3.3.4 PRACH time mask

The PRACH ON power is specified as the mean power over the PRACH measurement period excluding any transient periods as shown in Figure 9.3.3.4-1. The measurement period for different PRACH preamble format is specified in Table 9.3.3.4-1.

Table 9.3.3.4-1: PRACH ON power measurement period

|  |  |  |
| --- | --- | --- |
| Format | SCS | Measurement period |
| A1 | 60 kHz | 0.035677 ms |
|  | 120 kHz | 0.017839 ms |
| A2 | 60 kHz | 0.071354 ms |
|  | 120 kHz | 0.035677 ms |
| A3 | 60 kHz | 0.107031 ms |
|  | 120 kHz | 0.053516 ms |
| B1 | 60 kHz | 0.035091 ms |
|  | 120 kHz | 0.0175455 ms |
| B4 | 60 kHz | 0.207617 ms |
|  | 120 kHz | 0.103809 ms |
| A1/B1 | 60 kHz | 0.035677 ms for front X1 occasion0.035091 ms for last occasionX1 = [2,5] |
|  | 120 kHz | 0.017839 ms for front X1occasion0.017546 ms for last occasionX1 = [2,5] |
| A2/B2 | 60 kHz | 0.071354 ms for front X2 occasion0.069596 ms for last occasionX2 = [1,2] |
|  | 120 kHz | 0.035677 ms for front X2 occasion0.034798 ms for last occasionX2 = [1,2] |
| A3/B3 | 60 kHz | 0.107031 ms for first occasion0.104101 ms for second occasion |
|  | 120 kHz | 0.053515 ms for first occasion0.052050 ms for second occasion |
| C0 | 60 kHz | 0.026758 ms |
|  | 120 kHz | 0.013379 ms |
| C2 | 60 kHz | 0.083333 ms |
|  | 120 kHz | 0.0416667 ms |
| NOTE: For PRACH on PRACH occasion start from begin of 0ms or 0.5 ms boundary, the measurement period will plus 0.032552 μs |



Figure 9.3.3.4-1: PRACH ON/OFF time mask

#### 9.3.3.5 Void

#### 9.3.3.6 SRS time mask

In the case a single SRS transmission, the ON power is defined as the mean power over the symbol duration excluding any transient period; Figure 9.3.3.6-1.



Figure 9.3.3.6-1: Single SRS time mask for NR UL transmission

In the case multiple consecutive SRS transmission, the ON power is defined as the mean power for each symbol duration excluding any transient period. See Figure 7.7.4-2



Figure 9.3.3.6-2: Consecutive SRS time mask for the case when no power change is required

When power change between consecutive SRS transmissions is required, then Figure 9.3.3.6-3 and Figure 9.3.3.6-4 apply.



Figure 9.3.3.6-3: Consecutive SRS time mask for the case when power change is required and when 60kHz SCS is used in FR2



Figure 9.3.3.6-4: Consecutive SRS time mask for the case when power change is required and when 120kHz SCS is used in FR2

#### 9.3.3.7 PUSCH-PUCCH and PUSCH-SRS time masks

The PUCCH/PUSCH/SRS time mask defines the observation period between sounding reference symbol (SRS) and an adjacent PUSCH/PUCCH symbol and subsequent UL transmissions. The time masks apply for all types of frame structures and their allowed PUCCH/PUSCH/SRS transmissions unless otherwise stated.



Figure 9.3.3.7-1: PUCCH/PUSCH/SRS time mask when there is a transmission before or after or both before and after SRS

When there is no transmission preceding SRS transmission or succeeding SRS transmission, then the same time mask applies as shown in Figure 9.3.3.7-1.

#### 9.3.3.8 Transmit power time mask for consecutive slot or long subslot transmission and short subslot transmission boundaries

The transmit power time mask for consecutive slot or long subslot transmission and short subslot transmission boundaries defines the transient periods allowed between such transmissions.



Figure 9.3.3.8-1: Consecutive slot or long subslot transmission and short subslot transmission time mask

#### 9.3.3.9 Transmit power time mask for consecutive short subslot transmissions boundaries

The transmit power time mask for consecutive short subslot transmission boundaries defines the transient periods allowed between short subslot transmissions.

The transient period shall be equally shared as shown on Figure 9.3.3.9-1.

 

Figure 9.3.3.9-1: Consecutive short subslot transmissions time mask where DMRS is not the first symbol in the adjacent short subslot transmission



Figure 9.3.3.9-2: Consecutive short subslot (1 symbol gap) time mask for the case when transient period is required on both sides of the symbol and when 120 kHz SCS is used in FR2

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### [9.3.4 Power control

#### 9.3.4.1 General

The requirements on power control accuracy apply under normal conditions and are defined as a directional requirement. The requirements are verified in beam locked mode on beam peak direction.

#### 9.3.4.2 Absolute power tolerance

The absolute power tolerance is the ability of the UE transmitter to set its initial output power to a specific value for the first sub-frame (1 ms) at the start of a contiguous transmission or non-contiguous transmission with a transmission gap larger than 20 ms. The tolerance includes the channel estimation error RSRP estimate.

The minimum requirements specified in Table 9.3.4.2-1 apply in the power range bounded by the minimum output power as specified in sub-clause 9.3.1 ('Pmin') and the maximum output power as specified in sub-clause 9.2.1 as minimum peak EIRP ('Pmax'). The intermediate power point 'Pint' is defined in table 9.3.4.2-2.

Table 9.3.4.2-1: Absolute power tolerance

|  |  |
| --- | --- |
| Power Range | Tolerance |
| Pint ≥ P ≥ Pmin | [± 14.0 dB] |
| Pmax ≥ P > Pint | [± 12.0 dB] |

Table 9.3.4.2-2: Intermediate power point

|  |  |
| --- | --- |
| Power Parameter | Value |
| Pint | [Pmax – 12.0 dB] |

#### 9.3.4.3 Relative power tolerance

The relative power tolerance is the ability of the UE transmitter to set its output power in a target sub-frame (1 ms) relatively to the power of the most recently transmitted reference sub-frame (1 ms) if the transmission gap between these sub-frames is less than or equal to 20 ms.

The minimum requirements specified in Table 9.3.4.3-1 apply when the power of the target and reference sub-frames are within the power range bounded by the minimum output power as defined in sub-clause 9.3.1 and Pint as defined in sub-clause 9.3.4.2. The minimum requirements specified in Table 9.3.4.3-2 apply when the power of the target and reference sub-frames are within the power range bounded by Pint as defined in sub-clause 9.3.4.2 and the measured PUMAX as defined in sub-clause 9.2.4.

For a test pattern that is either a monotonically increasing or monotonically decreasing power sweep over the range specified for Tables 9.3.4.3-1 and 9.3.4.3-2, 3 exceptions are allowed for each of the test patterns. For these exceptions, the power tolerance limit is a maximum of ±11.0 dB.

Table 9.3.4.3-1: Relative power tolerance, Pint ≥ P ≥ Pmin

|  |  |
| --- | --- |
| Power step ∆P (Up or down) (dB) | All combinations of PUSCH and PUCCH, PUSCH/PUCCH and SRS transitions between sub-frames, PRACH (dB) |
| ΔP < 2 | [±5.0] |
| 2 ≤ ΔP < 3 | [±6.0] |
| 3 ≤ ΔP < 4 | [±7.0] |
| 4 ≤ ΔP < 10 | [±8.0] |
| 10 ≤ ΔP < 15 | [±10.0] |
| 15 ≤ ΔP | [±11.0] |
| NOTE: The requirements apply with *ue-BeamLockFunction* enabled. |

Table 9.3.4.3-2: Relative power tolerance, PUMAX ≥ P > Pint

|  |  |
| --- | --- |
| Power step ∆P (Up or down) (dB) | All combinations of PUSCH and PUCCH, PUSCH/PUCCH and SRS transitions between sub-frames, PRACH (dB) |
| ΔP < 2 | [± 3.0] |
| 2 ≤ ΔP < 3 | [± 4.0] |
| 3 ≤ ΔP < 4 | [± 5.0] |
| 4 ≤ ΔP < 10 | [± 6.0] |
| 10 ≤ ΔP < 15 | [± 8.0] |
| 15 ≤ ΔP | [± 9.0] |
| NOTE 1: The requirements apply with *ue-BeamLockFunction* enabled.NOTE 2: For PUSCH to PUSCH transitions with the allocated resource blocks fixed in frequency and no transmission gaps other than those generated by downlink subframes, guard periods: for a power step ΔP = 1 dB, the relative power tolerance for transmission is ± 1.0 dB. |

#### 9.3.4.4 Aggregate power tolerance

The aggregate power control tolerance is the ability of the UE transmitter to maintain its power in a sub-frame (1 ms) during non-contiguous transmissions within 21ms in response to 0 dB TPC commands with respect to the first UE transmission and all other power control parameters as specified in 38.213 kept constant.

The minimum requirements specified in Table 9.3.4.4-1 apply when the power of the target and reference sub-frames are within the power range bounded by the minimum output power as defined in sub-clause 9.3.1 and Pint as defined in sub-clause 9.3.4.2. The minimum requirements specified in Table 9.3.4.4-2 apply when the power of the target and reference sub-frames are within the power range bounded by Pint as defined in sub-clause 9.3.4.2 and the maximum output power as specified in sub-clause 9.2.1.

Table 9.3.4.4-1: Aggregate power tolerance, Pint ≥ P ≥ Pmin

|  |  |  |
| --- | --- | --- |
| TPC command | UL channel | Aggregate power tolerance within 21 ms |
| 0 dB | PUCCH | [± 5.5 dB] |
| 0 dB | PUSCH | [± 5.5 dB] |

Table 9.3.4.4-2: Aggregate power tolerance, Pmax ≥ P > Pint

|  |  |  |
| --- | --- | --- |
| TPC command | UL channel | Aggregate power tolerance within 21 ms |
| 0 dB | PUCCH | [± 3.5 dB] |
| 0 dB | PUSCH | [± 3.5 dB] |

## 9.4 Transmitter signal quality

### 9.4.1 Frequency Error

The VSAT UE basic measurement interval of modulated carrier frequency is 1 UL slot. The VSAT UE 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 VSAT UE 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 VSAT UE by SAN and UL pre-compensated Doppler frequency shift. For the test case, the location of the VSAT UE is explicitly provided to the VSAT UE 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

The requirements for transmit modulation quality defined in 3GPP TS 38.101-2 [x] clause 6.4.2 except caluse 6.4.2.6 shall apply for VSAT UE.

## 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 VSAT UE are configured for single CC operation, and they are of the same bandwidth.

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

9.5.2.2 Spectrum emission mask

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

9.5.2.2.1 General NR spectrum emission mask

The power of any VSAT UE 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 TRP for VSAT UE;NOTE 2: Transmission BW is in the unit of MHz;NOTE 3: SE limit 11dBm/1MHz is 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 VSAT UE 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(dBm) - 25 dB | 4 kHz |
| 0.002MHz+1xBW ≤ f\_offset < 2.5xBW-0.002MHz | Prated,UE(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: Prated,UE is TRP for VSAT UE;NOTE 2: Transmission BW is in the unit of MHz;NOTE 3: *Measurement bandwidth*s as in ITU-R SM.329 [2], s4.1.NOTE 4: Upper frequency as in ITU-R SM.329 [2], s2.5 table 1. |

9.5.2.3 Adjacent channel leakage ratio

Adjacent Channel Leakage power Ratio (ACLR) is the ratio of the filtered mean power centred on the assigned channel frequency to the filtered mean power centred on an adjacent channel frequency. ACLR requirement is specified for a scenario in which adjacent carrier is another NRchannel.

NR Adjacent Channel Leakage power Ratio (NRACLR) is the ratio of the filtered mean power centred on the assigned channel frequency to the filtered mean power centred on an adjacent channel frequency at nominal channel spacing. The assigned NR channel power and adjacent NR channel power are measured with rectangular filters with measurement bandwidths specified in Table 9.5.2.3-1 for FR2-NTN.

If the measured adjacent channel power is greater than –35 dBm then the NRACLR shall be higher than the value specified in Table 9.5.2.3-1. The requirement is verified in beam locked mode with the test metric of TRP (Link=TX beam peak direction, Meas=TRP grid).

**Table 9.5.2.3-1: General requirements for NRACLR for FR2-NTN**

|  |  |
| --- | --- |
|  | **Channel bandwidth / NRACLR / Measurement bandwidth** |
| **50****MHz** | **100****MHz** | **200****MHz** | **400****MHz** |
| NRACLR for band n512, n511, n510 | [14] dB | [14] dB | [14] dB | [14] dB |
| NR channel measurement bandwidth (MHz) | 47.58  | 95.16  | 190.20  | 380.28  |
| Adjacent channel centre frequency offset (MHz) | +50/-50 | +100/-100 | +200/-200 | +400/-400 |

### 9.5.3 Spurious Emissions

#### 9.5.3.1 General

Spurious emissions are emissions which are caused by unwanted transmitter effects such as harmonics emission, parasitic emissions, intermodulation products and frequency conversion products, but exclude out of band emissions unless otherwise stated. The spurious emission limits are specified in terms of general requirements in line with SM.329 [14] and NR operating band requirement to address UE co-existence. Spurious emissions are measured as TRP.

To improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

Unless otherwise stated, the spurious emission limits apply for the frequency ranges that are more than FOOB (MHz) in Table 9.5.3.1-1 starting from the edge of the assigned NR channel bandwidth. The spurious emission limits in Table 9.5.3.1-2 apply for all transmitter band configurations (NRB) and channel bandwidths. The requirement is verified in beam locked mode with the test metric of TRP (Link=TX beam peak direction, Meas=TRP grid).

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

Table 9.5.3.1-1: Boundary between NR out of band and spurious emission domain

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel bandwidth | 50MHz | 100MHz | 200MHz | 400MHz |
| OOB boundary FOOB (MHz) | 100 | 200 | 400 | 800 |

Table 9.5.3.1-2: Spurious emissions limits

|  |  |  |
| --- | --- | --- |
| Frequency Range | Maximum Level | Measurement bandwidth |
| 30 MHz ≤ f ≤ 2nd harmonic of the upper frequency edge of the UL operating band in GHz | -13 dBm | 4 kHz |

#### 9.5.3.2 On-axis spurious requirement

##### 9.5.3.2.1 Applicability

The On-axis spurious requirement is applicable to NTN VSAT operating in band n512. The On-axis spurious emissions are measured as EIRP.

These limits are applicable to the complete NTN VSAT equipment, including cabling between the units.

##### 9.5.3.2.2 “Emissions disabled” and “Carrier-off” states

The requirements specified in table 9.5.3.2.2-1 apply to NTN VSAT in “Emissions disabled” and “Carrier-off” states. They apply outside the transmission bandwidth.

Table 9.5.3.2.2-1: On-axis spurious limits in “Emissions disabled” and “Carrier-off” states

|  |  |  |
| --- | --- | --- |
| Frequency range(GHz) | EIRP Limit(dBm) | Measurement bandwidth(MHz) |
| 27.5 – 30.0 | 19 | 1 |

##### 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 bands 27,5 GHz to 29,1 GHz and 29,5 GHz to 30,0 GHz, are

indirectly limited by subclause 9.5.3.2.3. Consequently no specification is needed.

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

|  |  |  |
| --- | --- | --- |
| Frequency range(GHz) | EIRP Limit(dBm) | Measurement bandwidth(MHz) |
| 27.5 – 30.0 | 44 - K (Note) | 1 |
| Note: K = 0 if only one NTN VSAT transmits at any one time on a given carrier frequency, see 4.2.2.2.1 in [15] if not. |

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

|  |  |  |
| --- | --- | --- |
| Frequency range(GHz) | EIRP Limit(dBm) | Measurement bandwidth(MHz) |
| 27.5 – 30.0 | 58 - K (Note) | 1 |
| Note: K = 0 if only one NTN VSAT transmits at any one time on a given carrier frequency, see 4.2.2.2.1 in [15] if not. |

#### 9.5.3.3 Off-axis spurious requirement

##### 9.5.3.3.1 Applicability

The Off-axis spurious requirement is applicable to NTN VSAT operating in band n512. The Off-axis spurious emissions are measured as EIRP.

These limits are applicable to the complete NTN VSAT equipment, including cabling between the units.

##### 9.5.3.3.2 General

The requirements specified in table 9.5.3.3.2-1 apply to NTN VSAT at 10 meters distance from the NTN VSAT.

Table 9.5.3.3.2-1: Radiated field strength limits at 10m from the NTN VSAT

|  |  |  |
| --- | --- | --- |
| Frequency range(MHz) | EIRP Limit(dBμV/m) | Measurement bandwidth(kHz) |
| 30 – 230 | 30 | 120 |
| 230 – 1000 | 37 | 120 |

##### 9.5.3.3.3 “Emissions disabled” state

The requirements specified in table 9.5.3.3.3-1 apply to NTN VSAT in “Emissions disabled” state for all off-axis angles greater than 7° or greater than the minimum elevation angle supported, whichever is lower.

Table 9.5.3.3.3-1: Off-axis spurious limits in “Emissions disabled” state

|  |  |  |
| --- | --- | --- |
| Frequency range(GHz) | EIRP Limit(dBm) | Measurement bandwidth(kHz) |
| 1.0 – 2.0 | -48 | 100 |
| 2.0 – 10.7 | -42 | 100 |
| 10.7 – 21.2 | -36 | 100 |
| 21.2 – 60.0 | -30 | 100 |

##### 9.5.3.3.4 “Carrier-on” and “Carrier-off” states

The requirements specified in table 9.5.3.3.4-1 apply to NTN VSAT in “Carrier-on” and “Carrier-off” states for all off-axis angles greater than 7° or greater than the minimum elevation angle supported, whichever is lower.

Table 9.5.3.3.4-1: Off-axis spurious limits in “Carrier-on” and “Carrier-off” states

|  |  |  |
| --- | --- | --- |
| Frequency range(GHz) | EIRP Limit(dBm) | Measurement bandwidth(MHz) |
| 1.00 – 3.40 | -41 | 0.1 |
| 3.40 – 10.70 | -35 | 0.1 |
| 10.70 – 21.20 | -29 | 0.1 |
| 21.20 – 27.35 | -23 | 0.1 |
| 27.35 – 27.50 | -5 (note 1) | 1 |
| -23 (note 2) | 0.1 |
| 27.50 – 29.35 | -5 (note 1) | 1 |
| -23 (note 2) | 0.1 |
| 29.35 – 29.50 | -5 | 1 |
| 30.00 – 30.15 | -5 | 1 |
| 30.15 – 60.00 | -23 | 0.1 |
| Note 1: For mobile VSAT transmitting in the frequency range 29.5 – 30.0 GHzNote 2: For mobile VSAT transmitting in the frequency range 27.5 – 29.5 GHz |

### 9.6 Antenna point accuracy

#### 9.6.1 Minimum requirement for Mobile VSAT

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The applicant shall declare the peak pointing accuracy (δφ) and the associated statistical basis.

The antenna shall maintain the declared peak pointing accuracy (δφ), such that the off-axis EIRP emission density pattern projected onto the geostationary arc remains within the mask specified in clauses 9.2.2.2 and 9.2.2.3 when shifted by an angle of ±(δφ°), taking into account the following factors [EN 303 978]:

* the worst case operational environmental conditions;
* maximum ESOMP dynamics; and
* the range of latitude, longitude and altitude relative to the satellite orbital position.
* For linearly polarized ESOMPs, the following specification is required. The applicant shall declare the on-axis cross polarization isolation of the ESOMP [EN 303 978]:
* The polarization angle shall be continuously adjustable within the operational range as declared by the applicant.
* It shall be possible to fix the transmit antenna polarization angle with an accuracy of at least 1°.
* When linear polarization is used for both transmission and reception, the angle between the receive and corresponding transmit polarization planes shall not deviate by more than 1° from the nominal value declared by the applicant.

For circularly polarized ESOMPs, the applicant shall declare the voltage axial ratio.

#### 9.6.2 Minimum requirement for Fixed VSAT

|  |  |  |
| --- | --- | --- |
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The minimum requirements are defined in terms of a) pointing stability, b) pointing accuracy capability and c) polarization angle alignment capability for linear polarization, as follows:

a) Pointing stability: Under the condition of 100 km/h maximum wind speed, with gusts of 130 km/h lasting 3 seconds, the installation shall not show any sign of permanent distortion and shall not need repointing after the application of the wind load.

b) Pointing accuracy capability: The applicant shall declare the usage area in terms of the range of latitude and longitude relative to the satellite orbital position where the alignments specified below are possible. Two sets of specifications are further defined:

* Specification 1: Main beam pointing accuracy. The antenna sub-system alignment facilities shall enable the main beam axis to be adjusted and fixed with a pointing accuracy (δφ) of either:
	+ 1) 0,1º; or
	+ 2) a greater value declared by the applicant, subject to the following restrictions:
		- the pointing accuracy (δφ) shall not exceed 30 % of the antenna transmit main beam half power beamwidth;
		- the off-axis e.i.r.p. emission density pattern remains within the mask specified in clause 9.2.2.3 when shifted by an angle of ±(δφ - 0,1º).
* Specification 2: Alignment with the geostationary satellite orbit. For antennas with asymmetric main beam, the antenna shall be capable of having the plane defined by the antenna main beam axis and its major axis aligned with the tangent to the geostationary orbit in accordance with the method declared by the applicant.

c) Polarization angle alignment capability for linear polarization. Following conditions will apply:

- The polarization angle shall be continuously adjustable within the operational range as declared by the applicant.

- It shall be possible to fix the transmit antenna polarization angle with an accuracy of at least 1°.

- When linear polarization is used for both transmission and reception, the angle between the receive and corresponding transmit polarization planes shall not deviate by more than 1° from the nominal value declared by the applicant.

# 10 Radiated receiver characteristics

## 10.1 General

Unless otherwise stated, the receiver characteristics are specified over the air (OTA) at the RIB for Ka bands fixed and mobile VSAT. The reference effective isotropic sensitivity (EIS), wanted signals and interference is defined assuming a 0 dBi reference antenna located at the center of the quiet zone.

## 10.2 Polarization characteristics

The minimum requirements on the receiver characteristics apply under one polarization.

## 10.3 OTA reference sensitivity level

### 10.3.1 General

The OTA REFSENS requirement is a *directional requirement* and is intended to ensure the minimum OTA reference sensitivity level at the centre of the quiet zone in the RX beam peak direction. The OTA reference sensitivity power level EISREFSENS is the minimum mean power received over the air at the RIB, at which the throughput shall meet or exceed the requirements for a specified reference measurement channel.

### 10.3.2 Minimum requirement for mobile VSAT

The throughput shall be ≥ 95 % of the maximum throughput of the reference measurement channels as [specified in Annexes A.2.3.2 and A.3.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in Annex A.5.2.1) with peak reference sensitivity specified in Table 10.3.2-1]. The requirement is verified with the test metric of EIS (Link=RX beam peak direction, Meas=Link Angle).

Table 10.3.2-1: OTA reference sensitivity requirement for mobile VSAT

|  |  |  |  |
| --- | --- | --- | --- |
| *Operating band* | *VSAT channel bandwidth* (MHz) | UL/DL RB allocation | OTA reference sensitivity level, EISREFSENS(dBm) |
| n512, n511 | 50, 100, 200, 400 | Full RB allocation NRB as specified in clause 5.3.2 | EISREFSENS\_50MHz + 10log10(NRB x SCS x 12 / factor)(NOTE 1) |
| NOTE 1: The “factor” represents the normalized factor to scale EIS for different (Channel bandwidth, SCS) configurations. The value of factor is 66 RBs x 60 kHz SCS x 12, i.e. 47520 kHz. |

For Mobile VSAT communication with GSO, EISREFSENS\_50MHz is [-126.8] dBm.

### 10.3.3 Minimum requirement for fixed VSAT

The throughput shall be ≥ 95 % of the maximum throughput of the reference measurement channels as [specified in Annexes A.2.3.2 and A.3.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in Annex A.5.2.1) with peak reference sensitivity specified in Table 10.3.3-1]. The requirement is verified with the test metric of EIS (Link=RX beam peak direction, Meas=Link Angle).

Table 10.3.3-1: OTA reference sensitivity requirement for fixed VSAT

|  |  |  |  |
| --- | --- | --- | --- |
| *Operating band* | *VSAT channel bandwidth* (MHz) | UL/DL RB allocation | OTA reference sensitivity level, EISREFSENS(dBm) |
| n512, n511, n510 | 50, 100, 200, 400 | Full RB allocation NRB as specified in clause 5.3.2 | EISREFSENS\_50MHz + 10log10(NRB x SCS x 12 / factor)(NOTE 1) |
| NOTE 1: The “factor” represents the normalized factor to scale EIS for different (Channel bandwidth, SCS) configurations. The value of factor is 66 RBs x 60 kHz SCS x 12, i.e. 47520 kHz. |

For fixed VSAT communication with GSO and LEO, EISREFSENS\_50MHz is [-126.8] dBm.

For fixed VSAT communication with LEO only, EISREFSENS\_50MHz is [-115.6] dBm.

|  |  |  |
| --- | --- | --- |
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|  |  |  |
| --- | --- | --- |
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|  |  |  |
|  |  |  |

## 10.4 Maximum input level

### 10.4.1 General

The maximum input level is defined as the maximum mean power, for which the throughput shall meet or exceed the minimum requirements for the specified reference measurement channel.

The maximum input level is defined as a directional requirement. The requirement is verified in beam locked mode in the direction where peak gain is achieved.

### 10.4.2 Minimum requirement for Mobile VSAT

For mobile VSAT, the throughput shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in Annex A (with one sided dynamic OCNG Pattern for the DL-signal as described in Annex A.x.x.x) with parameters specified in Table 10.4.2-1. The requirement is verified with the test metric of EIS (Link=RX beam peak direction, Meas=Link angle).

Table 10.4.2-1: Maximum input level

|  |  |  |
| --- | --- | --- |
| Rx Parameter | Units | Channel bandwidth |
|  |  | 50MHz | 100MHz | 200MHz | 400MHz |
| Power in transmission bandwidth configuration | dBm | -[TBD](NOTE 2) |
| NOTE 1: The transmitter shall be set to [4 dB] below the PUMAX,f,c as defined in clause 9.2.3, with uplink configuration specified in Table 10.3-x.NOTE 2: Reference measurement channel is specified in Annex A.3.3.2: [QPSK, R=1/3] variant with one sided dynamic OCNG Pattern as described in Annex A. |

### 10.4.3 Minimum requirement for Fixed VSAT

For fixed VSAT, the throughput shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in Annex A (with one sided dynamic OCNG Pattern for the DL-signal as described in Annex A.x.x.x) with parameters specified in Table 10.4.3.-1. The requirement is verified with the test metric of EIS (Link=RX beam peak direction, Meas=Link angle).

Table 10.4.3-1: Maximum input level

|  |  |  |
| --- | --- | --- |
| Rx Parameter | Units | Channel bandwidth |
|  |  | 50MHz | 100MHz | 200MHz | 400MHz |
| Power in transmission bandwidth configuration | dBm | -[TBD](NOTE 2) |
| NOTE 1: The transmitter shall be set to [4 dB] below the PUMAX,f,c as defined in clause 9.2.3, with uplink configuration specified in Table 10.3-x.NOTE 2: Reference measurement channel is specified in Annex A.3.3.2: [QPSK, R=1/3] variant with one sided dynamic OCNG Pattern as described in Annex A. |

## 10.5 Adjacent channel selectivity

### 10.5.1 Minimum requirement for Mobile VSAT

### 10.5.2 Minimum requirement for Fixed VSAT

## 10.6 Blocking characteristics

### 10.6.1 General

The blocking characteristic is a measure of the receiver's ability to receive a wanted signal at its assigned channel frequency in the presence of an unwanted interferer on frequencies other than those of the spurious response or the adjacent channels, without this unwanted input signal causing a degradation of the performance of the receiver beyond a specified limit. The blocking performance shall apply at all frequencies except those at which a spurious response occurs.

The requirement applies at the RIB when the AoA of the incident wave of the wanted signal and the interfering signal are both from the direction where peak gain is achieved.

The wanted and interfering signals apply to all supported polarizations, under the assumption of polarization match.

### 10.6.2 Minimum requirement for Mobile VSAT

In-band blocking is a measure of a receiver's ability to receive a NR signal at its assigned channel frequency in the presence of an interferer at a given frequency offset from the centre frequency of the assigned channel.

For mobile VSAT, the throughput shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in Annexes A.2.3.2 and A.3.3.2 (with one sided dynamic OCNG Pattern for the DL-signal as described in Annex A.5.2.1). The requirement is verified with the test metric of EIS (Link=RX beam peak direction, Meas=Link angle).

Table 10.6.2-1: In band blocking requirements

|  |  |  |
| --- | --- | --- |
| Rx parameter | Units  | Channel bandwidth |
|  |  | 50 MHz  | 100 MHz | 200 MHz | 400 MHz |
| Power in Transmission Bandwidth Configuration | dBm | REFSENS + 14 dB |
| BWInterferer | MHz | 50 | 100 | 200 | 400 |
| PInterfererfor bands n512, n511 | dBm | REFSENS + [TBD] dB | REFSENS + [TBD] dB | REFSENS + [TBD] dB | REFSENS + [TBD] dB |
| FInterferer (offset) | MHz | ≤ -100 & ≥ 100NOTE 5 | ≤ -200 & ≥ 200NOTE 5 | ≤ -400 & ≥ 400NOTE 5 | ≤ -800 & ≥ 800NOTE 5 |
| FInterferer | MHz | FDL\_low + 25to FDL\_high - 25 | FDL\_low + 50to FDL\_high - 50 | FDL\_low + 100to FDL\_high - 100 | FDL\_low + 200to FDL\_high - 200 |
| NOTE 1: The interferer consists of the Reference measurement channel specified in Annex A.3.3.2 with one sided dynamic OCNG Pattern as described in Annex A.5.2.1 and set-up according to Annex C.NOTE2: The REFSENS power level is specified in Clause 10.3.2, which are applicable according to different VSAT types.NOTE 3: The wanted signal consists of the reference measurement channel specified in Annex A.3.3.2 with one sided dynamic OCNG pattern as described in Annex A.5.2.1 and set-up according to Annex C.NOTE 4: VoidNOTE 5: The absolute value of the interferer offset FInterferer (offset) shall be further adjusted (CEIL(|FInterferer(offset)|/SCS) + 0.5)\*SCS MHz with SCS the sub-carrier spacing of the wanted signal in MHz. Wanted and interferer signal have same SCS.NOTE 6: FInterferer range values for unwanted modulated interfering signals are interferer center frequencies.NOTE 7: The transmitter shall be set to [4 dB] below the PUMAX,f,c as defined in clause 9.2.3, with uplink configuration specified in Table 10.3.2.1-2. |

### 10.6.3 Minimum requirement for Fixed VSAT

In-band blocking is a measure of a receiver's ability to receive a NR signal at its assigned channel frequency in the presence of an interferer at a given frequency offset from the centre frequency of the assigned channel.

For fixed VSAT, the throughput shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in Annexes A.2.3.2 and A.3.3.2 (with one sided dynamic OCNG Pattern OP.1 TDD for the DL-signal as described in Annex A.5.2.1). The requirement is verified with the test metric of EIS (Link=RX beam peak direction, Meas=Link angle).

Table 10.6.3-1: In band blocking requirements

|  |  |  |
| --- | --- | --- |
| Rx parameter | Units  | Channel bandwidth |
|  |  | 50 MHz  | 100 MHz | 200 MHz | 400 MHz |
| Power in Transmission Bandwidth Configuration | dBm | REFSENS + 14 dB |
| BWInterferer | MHz | 50 | 100 | 200 | 400 |
| PInterfererfor bands n512, n511, n510 | dBm | REFSENS + [TBD] dB | REFSENS + [TBD] dB | REFSENS + [TBD] dB | REFSENS + [TBD] dB |
| FInterferer (offset) | MHz | ≤ -100 & ≥ 100NOTE 5 | ≤ -200 & ≥ 200NOTE 5 | ≤ -400 & ≥ 400NOTE 5 | ≤ -800 & ≥ 800NOTE 5 |
| FInterferer | MHz | FDL\_low + 25to FDL\_high - 25 | FDL\_low + 50to FDL\_high - 50 | FDL\_low + 100to FDL\_high - 100 | FDL\_low + 200to FDL\_high - 200 |
| NOTE 1: The interferer consists of the Reference measurement channel specified in Annex A.3.3.2 with one sided dynamic OCNG Pattern as described in Annex A.5.2.1 and set-up according to Annex C.NOTE2: The REFSENS power level is specified in Clause 10.3.2, which are applicable according to different VSAT types.NOTE 3: The wanted signal consists of the reference measurement channel specified in Annex A.3.3.2 with one sided dynamic OCNG pattern as described in Annex A.5.2.1 and set-up according to Annex C.NOTE 4: VoidNOTE 5: The absolute value of the interferer offset FInterferer (offset) shall be further adjusted (CEIL(|FInterferer(offset)|/SCS) + 0.5)\*SCS MHz with SCS the sub-carrier spacing of the wanted signal in MHz. Wanted and interferer signal have same SCS.NOTE 6: FInterferer range values for unwanted modulated interfering signals are interferer center frequencies.NOTE 7: The transmitter shall be set to [4 dB] below the PUMAX,f,c as defined in clause 9.2.3, with uplink configuration specified in Table 10.3.2.1-2. |

## 10.7 Spurious emissions

The requirement is not applicable in this version of the specification.

## *<End of Change 5>*

## *<Start of Change 6>*

Annex A (normative):
Measurement channels

…

## A.3.2 Reference measurement channels for PDSCH performance requirements

For PDSCH reference channels if more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).

### A.3.2.1 FDD

#### A.3.2.1.1 Reference measurement channels for SCS 15 kHz FR1

Table A.3.2.1.1-1: PDSCH Reference Channel for FDD (QPSK)

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| Reference channel |  | R.PDSCH.1-1.1 FDD |  |  |  |  |
| Channel bandwidth | MHz | 10 |  |  |  |  |
| Subcarrier spacing | kHz | 15 |  |  |  |  |
| Number of allocated resource blocks | PRBs | 52 |  |  |  |  |
| Number of consecutive PDSCH symbols |  | 12 |  |  |  |  |
| Allocated slots per 2 frames | Slots | 19 |  |  |  |  |
| MCS table |  | 64QAM |  |  |  |  |
| MCS index |  | 4 |  |  |  |  |
| Modulation |  | QPSK |  |  |  |  |
| Target Coding Rate |  | 0.30 |  |  |  |  |
| Number of MIMO layers |  | 1 |  |  |  |  |
| Number of DMRS REs |  | 18 |  |  |  |  |
| Overhead for TBS determination |  | 0 |  |  |  |  |
| Information Bit Payload per Slot  |  |  |  |  |  |  |
|  For Slot i = 0 | Bits | N/A |  |  |  |  |
|  For Slots i = 1,…, 19 | Bits | 3904 |  |  |  |  |
| Transport block CRC per Slot |  |  |  |  |  |  |
|  For Slot i = 0 | Bits | N/A |  |  |  |  |
|  For Slots i = 1,…, 19 | Bits | 24 |  |  |  |  |
| Number of Code Blocks per Slot |  |  |  |  |  |  |
|  For Slot i = 0 | CBs | N/A |  |  |  |  |
|  For Slots i = 1,…, 19 | CBs | 1 |  |  |  |  |
| Binary Channel Bits Per Slot |  |  |  |  |  |  |
|  For Slot i = 0 | Bits | N/A |  |  |  |  |
|  For Slots i = 10, 11 | Bits | 12480 |  |  |  |  |
|  For Slots i =1,…, 9, 12, …, 19 | Bits | 13104 |  |  |  |  |
| Max. Throughput averaged over 2 frames | Mbps | 3.709 |  |  |  |  |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 msNote 2: Slot i is slot index per 2 frames |

Table A.3.2.1.1-2: PDSCH Reference Channel for FDD (16QAM)

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Unit | Value |  |
| Reference channel |  | R.PDSCH.1-2.1 FDD |  |  |  |  |  |
| Channel bandwidth | MHz | 10 |  |  |  |  |  |
| Subcarrier spacing | kHz | 15 |  |  |  |  |  |
| Number of allocated resource blocks | PRBs | 52 |  |  |  |  |  |
| Number of consecutive PDSCH symbols |  | 12 |  |  |  |  |  |
| Allocated slots per 2 frames | Slots | 19 |  |  |  |  |  |
| MCS table |  | 64QAM |  |  |  |  |  |
| MCS index |  | 13 |  |  |  |  |  |
| Modulation |  | 16QAM |  |  |  |  |  |
| Target Coding Rate |  | 0.48 |  |  |  |  |  |
| Number of MIMO layers |  | 1 |  |  |  |  |  |
| Number of DMRS REs |  | 12 |  |  |  |  |  |
| Overhead for TBS determination |  | 0 |  |  |  |  |  |
| Information Bit Payload per Slot  |  |  |  |  |  |  |  |
|  For Slot i = 0 | Bits | N/A |  |  |  |  |  |
|  For Slots i = 1,…, 19 | Bits | 13064 |  |  |  |  |  |
| Transport block CRC per Slot |  |  |  |  |  |  |  |
|  For Slot i = 0 | Bits | N/A |  |  |  |  |  |
|  For Slots i = 1,…, 19 | Bits | 24 |  |  |  |  |  |
| Number of Code Blocks per Slot |  |  |  |  |  |  |  |
|  For Slot i = 0 | CBs | N/A |  |  |  |  |  |
|  For Slots i = 1,…, 19 | CBs | 2 |  |  |  |  |  |
| Binary Channel Bits Per Slot |  |  |  |  |  |  |  |
|  For Slot i = 0 | Bits | N/A |  |  |  |  |  |
|  For Slots i = 10, 11 | Bits | 26208 |  |  |  |  |  |
|  For Slots i = 1,…, 9, 12, …, 19 | Bits | 27456 |  |  |  |  |  |
| Max. Throughput averaged over 2 frames | Mbps | 12.411 |  |  |  |  |  |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 msNote 2: Slot i is slot index per 2 frames |

#### A.3.2.1.2 Reference measurement channels for SCS 60 kHz FR2-NTN

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Table A.3.2.1.2-1: PDSCH Reference Channel for FDD (QPSK)

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| Channel bandwidth | MHz | 50 | 100 | 200 |
| Subcarrier spacing configuration  |  | 2 | 2 | 2 |
| Allocated resource blocks |  | 66 | 132 | 264 |
| Subcarriers per resource block |  | 12 | 12 | 12 |
| Allocated slots per Frame (NOTE 7) |  | 23 /24 | 23 / 24 | 23 / 24 |
| MCS index |  | 4 | 4 | 4 |
| Modulation |  | QPSK | QPSK | QPSK |
| Target Coding Rate |  | 1/3 | 1/3 | 1/3 |
| Maximum number of HARQ transmissions |  | 1 | 1 | 1 |
| Information Bit Payload per Slot |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 5) = {3,4} for i from {0,…,79} (NOTE 5) | Bits | N/A | N/A | N/A |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,79} (NOTE 6) | Bits | 4224 | 8456 | 16896 |
| Transport block CRC | Bits | 24 | 24 | 24 |
| LDPC base graph |  | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 5) = {3,4} for i from {0,…,79} (NOTE 5) | CBs | N/A | N/A | N/A |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,79} (NOTE 6) | CBs | 1 | 2 | 3 |
| Binary Channel Bits Per Slot |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 5) = {3,4} for i from {0,…,79} (NOTE 5) | Bits | N/A | N/A | N/A |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,79} (NOTE 6) | Bits | 14256 | 28512 | 57024 |
| Max. Throughput averaged over 1 frame (NOTE 8) | Mbps | TBD | TBD | TBD |
| NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.3.1-1.NOTE 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).NOTE 3: SS/PBCH block is transmitted in slot 0 with periodicity 20 msNOTE 4: Slot i is slot index per 2 framesNOTE 5: When this DL RMC used together with the UL RMC for the transmitter requirements requiring at least one sub frame (1ms) for the measurement period, Slot i, if mod(i, 8) = {3,4,5,6,7} for i from {0,…,79} together with the TDD UL-DL configuration specified in A2.3.NOTE 6: When this DL RMC used together with the UL RMC for the transmitter requirements requiring at least one sub frame (1ms) for the measurement period, Slot i, if mod(i, 8) = {0,1,2} for i from {0,…,79} together with the TDD UL-DL configuration specified in A2.3.NOTE 7: First number corresponds to the number slots allocated in the first frame of the RMC; second number corresponds to the number slots allocated in the second frame of the RMC.NOTE 8: Throughput is averaged over 2nd frame of RMC. |

Table A.3.2.1.2-2: PDSCH Reference Channel for FDD (16/64QAM)

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| Channel bandwidth | MHz | 50 | 100 | 200 |
| Subcarrier spacing configuration  |  | 2 | 2 | 2 |
| Allocated resource blocks |  | 66 | 132 | 264 |
| Subcarriers per resource block |  | 12 | 12 | 12 |
| Allocated slots per Frame (NOTE 6) |  | 23 / 24 | 23 / 24 | 23 / 24 |
| MCS index |  |  |  |  |
| Modulation |  |  |  |  |
| Target Coding Rate |  |  |  |  |
| Maximum number of HARQ transmissions |  |  |  |  |
| Information Bit Payload per Slot |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 5) = {3,4} for i from {0,…,79} | Bits |  |  |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,79} | Bits |  |  |  |
| Transport block CRC | Bits |  |  |  |
| LDPC base graph |  |  |  |  |
| Number of Code Blocks per Slot |  |  |  |  |
| For Slot i, if mod(i, 10) = {0,1,2} for i from {1,…,79} | CBs |  |  |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,79} | CBs |  |  |  |
| Binary Channel Bits Per Slot |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 5) = {3,4} for i from {0,…,79} | Bits |  |  |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,79} | Bits |  |  |  |
| Max. Throughput averaged over 1 frame (NOTE 7) | Mbps |  |  |  |
| NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.3.1-1.NOTE 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).NOTE 3: SS/PBCH block is transmitted in slot 0 with periodicity 20 msNOTE 4: Slot i is slot index per 2 framesNOTE 5: PTRS is configured on symbols containing PDSCH with 1 port, per 2PRB in frequency domain, per symbol in time domain. Overhead for TBS calculation is assumed to be 6.NOTE 6: First number corresponds to the number slots allocated in the first frame of the RMC; second number corresponds to the number slots allocated in the second frame of the RMC.NOTE 7: Throughput is averaged over 2nd frame of RMC |

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#### A.3.2.1.3 Reference measurement channels for SCS 120 kHz FR2-NTN

[Table A.3.2.1.3-1: PDSCH Reference Channel for FDD (QPSK)

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| Channel bandwidth | MHz | 50 | 100 | 200 | 400 |
| Subcarrier spacing configuration  |  | 3 | 3 | 3 | 3 |
| Allocated resource blocks |  | 32 | 66 | 132 | 264 |
| Subcarriers per resource block |  | 12 | 12 | 12 | 12 |
| Allocated slots per Frame (NOTE 7) |  | 47 / 48 | 47 / 48 | 47 / 48 | 47 / 48 |
| MCS index |  | 4 | 4 | 4 | 4 |
| Modulation |  | QPSK | QPSK | QPSK | QPSK |
| Target Coding Rate |  | 1/3 | 1/3 | 1/3 | 1/3 |
| Maximum number of HARQ transmissions |  | 1 | 1 | 1 | 1 |
| Information Bit Payload per Slot |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 5) = {3,4} for i from {0,…,159} (NOTE 5) | Bits | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159} (NOTE 6) | Bits | 2088 | 4224 | 8456 | 16896 |
| Transport block CRC | Bits | 16 | 24 | 24 | 24 |
| LDPC base graph |  | 2 | 1 | 1 | 1 |
| Number of Code Blocks per Slot |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 5) = {3,4} for i from {0,…,159} (NOTE 5) | CBs | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159} (NOTE 6) | CBs | 1 | 1 | 2 | 3 |
| Binary Channel Bits Per Slot |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 5) = {3,4} for i from {0,…,159} (NOTE 5) | Bits | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159} (NOTE 6) | Bits | 6912 | 14256 | 28512 | 57024 |
| Max. Throughput averaged over 1 frame (NOTE 8) | Mbps | TBD | TBD | TBD | TBD |
| NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.3.1-1.NOTE 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).NOTE 3: SS/PBCH block is transmitted in slot 0 with periodicity 20 msNOTE 4: Slot i is slot index per 2 framesNOTE 5: When this DL RMC used together with the UL RMC for the transmitter requirements requiring at least one sub frame (1ms) for the measurement period, Slot i, if mod(i, 16) = {7,…,15} for i from {0,…,159} together with the TDD UL-DL configuration specified in A2.3.NOTE 6: When this DL RMC used together with the UL RMC for the transmitter requirements requiring at least one sub frame (1ms) for the measurement period, Slot i, if mod(i, 16) = {0,…,6} for i from {0,…,159} together with the TDD UL-DL configuration specified in A2.3.NOTE 7: First number corresponds to the number slots allocated in the first frame of the RMC; second number corresponds to the number slots allocated in the second frame of the RMC.NOTE 8: Throughput is averaged over 2nd frame of RMC. |

Table A.3.2.1.3-2: PDSCH Reference Channel for FDD (16/64QAM)

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| Channel bandwidth | MHz | 50 | 100 | 200 | 400 |
| Subcarrier spacing configuration  |  | 3 | 3 | 3 | 3 |
| Allocated resource blocks |  | 32 | 66 | 132 | 264 |
| Subcarriers per resource block |  | 12 | 12 | 12 | 12 |
| Allocated slots per Frame (NOTE 6) |  |  |  |  |  |
| MCS index |  |  |  |  |  |
| Modulation |  |  |  |  |  |
| Target Coding Rate |  |  |  |  |  |
| Maximum number of HARQ transmissions |  |  |  |  |  |
| Information Bit Payload per Slot |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 5) = {3,4} for i from {0,…,159} | Bits |  |  |  |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159} | Bits |  |  |  |  |
| Transport block CRC | Bits |  |  |  |  |
| LDPC base graph |  |  |  |  |  |
| Number of Code Blocks per Slot |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 5) = {3,4} for i from {0,…,159} | CBs |  |  |  |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159} | CBs |  |  |  |  |
| Binary Channel Bits Per Slot |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 5) = {3,4} for i from {0,…,159} | Bits |  |  |  |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159} | Bits |  |  |  |  |
| Max. Throughput averaged over 1 frame (NOTE 7) | Mbps |  |  |  |  |
| NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.3.1-1.NOTE 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).NOTE 3: SS/PBCH block is transmitted in slot 0 of each frameNOTE 4: Slot i is slot index per frameNOTE 5: PTRS is configured on symbols containing PDSCH with 1 port, per 2PRB in frequency domain, per symbol in time domain. Overhead for TBS calculation is assumed to be 6.NOTE 6: First number corresponds to the number slots allocated in the first frame of the RMC; second number corresponds to the number slots allocated in the second frame of the RMC.NOTE 7: Throughput is averaged over 2nd frame of RMC. |

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## *<End of Change 6>*

## *<Start of Change 7>*

Annex D Antenna modelling for NTN VSAT

[To be updated]

## *<End of Change 7>*