**3GPP TSG- Meeting # *R4-2412298***

**, –**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *CR-Form-v12.3* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  |  | **CR** | **0085** | **rev** |  | **Current version:** |  |  |
|  | | | | | | | | |
| *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)*.* | | | | | | | | |
|  | | | | | | | | |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network | **x** | Core Network |  |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | | | | | | | | |
| ***Title:*** |  | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** |  | | | | | | | | | |
| ***Source to TSG:*** |  | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** |  | | | | |  | ***Date:*** | | |  |
|  |  | | | |  | |  | | |  |
| ***Category:*** |  |  | | | | | ***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:*** | | In RAN4#111 meeting, companies agree to use “FRx-NTN” for NR NTN FRC table to differenciate NTN deployment bands, and also differenciate from different deployment scenarios to avoid misunderstanding of FRC table naming, such as TN and NTN deployment. In Rel-18 specifications, FR2-NTN demodulation part have been updated and it is reasonable to update RF part (reference sensitivity, dynamic range and ICS) as well. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | * Change “FR1” to “FR1-NTN” in all statements and tables. * Correct some editorial errors and adjust table format. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | It will not be aligned between RF and Demod part in same specifications and it would cause misunderstanding for TE vendors to implement FRC tables. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 7.2, 7.3, 7.8, 9.6, 9.7, 10.3, 10.4, 10.9, A.1, A.2, B.5 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **x** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | | **x** |  | Test specifications | | | | TS38.181 | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | | Revised from R4-2412298. | | | | | | | | |

################## Start of Change #1 ######################

# 7 Conducted receiver characteristics

## 7.1 General

Conducted receiver characteristics are specified at the *TAB connector* for *SAN type 1-H*, with full complement of transceivers for the configuration in normal operating condition.

Unless otherwise stated, the following arrangements apply for conducted receiver characteristics requirements in clause 7:

- Requirements shall be met for any transmitter setting.

- The requirements shall be met with the transmitter unit(s) ON.

- Throughput requirements do not assume HARQ retransmissions.

- When SAN is configured to receive multiple carriers, all the throughput requirements are applicable for each received carrier.

- For ACS and blocking characteristics, the negative offsets of the interfering signal apply relative to the lower *SAN RF Bandwidth* edge or *sub-block* edge inside a *sub-block gap*, and the positive offsets of the interfering signal apply relative to the upper *SAN RF Bandwidth* edge or *sub-block* edge inside a *sub-block gap*.

NOTE: In normal operating condition the SAN is configured to transmit and receive at the same time.

## 7.2 Reference sensitivity level

### 7.2.1 General

The reference sensitivity power level PREFSENS is the minimum mean power received at the *TAB connector* for *SAN type 1-H* at which a throughput requirement shall be met for a specified reference measurement channel.

### 7.2.2 Minimum requirements for *SAN type 1-H*

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel as specified in annex A.1 with parameters specified in table 7.2.2-1 and 7.2.2-2 for *SAN type 1-H* in all operating band in FR1-NTN.

Table 7.2.2-1: SAN GEO class reference sensitivity levels

|  |  |  |  |
| --- | --- | --- | --- |
| SAN channel bandwidth (MHz) | Sub-carrier spacing (kHz) | Reference measurement channel  (NOTE) | Reference sensitivity power level, PREFSENS  (dBm) |
| 5, 10, 15 | 15 | G-FR1-NTN-A1-1 | -99.3 |
| 10, 15 | 30 | G-FR1-NTN-A1-2 | -99.4 |
| 10, 15 | 60 | G-FR1-NTN-A1-3 | -96.5 |
| 20 | 15 | G-FR1-NTN-A1-4 | -92.9 |
| 20 | 30 | G-FR1-NTN-A1-5 | -93.2 |
| 20 | 60 | G-FR1-NTN-A1-6 | -93.3 |
| NOTE: PREFSENS is the power level of a single instance of the reference measurement channel. This requirement shall be met for each consecutive application of a single instance of the reference measurement channel mapped to disjoint frequency ranges with a width corresponding to the number of resource blocks of the reference measurement channel each, except for one instance that might overlap one other instance to cover the full *SAN channel bandwidth*. | | | |

Table 7.2.2-2: SAN LEO class reference sensitivity levels

|  |  |  |  |
| --- | --- | --- | --- |
| SAN channel bandwidth (MHz) | Sub-carrier spacing (kHz) | Reference measurement channel  (NOTE) | Reference sensitivity power level, PREFSENS  (dBm) |
| 5, 10, 15 | 15 | G-FR1-NTN-A1-1 | -102.4 |
| 10, 15 | 30 | G-FR1-NTN-A1-2 | -102.5 |
| 10, 15 | 60 | G-FR1-NTN-A1-3 | -99.6 |
| 20 | 15 | G-FR1-NTN-A1-4 | -96.0 |
| 20 | 30 | G-FR1-NTN-A1-5 | -96.3 |
| 20 | 60 | G-FR1-NTN-A1-6 | -96.4 |
| NOTE: PREFSENS is the power level of a single instance of the reference measurement channel. This requirement shall be met for each consecutive application of a single instance of the reference measurement channel mapped to disjoint frequency ranges with a width corresponding to the number of resource blocks of the reference measurement channel each, except for one instance that might overlap one other instance to cover the full *SAN channel bandwidth*. | | | |

## 7.3 Dynamic range

### 7.3.1 General

The dynamic range is specified as a measure of the capability of the receiver to receive a wanted signal in the presence of an interfering signal at the *TAB connector* for *SAN type 1-H* inside the received SAN channel bandwidth. In this condition, a throughput requirement shall be met for a specified reference measurement channel. The interfering signal for the dynamic range requirement is an AWGN signal.

### 7.3.2 Minimum requirements for *SAN type 1-H*

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel as specified in annex A.2 with parameters specified in table 7.3.2-1 for LEO.

Table 7.3.2-1: SAN LEO class dynamic range

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| SAN channel bandwidth (MHz) | Subcarrier spacing (kHz) | Reference measurement channel | Wanted signal mean power (dBm) | Interfering signal mean power (dBm) / BWConfig | Type of interfering signal |
| 5 | 15 | G-FR1-NTN-A2-1 | -76.4 | -88.2 | AWGN |
|  | 30 | G-FR1-NTN-A2-2 | -77.1 |  |  |
| 10 | 15 | G-FR1-NTN-A2-1 | -76.4 | -85.0 | AWGN |
|  | 30 | G-FR1-NTN-A2-2 | -77.1 |  |  |
|  | 60 | G-FR1-NTN-A2-3 | -74.1 |  |  |
| 15 | 15 | G-FR1-NTN-A2-1 | -76.4 | -83.2 | AWGN |
|  | 30 | G-FR1-NTN-A2-2 | -77.1 |  |  |
|  | 60 | G-FR1-NTN-A2-3 | -74.1 |  |  |
| 20 | 15 | G-FR1-NTN-A2-4 | -70.2 | -81.9 | AWGN |
|  | 30 | G-FR1-NTN-A2-5 | -70.2 |  |  |
|  | 60 | G-FR1-NTN-A2-6 | -70.5 |  |  |
| NOTE: The wanted signal mean power is the power level of a single instance of the corresponding reference measurement channel. This requirement shall be met for each consecutive application of a single instance of the reference measurement channel mapped to disjoint frequency ranges with a width corresponding to the number of resource blocks of the reference measurement channel each, except for one instance that might overlap one other instance to cover the full *SAN channel bandwidth*. | | | | | |

Omit unchanged text.

## 7.8 In-channel selectivity

### 7.8.1 General

In-channel selectivity (ICS) is a measure of the receiver ability to receive a wanted signal at its assigned resource block locations at *TAB connector* for *SAN type 1-H* in the presence of an interfering signal received at a larger power spectral density. In this condition a throughput requirement shall be met for a specified reference measurement channel. The interfering signal shall be an NR signal which is time aligned with the wanted signal.

### 7.8.2 Minimum requirements for *SAN type 1-H*

For *SAN type* *1-H*, the throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel as specified in annex A.1 with parameters specified in table 7.8.2-1 for GEO SAN, in table 7.8.2-2 for LEO SAN. The characteristics of the interfering signal is further specified in annex C.

Table 7.8.2-1: SAN GEO class ICS requirement

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *SAN channel bandwidth* (MHz) | Subcarrier spacing (kHz) | Reference measurement channel | Wanted signal mean power (dBm) | Interfering signal mean power (dBm) | Type of interfering signal |
| 5 | 15 | G-FR1-NTN-A1-7 | -98.2 | -92.0 | DFT-s-OFDM NR signal, 15 kHz SCS,  10 RBs |
| 10,15,20 | 15 | G-FR1-NTN-A1-1 | -96.3 | -88.1 | DFT-s-OFDM NR signal, 15 kHz SCS,  25 RBs |
| 5 | 30 | G-FR1-NTN-A1-8 | -98.9 | -92.0 | DFT-s-OFDM NR signal, 30 kHz SCS,  5 RBs |
| 10,15,20 | 30 | G-FR1-NTN-A1-2 | -96.4 | -89.0 | DFT-s-OFDM NR signal, 30 kHz SCS,  10 RBs |
| 10,15,20 | 60 | G-FR1-NTN-A1-9 | -95.8 | -89.0 | DFT-s-OFDM NR signal, 60 kHz SCS,  5 RBs |
| NOTE: Wanted and interfering signal are placed adjacently around Fc, where the Fc is defined for *SAN channel bandwidth* ofthe wanted signalaccording to the table 5.4.2.2-1. The aggregated wanted and interferer signal shall be centred in the *SAN channel bandwidth* of the wanted signal. | | | | | |

Table 7.8.2-2: SAN LEO class ICS requirement

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *SAN channel bandwidth* (MHz) | Subcarrier spacing (kHz) | Reference measurement channel | Wanted signal mean power (dBm) | Interfering signal mean power (dBm) | Type of interfering signal |
| 5 | 15 | G-FR1-NTN-A1-7 | -101.3 | -83.1 | DFT-s-OFDM NR signal, 15 kHz SCS,  10 RBs |
| 10,15,20 | 15 | G-FR1-NTN-A1-1 | -99.4 | -79.2 | DFT-s-OFDM NR signal, 15 kHz SCS,  25 RBs |
| 5 | 30 | G-FR1-NTN-A1-8 | -102.0 | -83.1 | DFT-s-OFDM NR signal, 30 kHz SCS,  5 RBs |
| 10,15,20 | 30 | G-FR1-NTN-A1-2 | -99.5 | -80.1 | DFT-s-OFDM NR signal, 30 kHz SCS,  10 RBs |
| 10,15,20 | 60 | G-FR1-NTN-A1-9 | -98.9 | -80.1 | DFT-s-OFDM NR signal, 60 kHz SCS,  5 RBs |
| NOTE: Wanted and interfering signal are placed adjacently around Fc, where the Fc is defined for *SAN channel bandwidth* ofthe wanted signalaccording to the table 5.4.2.2-1. The aggregated wanted and interferer signal shall be centred in the *SAN channel bandwidth* of the wanted signal. | | | | | |

################## End of Change #1 ######################

################## Start of Change #2 ######################

### 9.6.2 OTA modulation quality

#### 9.6.2.1 General

Modulation quality is defined by the difference between the measured carrier signal and an ideal signal. Modulation quality can e.g. be expressed as Error Vector Magnitude (EVM). Details about how the EVM is determined are specified in annex B for FR1-NTN.

OTA modulation quality requirement is defined as a *directional requirement* at the RIB and shall be met within the *OTA coverage range*.

#### 9.6.2.2 Minimum requirement for *SAN type 1-O*

For *SAN type 1-O*, the EVM levels of each carrier for different modulation schemes on PDSCH outlined in table 6.5.2.2-1 shall be met. Requirements shall be the same as clause 6.5.2.2 and follow EVM frame structure from clause 6.5.2.3.

Omit unchanged text.

### 9.7.4 OTA out-of-band emissions

#### 9.7.4.1 General

The OTA limits for out-of-band emissions are specified as TRP per RIB unless otherwise stated.

#### 9.7.4.2 Minimum requirement for *SAN type 1-O*

Out-of-band emissions in FR1-NTN are limited by OTA out-of-band emission limits. Unless otherwise stated, the out-of-band emission limits in FR1-NTN are defined from channel edge up to frequencies separated from the channel edge by 200% of the necessary bandwidth. The requirements shall apply whatever the type of transmitter considered and for all transmission modes foreseen by the manufacturer's specification. For a RIB operating in multi-carrier, the requirements apply to SAN channel bandwidths of the outermost carrier for the frequency ranges defined in clause 6.6.4.1.

The OTA out-of-band emissions requirement for SAN type 1-O shall not exceed each applicable limit in clause 6.6.4.2.

### 9.7.5 OTA transmitter spurious emissions

#### 9.7.5.1 General

Unless otherwise stated, all requirements are measured as mean power.

The OTA spurious emissions limits are specified as TRP per RIB unless otherwise stated.

#### 9.7.5.2 Minimum requirement for *SAN type 1-O*

##### 9.7.5.2.1 General

The OTA transmitter spurious emission limits for FR1-NTN shall apply from 30 MHz to the 5th harmonic of the upper frequency edge of the DL operating band, excluding the *SAN transponder bandwidth* BWSAN and the frequency range where the out-of-band emissions apply.

The requirements shall apply whatever the type of transmitter considered (single carrier or multi-carrier). It applies for all transmission modes foreseen by the manufacturer's specification.

##### 9.7.5.2.2 General OTA transmitter spurious emissions requirements

The *basic limits* of table 9.7.5.2.2-1 shall apply. The application of those limits shall be the same as for out-of-band emissionsin clause 6.6.4.

Table 9.7.5.2.2-1: General SAN transmitter spurious emission basic limits in FR1-NTN

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Spurious frequency range | Prated,t,TRP  (dBm) | Basic limit  (dBm) | Measurement bandwidth  (kHz) | Notes |
| 30 MHz – 5th harmonic of the upper frequency edge of the DL operating band | ≤ 47 | -13 | 4 | NOTE 1, NOTE 2, NOTE 3 |
|  | > 47 | Prated,t,TRP – 60dB |  |  |
| NOTE 1: *Measurement bandwidth*s as in ITU-R SM.329 [2], s4.1.  NOTE 2: Upper frequency as in ITU-R SM.329 [2], s2.5 table 1.  NOTE 3: The lower frequency limit is replaced by 0.7 times the waveguide cut-off frequency, according to ITU-R SM.329 [2], for systems having an integral antenna incorporating a waveguide section, or with an antenna connection in such form, and of unperturbed length equal to at least twice the cut-off. | | | | |

The transmitter spurious emissions minimum requirements for *SAN type 1-O* are that the power summation emissions at the *TAB connectors* shall not exceed the *basic limit* in table 9.7.5.2.2-1.

##### 9.7.5.2.3 Protection of the SAN receiver

The co-location requirement is not applicable for SAN in this version of the specification.

##### 9.7.5.2.4 Additional spurious emissions requirements

The additional spurious emissions requirement is not applicable for SAN.

################## End of Change #2 ######################

################## Start of Change #3 ######################

# 10 Radiated receiver characteristics

## 10.1 General

Radiated receiver characteristics are specified at RIB for *SAN type 1-H or* *SAN type 1-O*, with full complement of transceivers for the configuration in normal operating condition.

Unless otherwise stated, the following arrangements apply for the radiated receiver characteristics requirements in clause 10:

- Requirements shall be met for any transmitter setting.

- The requirements shall be met with the transmitter unit(s) ON.

- Throughput requirements defined for the radiated receiver characteristics do not assume HARQ retransmissions.

- When SAN is configured to receive multiple carriers, all the throughput requirements are applicable for each received carrier.

- For ACS and blocking characteristics, the negative offsets of the interfering signal apply relative to the lower *SAN RF Bandwidth* edge, and the positive offsets of the interfering signal apply relative to the upper *SAN RF Bandwidth* edge.

- Each requirement shall be met over the RoAoA specified.

NOTE 1: In normal operating condition the SAN in FDD operation is configured to transmit and receive at the same time.

For FR1-NTN requirements which are to be met over the *OTA REFSENS RoAoA* absolute requirement values are offset by the following term:

ΔOTAREFSENS = 44.1 - 10\*log10(BeWθ,REFSENS\*BeWφ,REFSENS) dB for the reference direction

and

ΔOTAREFSENS = 41.1 - 10\*log10(BeWθ,REFSENS\*BeWφ,REFSENS) dB for all other directions

For requirements which are to be met over the *minSENS RoAoA* absolute requirement values are offset by the following term:

ΔminSENS = PREFSENS – EISminSENS (dB)

## 10.2 OTA sensitivity

#### 10.2.1 General

The OTA sensitivity requirement is a *directional requirement* based upon the declaration of one or more *OTA sensitivity direction declarations* (OSDD), related to a *SAN type 1-H* and *SAN type 1-O* receiver.

The *SAN type 1-H* and *SAN type 1-O* may optionally be capable of redirecting/changing the *receiver target* by means of adjusting SAN settings resulting in multiple *sensitivity RoAoA*. The *sensitivity RoAoA* resulting from the current SAN settings is the active *sensitivity RoAoA*.

If the SAN is capable of redirecting the *receiver target* related to the OSDD then the OSDD shall include:

- *SAN channel bandwidth* and declared minimum EISlevel applicable to any active *sensitivity RoAoA* inside the *receiver target redirection range* in the OSDD.

- A declared *receiver target redirection range*, describing all the angles of arrival that can be addressed for the OSDD through alternative settings in the SAN.

- Five declared *sensitivity RoAoA* comprising the conformance testing directions as detailed in TS 38.181 [3].

- The *receiver target reference direction*.

NOTE 1: Some of the declared *sensitivity RoAoA* may coincide depending on the redirection capability.

NOTE 2: In addition to the declared *sensitivity RoAoA*, several *sensitivity RoAoA* may be implicitly defined by the *receiver target redirection range* without being explicitly declared in the OSDD.

If the SAN is not capable of redirecting the *receiver target* related to the OSDD, then the OSDD includes only:

- The set(s) of RAT, *SAN channel bandwidth* and declared minimum EISlevel applicable to the *sensitivity RoAoA* in the OSDD.

- One declared active *sensitivity RoAoA*.

- The *receiver target reference direction*.

NOTE 3: For SAN without target redirection capability, the declared (fixed) *sensitivity RoAoA* is always the active *sensitivity RoAoA*.

The OTA sensitivity EIS level declaration shall apply to each supported polarization, under the assumption of *polarization match*.

### 10.2.2 Minimum requirement for *SAN type 1-O*

For a received signal whose AoA of the incident wave is within the active *sensitivity RoAoA* of an OSDD, the error rate criterion as described in clause 7.2 shall be met when the level of the arriving signal is equal to the minimum EIS level in the respective declared set of EIS level and *SAN channel bandwidth*.

## 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 for a declared *OTA REFSENS RoAoA*. The OTA reference sensitivity power level EISREFSENS is the minimum mean power received at the RIB at which a reference performance requirement shall be met for a specified reference measurement channel.

The OTA REFSENS requirement shall apply to each supported polarization, under the assumption of *polarization match*.

### 10.3.2 Minimum requirement for *SAN type 1-O*

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel as specified in the corresponding table and annex A.1 when the OTA test signal is at the corresponding EISREFSENS level and arrives from any direction within the *OTA REFSENS RoAoA.*

Table 10.3.2-1: SAN GEO class reference sensitivity levels

|  |  |  |  |
| --- | --- | --- | --- |
| SAN channel bandwidth (MHz) | Sub-carrier spacing (kHz) | Reference measurement channel | OTA reference sensitivity level, EISREFSENS  (dBm) |
| 5, 10, 15 | 15 | G-FR1-NTN-A1-1 | -99.3 - ΔOTAREFSENS |
| 10, 15 | 30 | G-FR1-NTN-A1-2 | -99.4 - ΔOTAREFSENS |
| 10, 15 | 60 | G-FR1-NTN-A1-3 | -96.5 - ΔOTAREFSENS |
| 20 | 15 | G-FR1-NTN-A1-4 | -92.9 - ΔOTAREFSENS |
| 20 | 30 | G-FR1-NTN-A1-5 | -93.2 - ΔOTAREFSENS |
| 20 | 60 | G-FR1-NTN-A1-6 | -93.3 - ΔOTAREFSENS |
| NOTE: EISREFSENS is the power level of a single instance of the reference measurement channel. This requirement shall be met for each consecutive application of a single instance of the reference measurement channel mapped to disjoint frequency ranges with a width corresponding to the number of resource blocks of the reference measurement channel each, except for one instance that might overlap one other instance to cover the full *SAN channel bandwidth*. | | | |

Table 10.3.2-2: SAN LEO class reference sensitivity levels

|  |  |  |  |
| --- | --- | --- | --- |
| SAN channel bandwidth (MHz) | Sub-carrier spacing (kHz) | Reference measurement channel | OTA reference sensitivity level, EISREFSENS  (dBm) |
| 5, 10, 15 | 15 | G-FR1-NTN-A1-1 | -102.4 - ΔOTAREFSENS |
| 10, 15 | 30 | G-FR1-NTN-A1-2 | -102.5 - ΔOTAREFSENS |
| 10, 15 | 60 | G-FR1-NTN-A1-3 | -99.6 - ΔOTAREFSENS |
| 20 | 15 | G-FR1-NTN-A1-4 | -96.0 - ΔOTAREFSENS |
| 20 | 30 | G-FR1-NTN-A1-5 | -96.3 - ΔOTAREFSENS |
| 20 | 60 | G-FR1-NTN-A1-6 | -96.4 - ΔOTAREFSENS |
| NOTE: EISREFSENS is the power level of a single instance of the reference measurement channel. This requirement shall be met for each consecutive application of a single instance of the reference measurement channel mapped to disjoint frequency ranges with a width corresponding to the number of resource blocks of the reference measurement channel each, except for one instance that might overlap one other instance to cover the full *SAN channel bandwidth*. | | | |

## 10.4 OTA dynamic range

## 10.4.1 General

The OTA dynamic range is a measure of the capability of the receiver unit to receive a wanted signal in the presence of an interfering signal inside the received *SAN channel bandwidth*.

The requirement shall apply at the RIB when the AoA of the incident wave of a received signal and the interfering signal are from the same direction and are within the *OTA REFSENS RoAoA.*

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

### 10.4.2 Minimum requirement for *SAN type 1-O*

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel as specified in annex A.2 with parameters specified in table 10.4.2-1 for LEO SAN.

Table 10.4.2-1: SAN LEO class dynamic range

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| SAN channel bandwidth (MHz) | Subcarrier spacing (kHz) | Reference measurement channel | Wanted signal mean power (dBm) | Interfering signal mean power (dBm) / BWConfig | Type of interfering signal |
| 5 | 15 | G-FR1-NTN-A2-1 | -76.4 - ΔOTAREFSENS | -88.2 - ΔOTAREFSENS | AWGN |
|  | 30 | G-FR1-NTN-A2-2 | -77.1 - ΔOTAREFSENS |  |  |
| 10 | 15 | G-FR1-NTN-A2-1 | -76.4 - ΔOTAREFSENS | -85.0 - ΔOTAREFSENS | AWGN |
|  | 30 | G-FR1-NTN-A2-2 | -77.1 - ΔOTAREFSENS |  |  |
|  | 60 | G-FR1-NTN-A2-3 | -74.1- ΔOTAREFSENS |  |  |
| 15 | 15 | G-FR1-NTN-A2-1 | -76.4- ΔOTAREFSENS | -83.2 - ΔOTAREFSENS | AWGN |
|  | 30 | G-FR1-NTN-A2-2 | -77.1 - ΔOTAREFSENS |  |  |
|  | 60 | G-FR1-NTN-A2-3 | -74.1 - ΔOTAREFSENS |  |  |
| 20 | 15 | G-FR1-NTN-A2-4 | -70.2 – ΔOTAREFSENS | -81.9 – ΔOTAREFSENS | AWGN |
|  | 30 | G-FR1-NTN-A2-5 | -70.2 - ΔOTAREFSENS |  |  |
|  | 60 | G-FR1-NTN-A2-6 | -70.5 - ΔOTAREFSENS |  |  |
| NOTE: The wanted signal mean power is the power level of a single instance of the corresponding reference measurement channel. This requirement shall be met for each consecutive application of a single instance of the reference measurement channel mapped to disjoint frequency ranges with a width corresponding to the number of resource blocks of the reference measurement channel each, except for one instance that might overlap one other instance to cover the full *SAN channel bandwidth*. | | | | | |

Omit unchanged text.

### 10.5.1 OTA adjacent channel selectivity

#### 10.5.1.1 General

OTA Adjacent channel selectivity (ACS) is a measure of the receiver's ability to receive an OTA wanted signal at its assigned channel frequency in the presence of an OTA adjacent channel signal with a specified centre frequency offset of the interfering signal to the band edge of a victim system.

#### 10.5.1.2 Minimum requirement for *SAN type 1-O*

The requirement shall apply at the RIB when the AoA of the incident wave of a received signal and the interfering signal are from the same direction and are within the *minSENS RoAoA*.

The wanted and interfering signals apply to each supported polarization, under the assumption o*f polarization match*.

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel.

For FR1-NTN, the OTA wanted signal and the interfering signal are specified in table 10.5.1.2-1 and table 10.5.1.2-2 for OTA ACS. The reference measurement channel for the OTA wanted signal is further specified in annex A.1. The characteristic of the interfering signal is further specified in annex C.

The OTA ACS requirement is applicable outside the *SAN RF Bandwidth* or *Radio Bandwidth*. The OTA interfering signal offset is defined relative to the *SAN RF Bandwidth edges* or *Radio Bandwidth edges*.

Table 10.5.1.2-1: OTA ACS requirement for *SAN type 1-O*

|  |  |  |
| --- | --- | --- |
| SAN channel bandwidth of the lowest/highest carrier received (MHz) | Wanted signal mean power (dBm)  (NOTE 2) | Interfering signal mean power (dBm) |
| 5, 10, 15, 20 (NOTE 1) | EISminSENS + 6 dB | SAN LEO class: -60 – ΔminSENS  SAN GEO class: -57 – ΔminSENS |
| NOTE 1: The SCS for the *lowest/highest carrier* received is the lowest SCS supported by the SAN for that bandwidth  NOTE 2: EISminSENS depends on the *SAN channel bandwidth* | | |

Table 10.5.1.2-2: OTA ACS interferer frequency offset for *SAN type 1-O*

|  |  |  |
| --- | --- | --- |
| SAN channel bandwidth of the lowest/highest carrier received (MHz) | Interfering signal centre frequency offset from the lower/upper SAN RF Bandwidth edge or sub-block edge inside a sub-block gap (MHz) | Type of interfering signal |
| 5 | ±2.5025 | 5 MHz CP-OFDM NR signal,  15 kHz SCS, 25 RBs |
| 10 | ±2.5075 |
| 15 | ±2.5125 |
| 20 | ±2.5025 |

Omit unchanged text.

## 10.9 OTA in-channel selectivity

### 10.9.1 General

In-channel selectivity (ICS) is a measure of the receiver ability to receive a wanted signal at its assigned resource block locations in the presence of an interfering signal received at a larger power spectral density. In this condition a throughput requirement shall be met for a specified reference measurement channel. The interfering signal shall be an NR signal as specified in annex A.1 and shall be time aligned with the wanted signal.

### 10.9.2 Minimum requirement for *SAN type 1-O*

The requirement shall apply at the RIBwhen the AoA of the incident wave of the received signal and the interfering signal are the same direction and are within the *minSENS RoAoA*.

The wanted and interfering signals applies to each supported polarization, under the assumption of *polarization match.*

For a wanted and an interfering signal coupled to the RIB, the following requirements shall be met:

- For *SAN type 1-O*, the throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel as specified in annex A.1 with parameters specified in table 10.9.2-1 for GEO SAN, in table 10.9.2-2 for LEO SAN. The characteristics of the interfering signal is further specified in annex C.

Table 10.9.2-1: SAN GEO classICS requirement

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| SAN channel bandwidth (MHz) | Subcarrier spacing (kHz) | Reference measurement channel | Wanted signal mean power (dBm) | Interfering signal mean power (dBm) | Type of interfering signal |
| 5 | 15 | G-FR1-NTN-A1-7 | -98.2 - ΔminSENS | -92.0 - ΔminSENS | DFT-s-OFDM NR signal, 15 kHz SCS,  10 RBs |
| 10,15,20 | 15 | G-FR1-NTN-A1-1 | -96.3 - ΔminSENS | -88.1 - ΔminSENS | DFT-s-OFDM NR signal, 15 kHz SCS,  25 RBs |
| 5 | 30 | G-FR1-NTN-A1-8 | -98.9 - ΔminSENS | -92.0 - ΔminSENS | DFT-s-OFDM NR signal, 30 kHz SCS,  5 RBs |
| 10,15,20 | 30 | G-FR1-NTN-A1-2 | -96.4 - ΔminSENS | -89.0 - ΔminSENS | DFT-s-OFDM NR signal, 30 kHz SCS,  10 RBs |
| 10,15,20 | 60 | G-FR1-NTN-A1-9 | -95.8 - ΔminSENS | -89.0 - ΔminSENS | DFT-s-OFDM NR signal, 60 kHz SCS,  5 RBs |
| NOTE: Wanted and interfering signal are placed adjacently around Fc, where the Fc is defined for *SAN channel bandwidth* ofthe wanted signalaccording to the table 5.4.2.2-1. The aggregated wanted and interferer signal shall be centred in the *SAN channel bandwidth* of the wanted signal. | | | | | |

Table 10.9.2-2: SAN LEO class ICS requirement

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| SAN channel bandwidth (MHz) | Subcarrier spacing (kHz) | Reference measurement channel | Wanted signal mean power (dBm) | Interfering signal mean power (dBm) | Type of interfering signal |
| 5 | 15 | G-FR1-NTN-A1-7 | -101.3 - ΔminSENS | -83.1 - ΔminSENS | DFT-s-OFDM NR signal, 15 kHz SCS,  10 RBs |
| 10,15,20 | 15 | G-FR1-NTN-A1-1 | -99.4 - ΔminSENS | -79.2 - ΔminSENS | DFT-s-OFDM NR signal, 15 kHz SCS,  25 RBs |
| 5 | 30 | G-FR1-NTN-A1-8 | -102.0 - ΔminSENS | -83.1 - ΔminSENS | DFT-s-OFDM NR signal, 30 kHz SCS,  5 RBs |
| 10,15,20 | 30 | G-FR1-NTN-A1-2 | -99.5 - ΔminSENS | -80.1 - ΔminSENS | DFT-s-OFDM NR signal, 30 kHz SCS,  10 RBs |
| 10,15,20 | 60 | G-FR1-NTN-A1-9 | -98.9 - ΔminSENS | -80.1 - ΔminSENS | DFT-s-OFDM NR signal, 60 kHz SCS,  5 RBs |
| NOTE: Wanted and interfering signal are placed adjacently around Fc, where the Fc is defined for *SAN channel bandwidth* ofthe wanted signalaccording to the table 5.4.2.2-1. The aggregated wanted and interferer signal shall be centred in the *SAN channel bandwidth* of the wanted signal. | | | | | |

################## End of Change #3 ######################

################## Start of Change #4 ######################

Annex A (normative):  
Reference measurement channels

# A.1 Fixed Reference Channels for RF Rx requirements in FR1-NTN (QPSK, R=1/3)

The parameters for the reference measurement channels are specified in table A.1-1 for FR1-NTN reference sensitivity level, ACS, out-of-band blocking, in-channel selectivity, OTA sensitivity, OTA reference sensitivity level, OTA ACS, OTA out-of-band blocking and OTA in-channel selectivity.

The reference measurement channels for the dynamic range requirement are captured in annex A.2.

Table A.1-1: Fixed Reference Channels for SAN Rx requirements, FR1-NTN

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Reference channel | G-FR1-NTN-A1-1 | G-FR1-NTN-A1-2 | G-FR1-NTN-A1-3 | G-FR1-NTN-A1-4 | G-FR1-NTN-A1-5 | G-FR1-NTN-A1-6 | G-FR1-NTN-A1-7 | G-FR1-NTN-A1-8 | G-FR1-NTN-A1-9 |
| Subcarrier spacing (kHz) | 15 | 30 | 60 | 15 | 30 | 60 | 15 | 30 | 60 |
| Allocated resource blocks | 25 | 11 | 11 | 106 | 51 | 24 | 15 | 6 | 6 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Modulation | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK |
| Code rate (Note 2) | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 |
| Payload size (bits) | 2152 | 984 | 984 | 9224 | 4352 | 2088 | 1320 | 528 | 528 |
| Transport block CRC (bits) | 16 | 16 | 16 | 24 | 24 | 16 | 16 | 16 | 16 |
| Code block CRC size (bits) | - | - | - | 24 | - | - | - | - | - |
| Number of code blocks - C | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 |
| Code block size including CRC (bits) (Note 3) | 2168 | 1000 | 1000 | 4648 | 4376 | 2104 | 1336 | 544 | 544 |
| Total number of bits per slot | 7200 | 3168 | 3168 | 30528 | 14688 | 6912 | 4320 | 1728 | 1728 |
| Total symbols per slot | 3600 | 1584 | 1584 | 15264 | 7344 | 3456 | 2160 | 864 | 864 |
| NOTE 1: *UL-DMRS-config-type* = 1 with *UL-DMRS-max-len* = 1, *UL-DMRS-add-pos* = 1 with *l0*= 2, *l* = 11 as per table 6.4.1.1.3-3 of TS 38.211 [5].  NOTE 2: MCS index 4 and target coding rate = 308/1024 are adopted to calculate payload size for receiver sensitivity and in-channel selectivity.  NOTE 3: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [10]. | | | | | | | | | |

# A.2 Fixed Reference Channels for dynamic range (16QAM, R=2/3)

The parameters for the reference measurement channels are specified in table A.2-1 for FR1-NTN dynamic range and OTA dynamic range.

Table A.2-1: Fixed Reference Channels for dynamic range and OTA dynamic range, FR1-NTN

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Reference channel | G-FR1-NTN-A2-1 | G-FR1-NTN-A2-2 | G-FR1-NTN-A2-3 | G-FR1-NTN-A2-4 | G-FR1-NTN-A2-5 | G-FR1-NTN-A2-6 |
| Subcarrier spacing (kHz) | 15 | 30 | 60 | 15 | 30 | 60 |
| Allocated resource blocks | 25 | 11 | 11 | 106 | 51 | 24 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 | 12 | 12 | 12 | 12 |
| Modulation | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Code rate (Note 2) | 2/3 | 2/3 | 2/3 | 2/3 | 2/3 | 2/3 |
| Payload size (bits) | 9224 | 4032 | 4032 | 38936 | 18960 | 8968 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | - | - | 24 | 24 | 24 |
| Number of code blocks – C | 2 | 1 | 1 | 5 | 3 | 2 |
| Code block size including CRC (bits) (Note 3) | 4648 | 4056 | 4056 | 7816 | 6352 | 4520 |
| Total number of bits per slot | 14400 | 6336 | 6336 | 61056 | 29376 | 13824 |
| Total symbols per slot | 3600 | 1584 | 1584 | 15264 | 7344 | 3456 |
| NOTE 1: DM-RS configuration type = 1 with DM-RS duration = single-symbol DM-RS, additional DM-RS position = pos1 with *l0*= 2, *l* = 11 as per table 6.4.1.1.3-3 of TS 38.211 [5].  NOTE 2: MCS index 16 and target coding rate = 658/1024 are adopted to calculate payload size.  NOTE 3: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [10]. | | | | | | |

################## End of Change #4 ######################

################## Start of Change #5 ######################

# B.5 Estimation of time offset

## B.5.1 General

The observation period for determining the sample timing difference shall be 1 slot.

In the following  represents the middle sample of the EVM window of length *W* (defined in annex B.5.2) or the last sample of the first window half if *W* is even.

is estimated so that the EVM window of length *W* is centred on the measured cyclic prefix of the considered OFDM symbol. To minimize the estimation error the timing shall be based on demodulation reference signals. To limit time distortion of any transmit filter the reference signals in the 1 outer RBs are not taken into account in the timing estimation

Two values for  are determined:

 and

 where  if *W* is odd and  if *W* is even.

When the cyclic prefix length varies from symbol to symbol then *T* shall be further restricted to the subset of symbols with the considered modulation scheme being active and with the considered cyclic prefix length type.

## B.5.2 Window length

Table B.5.2-1, B.5.2-2, B.5.2-3 specify the EVM window length (*W*) for normal CP.

Table B.5.2-1: EVM window length for normal CP, FR1-NTN, 15 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel bandwidth (MHz) | FFT size | CP length for symbols 1‑6 and 8-13 in FFT samples | EVM window length *W* | Ratio of *W* to total CP length for symbols 1‑6 and 8-13 (Note) (%) |
| 5 | 512 | 36 | 14 | 40 |
| 10 | 1024 | 72 | 28 | 40 |
| 15 | 1536 | 108 | 44 | 40 |
| 20 | 2048 | 144 | 58 | 40 |
| NOTE: These percentages are informative and apply to a slot's symbols 1 to 6 and 8 to 13. Symbols 0 and 7 have a longer CP and therefore a lower percentage. | | | | |

Table B.5.2-2: EVM window length for normal CP, FR1-NTN, 30 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel bandwidth (MHz) | FFT size | CP length for symbols 1‑13 in FFT samples | EVM window length *W* | Ratio of *W* to total CP length for symbols 1‑13 (Note) (%) |
| 5 | 256 | 18 | 8 | 40 |
| 10 | 512 | 36 | 14 | 40 |
| 15 | 768 | 54 | 22 | 40 |
| 20 | 1024 | 72 | 28 | 40 |
| NOTE: These percentages are informative and apply to a slot's symbols 1 through 13. Symbol 0 has a longer CP and therefore a lower percentage. | | | | |

Table B.5.2-3: EVM window length for normal CP, FR1-NTN, 60 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel bandwidth (MHz) | FFT size | CP length in FFT samples | EVM window length *W* | Ratio of *W* to total CP length (Note) (%) |
| 10 | 256 | 18 | 8 | 40 |
| 15 | 384 | 27 | 11 | 40 |
| 20 | 512 | 36 | 14 | 40 |
| NOTE: These percentages are informative and apply to all OFDM symbols within subframe except for symbol 0 of slot 0 and slot 2. Symbol 0 of slot 0 and slot 2 may have a longer CP and therefore a lower percentage. | | | | |

Table B.5.2-4 below specifies the EVM window length (*W*) for extended CP. The number of CP samples excluded from the EVM window is the same as for normal CP length.

Table B.5.2-4: EVM window length for extended CP, FR1-NTN, 60 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel bandwidth (MHz) | FFT size | CP length in FFT samples | EVM window length *W* | Ratio of *W* to total CP length (Note) (%) |
| 10 | 256 | 64 | 54 | 84 |
| 15 | 384 | 96 | 80 | 83 |
| 20 | 512 | 128 | 106 | 83 |
| NOTE: These percentages are informative. | | | | |

################## End of Change #5 ######################