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| Technical Specification |
| 3rd Generation Partnership Project;Technical Specification Group Radio Access Network;NR;Satellite Access Node (SAN) conformance testing(Release 17) |
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| ***3GPP***Postal address3GPP support office address650 Route des Lucioles - Sophia AntipolisValbonne - FRANCETel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16Internethttp://www.3gpp.org |
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# Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

In drafting the TS/TR, pay particular attention to the use of modal auxiliary verbs! TRs shall not contain any normative provisions.

In the present document, modal verbs have the following meanings:

**shall** indicates a mandatory requirement to do something

**shall not** indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

**should** indicates a recommendation to do something

**should not** indicates a recommendation not to do something

**may** indicates permission to do something

**need not** indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

**can** indicates that something is possible

**cannot** indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

**will** indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**will not** indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**might** indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

**might not** indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

**is** (or any other verb in the indicative mood) indicates a statement of fact

**is not** (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

# 1 Scope

The present document specifies the Radio Frequency (RF) test methods and conformance requirements for NR operation in Satellite Access Node (SAN) type 1-H and type 1-O. these have been derived from and are consistent with the requirements for SAN type 1-H and SAN type 1-H in SAN specification defined in TS 38.108 [2].

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 38.108: “Satellite Access Node radio transmission and reception”

# 3 Definitions of terms, symbols and abbreviations

## 3.1 Terms

For the purposes of the present document, the terms given in 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 TR 21.905 [1].

## 3.2 Symbols

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

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

# 4 General test conditions and declarations

## 4.1 Measurement uncertainties and test requirements

## 4.2 Requirement reference point

## 4.3 Base station classes

## 4.4 Regional requirements

## 4.5 BS configurations

## 4.6 Manufacturer declarations

## 4.7 Test configurations

## 4.8 Applicability of requirements

## 4.9 RF channels and test models

## 4.10 co-location requirements

## 4.11 Reference coordinate system

## 4.12 Format and interpretation of tests

Each test has a standard format:

**X Title**

All tests are applicable to all equipment within the scope of the present document, unless otherwise stated.

**X.1 Definition and applicability**

This clause gives the general definition of the parameter under consideration and specifies whether the test is applicable to all equipment or only to a certain subset. Required manufacturer declarations may be included here.

**X.2 Minimum requirement**

This clause contains the reference to the clause to the 3GPP reference (or core) specification which defines the minimum requirement.

**X.3 Test purpose**

This clause defines the purpose of the test.

**X.4 Method of test**

**X.4.1 General**

In some cases there are alternative test procedures or initial conditions. In such cases, guidance for which initial conditions and test procedures can be applied are stated here. In the case only one test procedure is applicable, that is stated here.

**X.4.2 First test method**

**X.4.2.1 Initial conditions**

This clause defines the initial conditions for each test, including the test environment, the RF channels to be tested and the basic measurement set-up.

**X.4.2.2 Procedure**

This clause describes the steps necessary to perform the test and provides further details of the test definition like domain (e.g. frequency-span), range, weighting (e.g. bandwidth), and algorithms (e.g. averaging). The procedure may comprise data processing of the measurement result before comparison with the test requirement (e.g. average result from several measurement positions).

**X.4.2a Alternative test method (if any)**

If there are alternative test methods, each is described with its initial conditions and procedures.

**X.5 Test requirement**

This clause defines the pass/fail criteria for the equipment under test, see clause 4.1.3 (Interpretation of measurement results). Test requirements for every minimum requirement referred in clause X.2 are listed here. Cases where minimum requirements do not apply need not be mentioned.

# 5 Operating bands and channel arrangement

# 6 Conducted transmitter characteristics

## 6.1 General

## 6.2 Base station output power

## 6.3 Output power dynamics

## 6.4 Transmit ON/OFF power

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

## 6.5 Transmitted signal quality

6.5.3 Modulation quality

6.5.3.1 Definition and applicability

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). The Error Vector Magnitude is a measure of the difference between the ideal symbols and the measured symbols after the equalization. This difference is called the error vector.

For *SAN type 1-H* this requirement shall be applied at each *TAB connector* supporting transmission in the *operating band.*

6.5.3.2 Minimum Requirement

The minimum requirement is in TS 38.108 [x], clause 6.5.2.2.

6.5.3.3 Test purpose

The test purpose is to verify that modulation quality is within the limit specified by the minimum requirement.

6.5.3.4 Method of test

6.5.3.4.1 Initial conditions

Test environment: Normal; see annex B.2.

RF channels to be tested for single carrier: B, M and T; see clause 4.9.1.

RF bandwidth positions to be tested for multi-carrier:

- BRFBW, MRFBW and TRFBW in single-band operation, see clause 4.9.1.

6.5.3.4.2 Procedure

The minimum requirement is applied to all *TAB connectors*, they may be tested one at a time or multiple *TAB connectors* may be tested in parallel as shown in annex D.3.1 for *SAN type 1-H*. Whichever method is used the procedure is repeated until all *TAB connectors* necessary to demonstrate conformance have been tested.

1) For a *TAB connector* declared to be capable of single carrier operation only ([D.16]), set the *TAB connector* under test to transmit a signal according to the applicable test configuration in clause 4.8 using the corresponding test models:

- NR-FR1-TM3.1 if highest modulation order supported by SAN is 64QAM, or

- NR-FR1-TM3.2 if highest modulation order supported by SAN is 16QAM, or

- NR-FR1-TM3.3 if highest modulation order supported by SAN is QPSK.

 For *TAB connector* declared to be capable of multi-carrier operation, set the *TAB connector* under test to transmit according to the applicable test configuration and corresponding power setting specified in clauses 4.7 and 4.8 using the corresponding test models on all carriers configured:

- NR-FR1-TM3.1 if highest modulation order supported by SAN is 64QAM, or

- NR-FR1-TM3.2 if highest modulation order supported by SAN is 16QAM, or

- NR-FR1-TM3.3 if highest modulation order supported by SAN is QPSK.

For NR-FR1-TM3.1a and NR-FR1-TM3.1b, power back-off shall be applied if it is declared.

2) Measure the EVM and frequency error as defined in [annex H].

6.5.3.5 Test requirements

The EVM of each NR carrier for different modulation schemes on PDSCH shall be less than the limits in table 6.5.3.5-1.

**Table 6.5.3.5-1 EVM requirements for *SAN type 1-H carrier***

|  |  |
| --- | --- |
| **Modulation scheme for PDSCH** | **Required EVM** |
| QPSK | 17.5 % |
| 16QAM | 12.5 % |
| 64QAM (NOTE) | 8 % |
| NOTE: EVM requirement for 64QAM is optional. |

EVM shall be evaluated for each NR carrier over all allocated resource blocks and downlink slots. Different modulation schemes listed in table 6.5.3.5-1 shall be considered for rank 1.

For all bandwidths, the EVM measurement shall be performed for each NR carrier over all allocated resource blocks and downlink slots within 10 ms measurement periods. The boundaries of the EVM measurement periods need not be aligned with radio frame boundaries.

Table 6.5.3.5-2, 6.5.3.5-3, 6.5.3.5-4 below specify the EVM window length (*W*) for normal CP for *SAN type 1-H*.

**Table 6.5.3.5-2 EVM window length for normal CP for NR, FR1, 15 kHz SCS**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Channelbandwidth (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 6.5.3.5-3 EVM window length for normal CP for NR, FR1, 30 kHz SCS**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Channelbandwidth (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 6.5.3.5-4 EVM window length for normal CP for NR, FR1, 60 kHz SCS**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Channelbandwidth (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. |

## 6.6 Unwanted emissions

6.6.3 Adjacent Channel Leakage Power Ratio (ACLR)

6.6.3.1 Definition and applicability

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.

The requirements shall apply outside the Satellite Access Node RF Bandwidth or Radio Bandwidth whatever the type of transmitter considered (e.g. single carrier or multi-carrier) and for all transmission modes foreseen by the manufacturer's specification.

6.6.3.2 Minimum requirement

The minimum requirement applies per *single-band connector* supporting transmission in the *operating band*.

The minimum requirement for *SAN type 1-H* is defined in TS 38.108 [x], clause 6.6.3.4.

6.6.3.3 Test purpose

To verify that the adjacent channel leakage power ratio requirement shall be met as specified by the minimum requirement.

6.6.3.4 Method of test

6.6.3.4.1 Initial conditions

Test environment: Normal; see annex B.2.

RF channels to be tested for single carrier: B, M and T; see clause 4.9.1.

*Satellite Access Node RF Bandwidth* positions to be tested for multi-carrier:

- BRFBW, MRFBW and TRFBW in single-band operation; see clause 4.9.1.

6.6.3.4.2 Procedure

For *SAN type 1-H* where there may be multiple *TAB connectors*, they may be tested one at a time or multiple *TAB connectors* may be tested in parallel as shown in annex D.3.1 for *SAN type 1-H*. Whichever method is used the procedure is repeated until all *TAB connectors* necessary to demonstrate conformance have been tested.

1) Connect the *single-band connector* or *multi-band connector* under test to measurement equipment as shown in annex D.3.1 for *SAN type 1-H*. All connectors not under test shall be terminated.

 The measurement device characteristics shall be:

- Measurement filter bandwidth: defined in clause 6.6.3.5.

- Detection mode: true RMS voltage or true average power.

2) For a connectors declared to be capable of single carrier operation only ([D.16]), set the representative connectors under test to transmit according to the applicable test configuration in clause 4.8 using the corresponding test models NR-FR1‑TM 1.1 in clause 4.9.2 at *rated carrier output power* Prated,c,TABC for *SAN type 1-H* ([D.21]).

 For a connector under test declared to be capable of multi-carrier operation set the connector under test to transmit on all carriers configured using the applicable test configuration and corresponding power setting specified in clauses 4.7 and 4.8 using the corresponding test models or set of physical channels in clause 4.9.2.

3) Measure ACLR for the frequency offsets both side of channel frequency as specified in table 6.6.3.5.2‑1. In multiple carrier case only offset frequencies below the lowest and above the highest carrier frequency used shall be measured.

4) For the ACLR requirement applied inside sub-block gap for non-contiguous spectrum operation:

a) Measure ACLR inside sub-block gap or *Inter RF Bandwidth gap* as specified in clause 6.6.3.5.2, if applicable.

b) Measure CACLR inside sub-block gap or *Inter RF Bandwidth gap* as specified in clause 6.6.3.5.2, if applicable.

5) Repeat the test with the channel set-up according to NR-FR1-TM 1.2 in clause 4.9.2.

6.6.3.5 Test requirements

6.6.3.5.1 General requirements

The ACLR requirements in clause 6.6.3.5.2 shall apply as described in clauses 6.6.3.5.3 or 6.6.3.5.4.

6.6.3.5.2 Limits

The ACLR is defined with a square filter of bandwidth equal to the transmission bandwidth configuration of the transmitted signal (BWConfig) centred on the assigned channel frequency and a filter centred on the adjacent channel frequency according to the tables below.

The ACLR shall be higher than the value specified in Table 6.6.3.5.2-1/2.

**Table 6.6.3.5.2-1: SAN ACLR limit for GEO class**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SAN channel bandwidth of lowest/highest carrier transmitted BWChannel (MHz)** | **SAN adjacent channel centre frequency offset below the lowest or above the highest carrier centre frequency transmitted** | **Assumed adjacent channel carrier (informative)** | **Filter on the adjacent channel frequency and corresponding filter bandwidth** | **ACLR limit** |
| 5, 10, 15, 20 | BWChannel | NR of same BW (NOTE 2) | Square (BWConfig) (NOTE 1) | 14 |
|  | 2 x BWChannel | NR of same BW (NOTE 2) | Square (BWConfig) (NOTE 1) | 14 |
| NOTE 1: BWChannel and BWConfig are the *SAN channel bandwidth* and *transmission bandwidth configuration* of the *lowest/highest carrier* transmitted on the assigned channel frequency.NOTE 2: With SCS that provides largest transmission bandwidth configuration (BWConfig). |

**Table 6.6.3.5.2-2: SAN ACLR limit for LEO class**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SAN channel bandwidth of lowest/highest carrier transmitted BWChannel (MHz)** | **SAN adjacent channel centre frequency offset below the lowest or above the highest carrier centre frequency transmitted** | **Assumed adjacent channel carrier (informative)** | **Filter on the adjacent channel frequency and corresponding filter bandwidth** | **ACLR limit** |
| 5, 10, 15, 20 | BWChannel | NR of same BW (NOTE 2) | Square (BWConfig)(NOTE 1) | 24 |
|  | 2 x BWChannel | NR of same BW (NOTE 2) | Square (BWConfig) (NOTE 1) | 24 |
| NOTE 1: BWChannel and BWConfig are the *SAN channel bandwidth* and *transmission bandwidth configuration* of the *lowest/highest carrier* transmitted on the assigned channel frequency.NOTE 2: With SCS that provides largest transmission bandwidth configuration (BWConfig). |

6.6.3.5.3 *SAN type 1-H*

## 6.7 Transmitter intermodulation

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

# 7 Conducted receiver characteristics

## 7.1 General

## 7.2 Reference sensitivity level

## 7.3 Dynamic range

## 7.4 In-band sensitivity and blocking

## 7.5 Out-of-band blocking

## 7.6 Receiver spurious emission

## 7.7 Receiver intermodulation

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

## 7.8 In-channel selectivity

# 8 Conducted performance characteristics

## 8.1 General

## 8.2 Performance requirements for PUSCH

## 8.3 Performance requirements for PUCCH

## 8.4 Performance requirements for PRACH

# 9 Radiated transmitter characteristics

## 9.1 General

## 9.2 Radiated transmit power

## 9.3 OTA base station output power

## 9.4 OTA output power dynamics

## 9.5 OTA transmit ON/OFF power

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

## 9.6 OTA transmitted signal quality

## 9.7 OTA unwanted emissions

## 9.8 OTA transmitter intermodulation

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

# 10 Radiated receiver characteristic

## 10.1 General

## 10.2 OTA sensitivity

## 10.3 OTA reference sensitivity level

## 10.4 OTA dynamic range

## 10.5 OTA in-band selectivity and blocking

## 10.6 OTA out-of-band blocking

## 10.7 OTA receiver spurious emissions

## 10.8 OTA receiver intermodulation

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

# 11 Radiated performance requirements

## 11.1 General

## 11.2 OTA performance requirements for PUSCH

## 11.3 OTA performance requirements for PUCCH

## 11.4 OTA performance requirements for PRACH

Annex <A> (normative):
Reference measurement channel

# A.1 Fixed Reference Channels for RF Rx requirement (QPSK, R=1/3)

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

# A.3 Fixed Reference Channels for performance requirements

# A.4 PRACH test parameters

Annex B (informative):
Environmental requirements for the BS equipment

# B.1 General

# B.2 Normal test environment

# B.3 Extreme test environment

# B.4 Vibration

# B.5 Power supply

# B.6 Measurement of test environment

# B.7 OTA extreme test method

Annex C (informative):
Test tolerances and derivation of test requirements

# C.1 Measurement of transmitter

*<Editor’s note: measurement uncertainty can be captured in separate tables for FR1 and FR2 respectively>*

# C.2 Measurement of Receiver

*<Editor’s note: measurement uncertainty can be captured in separate tables for FR1 and FR2 respectively>*

# C.3 measurement of performance requirements

*<Editor’s note: measurement uncertainty can be captured in separate tables for FR1 and FR2 respectively>*

Annex D (informative):
Measurement system set-up

*<Editor’s note: Separate subsections can be used for FR1 and FR2 respectively>*

Annex E (normative):
Characteristic of interfering signal

*<Editor’s note: Separate subsections can be used for FR1 and FR2 respectively>*

Annex F (normative):
Calibration

Annex G (normative):
Propagation conditions

Annex H (normative):
In-channel Tx test

Annex I (normative):
Transmitter spatial emissions declaration

Annex J (normative):
TRP measurement procedures

Annex K (informative):
Measuring noise close to the noise-floor

Annex L (normative):
General rules for statistical testing

Annex M (informative):
Change history

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| --- |
| Change history |
| Date | Meeting | TDoc | CR | Rev | Cat | Subject/Comment | New version |
|  |  |  |  |  |  |  |  |