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TECHNICAL SPECIFICATION

**5G;
NR;
Satellite Access Node radio transmission and reception
(3GPP TS 38.108 version 17.13.0 Release 17)**

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Reference

RTS/TSGR-0438108vhd0

Keywords

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Foreword

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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.

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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.

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1 Scope

The present document establishes the minimum RF characteristics and minimum performance requirements of NR Satellite Access Node (SAN).

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] ITU-R Recommendation SM.329: "Unwanted emissions in the spurious domain".
- [3] 3GPP TS 38.181: "NR; Satellite Node conformance testing".
- [4] ITU-R Recommendation M.1545: "Measurement uncertainty as it applies to test limits for the terrestrial component of International Mobile Telecommunications-2000".
- [5] 3GPP TS 38.211: "NR; Physical channels and modulation".
- [6] 3GPP TS 38.331: "NR; Radio Resource Control (RRC); Protocol specification".
- [7] 3GPP TS 38.213: "NR; Physical layer procedures for control".
- [8] ITU-R Recommendation SM.328: "Spectra and bandwidth of emissions".
- [9] ITU-R Recommendation SM.1541-6: "Unwanted emissions in the out-of-band domain".
- [10] 3GPP TS 38.212: "NR; Multiplexing and channel coding".
- [11] 3GPP TS 38.101-5: "NR; User Equipment (UE) radio transmission and reception; Part 5: Satellite access Radio Frequency (RF) and performance requirements"
- [12] 3GPP TR 38.901: "Study on channel model for frequencies from 0.5 to 100 GHz"
- [13] 3GPP TR 38.811: "Study on New Radio (NR) to support non-terrestrial networks"

3 Definitions, symbols and abbreviations

3.1 Definitions

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].

basic limit: emissions limit relating to the power supplied by a single transmitter to a single antenna transmission line in ITU-R SM.329 [2] used for the formulation of unwanted emission requirements for FR1-NTN.

beam: beam (of the antenna) is the main lobe of the radiation pattern of an *antenna array*.

NOTE: For certain *antenna array*, there may be more than one beam.

beam centre direction: direction equal to the geometric centre of the half-power contour of the beam.

beam direction pair: data set consisting of the *beam centre direction* and the related *beam peak direction*.

beam peak direction: direction where the maximum EIRP is found.

beamwidth: beam which has a half-power contour that is essentially elliptical, the half-power beamwidths in the two pattern cuts that respectively contain the major and minor axis of the ellipse.

Channel edge: lowest or highest frequency of the NR carrier, separated by the *SAN channel bandwidth*.

directional requirement: requirement which is applied in a specific direction within the *OTA coverage range* for the Tx and when the AoA of the incident wave of a received signal is within the *OTA REFSENS RoAoA* or the *minSENS RoAoA* as appropriate for the receiver.

equivalent isotropic radiated power: equivalent power radiated from an isotropic directivity device producing the same field intensity at a point of observation as the field intensity radiated in the direction of the same point of observation by the discussed device.

NOTE: Isotropic directivity is equal in all directions (i.e. 0 dBi).

equivalent isotropic sensitivity: sensitivity for an isotropic directivity device equivalent to the sensitivity of the discussed device exposed to an incoming wave from a defined AoA.

NOTE 1: The sensitivity is the minimum received power level at which specific requirement is met.

NOTE 2: Isotropic directivity is equal in all directions (i.e. 0 dBi).

feeder link: Wireless link between satellite-gateway and satellite.

Geostationary Earth Orbit: Circular orbit at 35,786 km above the Earth's equator and following the direction of the Earth's rotation. An object in such an orbit has an orbital period equal to the Earth's rotational period and thus appears motionless, at a fixed position in the sky, to ground observers.

Low Earth Orbit: Orbit around the Earth with an altitude between 300 km, and 1500 km.

Highest Carrier: The carrier with the highest carrier frequency transmitted/received in a specified frequency band.

Lowest Carrier: The carrier with the lowest carrier frequency transmitted/received in a specified frequency band.

maximum carrier output power: mean power level measured per carrier at the indicated interface, during the *transmitter ON period* in a specified reference condition.

maximum carrier TRP output power: mean power level measured per RIB during the *transmitter ON period* for a specific carrier in a specified reference condition and corresponding to the declared *rated carrier TRP output power* ($P_{\text{rated,c,TRP}}$).

maximum total output power: mean power level measured within the *operating band* at the indicated interface, during the *transmitter ON period* in a specified reference condition.

maximum total TRP output power: mean power level measured per RIB during the *transmitter ON period* in a specified reference condition and corresponding to the declared *rated total TRP output power* ($P_{\text{rated,t,TRP}}$).

measurement bandwidth: RF bandwidth in which an emission level is specified.

minSENS: the lowest declared EIS value for the OSDD's declared for OTA sensitivity requirement.

minSENS RoAoA: The *reference RoAoA* associated with the OSDD with the lowest declared EIS.

minimum elevation angle: Minimum angle under which the satellite can be seen by a UE.

necessary bandwidth: The width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions.

non-terrestrial networks: Networks, or segments of networks, using an airborne or space-borne vehicle to embark a transmission equipment relay node or SAN.

operating band: frequency range in which NR operates (paired or unpaired), that is defined with a specific set of technical requirements.

NOTE: The *operating band(s)* for a SAN is declared by the manufacturer according to the designations in tables 5.2-1 and 5.2-2.

OTA coverage range: a common range of directions within which TX OTA requirements that are neither specified in the *OTA peak directions sets* nor as *TRP requirement* are intended to be met.

OTA peak directions set: set(s) of *beam peak directions* within which certain TX OTA requirements are intended to be met, where all *OTA peak directions set(s)* are subsets of the *OTA coverage range*.

NOTE: The *beam peak directions* are related to a corresponding contiguous range or discrete list of *beam centre directions* by the *beam direction pairs* included in the set.

OTA REFSENS RoAoA: the RoAoA determined by the contour defined by the points at which the achieved EIS is 3dB higher than the achieved EIS in the reference direction assuming that for any AoA, the receiver gain is optimized for that AoA.

NOTE: This contour will be related to the average element/sub-array radiation pattern 3dB beamwidth.

OTA sensitivity directions declaration: set of manufacturer declarations comprising at least one set of declared minimum EIS values (with *SAN channel bandwidth*), and related directions over which the EIS applies.

NOTE: All the directions apply to all the EIS values in an OSDD.

polarization match: condition that exists when a plane wave, incident upon an antenna from a given direction, has a polarization that is the same as the receiving polarization of the antenna in that direction.

radiated interface boundary: *operating band* specific radiated requirements reference where the radiated requirements apply.

NOTE: For requirements based on EIRP/EIS, the *radiated interface boundary* is associated to the far-field region.

Radio Bandwidth: frequency difference between the upper edge of the highest used carrier and the lower edge of the lowest used carrier.

rated beam EIRP: For a declared beam and *beam direction pair*, the *rated beam EIRP* level is the maximum power that the SAN is declared to radiate at the associated *beam peak direction* during the *transmitter ON period*.

rated carrier output power: mean power level associated with a particular carrier the manufacturer has declared to be available at the indicated interface, during the *transmitter ON period* in a specified reference condition.

rated carrier TRP output power: mean power level declared by the manufacturer per carrier, for SAN operating in single carrier, multi-carrier, or carrier aggregation configurations that the manufacturer has declared to be available at the RIB during the *transmitter ON period*.

rated total output power: mean power level associated with a particular *operating band* the manufacturer has declared to be available at the indicated interface, during the *transmitter ON period* in a specified reference condition.

rated total TRP output power: mean power level declared by the manufacturer, that the manufacturer has declared to be available at the RIB during the *transmitter ON period*.

reference beam direction pair: declared *beam direction pair*, including reference *beam centre direction* and reference *beam peak direction* where the reference *beam peak direction* is the direction for the intended maximum EIRP within the *OTA peak directions set*.

receiver target: AoA in which reception is performed by *SAN types I-H* or *SAN type I-O*.

receiver target redirection range: union of all the *sensitivity RoAoA* achievable through redirecting the *receiver target* related to particular OSDD.

receiver target reference direction: direction inside the *OTA sensitivity directions declaration* declared by the manufacturer for conformance testing. For an OSDD without *receiver target redirection range*, this is a direction inside the *sensitivity RoAoA*.

reference RoAoA: the *sensitivity RoAoA* associated with the *receiver target reference direction* for each OSDD.

requirement set: one of the NR SAN requirement's set as defined for *SAN type 1-H*, *SAN type 1-O*.

SAN channel bandwidth: RF bandwidth supporting a single NR RF carrier with the *transmission bandwidth* configured in the uplink or downlink.

NOTE 1: The *SAN channel bandwidth* is measured in MHz and is used as a reference for transmitter and receiver RF requirements.

NOTE 2: It is possible for the SAN to transmit to and/or receive from one or more satellite UE bandwidth parts that are smaller than or equal to the *SAN transmission bandwidth configuration*, in any part of the *SAN transmission bandwidth configuration*.

SAN RF Bandwidth: RF bandwidth in which a SAN transmits and/or receives single or multiple carrier(s) within a supported *operating band*.

NOTE: In single carrier operation, the *SAN RF Bandwidth* is equal to the *SAN channel bandwidth*.

SAN RF Bandwidth edge: frequency of one of the edges of the *SAN RF Bandwidth*.

SAN transmission bandwidth configuration: set of resource blocks located within the *SAN channel bandwidth* which may be used for transmitting or receiving by the SAN.

SAN type 1-H: Satellite Access Node operating at FR1-NTN with a requirement set consisting of conducted requirements defined at individual *TAB connectors* and OTA requirements defined at RIB.

SAN type 1-O: Satellite Access Node operating at FR1-NTN with a requirement set consisting only of OTA requirements defined at the RIB.

SAN total assigned bandwidth: Bandwidth of the total assigned band (frequencies range) as defined in SM.1541-6 [9].

SAN transponder bandwidth: Total bandwidth of the carrier(s) in operation by one SAN transponder.

NOTE: When the SAN transponder operates one carrier only, the SAN transponder bandwidth is equal to the SAN channel bandwidth of this carrier.

SAN transponder: part of the SAN permitting to receive, channelize and transmit signals within an allocated bandwidth.

satellite: A space-borne vehicle embarking a transparent payload, or a regenerative payload telecommunication transmitter, placed into Low-Earth Orbit (LEO) or Geostationary Earth Orbit (GEO).

Satellite Access Node: node providing NR user plane and control plane protocol terminations towards NTN satellite capable UE, and connected via the NG interface to the 5GC. It encompasses a transparent payload on board a NTN platform, with satellite-gateway and gNB functions.

satellite-gateway: An earth station or gateway is located at the surface of Earth, and providing sufficient RF power and RF sensitivity for accessing to the satellite.

sensitivity RoAoA: RoAoA within the *OTA sensitivity directions declaration*, within which the declared EIS(s) of an OSDD is intended to be achieved at any instance of time for a specific SAN direction setting.

TAB connector: *transceiver array boundary* connector.

total radiated power: is the total power radiated by the antenna.

NOTE: The *total radiated power* is the power radiating in all direction for two orthogonal polarizations. *Total radiated power* is defined in both the near-field region and the far-field region.

transceiver array boundary: conducted interface between the transceiver unit array and the composite antenna.