**3GPP TSG-RAN4 Meeting # 111 *R4-2409909***

**Fukuoka City, Fukuoka, Japan, May 20th – 24th 2024**

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| *CR-Form-v12.3* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.181** | **CR** | **0031** | **rev** | **-** | **Current version:** | **18.1.0** |  |
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| *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 | **x** | Core Network |  |

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| ***Title:*** | Big CR for 38.181 on NR NTN enhancement SAN demodualtion requirements | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Ericsson | | | | | | | | | |
| ***Source to TSG:*** | RAN4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_NTN\_enh-Perf | | | | |  | ***Date:*** | | | 2024-05-27 |
|  |  | | | |  | |  | | |  |
| ***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 can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)  Rel-20 (Release 20)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | The discussion on the Rel-18 NR NTN enhancement demodulation requirements have achieved good progress and most of open issues are settled. The draft CR R4-2409861, R4-2409864, R4-2409865, R4-2409870, R4-2409872 and R4-2410011 were endorsed in RAN4#111 meeting. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | R4-2410011:   * introducing MU, manufacturer declarations and applicability rules for NTN, update clause 4.1.2.4, 4.6, 11.   R4-2409861:   * Inclusion of PUSCH with DMRS bundling requirements in new clauses 8.2.5 and 11.2.5.   R4-2409872:   * Add PUSCH requirement with transform precoding disabled   + Update section of 11.2.1.2   + Update the Table 11.2.1.4.2-1 and Table 11.2.1.4.2-2 with adding SAN type 2-O test setup   + Add the new section of 11.2.1.6 for SAN type 2-O * Add PUSCH requirement with transform precoding enabled   + Update 11.2.2.2   + Update the Table 11.2.2.4.2-1 and Table 11.2.2.4.2-1 with adding SAN type 2-O test setup   + Add the new section of 11.2.2.6 for SAN type 2-O * Add PUSCH requirement wth repetition mapping type A   + Update 11.2.4.2   + Update the Table 11.2.4.4.2-1 and Table 11.2.4.4.2-1 with adding SAN type 2-O test setup   + Add the new section of 11.2.4.6 for SAN type 2-O   R4-2409870:   * introducing NTN OTA performance requirements for PUCCH, update clause 11.3   R4-2409864:   * To add NTN-TDLC5-1200 channel for time error tolerance requirement * To add AWGN power input for SAN type 2-O * To add test requirement for SAN type 2-O   R4-2409865:   * Add FRC tables for FR2-NTN   + MCS 2 with 1 layer for precoding disabled and enabled   + MCS 12 with 1 layer for precoding disabled   + MCS 5 (in table 3) for PUSCH repetition typa A * Add FRC table for FR1-NTN DM-RS bundling   + MCS 4 with 1 layer * Add PRACH preamble configurations. * Add Test tolerance and derivation of test requirements for FR1-NTN PUSCH with DM-RS bundling and FR2-NTN demodulaiton requirements * Add measurement system set-up for SAN-2O * Add propagation conditions for FR2-NTN * Add suffix “NTN” to frequency range abbservation “FR1” and “FR2” to “FR1-NTN” and “FR2-NTN”. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | There is no SAN demodulation requirements for FR2-NTN and FR1 PUSCH DM-RS bundling. | | | | | | | | |
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| ***Clauses affected:*** | | R4-2410011: 4.1.2.4, 4.6, 11  R4-2409861: 8.2.5, 11.2.5  R4-2409872: 11.2.1, 11.2.2, 11.2.4  R4-2409870: 11.3, New clause: 11.3.1.5.2, 11.3.2.1.5.2, 11.3.2.2.5.2, 11.3.3.1.5.2, 11.3.3.2.5.2, 11.3.4.5.2, 11.3.5.5.2.  R4-2409864: 11.4, 11.4.1.5.1 (new), 11.4.1.5.2 (new),  R4-2409865: A.3, A.3A, A.4, A.5 (new), A.6 (new), C3, G.2 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **x** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  | **x** | Test specifications | | | | TS/TR… CR … | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

################## Start of Change #1 R4-2410011 ######################

4.1.2.4 Measurement of performance requirements

**Table 4.1.2.4-1: Maximum Test System Uncertainty for FR1 conducted performance requirements**

| **Clause** | **Maximum Test System Uncertainty** | **Derivation of Test System Uncertainty** |
| --- | --- | --- |
| 8 PUSCH, PUCCH, PRACH with single antenna port and fading channel | ± 0.6 dB | Overall system uncertainty for fading conditions comprises two quantities:  1. Signal-to-noise ratio uncertainty  2. Fading profile power uncertainty  Items 1 and 2 are assumed to be uncorrelated so can be root sum squared:  Test System uncertainty = [SQRT (Signal-to-noise ratio uncertainty 2 + Fading profile power uncertainty 2)]  Signal-to-noise ratio uncertainty ±0.3 dB  Fading profile power uncertainty ±0.5 dB |
| 8 PRACH with single antenna port and AWGN | ± 0.3 dB | Signal-to-noise ratio uncertainty ±0.3 dB |

**Table 4.1.2.4-2: Maximum Test System Uncertainty for FR1 radiated performance requirements**

| **Clause** | **Maximum Test System Uncertainty** | **Derivation of Test System Uncertainty** |
| --- | --- | --- |
| 11 PUSCH, PUCCH, PRACH with single antenna port and fading channel | ± 0.6 dB | Overall system uncertainty for fading conditions comprises two quantities:  1. Signal-to-noise ratio uncertainty  2. Fading profile power uncertainty  Items 1 and 2 are assumed to be uncorrelated so can be root sum squared:  Test System uncertainty = [SQRT (Signal-to-noise ratio uncertainty 2 + Fading profile power uncertainty 2)]  Signal-to-noise ratio uncertainty ±0.3 dB  Fading profile power uncertainty ±0.5 dB |
| 11 PRACH with single antenna port and AWGN | ± 0.3 dB | Signal-to-noise ratio uncertainty ±0.3 dB |

**Table 4.1.2.4-3: Maximum Test System Uncertainty for FR2-NTN radiated performance requirements**

| **Clause** | **Maximum Test System Uncertainty** | **Derivation of Test System Uncertainty** |
| --- | --- | --- |
| 11 PUSCH, PUCCH, PRACH with single antenna port and fading channel | [± 0.6] dB | Overall system uncertainty for fading conditions comprises two quantities:  1. Signal-to-noise ratio uncertainty  2. Fading profile power uncertainty  Items 1 and 2 are assumed to be uncorrelated so can be root sum squared:  Test System uncertainty = [SQRT (Signal-to-noise ratio uncertainty 2 + Fading profile power uncertainty 2)]  Signal-to-noise ratio uncertainty ±0.3 dB  Fading profile power uncertainty ±0.5 dB |

################## End of Change #1 R4-2410011 ######################

################## Start of Change #2 R4-2410011 ######################

4.6 Manufacturer declarations

The following SAN declarations listed in table 4.6-1, when applicable to the SAN under test, are required to be provided by the manufacturer for the conducted requirements testing of the *SAN type 1-H*, and radiated requirements testing of *SAN type 1-H* and *SAN type 1-O* and *SAN type 2-O*.

**Table 4.6-1 Manufacturers declarations for *SAN type 1-H* conducted test requirements, and for *SAN type 1-H and SAN type 1-O* radiated test requirements**

| **Declaration identifier** | **Declaration** | **Description** | **Applicability**  **(Note 1)** | | |
| --- | --- | --- | --- | --- | --- |
| **SAN type 1-H**  **(Note 2)** | **SAN type 1-O** | **SAN type 2-O** |
| D.1 | Coordinate system reference point | Location of coordinated system reference point in reference to an identifiable physical feature of the SAN enclosure. | x | x |  |
| D.2 | Coordinate system orientation | Orientation of the coordinate system in reference to an identifiable physical feature of the SAN enclosure. | x | x |  |
| D.3 | Beam identifier | A unique title to identify a beam, e.g. a, b, c or 1, 2, 3. The vendor may declare any number of beams with unique identifiers. The minimum set to declare for conformance, corresponds to the beams at the reference beam direction with the highest intended EIRP, and covering the properties listed below:  1) A beam with the narrowest intended BeWθ and narrowest intended BeWϕ possible when narrowest intended BeWθ is used.  2) A beam with the narrowest intended BeWϕ and narrowest intended BeWθ possible when narrowest intended BeWϕ is used.  3) A beam with the widest intended BeWθ and widest intended BeWϕ possible when widest intended BeWθ is used.  4) A beam with the widest intended BeWϕ and widest intended BeWθ possible when widest intended BeWϕ is used.  5) A beam which provides the highest intended EIRP of all possible beams.  When selecting the above five beam widths for declaration, all beams that the SAN is intended to produce shall be considered, including beams that during operation may be identified by any kind of cell or UE specific reference signals, with the exception of any type of beam that is created from a group of transmitters that are not all phase synchronised.  (Note 3) | x | x |  |
| D.4 | *Operating bands* and frequency ranges | List of NR *operating band(s)* supported by the SAN and if applicable, frequency range(s) within the *operating band(s)* that the SAN can operate in.  Supported bands declared for every beam for *SAN type 1-O* (D.3), or every *TAB connector* for *SAN type 1-H*.  (Note 4) | c | x |  |
| D.5 | SAN requirements set | Declaration of one of the NR satellite access node *requirement*'*s set* as defined for *SAN type 1-H*, or *SAN type 1-O*. | c | x |  |
| D.6 | SAN class | Declared as GEO SAN, or LEO SAN. | c | x |  |
| D.7 | SAN channel band width and SCS support | SAN supported SCS and channel bandwidth per supported SCS. Declared for each beam for *SAN type 1-O* (D.3) or each *TAB connector* for *SAN type 1-H*, and each *operating band* (D.4). | c | x |  |
| D.8 | *OTA peak directions set* reference beam direction pair | The beam direction pair, describing the reference beam peak direction and the reference beam centre direction. Declared for every beam (D.3). | x | x |  |
| D.9 | OTA peak directions set | The OTA peak directions set for each beam. Declared for every beam (D.3). | x | x |  |
| D.10 | *OTA peak directions set* maximum steering direction(s) | The *beam direction pair(s)* corresponding to the following points:  1) The beam peak direction corresponding to the maximum steering from the reference beam centre direction in the positive Φ direction, while the θ value being the closest possible to the reference beam centre direction.  2) The beam peak direction corresponding to the maximum steering from the reference beam centre direction in the negative *Φ* direction, while the *θ value being the closest possible to the* reference beam centre direction*.*  3) The beam peak direction corresponding to the maximum steering from the reference beam centre direction in the positive *θ* direction, while the *Φ value being the closest possible to the* reference beam centre direction.  4) The beam peak direction corresponding to the maximum steering from the reference beam centre direction in the negative *θ* direction, while the *Φ value being the closest possible to the* reference beam centre direction*.*  The maximum steering direction(s) may coincide with *the reference beam centre direction*.  Declared for every beam (D.3). | x | x |  |
| D.11 | Rated beam EIRP (Prated,c,EIRP) | The rated EIRP level per carrier (Prated,c,EIRP) at the *beam peak direction* associated with a particular *beam direction pair* for each of the declared maximum steering directions (D.10), as well as the reference *beam direction pair* (D.8). Declared for every beam (D.3).  (Note 11) | x | x |  |
| D.12 | Beamwidth | The *beamwidth* for the reference *beam direction pair* and the four maximum steering directions. Declared for every beam (D.3). | x | x |  |
| D.13 | Equivalent beams | List of beams which are declared to be equivalent.  Equivalent beams imply that the beams are expected to have identical *OTA peak directions sets* and intended to have identical spatial properties at all steering directions within the *OTA peak directions set* when presented with identical signals. All declarations (D.4 – D.12) made for the beams are identical and the transmitter unit*,* RDN and antenna array responsible for generating the beam are of identical design. | x | x |  |
| D.14 | Parallel beams | List of beams which have been declared equivalent (D.13) and can be generated in parallel using independent RF power resources.  Independent power resources mean that the beams are transmitted from mutually exclusive transmitter units. | x | x |  |
| D.15 | Number of carriers at maximum TRP | The number of carriers per operating band the SAN is capable of generating at maximum TRP declared for every beam (D.3). | n/a | x |  |
| D.16 | Maximum Satellite Access Node RF Bandwidth | Maximum *Satellite Access Node RF Bandwidth* in the *operating band*, declared for each supported operating band for each beam for SAN type 1-O, or for each TAB connector for SAN type 1-H (D.4).  (Note 10) | c | x |  |
| D.17 | Total RF bandwidth (BWtot) | Total RF bandwidth BWtot of transmitter and receiver, declared per the band combinations (D.42). | c | x |  |
| D.18 | Contiguous spectrum operation support | Ability of SAN to support contiguous frequency distribution of carriers when operating multi-carrier in an operating band.  Declared for each *single-band RIB* for *SAN type 1-O* or each *single-band connector* for *SAN type 1-H*, for each *operating band*. | c | x |  |
| D.19 | OSDD identifier | A unique identifier for the OSDD. | x | x |  |
| D.20 | OSDD operating band support | Operating band supported by the OSDD, declared for every OSDD (D.19).  (Note 5) | x | x |  |
| D.21 | OTA sensitivity supported SAN channel bandwidth and SCS | The SANsupported SCS and channel bandwidth per supported SCS by each OSDD. | x | x |  |
| D.22 | Redirection of receiver target support | Ability to redirect the receiver target related to the OSDD. | x | x |  |
| D.23 | Minimum EIS for FR1 (EISminSENS) | The minimum EISminSENS requirement (i.e. maximum allowable EIS value) applicable to all sensitivity RoAoA per OSDD.  Declared per NR supported channel BW for the OSDD (D.19).  The lowest EIS value for all the declared OSDD's is called minSENS, while its related range of angles of arrival is called *minSENS RoAoA*.  (Note 6) | x | x |  |
| D.24 | Receiver target reference direction Sensitivity Range of Angle of Arrival | The sensitivity RoAoA associated with the receiver target reference direction (D.26) for each OSDD. | x | x |  |
| D.25 | Receiver target redirection range | For each OSDD the associated union of all the sensitivity RoAoA achievable through redirecting the receiver target related to the OSDD. | x | x |  |
| D.26 | Receiver target reference direction | For each OSDD an associated direction inside the receiver target redirection range (D.25).  (Note 7) | x | x |  |
| D.27 | Conformance test directions sensitivity RoAoA | For each OSDD that includes a receiver target redirection range, four sensitivity RoAoA comprising the conformance test directions (D.28). | x | x |  |
| D.28 | Conformance test directions | For each OSDD four conformance test directions.  If the OSDD includes a receiver target redirection range the following four directions shall be declared:  1) The direction determined by the maximum φ value achievable inside the receiver target redirection range, while θ value being the closest possible to the receiver target reference direction.  2) The direction determined by the minimum φ value achievable inside the receiver target redirection range, while θ value being the closest possible to the receiver target reference direction.  3) The direction determined by the maximum θ value achievable inside the receiver target redirection range, while φ value being the closest possible to the receiver target reference direction.  4) The direction determined by the minimum θ value achievable inside the receiver target redirection range, while φ value being the closest possible to the receiver target reference direction.  If an OSDD does not include a receiver target redirection range the following 4 directions shall be declared:  1) The direction determined by the maximum φ value achievable inside the sensitivity RoAoA, while θ value being the closest possible to the receiver target reference direction.  2) The direction determined by the minimum φ value achievable inside the sensitivity RoAoA, while θ value being the closest possible to the receiver target reference direction.  3) The direction determined by the maximum θ value achievable inside the sensitivity RoAoA, while φ value being the closest possible to the receiver target reference direction.  4) The direction determined by the minimum θ value achievable inside the sensitivity RoAoA, while φ value being the closest possible to the receiver target reference direction. | x | x |  |
| D.29 | OTA coverage range | Declared as a single range of directions within which selected TX OTA requirements are intended to be met.  (Note 8) | x | x |  |
| D.30 | *OTA coverage range* reference direction | The direction describing the reference direction of the *OTA converge range* (D.29).  (Note 9) | x | x |  |
| D.31 | OTA coverage range maximum directions | The directions corresponding to the following points:  1) The direction determined by the maximum φ value achievable inside the *OTA coverage range*, while θ value being the closest possible to the *OTA coverage range* reference direction.  2) The direction determined by the minimum φ value achievable inside the *OTA coverage range*, while θ value being the closest possible to the *OTA coverage range* reference direction.  3) The direction determined by the maximum θ value achievable inside the *OTA coverage range*, while φ value being the closest possible to the *OTA coverage range* reference direction.  4) The direction determined by the minimum θ value achievable inside the OTA coverage range, while φ value being the closest possible to the OTA coverage range reference direction. | x | x |  |
| D.32 | The rated carrier OTA SAN power, Prated,c,TRP | Prated,c,TRP is declared as TRP OTA power per carrier, declared per supported operating band.  (Note 11) | n/a | x |  |
| D.33 | Rated transmitter TRP, Prated,t,TRP | Rated total radiated output power*.*  Declared per supported *operating band*.  (Note 11) | n/a | x |  |
| D.34 | Rated carrier output power(Prated,c,TABC) | Conducted rated carrier output power, per *single band connector.*  Declared per supported *operating band*, per *TAB connector* for *SAN type 1-H*.  (Note 11) | c | n/a |  |
| D.35 | Rated total output power(Prated,t,TABC) | Conducted total rated output power*.*  Declared per supported *operating band*, per *TAB connector* for *SAN type 1-H.*  (Note 11) | c | n/a |  |
| D.36 | Single band connector | List of single-band connector for the supported operating bands (D.4). | c | n/a |  |
| D.37 | Equivalent connectors | List of *TAB connector* of *SAN type 1-H*, which have been declared equivalent.  Equivalent connectors imply that the *TAB connector* of *SAN type 1-H*, are expected to behave in the same way when presented with identical signals under the same operating conditions. All declarations made for the *TAB connector* of *SAN type 1-H* are identical and the transmitter unit and/or receiver unit driving *TAB connector* of *SAN type 1-H* are of identical design. | c | n/a |  |
| D.38 | Single-band RIB | List of single-band RIB for the supported operating bands (D.4). | n/a | x |  |
| D.39 | Single or multiple carrier | SAN capability to operate with a single carrier (only) or multiple carriers. Declared per supported *operating band*, per *RIB* for *SAN type 1-O* or per *TAB connector* for *SAN type 1-H*. | c | x |  |
| D.40 | Maximum number of supported carriers per *operating band* | Maximum number of supported carriers. Declared per supported *operating band*, per *RIB* for *SAN type 1-O* or per *TAB connector* for *SAN type 1-H*.  (Note 10) | c | x |  |
| D.41 | Maximum supported power difference between carriers | Maximum supported power difference between carriers in each supported *operating band*. Declared per *operating band* (D.4), per *RIB* for *SAN type 1-O* or per *TAB connector* for *SAN type 1-H*. | c | x |  |
| D.42 | Operating band combination support | List of *operating bands* combinations supported by *single-band RIB(s)* of *SAN type 1-O*, or *single-band connector*(s) of *SAN type 1-H*. | c | x |  |
| D.43 | OTA REFSENS RoAoA | Range of angles of arrival associated with the OTA REFSENS. | n/a | x |  |
| D.44 | OTA REFSENS receiver target reference direction | Reference direction inside the OTA REFSENS RoAoA (D.43). | n/a | x |  |
| D.45 | OTA REFSENS conformance test directions | The following four OTA REFSENS conformance test directions shall be declared:  1) The direction determined by the maximum φ value achievable inside the OTA REFSENS RoAoA, while θ value being the closest possible to the OTA REFSENS receiver target reference direction.  2) The direction determined by the minimum φ value achievable inside the OTA REFSENS RoAoA, while θ value being the closest possible to the OTA REFSENS receiver target reference direction.  3) The direction determined by the maximum θ value achievable inside the OTA REFSENS RoAoA, while φ value being the closest possible to the OTA REFSENS receiver target reference direction.  4) The direction determined by the minimum θ value achievable inside the OTA REFSENS RoAoA, while φ value being the closest possible to the OTA REFSENS receiver target reference direction. | n/a | x |  |
| D.46 | Relation between supported maximum RF bandwidth, number of carriers and Rated maximum TRP | If the rated transmitter TRP and total number of supported carriers are not simultaneously supported, the manufacturer shall declare the following additional parameters:  - The reduced number of supported carriers at the rated transmitter TRP;  - The reduced total output power at the maximum number of supported carriers. | n/a | x |  |
| D.47 | Relation between supported maximum RF bandwidth, number of carriers and Rated total output power | If the rated total output power and total number of supported carriers are not simultaneously supported, the manufacturer shall declare the following additional parameters:  - The reduced number of supported carriers at the rated total output power;  - The reduced total output power at the maximum number of supported carriers. | c | n/a |  |
| D.48 | *TAB connectors* used for performance requirement testing | To reduce test complexity, declaration of a representative (sub)set of *TAB connectors* to be used for performance requirement test purposes. At least one *TAB connector* mapped to each *demodulation branch* is declared. | c | n/a |  |
| D.49 | **Prated,c,sys,GEO** | The sum of Prated,c,TABC for all *TAB connectors* for a single carrier of the SAN GEO class. | c | n/a |  |
| D.50 | **Prated,c,TABC,GEO** | The *rated carrier output power per TAB connector* of the SAN GEO class*.* | c | n/a |  |
| D.51 | **Prated,c,sys,LEO** | The sum of Prated,c,TABC for all *TAB connectors* for a single carrier of the SAN LEO class. | c | n/a |  |
| D.52 | **Prated,c,TABC,LEO** | The *rated carrier output power per TAB connector* of the SAN LEO class*.* | c | n/a |  |
| D.100 | PUSCH mapping type | Declaration of the supported PUSCH mapping type as specified in TS 38.211 [8], i.e., type A, type B or both. | c | x | n/a |
| D.101 | PUCCH format | Declaration of the supported PUCCH format(s) as specified in TS 38.211 [8], i.e., format 0, format 1, format 2, format 3, format 4. | c | x | x |
| D.102 | PRACH format and SCS | Declaration of the supported PRACH format(s) as specified in TS 38.211 [8], i.e., format: 0, 2, B4, C2.  Declaration of the supported SCS(s) per supported PRACH format with short sequence, as specified in TS 38.211 [8], i.e.,  For *SAN type 1-O*: 15 kHz, 30 kHz or both.  For *SAN type 2-O*: 120kHz. | c | x | x |
| D.103 | Additional DM-RS for PUCCH format 3 | Declaration of the supported additional DM-RS for PUCCH format 3: without additional DM-RS, with additional DM-RS or both. | c | x | x |
| D.104 | Additional DM-RS for PUCCH format 4 | Declaration of the supported additional DM-RS for PUCCH format 4: without additional DM-RS, with additional DM-RS or both. | c | x | x |
| D.105 | PUCCH multi-slot | Declaration of multi-slot PUCCH support. | c | x | n/a |
| NOTE 1: Manufacturer declarations applicable per SAN *requirement set* were marked as "x" or "c". Manufacturer declarations not applicable per SAN *requirement set* were marked as "n/a".  NOTE 2: For *SAN type 1-H*, the only radiated declarations are related to EIRP and EIS requirements. For declarations marked as 'c', related conducted declarations apply, and for declarations marked as 'x', related radiated declarations apply.  NOTE 3: Depending on the capability of the system some of these beams may be the same. For those same beams, testing is not repeated.  NOTE 4: These *operating bands* are related to their respective single‑band RIBs, or single-band TAB connectors.  NOTE 5: As each identified OSDD has a declared minimum EIS value (D.23), multiple operating band can only be declared if they have the same minimum EIS declaration.  NOTE 6: If the *SAN type 1-H* or *SAN type 1-O* is not capable of redirecting the receiver target related to the OSDD then there is only one RoAoA applicable to the OSDD.  NOTE 7: For an OSDD without receiver target redirection range, this is a direction inside the sensitivity RoAoA.  NOTE 8: *OTA coverage range* is used for conformance testing of such TX OTA requirements as occupied bandwidth, frequency error or EVM.  NOTE 9: The *OTA coverage reference* direction may be the same as the Reference beam direction pair (D.8) but does not have to be.  NOTE 10: Parameters for contiguous spectrum operation in the operating band are assumed to be the same unless they are separately declared. When separately declared, they shall still use the same declaration identifier.  NOTE 11: If a SAN is capable of 64QAM DL operation then up to two rated output power declarations may be made. One declaration is applicable when configured for 64QAM transmissions, and the other declaration is applicable when not configured for 64QAM transmissions. | | | | | |

################## End of Change #2 R4-2410011 ######################

################## Start of Change #3 R4-2409861 ######################

### 8.2.4 Performance requirements for PUSCH repetition Type A

#### 8.2.4.1 Definition and applicability

The performance requirement of PUSCH with slot aggregation factor configured is determined by a minimum required throughput measured for a given SNR. The required throughput is expressed as a fraction of maximum throughput for the FRCs listed in annex A. The performance requirements assume HARQ re-transmissions.

Which specific test(s) are applicable to SAN is based on the test applicability rules defined in clause 8.1.2.

#### 8.2.4.2 Minimum Requirement

The minimum requirement is in TS 38.108 [2] clause 8.2.4.

#### 8.2.4.3 Test Purpose

The test shall verify the receiver's ability to achieve throughput measured with PUSCH repetition Type A under multipath fading propagation conditions for a given SNR.

#### 8.2.4.4 Method of test

##### 8.2.4.4.1 Initial Conditions

Test environment: Normal, see Annex B.2.

RF channels to be tested for single carrier: M; see clause 4.9.1.

##### 8.2.4.4.2 Procedure

1) Connect the SAN tester generating the wanted signal, multipath fading simulators and AWGN generators to all SAN TAB connectors for diversity reception via a combining network as shown in annex D.6 for *SAN type 1-H*.

2) Adjust the AWGN generator, according to the channel bandwidth, defined in table 8.2.4.4.2-1.

Table 8.2.4.4.2-1: AWGN power level at the SAN input

|  |  |  |
| --- | --- | --- |
| Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| 15 kHz | 5 | -86.5 dBm / 4.5MHz |
| 30 kHz | 10 | -83.6 dBm / 8.64MHz |
| NOTE: The AWGN power level contains an AWGN offset of 16dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 16dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level. | | |

3) The characteristics of the wanted signal shall be configured according to the corresponding UL reference measurement channel defined in annex A and the test parameters in table 8.2.4.4.2-2.

Table 8.2.4.4.2-2: Test parameters for testing PUSCH repetition Type A

|  |  |  |
| --- | --- | --- |
| Parameter | | Value |
| Transform precoding | | Disabled |
| HARQ | Maximum number of HARQ transmissions | 4 |
| RV sequence | 0, 3, 0, 3 [Note 1] |
| DM-RS | DM-RS configuration type | 1 |
| DM-RS duration | single-symbol DM-RS |
| Additional DM-RS position | pos1 |
| Number of DM-RS CDM group(s) without data | 2 |
| Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB |
| DM-RS port | 0 |
| DM-RS sequence generation | NID0=0, nSCID =0 |
| Time domain resource assignment | PUSCH mapping type | A, B |
| Start symbol | 0 |
| Allocation length | 14 |
| PUSCH aggregation factor | n2 |
| Frequency domain resource assignment | RB assignment | Full applicable test bandwidth |
| Frequency hopping | Disabled |
| Code block group based PUSCH transmission | | Disabled |
| Note 1: The effective RV sequence is {0, 2, 3, 1} with slot aggregation. | | |

4) The multipath fading emulators shall be configured according to the corresponding channel model defined in annex G.2.

5) Adjust the equipment so that required SNR specified in table 8.2.4.5-1 to 8.2.4.5-4 is achieved at the SAN input.

6) For each of the reference channels in table 8.2.4.5-1 to 8.2.4.5-4 applicable for the base station, measure the throughput.

#### 8.2.4.5 Test Requirement

The throughput measured according to clause 8.2.1.4.2 shall not be below the limits for the SNR levels specified in table 8.2.4.5-1 to 8.2.4.5-4.

Table 8.2.4.5-1: Minimum requirements for PUSCH, Type A, 5 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (Annex G) | Fraction of maximum throughput | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70% | G-FR1-A3A-1 | pos1 | -4.5 |
| 2 | Normal | NTN-TDLA100-200 Low | 70% | G-FR1-A3A-1 | pos1 | -7.9 |

Table 8.2.4.5-2: Minimum requirements for PUSCH, Type B, 5 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (Annex G) | Fraction of maximum throughput | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70% | G-FR1-A3A-1 | pos1 | -4.5 |
| 2 | Normal | NTN-TDLA100-200 Low | 70% | G-FR1-A3A-1 | pos1 | -7.9 |

Table 8.2.4.5-3: Minimum requirements for PUSCH, Type A, 10 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (Annex G) | Fraction of maximum throughput | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70% | G-FR1-A3A-2 | pos1 | -4.5 |
| 2 | Normal | NTN-TDLA100-200 Low | 70% | G-FR1-A3A-2 | pos1 | -7.9 |

Table 8.2.4.5-4: Minimum requirements for PUSCH, Type B, 10 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (Annex G) | Fraction of maximum throughput | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70% | G-FR1-A3A-2 | pos1 | -4.5 |
| 2 | Normal | NTN-TDLA100-200 Low | 70% | G-FR1-A3A-2 | pos1 | -7.9 |

### 8.2.5 Performance requirements for PUSCH with DMRS bundling

#### 8.2.5.1 Definition and applicability

The performance requirement of PUSCH with DMRS bundling is determined by a minimum required throughput for a given SNR. The required throughput is expressed as a fraction of maximum throughput for the FRCs listed in annex A. The performance requirements assume HARQ re-transmissions.

Which specific test(s) are applicable to SAN is based on the test applicability rules defined in clause [8.1.2.9].

#### 8.2.5.2 Minimum Requirement

The minimum requirement is in TS 38.108 [2] clause [8.2.5].

#### 8.2.5.3 Test Purpose

The test shall verify the receiver's ability to achieve throughput under multipath fading propagation conditions for a given SNR with DMRS bundling.

#### 8.2.5.4 Method of test

##### 8.2.5.4.1 Initial Conditions

Test environment: Normal, see annex [B.2].

RF channels to be tested for single carrier: M; see clause [4.9.1].

RF channels to be tested for carrier aggregation: MBW Channel CA; see clause [4.9.1].

##### 8.2.5.4.2 Procedure

1) Connect the SAN tester generating the wanted signal, multipath fading simulators and AWGN generators to all SAN TAB connectors for diversity reception via a combining network as shown in annex D.6 for *SAN type 1-H*.

2) Adjust the AWGN generator, according to the channel bandwidth, defined in table 8.2.5.4.2-1.

Table 8.2.5.4.2-1: AWGN power level at the SAN input

|  |  |  |
| --- | --- | --- |
| Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| 15kHz | 5 | -86.5 dBm / 4.5MHz |
| 30kHz | 10 | -83.6 dBm / 8.64MHz |
| NOTE: The AWGN power level contains an AWGN offset of 16dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 16dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level. | | |

3) The characteristics of the wanted signal shall be configured according to the corresponding UL reference measurement channel defined in annex A and the test parameters in table 8.2.5.4.2-2.

Table 8.2.5.4.2-2: Test parameters for testing PUSCH with DMRS bundling

|  |  |  |
| --- | --- | --- |
| Parameter | | Value |
| Transform precoding | | Disabled |
| HARQ | Maximum number of HARQ transmissions | 4 |
| RV sequence (Note 1) | 0,0,0,0 |
| DM-RS | DM-RS configuration type | 1 |
| DM-RS duration | single-symbol DM-RS |
| Additional DM-RS position | pos1 |
| Number of DM-RS CDM group(s) without data | 2 |
| Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB |
| DM-RS port(s) | {0} |
| DM-RS sequence generation | NID0=0, nSCID =0 |
| Time domain resource assignment | PUSCH mapping type | A, B |
| Start symbol | 0 |
| Allocation length | 14 |
| PUSCH aggregation factor | n4 for 15kHz SCS  n8 for 30kHz SCS |
| pusch-TimeDomainWindowLength | | 4 for 15kHz SCS  8 for 30kHz SCS |
| Frequency domain resource assignment | RB assignment | 6 RBs in the middle of the channel bandwidth |
| Frequency hopping | Disabled |
| Code block group based PUSCH transmission | | Disabled |
| NOTE 1: The effective RV sequence is {0, 2, 3, 1} with slot aggregation. | | |

4) The multipath fading emulators shall be configured according to the corresponding channel model defined in annex G.2.

5) Adjust the equipment so that required SNR specified in table 8.2.5.5-1 to table 8.2.5.5-4 is achieved at the SAN input.

6) For each of the reference channels in table 8.2.5.5-1 to table 8.2.5.5-4 applicable for the base station, measure the throughput.

#### 8.2.5.5 Test Requirement

The throughput measured according to clause 11.2.5.4.2 shall not be below the limits for the SNR levels specified in table 8.2.5.5-1 to table 8.2.5.5-4.

Table 8.2.5.5-1: Test requirements for PUSCH with 70% of maximum throughput, Type A, 5 MHz channel bandwidth, FR1-NTN, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex G) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-7 | pos1 | TBD |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-7 | pos1 | TBD |

Table 8.2.5.5-2: Test requirements for PUSCH with 70% of maximum throughput, Type A, 10 MHz channel bandwidth, FR1-NTN, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex G) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-8 | pos1 | TBD |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-8 | pos1 | TBD |

Table 8.2.5.5-3: Test requirements for PUSCH with 70% of maximum throughput, Type B, 5 MHz channel bandwidth, FR1-NTN, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex G) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-7 | pos1 | TBD |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-7 | pos1 | TBD |

Table 8.2.5.5-4: Test requirements for PUSCH with 70% of maximum throughput, Type B, 10 MHz channel bandwidth, FR1-NTN, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex G) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-8 | pos1 | TBD |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-8 | pos1 | TBD |

################## End of Change #3 R4-2409861 ######################

################## Start of Change #3 R4-2410011 ######################

11 Radiated performance requirements

11.1 General

11.1.1 Scope and definitions

Radiated performance requirements specify the ability of the *SAN type 1-O* or *SAN type 2-O* to correctly transmit and receive radiated signals in various conditions and configurations. Radiated performance requirements are specified at the RIB.

Radiated performance requirements for the SAN are specified for the fixed reference channels defined in TS 38.108 [2] annex A and for the propagation conditions defined in Recommendation ITU-R P.618 (*Propagation data and prediction methods required for the design of Earth-space telecommunication systems*). The requirements only apply to those FRCs that are supported by the SAN.

The radiated performance requirements for *SAN type 1-O* and for *SAN type 2-O* are limited to two OTA *demodulation branches* as described in clause 11.1.2. Conformance requirements can only be tested for 1 or 2 *demodulation branches* depending on the number of polarizations supported by the SAN, with the required SNR applied separately per polarization.

Unless stated otherwise, radiated performance requirements apply for a single carrier only. Radiated performance requirements for a SAN supporting carrier aggregation are defined in terms of single carrier requirements.

For *SAN type 1-O* in FDD operation the requirements in clause 8 shall be met with the transmitter units associated with the RIB in the *operating* *band* turned ON.

NOTE 1: *SAN type 1-O* in normal operating conditions in FDD operation is configured to transmit and receive at the same time. The transmitter unit(s) associated with the RIB may be OFF for some of the tests.

In tests performed with signal generators a synchronization signal may be provided from the SAN to the signal generator, to enable correct timing of the wanted signal.

Whenever the "RX antennas" term is used for the radiated performance requirements description, it shall refer to the *demodulation branches* (i.e. not physical antennas of the antenna array).

The SNR used in this clause is specified based on a single carrier and defined as:

SNR = S / N

Where:

*S* is the total signal power in a slot on a RIB.

*N* is the noise density integrated in a bandwidth corresponding to the *transmission bandwidth* over the duration where signal energy exists on a RIB.

11.1.2 OTA demodulation branches

Radiated performance requirements are only specified for up to 2 *demodulation branches*.

If the *SAN type 1-O* or the *SAN type 2-O* uses polarization diversity and has the ability to maintain isolation between the signals for each of the *demodulation branches*, then radiated performance requirements can be tested for up to two *demodulation branches* (i.e. 1RX or 2RX test setups). When tested for two *demodulation branches*, each demodulation branch maps to one polarization.

If the *SAN type 1-O* or the *SAN type 2-O* does not use polarization diversity then radiated performance requirements can only be tested for a single *demodulation branch* (i.e. 1RX test setup).

11.1.3 Applicability rule

11.1.3.1 General

Unless otherwise stated, for a SAN declared to support more than 2 demodulation branches (for *SAN type 1-O* and *SAN type 2-O*), the performance requirement tests for 2 demodulation branches shall apply, and the mapping between connectors and demodulation branches is up to SAN implementation.

The tests requiring more than [20] dB SNR level are set to N/A in the test requirements.

11.1.3.2 Applicability of PUSCH performance requirements

11.1.3.2.1 Applicability of requirements for different subcarrier spacings

Unless otherwise stated, PUSCH requirement tests shall apply only for each subcarrier spacing declared to be supported (see D.7 in table 4.6-1).

11.1.3.2.2 Applicability of requirements for different channel bandwidths

For each subcarrier spacing declared to be supported, the test requirements for a specific channel bandwidth shall apply only if the SAN supports it (see D.7 in table 4.6-1).

Unless otherwise stated, for each subcarrier spacing declared to be supported, the tests shall be done only for the widest supported channel bandwidth. If performance requirement is not specified for this widest supported channel bandwidth, the tests shall be done by using performance requirement for the closest channel bandwidth lower than this widest supported bandwidth; the tested PRBs shall then be centered in this widest supported channel bandwidth.

11.1.3.2.3 Applicability of requirements for different configurations

Unless otherwise stated, for *SAN type 1-O*, PUSCH requirement tests shall apply only for the mapping type declared to be supported (see D.100 in table 4.6-1). If both mapping type A and type B are declared to be supported, the tests shall be done for either type A or type B; the same chosen mapping type shall then be used for all tests.

11.1.3.3 Applicability of PUCCH performance requirements

11.1.3.3.1 Applicability of requirements for different formats

Unless otherwise stated, PUCCH requirement tests shall apply only for each PUCCH format declared to be supported (see D.101 in table 4.6-1).

11.1.3.3.2 Applicability of requirements for different subcarrier spacings

Unless otherwise stated, PUCCH requirement tests shall apply only for each subcarrier spacing declared to be supported (see D.7 in table 4.6-1).

11.1.3.3.3 Applicability of requirements for different channel bandwidths

For each subcarrier spacing declared to be supported by the SAN, the test requirements for a specific channel bandwidth shall apply only if the SAN supports it (see D.7 in table 4.6-1).

Unless otherwise stated, for each subcarrier spacing declared to be supported, the tests shall be done only for the widest supported channel bandwidth. If performance requirement is not specified for this widest supported channel bandwidth, the tests shall be done by using performance requirement for the closest channel bandwidth lower than this widest supported bandwidth; the tested PRBs shall then be centered in this widest supported channel bandwidth.

11.1.3.3.4 Applicability of requirements for different configurations

Unless otherwise stated, PUCCH format 3 requirement tests shall apply only for the additional DM-RS configuration declared to be supported (see D.103 in table 4.6-1). If both options (without and with additional DM-RS) are declared to be supported, the tests shall be done for either without or with additional DM-RS; the same chosen option shall then be used for all tests.

Unless otherwise stated, PUCCH format 4 requirement tests shall apply only for the additional DM-RS configuration declared to be supported (see D.104 in table 4.6-1). If both options (without and with additional DM-RS) are declared to be supported, the tests shall be done for either without or with additional DM-RS; the same chosen option shall then be used for all tests.

11.1.3.3.5 Applicability of requirements for multi-slot PUCCH

Unless otherwise stated, multi-slot PUCCH requirement tests shall apply only if the SAN supports it (see D.105 in table 4.6-1).

11.1.3.4 Applicability of PRACH performance requirements

11.1.3.4.1 Applicability of requirements for different formats

Unless otherwise stated, PRACH requirement tests shall apply only for each PRACH format declared to be supported (see D.102 in table 4.6-1).

11.1.3.4.2 Applicability of requirements for different subcarrier spacings

Unless otherwise stated, for each PRACH format with short sequence declared to be supported, for each FR, the tests shall apply only for the smallest supported subcarrier spacing in the FR (see D.102 in table 4.6-1).

11.1.3.4.3 Applicability of requirements for different channel bandwidths

Unless otherwise stated, for the subcarrier spacing to be tested, the test requirements shall apply only for anyone channel bandwidth declared to be supported (see D.7 in table 4.6-1).

################## End of Change #3 R4-2410011 ######################

################## Start of Change #4 R4-2409872 ######################

## 11.2 OTA performance requirements for PUSCH

### 11.2.1 Performance requirements for PUSCH with transform precoding disabled

#### 11.2.1.1 Definition and applicability

The performance requirement of PUSCH is determined by a minimum required throughput for a given SNR. The required throughput is expressed as a fraction of maximum throughput for the FRCs listed in annex A. The performance requirements assume HARQ re-transmissions.

Which specific test(s) are applicable to SAN is based on the test applicability rules defined in clause 11.1.3.

#### 11.2.1.2 Minimum Requirement

For *SAN type 1-O*, the minimum requirement is in TS 38.108 [2] clause 11.2.1.

For *SAN type 2-O*, the minimum requirement is in TS 38.108 [2], clause 11.2.2.1.

#### 11.2.1.3 Test Purpose

The test shall verify the receiver's ability to achieve throughput under multipath fading propagation conditions for a given SNR.

#### 11.2.1.4 Method of test

##### 11.2.1.4.1 Initial Conditions

Test environment: Normal, see annex B.2.

RF channels to be tested for single carrier: M; see clause 4.9.1.

Direction to be tested: OTA REFSENS *receiver target reference direction* (see D.44 in table 4.6-1).

##### 11.2.1.4.2 Procedure

1) Place the SAN with its manufacturer declared coordinate system reference point in the same place as calibrated point in the test system, as shown in annex D.7.

2) Align the manufacturer declared coordinate system orientation of the SAN with the test system.

3) Set the SAN in the declared direction to be tested.

4) Connect the SAN tester generating the wanted signal, multipath fading simulators and AWGN generators to a test antenna via a combining network in OTA test setup, as shown in annex D.7. Each of the demodulation branch signals should be transmitted on one polarization of the test antenna(s).

5) The characteristics of the wanted signal shall be configured according to the corresponding UL reference measurement channel defined in annex A, and according to additional test parameters listed in table 11.2.1.4.2-1.

Table 11.2.1.4.2-1: Test parameters for testing PUSCH

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Value | |
| SAN type 1-O | SAN type 2-O |
| Transform precoding | | Disabled | |
| HARQ | Maximum number of HARQ transmissions | 4 | |
| RV sequence | 0, 2, 3, 1 | |
| DM-RS | DM-RS configuration type | 1 | |
| DM-RS duration | single-symbol DM-RS | |
| Additional DM-RS position | pos1 | |
| Number of DM-RS CDM group(s) without data | 2 | |
| Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB | |
| DM-RS port | {0} | |
| DM-RS sequence generation | NID0=0, nSCID =0 | |
| Time domain resource assignment | PUSCH mapping type | A, B | B |
| Start symbol | 0 | |
| Allocation length | 14 | 10 |
| Frequency domain resource assignment | RB assignment | Full applicable test bandwidth | |
| Frequency hopping | Disabled | |
| Code block group based PUSCH transmission | | Disabled | |
| Frequency domain resource assignment | RB assignment | N.A. | Disabled |
| Frequency hopping | N.A. | Disabled |

6) The multipath fading emulators shall be configured according to the corresponding channel model defined in annex G.

7) Adjust the test signal mean power so the calibrated radiated SNR value at the SAN receiver is as specified in clause 11.2.1.5 and clause 11.2.1.6for *SAN type 1-O* and *SAN type 2-O* respectively, and that the SNR at the SAN receiver is not impacted by the noise floor.

The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level in table 11.2.1.4.2-2.

Table 11.2.1.4.2-2: AWGN power level at the SAN input

|  |  |  |  |
| --- | --- | --- | --- |
| SAN type | Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| 1-O  (Note 2) | 15 | 5 | -86.5 - ΔOTAREFSENS dBm / 4.5 MHz |
| 30 | 10 | -83.6 - ΔOTAREFSENS dBm / 8.64 MHz |
| 2-O (Note 5) | 120 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 46.08 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.43 in table 4.6-1 and clause 10.1  [NOTE 2: The AWGN power level contains an AWGN offset of 16dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 16dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level.]  NOTE 3: ΔFR2\_REFSENS = -3 dB as described in clause 10.1, since the OTA REFSENS reference direction (as declared in D.43 in table 4.6-1) is used for testing.  NOTE 4: EISREFSENS\_50M as declared in D.xx in table 4.6-1.  NOTE 5: The AWGN power level contains an AWGN offset of 15dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 15dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level. | | | |

8) For reference channels applicable to the SAN, measure the throughput.

#### 11.2.1.5 Test Requirement

The throughput measured according to clause 11.2.1.4.2 shall not be below the limits for the SNR levels specified in table 11.2.1.5-1 to 11.2.1.5-4.

Table 11.2.1.5-1: Test requirements for PUSCH with 70% of maximum throughput, Type A, 5 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (Annex [G]) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-A3-1 | pos1 | 3.8 |
| Normal | NTN-TDLC5-200 Low | 70 % | G-FR1-A3-1 | pos1 | 2.2 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-A3-1 | pos1 | -0.1 |
| Normal | NTN-TDLC5-200 Low | 70% | G-FR1-A3-1 | pos1 | -0.6 |

Table 11.2.1.5-2: Test requirements for PUSCH with 70% of maximum throughput, Type A, 10 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (Annex [G]) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-A3-2 | pos1 | 3.5 |
| Normal | NTN-TDLC5-200 Low | 70 % | G-FR1-A3-2 | pos1 | 2.0 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-A3-2 | pos1 | -0.4 |
| Normal | NTN-TDLC5-200 Low | 70% | G-FR1-A3-2 | pos1 | -0.8 |

Table 11.2.1.5-3: Test requirements for PUSCH with 70% of maximum throughput, Type B, 5 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (Annex [G]) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-A3-1 | pos1 | 3.9 |
| Normal | NTN-TDLC5-200 Low | 70 % | G-FR1-A3-1 | pos1 | 2.2 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-A3-1 | pos1 | 0.0 |
| Normal | NTN-TDLC5-200 Low | 70% | G-FR1-A3-1 | pos1 | -0.6 |

Table 11.2.1.5-4: Test requirements for PUSCH with 70% of maximum throughput, Type B, 10 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (Annex [G]) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-A3-2 | pos1 | 3.5 |
| Normal | NTN-TDLC5-200 Low | 70 % | G-FR1-A3-2 | pos1 | 1.9 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-A3-2 | pos1 | -0.4 |
| Normal | NTN-TDLC5-200 Low | 70% | G-FR1-A3-2 | pos1 | -0.8 |

#### 11.2.1.6 Test Requirement for *SAN type 2-O*

The throughput measured according to clause 11.2.1.4.2 shall not be below the limits for the SNR levels specified in table 11.2.1.6-1

Table 11.2.1.6-1: Test requirements for PUSCH with 70% of maximum throughput, 50 MHz Channel Bandwidth, 120 kHz SCS in FR2-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (Annex G) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLC5-1200 Low | 70 % | [G-FR2-NTN-A5-1] | pos1 | [0.6] |
| Normal | NTN-TDLC5-1200 Low | 70 % | [G-FR2-NTN-A6-1] | pos1 | [9.5] |
| 2 | Normal | NTN-TDLC5-1200 Low | 70 % | [G-FR2-NTN-A5-1] | pos1 | [-2.8] |
| Normal | NTN-TDLC5-1200 Low | 70% | [G-FR2-NTN-A6-1] | pos1 | [6.1] |

### 11.2.2 Performance requirements for PUSCH with transform precoding enabled

#### 11.2.2.1 Definition and applicability

The performance requirement of PUSCH is determined by a minimum required throughput for a given SNR. The required throughput is expressed as a fraction of maximum throughput for the FRCs listed in annex A. The performance requirements assume HARQ re-transmissions.

Which specific test(s) are applicable to SAN is based on the test applicability rules defined in clause 11.1.3.

#### 11.2.2.2 Minimum Requirement

For *SAN type 1-O*, the minimum requirement is in TS 38.108 [2] clause 11.2.2.

For *SAN type 2-O*, the minimum requirement is in TS 38.108 [2] clause 11.2.2.2.

#### 11.2.2.3 Test Purpose

The test shall verify the receiver's ability to achieve throughput under multipath fading propagation conditions for a given SNR.

#### 11.2.2.4 Method of test

##### 11.2.2.4.1 Initial Conditions

Test environment: Normal, see annex B.2.

RF channels to be tested for single carrier: M; see clause 4.9.1.

Direction to be tested: OTA REFSENS *receiver target reference direction* (see D.44 in table 4.6-1).

##### 11.2.2.4.2 Procedure

1) Place the SAN with its manufacturer declared coordinate system reference point in the same place as calibrated point in the test system, as shown in annex D.7.

2) Align the manufacturer declared coordinate system orientation of the SAN with the test system.

3) Set the SAN in the declared direction to be tested.

4) Connect the SAN tester generating the wanted signal, multipath fading simulators and AWGN generators to a test antenna via a combining network in OTA test setup, as shown in annex D.7. Each of the demodulation branch signals should be transmitted on one polarization of the test antenna(s).

5) The characteristics of the wanted signal shall be configured according to the corresponding UL reference measurement channel defined in annex A, and according to additional test parameters listed in table 11.2.2.4.2-1.

Table 11.2.2.4.2-1: Test parameters for testing PUSCH

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Value | |
| SAN type 1-O | SAN type 2-O |
| Transform precoding | | Enabled | |
| HARQ | Maximum number of HARQ transmissions | 4 | |
| RV sequence | 0, 2, 3, 1 | |
| DM-RS | DM-RS configuration type | 1 | |
| DM-RS duration | single-symbol DM-RS | |
| Additional DM-RS position | pos1 | |
| Number of DM-RS CDM group(s) without data | 2 | |
| Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB | |
| DM-RS port | {0} | |
| DM-RS sequence generation | NID0=0, group hopping and sequence hopping are disabled | |
| Time domain resource assignment | PUSCH mapping type | A, B | B |
| Start symbol | 0 | |
| Allocation length | 14 | 10 |
| Frequency domain resource assignment | RB assignment | Full applicable test bandwidth | 30 PRBs in the middle of the test bandwidth |
| Frequency hopping | Disabled | |
| Code block group based PUSCH transmission | | Disabled | |
| PTRS configuration | Frequency density (*KPT-RS*) | N.A. | Disabled |
| Time density (*LPT-RS*) | N.A. | Disabled |

6) The multipath fading emulators shall be configured according to the corresponding channel model defined in annex G.

7) Adjust the test signal mean power so the calibrated radiated SNR value at the SAN receiver is as specified in clause 11.2.2.5 and clause 11.2.2.6 for *SAN type 1-O* and *SAN type 1-O* respectively, and that the SNR at the SAN receiver is not impacted by the noise floor.

The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level in table 11.2.2.4.2-2.

Table 11.2.2.4.2-2: AWGN power level at the SAN input

|  |  |  |  |
| --- | --- | --- | --- |
| SAN type | Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| *1-O*  (Note 2) | 15 | 5 | -86.5 - ΔOTAREFSENS dBm / 4.5 MHz |
| 30 | 10 | -83.6 - ΔOTAREFSENS dBm / 8.64 MHz |
| *2-O*  (Note 5) | 120 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 46.08 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.43 in table 4.6-1 and clause 10.1.  [NOTE 2: The AWGN power level contains an AWGN offset of 16dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 16dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level.]  NOTE 3: ΔFR2\_REFSENS = -3 dB as described in clause 10.1, since the OTA REFSENS reference direction (as declared in D.43 in table 4.6-1) is used for testing.  NOTE 4: EISREFSENS\_50M as declared in D.xx in table 4.6-1.  NOTE 5: The AWGN power level contains an AWGN offset of 15dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 15dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level. | | | |

8) For reference channels applicable to the SAN, measure the throughput.

#### 11.2.2.5 Test Requirement

The throughput measured according to clause 11.2.2.4.2 shall not be below the limits for the SNR levels specified in table 11.2.2.5-1 to 11.2.2.5-4.

Table 11.2.2.5-1: Test requirements for PUSCH with 70% of maximum throughput, PUSCH mapping Type A, 5 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (Annex [G]) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-A3-3 | pos1 | 4.3 |
| Normal | NTN-TDLC5-200 Low | 70 % | G-FR1-A3-3 | pos1 | 2.2 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-A3-3 | pos1 | 0.1 |
| Normal | NTN-TDLC5-200 Low | 70% | G-FR1-A3-3 | pos1 | -0.6 |

Table 11.2.2.5-2: Test requirements for PUSCH with 70% of maximum throughput, PUSCH mapping Type A, 10 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (Annex [G]) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-A3-4 | pos1 | 4.1 |
| Normal | NTN-TDLC5-200 Low | 70 % | G-FR1-A3-4 | pos1 | 1.9 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-A3-4 | pos1 | -0.1 |
| Normal | NTN-TDLC5-200 Low | 70% | G-FR1-A3-4 | pos1 | -0.8 |

Table 11.2.2.5-3: Test requirements for PUSCH with 70% of maximum throughput, PUSCH mapping Type B, 5 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (Annex [G]) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-A3-3 | pos1 | 4.3 |
| Normal | NTN-TDLC5-200 Low | 70 % | G-FR1-A3-3 | pos1 | 2.2 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-A3-3 | pos1 | 0.1 |
| Normal | NTN-TDLC5-200 Low | 70% | G-FR1-A3-3 | pos1 | -0.6 |

Table 11.2.2.5-4: Test requirements for PUSCH with 70% of maximum throughput, PUSCH mapping Type B, 10 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (Annex [G]) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-A3-4 | pos1 | 4.1 |
| Normal | NTN-TDLC5-200 Low | 70 % | G-FR1-A3-4 | pos1 | 1.9 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-A3-4 | pos1 | -0.1 |
| Normal | NTN-TDLC5-200 Low | 70% | G-FR1-A3-4 | pos1 | -0.8 |

#### 11.2.2.6 Test Requirement for *SAN type 2-O*

The throughput measured according to clause 11.2.2.4.2 shall not be below the limits for the SNR levels specified in table 11.2.2.6-1

Table 11.2.2.6-1: Test requirements for PUSCH with 70% of maximum throughput, PUSCH mapping Type B, 50 MHz channel bandwidth, 120 kHz SCS in FR2-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (Annex G) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLC5-1200 Low | 70 % | [G-FR2-NTN-A5-2] | pos1 | [0.7] |
| 2 | Normal | NTN-TDLC5-1200 Low | 70 % | [G-FR2-NTN-A5-2] | pos1 | [-2.6] |

################## End of Change #4 R4-2409872 ######################

################## Start of Change #5 R4-2409872 ######################

### 11.2.4 Performance requirements for PUSCH repetition Type A

#### 11.2.4.1 Definition and applicability

The performance requirement of PUSCH with slot aggregation factor configured is determined by a maximum target BLER for a given SNR. The required BLER is defined as the probability of incorrectly decoding the PUSCH information when the PUSCH information is sent for the FRCs listed in annex A. The performance requirements assume HARQ re-transmissions.

Which specific test(s) are applicable to SAN is based on the test applicability rules defined in clause 11.1.3.

#### 11.2.4.2 Minimum Requirement

For *SAN type 1-O*, the minimum requirement is in TS 38.108 [2] clause 11.2.4.

For *SAN type 2-O*, the minimum requirement is in TS 38. 108 [2], clause 11.2.2.3.

#### 11.2.4.3 Test Purpose

The test shall verify the receiver's ability to achieve 1% BLER with PUSCH repetition Type A under multipath fading propagation conditions for a given SNR.

#### 11.2.4.4 Method of test

##### 11.2.4.4.1 Initial Conditions

Test environment: Normal, see annex B.2.

RF channels to be tested for single carrier: M; see clause 4.9.1.

Direction to be tested: OTA REFSENS *receiver target reference direction* (see D.44 in table 4.6-1).

##### 11.2.4.4.2 Procedure

1) Place the SAN with its manufacturer declared coordinate system reference point in the same place as calibrated point in the test system, as shown in annex D.7.

2) Align the manufacturer declared coordinate system orientation of the SAN with the test system.

3) Set the SAN in the declared direction to be tested.

4) Connect the SAN tester generating the wanted signal, multipath fading simulators and AWGN generators to a test antenna via a combining network in OTA test setup, as shown in annex D.7. Each of the demodulation branch signals should be transmitted on one polarization of the test antenna(s).

5) The characteristics of the wanted signal shall be configured according to the corresponding UL reference measurement channel defined in annex A, and according to additional test parameters listed in table 11.2.4.4.2-1.

Table 11.2.4.4.2-1: Test parameters for testing PUSCH repetition Type A

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Value | |
| SAN Type 1-O | SAN Type 2-O |
| Transform precoding | | Disabled | |
| HARQ | Maximum number of HARQ transmissions | 4 | |
| RV sequence | 0, 3, 0, 3 [Note 1] | |
| DM-RS | DM-RS configuration type | 1 | |
| DM-RS duration | single-symbol DM-RS | |
| Additional DM-RS position | pos1 | |
| Number of DM-RS CDM group(s) without data | 2 | |
| Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB | |
| DM-RS port | {0} | |
| DM-RS sequence generation | NID0=0, nSCID =0 | |
| Time domain  resource  assignment | PUSCH mapping type | A, B | B |
| Start symbol | 0 | |
| Allocation length | 14 | 10 |
| PUSCH aggregation factor | n2 | |
| Frequency domain resource assignment | RB assignment | Full applicable test bandwidth | |
| Frequency hopping | Disabled | |
| Code block group based PUSCH transmission | | Disabled | |
| PTRS configuration | Frequency density (*KPT-RS*) | N.A. | Disabled |
| Time density (*LPT-RS*) | N.A. | Disabled |
| Note 1: The effective RV sequence is {0, 2, 3, 1} with slot aggregation. | | | |

6) The multipath fading emulators shall be configured according to the corresponding channel model defined in annex G.

7) Adjust the test signal mean power so the calibrated radiated SNR value at the SAN receiver is as specified in clause 11.2.4.5 and clause 11.2.4.6 for *SAN type 1-O* and *SAN type 2-O* respectively, and that the SNR at the SAN receiver is not impacted by the noise floor.

The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level in table 11.2.4.4.2-2.

Table 11.2.4.4.2-2: AWGN power level at the SAN input

|  |  |  |  |
| --- | --- | --- | --- |
| SAN type | Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| *1-O* (NOTE 2) | 15 | 5 | -86.5 - ΔOTAREFSENS dBm / 4.5 MHz |
| 30 | 10 | -83.6 - ΔOTAREFSENS dBm / 8.64 MHz |
| *2-O* (NOTE 5) | 120 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 46.08 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.43 in table 4.6-1 and clause 10.1.  [NOTE 2: The AWGN power level contains an AWGN offset of 16dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 16dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level.]  NOTE 3: ΔFR2\_REFSENS = -3 dB as described in clause 10.1, since the OTA REFSENS reference direction (as declared in D.43 in table 4.6-1) is used for testing.  NOTE 4: EISREFSENS\_50M as declared in D.xx in table 4.6-1.  NOTE 5: The AWGN power level contains an AWGN offset of 15dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 15dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level. | | | |

8) For reference channels applicable to the SAN, measure the throughput.

#### 11.2.4.5 Test Requirement

The BLER measured according to clause 11.2.4.4.2 shall not be above the limits for the SNR levels specified in table 11.2.4.5-1 to 11.2.4.5-4.

Table 11.2.4.5-1: Test requirements for PUSCH repetition TypeA, PUSCH mapping Type A, 5 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (Annex [G]) | Target BLER | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 1% (Note 1) | G-FR1-A3A-1 | pos1 | -4.5 |
| 2 | Normal | NTN-TDLA100-200 Low | 1% (Note 1) | G-FR1-A3A-1 | pos1 | -7.9 |
| Note 1: BLER is defined as residual BLER; i.e. ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block. | | | | | | | |

Table 11.2.4.5-2: Test requirements for PUSCH, PUSCH mapping Type A, 10 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (Annex [G]) | Target BLER | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 1% (Note 1) | G-FR1-A3A-2 | pos1 | -4.5 |
| 2 | Normal | NTN-TDLA100-200 Low | 1% (Note 1) | G-FR1-A3A-2 | pos1 | -7.9 |
| Note 1: BLER is defined as residual BLER; i.e. ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block. | | | | | | | |

Table 11.2.4.5-3: Test requirements for PUSCH, PUSCH mapping Type B, 5 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (Annex [G]) | Target BLER | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 1% (Note 1) | G-FR1-A3A-1 | pos1 | -4.5 |
| 2 | Normal | NTN-TDLA100-200 Low | 1% (Note 1) | G-FR1-A3A-1 | pos1 | -7.9 |
| Note 1: BLER is defined as residual BLER; i.e. ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block. | | | | | | | |

Table 11.2.4.5-4: Test requirements for PUSCH, PUSCH mapping Type B, 10 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (Annex [G]) | Target BLER | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 1% (Note 1) | G-FR1-A3A-2 | pos1 | -4.5 |
| 2 | Normal | NTN-TDLA100-200 Low | 1% (Note 1) | G-FR1-A3A-2 | pos1 | -7.9 |
| Note 1: BLER is defined as residual BLER; i.e. ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block. | | | | | | | |

### 11.2.5 Performance requirements for PUSCH with DMRS bundling

#### 11.2.5.1 Definition and applicability

The performance requirement of PUSCH with DMRS bundling is determined by a minimum required throughput for a given SNR. The required throughput is expressed as a fraction of maximum throughput for the FRCs listed in annex A. The performance requirements assume HARQ re-transmissions.

Which specific test(s) are applicable to SAN is based on the test applicability rules defined in clause [11.1.3].

#### 11.2.5.2 Minimum Requirement

For *SAN type 1-O*, the minimum requirement is in TS 38.108 [2], clause [11.2.2.1].

#### 11.2.5.3 Test purpose

The test shall verify the receiver's ability to achieve throughput under multipath fading propagation conditions for a given SNR with DMRS bundling.

#### 11.2.5.4 Method of test

##### 11.2.5.4.1 Initial conditions

Test environment: Normal, see annex [B.2].

RF channels to be tested for single carrier: M, see clause [4.9.1.]

Direction to be tested: OTA REFSENS *receiver target reference direction* (see [D.54] in table 4.6-1).

##### 11.2.5.4.2 Procedure

1) Place the SAN with its manufacturer declared coordinate system reference point in the same place as calibrated point in the test system, as shown in annex [D.7].

2) Align the manufacturer declared coordinate system orientation of the SAN with the test system.

3) Set the SAN in the declared direction to be tested.

4) Connect the SAN tester generating the wanted signal, multipath fading simulators and AWGN generators to a test antenna via a combining network in OTA test setup, as shown in annex E.3. Each of the demodulation branch signals should be transmitted on one polarization of the test antenna(s).

5) The characteristics of the wanted signal shall be configured according to the corresponding UL reference measurement channel defined in annex A, and according to additional test parameters listed in table 11.2.5.4.2-1.

Table 11.2.5.4.2-1: Test parameters for testing PUSCH

|  |  |  |
| --- | --- | --- |
| Parameter | | Value |
| Transform precoding | | Disabled |
| HARQ | Maximum number of HARQ transmissions | 4 |
| RV sequence (Note 1) | 0,0,0,0 |
| DM-RS | DM-RS configuration type | 1 |
| DM-RS duration | single-symbol DM-RS |
| Additional DM-RS position | pos1 |
| Number of DM-RS CDM group(s) without data | 2 |
| Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB |
| DM-RS port(s) | {0} |
| DM-RS sequence generation | NID0=0, nSCID =0 |
| Time domain resource assignment | PUSCH mapping type | A, B |
| Start symbol | 0 |
| Allocation length | 14 |
| PUSCH aggregation factor | n4 for 15kHz SCS  n8 for 30kHz SCS |
| pusch-TimeDomainWindowLength | | 4 for 15kHz SCS  8 for 30kHz SCS |
| Frequency domain resource assignment | RB assignment | 6 RBs in the middle of the channel bandwidth |
| Frequency hopping | Disabled |
| Code block group based PUSCH transmission | | Disabled |
| SAN type | | 1-O |
| NOTE 1: The effective RV sequence is {0, 2, 3, 1} with slot aggregation. | | |

6) The multipath fading emulators shall be configured according to the corresponding channel model defined in annex J.

7) Adjust the test signal mean power so the calibrated radiated SNR value at the SAN receiver is as specified in clause 11.2.5.5.1 for *SAN type 1-O*, and that the SNR at the SAN receiver is not impacted by the noise floor.

The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level in table 11.2.5.4.2-2.

Table 11.2.5.4.2-2: AWGN power level at the SAN input

|  |  |  |  |
| --- | --- | --- | --- |
| SAN Type | Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| Type 1-O | 15 | 5 | -86.5 - ΔOTAREFSENS dBm / 4.5 MHz |
|  | 30 | 10 | -83.6 - ΔOTAREFSENS dBm / 8.64 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.53 in table 4.6-1 and clause 7.1.  NOTE 2: The AWGN power level contains an AWGN offset of 15dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 15dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level.. | | | |

8) For reference channels applicable to the SAN, measure the throughput.

#### 11.2.5.5 Test Requirement

##### 11.2.5.5.1 Test requirement for *SAN type 1-O*

The throughput measured according to clause 11.2.5.4.2 shall not be below the limits for the SNR levels specified in table 11.2.5.5.1-1 ~ 11.2.5.5.1.4

Table 11.2.5.5.1-1: Test requirements for PUSCH with 70% of maximum throughput, Type A, 5 MHz channel bandwidth, FR1-NTN, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex G) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-7 | pos1 | TBD |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-7 | pos1 | TBD |

Table 11.2.5.5.1-2: Test requirements for PUSCH with 70% of maximum throughput, Type A, 10 MHz channel bandwidth, FR1-NTN, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex G) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-8 | pos1 | TBD |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-8 | pos1 | TBD |

Table 11.2.5.5.1-3: Test requirements for PUSCH with 70% of maximum throughput, Type B, 5 MHz channel bandwidth, FR1-NTN, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex G) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-7 | pos1 | TBD |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-7 | pos1 | TBD |

Table 11.2.5.5.1-4: Test requirements for PUSCH with 70% of maximum throughput, Type B, 10 MHz channel bandwidth, FR1-NTN, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex G) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-8 | pos1 | TBD |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-8 | pos1 | TBD |

#### 11.2.4.6 Test Requirement for *SAN type 2-O*

The BLER measured according to clause 11.2.4.4.2 shall not be above the limits for the SNR levels specified in table 11.2.4.6-1.

Table 11.2.4.6-1: Test requirements for PUSCH repetition TypeA, PUSCH mapping Type B, 50 MHz channel bandwidth, 120 kHz SCS in FR2-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (Annex G) | Target BLER | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 1 | Normal | NTN-TDLC5-1200 Low | 1% (Note 1) | [G-FR2-NTN-A3A-1] | pos1 | TBD |
| 2 | Normal | NTN-TDLC5-1200 Low | 1% (Note 1) | [G-FR2-NTN-A3A-1] | pos1 | TBD |
| Note 1: BLER is defined as residual BLER; i.e., ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block. | | | | | | | |

################## End of Change #5 R4-2409872 ######################

################## Start of Change #6 R4-2409870 ######################

11.3 OTA performance requirements for PUCCH

11.3.1 Performance requirements for PUCCH format 0

11.3.1.1 Definition and applicability

The performance requirement of single user PUCCH format 0 for ACK missed detection is determined by the two parameters: probability of false detection of the ACK and the probability of detection of ACK. The performance is measured by the required SNR at probability of detection equal to 0.99. The probability of false detection of the ACK shall be 0.01 or less.

The probability of false detection of the ACK is defined as a conditional probability of erroneous detection of the ACK when input is only noise.

The probability of detection of ACK is defined as conditional probability of detection of the ACK when the signal is present.

The transient period as specified in TS 38.101-5 [12] clause 6.3.3 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the CC center, i.e. intra-slot frequency hopping is enabled.

Which specific test(s) are applicable to SAN is based on the test applicability rules defined in clause 11.1.3.

11.3.1.2 Minimum Requirement

For *SAN type 1-O*, the minimum requirements are in TS 38.108 [2] clause 11.3.1.1 and 11.3.1.2.

For *SAN type 2-O*, the minimum requirements are in TS 38.108 [2] clause [11.3.2.1] and [11.3.2.2].

11.3.1.3 Test purpose

The test shall verify the receiver's ability to detect ACK under multipath fading propagation conditions for a given SNR.

11.3.1.4 Method of test

11.3.1.4.1 Initial conditions

Test environment: Normal, see Annex B.2.

RF channels to be tested: single carrier M; see clause 4.9.1.

Direction to be tested: OTA REFSENS *receiver target reference direction* (see D.44 in table 4.6-1).

11.3.1.4.2 Procedure

1) Place the SAN with its manufacturer declared coordinate system reference point in the same place as calibrated point in the test system, as shown in annex D.7.

2) Align the manufacturer declared coordinate system orientation of the SAN with the test system.

3) Set the SAN in the declared direction to be tested.

4) Connect the SAN tester generating the wanted signal, multipath fading simulators and AWGN generators to a test antenna via a combining network in OTA test setup, as shown in annex D.7. Each of the demodulation branch signals should be transmitted on one polarization of the test antenna(s).

5) The characteristics of the wanted signal shall be configured according to TS 38.211 [8] and according to additional test parameters listed in table 11.3.1.4.2-1.

**Table 11.3.1.4.2-1: Test parameters**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **SAN type 1-O** | **SAN type 2-O** |
| number of UCI information bits | 1 | |
| Number of PRBS | 1 | |
| First PRB prior to frequency hopping | 0 | |
| Intra-slot frequency hopping | Enabled | |
| First PRB after frequency hopping | N/A | |
| Group and sequence hopping | neither | |
| Hopping ID | 0 | |
| Initial cyclic shift | 0 | |
| First symbol | 12 for 2 symbols | |

6) The multipath fading emulators shall be configured according to the corresponding channel model defined in annex G.2.

7) Adjust the test signal mean power so the calibrated radiated SNR value at the SAN receiver is as specified in clause 11.3.1.5.1 and 11.3.1.5.2 for *SAN type 1-O* and *SAN type 2-O* respectively, and that the SNR at the SAN receiver is not impacted by the noise floor.

The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level quoted in table 11.3.1.4.2-2.

**Table 11.3.1.4.2-2: AWGN power level at the SAN input**

|  |  |  |  |
| --- | --- | --- | --- |
| **SAN type** | **Sub-carrier spacing (kHz)** | **Channel bandwidth (MHz)** | **AWGN power level** |
| SAN type 1-O (Note 2) | 15 | 5 | -86.5 - ΔOTAREFSENS dBm / 4.5 MHz |
| 30 | 10 | -83.6 - ΔOTAREFSENS dBm / 8.64 MHz |
| SAN type 2-O (Note 5) | 120 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 46.08 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.43 in table 4.6-1 and clause 10.1.  NOTE 2: The AWGN power level contains an AWGN offset of 16dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 16dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level.  NOTE 3: ΔFR2\_REFSENS = -3 dB as described in clause 10.1, since the OTA REFSENS reference direction (as declared in D.54 in table 4.6-1) is used for testing.  NOTE 4: EISREFSENS\_50M as declared in D.xx in table 4.6-1.  NOTE 5: The AWGN power level contains an AWGN offset of 15dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 15dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level. | | | |

8) The signal generator sends a test pattern with the pattern outlined in figure 11.3.1.4.2-1. The following statistics are kept: the number of ACKs detected in the idle periods and the number of missed ACKs.

****

**Figure 11.3.1.4.2-1: Test signal pattern for single user PUCCH format 0 demodulation tests**

11.3.1.5 Test Requirement

11.3.1.5.1 Test requirement for *SAN type 1-O*

The fraction of falsely detected ACKs shall be less than 1% and the fraction of correctly detected ACKs shall be larger than 99% for the SNR listed in table 11.3.1.5.1-1 and in table 11.3.1.5.1-2.

**Table 11.3.1.5.1-1: Required SNR for PUCCH format 0, 15 kHz SCS and 5MHz channel bandwidth**

|  |  |  |  |
| --- | --- | --- | --- |
| **Number of**  **TX antennas** | **Number of demodulation branches** | **Propagation conditions and**  **correlation matrix (Annex X)** | **SNR (dB)** |
| 1 | 1 | NTN-TDLA100-200 Low | 9.5 |
| 2 | NTN-TDLA100-200 Low | 3.9 |

**Table 11.3.1.5.1-2: Required SNR for PUCCH format 0, 30 kHz SCS and 10MHz channel bandwidth**

|  |  |  |  |
| --- | --- | --- | --- |
| **Number of**  **TX antennas** | **Number of demodulation branches** | **Propagation conditions and**  **correlation matrix (Annex X)** | **SNR (dB)** |
| 1 | 1 | NTN-TDLA100-200 Low | 11.7 |
| 2 | NTN-TDLA100-200 Low | 5.4 |

11.3.1.5.2 Test requirement for *SAN type 2-O*

The fraction of falsely detected ACKs shall be less than 1% and the fraction of correctly detected ACKs shall be larger than 99% for the SNR listed in table 11.3.1.5.2-1.

**Table 11.3.1.5.2-1: Required SNR for PUCCH format 0, 120 kHz SCS and 50MHz channel bandwidth**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Number of**  **TX antennas** | **Number of demodulation branches** | **Propagation conditions and**  **correlation matrix (Annex G)** | **Number of OFDM symbols** | **SNR (dB)** |
| 1 | 1 | NTN-TDLC5-1200 Low | 2 | TBD |
| 2 | NTN-TDLC5-1200 Low | 2 | [1.9] |

11.3.2 Performance requirements for PUCCH format 1

11.3.2.1 NACK to ACK detection

11.3.2.1.1 Definition and applicability

The performance requirement of PUCCH format 1 for NACK to ACK detection is determined by the two parameters: probability of false detection of the ACK and the NACK to ACK detection probability. The performance is measured by the required SNR at probability of the NACK to ACK detection equal to 0.1% or less. The probability of false detection of the ACK shall be 0.01 or less.

The probability of false detection of the ACK is defined as a conditional probability of erroneous detection of the ACK at particular bit position when input is only noise. Each false bit detection is counted as one error.

The NACK to ACK detection probability is the probability of detecting an ACK bit when a NACK bit was sent on particular bit position. Each NACK bit erroneously detected as ACK bit is counted as one error. Erroneously detected NACK bits in the definition do not contain the NACK bits which are mapped from DTX, i.e., NACK bits received when DTX is sent should not be considered.

The transient period as specified in TS 38.101-5 [12] clause 6.3.3 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the CC center, i.e., intra-slot frequency hopping is enabled.

Which specific test(s) are applicable to SAN is based on the test applicability rules defined in clause 11.1.3.

11.3.2.1.2 Minimum Requirement

For SAN type 1-O, the minimum requirement is in TS 38.108 [2], clause 11.3.1.3.

For SAN type 2-O, the minimum requirement is in TS 38.108 [2], clause [11.3.2.3].

11.3.2.1.3 Test purpose

The test shall verify the receiver's ability not to falsely detect NACK bits as ACK bits under multipath fading propagation conditions for a given SNR.

11.3.2.1.4 Method of test

11.3.2.1.4.1 Initial Conditions

Test environment: Normal, see Annex B.2.

RF channels to be tested for single carrier: M; see clause 4.9.1

Direction to be tested: OTA REFSENS receiver target reference direction (see D.44 in table 4.6-1).

11.3.2.1.4.2 Procedure

1) Place the SAN with its manufacturer declared coordinate system reference point in the same place as calibrated point in the test system, as shown in annex D.7.

2) Align the manufacturer declared coordinate system orientation of the SAN with the test system.

3) Set the SAN in the declared direction to be tested.

4) Connect the SAN tester generating the wanted signal, multipath fading simulators and AWGN generators to a test antenna via a combining network in OTA test setup, as shown in annex D.7. Each of the demodulation branch signals should be transmitted on one polarization of the test antenna(s).

5) The characteristics of the wanted signal shall be configured according to TS 38.211 [8], and according to additional test parameters listed in table 11.3.2.1.4.2-1.

**Table 11.3.2.1.4.2-1: Test parameters**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Test** | |
| **SAN type 1-O** | **SAN type 2-O** |
| Number of information bits | 2 | |
| Number of PRBs | 1 | |
| Number of symbols | 14 | |
| First PRB prior to frequency hopping | 0 | |
| Intra-slot frequency hopping | enabled | |
| First PRB after frequency hopping | The largest PRB index - (nrofPRBs - 1) | |
| Group and sequence hopping | neither | |
| Hopping ID | 0 | |
| Initial cyclic shift | 0 | |
| First symbol | 0 | |
| Index of orthogonal cover code (*timeDomainOCC*) | 0 | |

6) The multipath fading emulators shall be configured according to the corresponding channel model defined in annex G.2.

7) Adjust the test signal mean power so the calibrated radiated SNR value at the SAN receiver is as specified in clause 11.3.2.1.5.1 and 11.3.2.1.5.2 for SAN type 1-O and SAN type 2-O respectively, and that the SNR at the SAN receiver is not impacted by the noise floor.

The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level in table 11.3.2.1.4.2-2.

**Table 11.3.2.1.4.2-2: AWGN power level at the SAN input**

|  |  |  |  |
| --- | --- | --- | --- |
| **SAN type** | **Subcarrier spacing (kHz)** | **Channel bandwidth (MHz)** | **AWGN power level** |
| SAN type 1-O (Note 2) | 15 kHz | 5 | -86.5 - ΔOTAREFSENS dBm / 4.5 MHz |
| 30 kHz | 10 | -83.6 – ΔOTAREFSENS dBm / 8.64 MHz |
| SAN type 2-O (Note 5) | 120 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 46.08 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.43 in table 4.6-1 and clause 10.1.  NOTE 2: The AWGN power level contains an AWGN offset of 16dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 16dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level.  NOTE 3: ΔFR2\_REFSENS = -3 dB as described in clause 10.1, since the OTA REFSENS reference direction (as declared in D.54 in table 4.6-1) is used for testing.  NOTE 4: EISREFSENS\_50M as declared in D.xx in table 4.6-1.  NOTE 5: The AWGN power level contains an AWGN offset of 15dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 15dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level. | | | |

8) The signal generator sends random codeword from applicable codebook, in regular time periods. The following statistics are kept: the number of ACK bits detected in the idle periods and the number of NACK bits detected as ACK.

11.3.2.1.5 Test Requirement

11.3.2.1.5.1 Test Requirement for *SAN type 1-O*

The fraction of falsely detected ACK bits shall be less than 1 % and the fraction of NACK bits falsely detected as ACK shall be less than 0.1 % for the SNR listed in tables 11.3.2.1.5.1-1 and table 11.3.2.1.5.1-2.

**Table 11.3.2.1.5.1-1: Required SNR for PUCCH format 1 with 15 kHz SCS 5MHz channel bandwidth**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Number of**  **TX antennas** | **Number of demodulation branches** | **Cyclis Prefix** | **Propagation conditions and**  **correlation matrix (Annex X)** | **SNR (dB)** |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 2.8 |
| 2 | Normal | NTN-TDLA100-200 Low | -3.5 |

**Table 11.3.2.1.5.1-2: Required SNR for PUCCH format 1 with 30 kHz SCS 10MHz channel bandwidth**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Number of**  **TX antennas** | **Number of demodulation branches** | **Cyclis Prefix** | **Propagation conditions and**  **correlation matrix (Annex X)** | **SNR (dB)** |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 3.6 |
| 2 | Normal | NTN-TDLA100-200 Low | -2.9 |

11.3.2.1.5.2 Test Requirement for *SAN type 2-O*

The fraction of falsely detected ACK bits shall be less than 1 % and the fraction of NACK bits falsely detected as ACK shall be less than 0.1 % for the SNR listed in tables 11.3.2.1.5.2-1.

**Table 11.3.2.1.5.2-1: Required SNR for PUCCH format 1 with 120 kHz SCS 50MHz channel bandwidth**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Number of**  **TX antennas** | **Number of demodulation branches** | **Cyclis Prefix** | **Propagation conditions and**  **correlation matrix (Annex G)** | **SNR (dB)** |
| 1 | 1 | Normal | NTN-TDLC5-1200 Low | [-0.4] |
| 2 | Normal | NTN-TDLC5-1200 Low | [-4.7] |

11.3.2.2 ACK missed detection

11.3.2.2.1 Definition and applicability

The performance requirement of PUCCH format 1 for ACK missed detection is determined by the two parameters: probability of false detection of the ACK and the probability of detection of ACK. The performance is measured by the required SNR at probability of detection equal to 0.99. The probability of false detection of the ACK shall be 0.01 or less.

The probability of false detection of the ACK is defined as a conditional probability of erroneous detection of the ACK when input is only noise.

The probability of detection of ACK is defined as conditional probability of detection of the ACK when the signal is present.

The transient period as specified in TS 38.101-5 [12] clause 6.3.3 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the CC center, i.e., intra-slot frequency hopping is enabled.

Which specific test(s) are applicable to SAN is based on the test applicability rules defined in clause 11.1.3.

11.3.2.2.2 Minimum Requirement

For SAN type 1-O, the minimum requirement is in TS 38.108 [2], clause 11.3.1.3.

For SAN type 2-O, the minimum requirement is in TS 38.108 [2], clause [11.3.2.3].

11.3.2.2.3 Test purpose

The test shall verify the receiver's ability to detect ACK bits under multipath fading propagation conditions for a given SNR.

11.3.2.2.4 Method of test

11.3.2.2.4.1 Initial Conditions

Test environment: Normal, see Annex B.2.

RF channels to be tested for single carrier: M; see clause 4.9.1

Direction to be tested: OTA REFSENS receiver target reference direction (see D.44 in table 4.6-1).

11.3.2.2.4.2 Procedure

1) Place the SAN with its manufacturer declared coordinate system reference point in the same place as calibrated point in the test system, as shown in annex D.7.

2) Align the manufacturer declared coordinate system orientation of the SAN with the test system.

3) Set the SAN in the declared direction to be tested.

4) Connect the SAN tester generating the wanted signal, multipath fading simulators and AWGN generators to a test antenna via a combining network in OTA test setup, as shown in annex D.7. Each of the demodulation branch signals should be transmitted on one polarization of the test antenna(s).

5) The characteristics of the wanted signal shall be configured according to TS 38.211 [8], and according to additional test parameters listed in table 11.3.2.2.4.2-1.

**Table 11.3.2.2.4.2-1: Test Parameters**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Value** | |
| **SAN type 1-O** | **SAN type 2-O** |
| Number of information bits | 2 | |
| Number of PRBs | 1 | |
| Number of symbols | 14 | |
| First PRB prior to frequency hopping | 0 | |
| Intra-slot frequency hopping | enabled | |
| First PRB after frequency hopping | The largest PRB index – (nrofPRBS – 1) | |
| Group and sequence hopping | neither | |
| Hopping ID | 0 | |
| Initial cyclic shift | 0 | |
| First symbol | 0 | |
| Index of orthogonal cover code (*timeDomainOCC*) | 0 | |

6) The multipath fading emulators shall be configured according to the corresponding channel model defined in annex G.2.

7) Adjust the test signal mean power so the calibrated radiated SNR value at the SAN receiver is as specified in clause 11.3.2.2.5.1 and 11.3.2.2.5.2 for SAN type 1-O and SAN type 2-O respectively, and that the SNR at the SAN receiver is not impacted by the noise floor.

The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level in table 11.3.2.2.4.2-2.

**Table 11.3.2.2.4.2-2: AWGN power level at the SAN input**

|  |  |  |  |
| --- | --- | --- | --- |
| **SAN type** | **Subcarrier spacing (kHz)** | **Channel bandwidth (MHz)** | **AWGN power level** |
| SAN type 1-O (Note 2) | 15 kHz | 5 | -86.5 – ΔOTAREFSENS dBm / 4.5 MHz |
| 30 kHz | 10 | -83.6 – ΔOTAREFSENS dBm / 8.64 MHz |
| SAN type 2-O (Note 5) | 120 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 46.08 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.43 in table 4.6-1 and clause 10.1.  NOTE 2: The AWGN power level contains an AWGN offset of 16dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 16dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level.  NOTE 3: ΔFR2\_REFSENS = -3 dB as described in clause 10.1, since the OTA REFSENS reference direction (as declared in D.54 in table 4.6-1) is used for testing.  NOTE 4: EISREFSENS\_50M as declared in D.xx in table 4.6-1.  NOTE 5: The AWGN power level contains an AWGN offset of 15dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 15dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level. | | | |

8) The signal generator sends random codewords from applicable codebook, in regular time periods. The following statistics are kept: the number of ACK bits falsely detected in the idle periods and the number of missed ACK bits. Each falsely detected ACK bit in the idle periods is accounted as one error for the statistics of false ACK detection, and each missed ACK bit is accounted as one error for the statistics of missed ACK detection.

Note that the procedure described in this clause for ACK missed detection has the same condition as that described in clause 11.3.2.1.4.2 for NACK to ACK detection. Both statistics are measured in the same testing.

11.3.2.2.5 Test Requirement

11.3.2.2.5.1 Test Requirement for SAN type 1-O

The fraction of falsely detected ACK bits shall be less than 1% and the fraction of correctly detected ACK bits shall be larger than 99% for the SNR listed in tables 11.3.2.2.5-1 and table 11.3.2.2.5-2.

**Table 11.3.2.2.5.1-1: Required SNR for PUCCH format 1 with 15 kHz SCS 5MHz channel bandwidth**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Number of**  **TX antennas** | **Number of demodulation branches** | **Cyclis Prefix** | **Propagation conditions and**  **correlation matrix (Annex X)** | **SNR (dB)** |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 2.1 |
| 2 | Normal | NTN-TDLA100-200 Low | -4.0 |

**Table 11.3.2.2.5.1-2: Required SNR for PUCCH format 1 with 30 kHz SCS 10MHz channel bandwidth**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Number of**  **TX antennas** | **Number of demodulation branches** | **Cyclis Prefix** | **Propagation conditions and**  **correlation matrix (Annex X)** | **SNR (dB)** |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 3.7 |
| 2 | Normal | NTN-TDLA100-200 Low | -2.8 |

11.3.2.2.5.2 Test Requirement for SAN type 2-O

The fraction of falsely detected ACK bits shall be less than 1% and the fraction of correctly detected ACK bits shall be larger than 99% for the SNR listed in tables 11.3.2.2.5.2-1.

**Table 11.3.2.2.5.2-1: Required SNR for PUCCH format 1 with 120 kHz SCS 50MHz channel bandwidth**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Number of**  **TX antennas** | **Number of demodulation branches** | **Cyclis Prefix** | **Propagation conditions and**  **correlation matrix (Annex G)** | **SNR (dB)** |
| 1 | 1 | Normal | NTN-TDLC5-1200 Low | [-0.8] |
| 2 | Normal | NTN-TDLC5-1200 Low | [-5.3] |

11.3.3 Performance requirements for PUCCH format 2

11.3.3.1 ACK missed detection performance requirements

11.3.3.1.1 Definition and applicability

The performance requirement of PUCCH format 2 for ACK missed detection is determined by the two parameters: probability of false detection of the ACK and the probability of detection of ACK on the wanted signal. The performance is measured by the required SNR at probability of detection equal to 0.99. The probability of false detection of the ACK shall be 0.01 or less.

The probability of false detection of the ACK is defined as a probability of erroneous detection of the ACK when input is only noise.

The probability of detection of ACK is defined as probability of detection of the ACK when the signal is present.

Which specific test(s) are applicable to SAN is based on the test applicability rules defined in clause 11.1.3.

The transient period as specified in TS 38.101-5 [12] clause 6.3.3 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the CC center, i.e., intra-slot frequency hopping is enabled.

11.3.3.1.2 Minimum Requirement

For *SAN type 1-O*, the minimum requirement is in TS 38.108 [2] clause 11.3.1.4.

For *SAN type 2-O*, the minimum requirement is in TS 38.108 [2] clause [11.3.2.4].

11.3.3.1.3 Test Purpose

The test shall verify the receiver's ability to detect ACK bits under multipath fading propagation conditions for a given SNR.

11.3.3.1.4 Method of test

11.3.3.1.4.1 Initial conditions

Test environment: Normal, see Annex B.2.

RF channels to be tested for single carrier; M; see clause 4.9.1.

Direction to be tested: OTA REFSENS *receiver target reference direction* (see D.44 in table.4.6-1).

11.3.3.1.4.2 Procedure

1) Place the SAN with its manufacturer declared coordinate system reference point in the same place as calibrated point in the test system, as shown in annex D.7.

2) Align the manufacturer declared coordinate system orientation of the SAN with the test system.

3) Set the SAN in the declared direction to be tested.

4) Connect the SAN tester generating the wanted signal, multipath fading simulators and AWGN generators to a test antenna via a combining network in OTA test setup, as shown in annex D.7. Each of the demodulation branch signals should be transmitted one polarization of the test antenna(s).

5) The characteristics of the wanted signal shall be configured according to TS 38.211 [8], and according to additional test parameters listed in table 11.3.3.1.4.2-1.

**Table 11.3.3.1.4.2-1: Test parameters**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Value** | |
| **SAN type 1-O** | **SAN type 2-O** |
| Modulation order | QPSK | |
| First PRB prior to frequency hopping | 0 | |
| Intra-slot frequency hopping | N/A | |
| First PRB after frequency hopping | The largest PRB index - (Number of PRBs-1) | |
| Number of PRBs | 4 | |
| Number of symbols | 1 | |
| The number of UCI information bits | 4 | |
| First symbol | 13 | |
| DM-RS sequence generation | *NID*0=0 | |

6) The multipath fading emulators shall be configured according to the corresponding channel model defined in annex G.2.

7) Adjust the test signal mean power so the calibrated radiated SNR value at the SAN receiver is as specified in clause 11.3.3.1.5.1 and 11.3.3.1.5.2 for *SAN type 1-O* and *SAN type 2-O* respectively, and that the SNR at the SAN receiver is not impacted by the noise floor.

The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level in table 11.3.3.1.4.2-2.

**Table 11.3.3.1.4.2-2: AWGN power level at the SAN input**

|  |  |  |  |
| --- | --- | --- | --- |
| **SAN type** | **Sub-carrier spacing**  **(kHz)** | **Channel bandwidth**  **(MHz)** | **AWGN power level** |
| SAN type 1-O (Note 2) | 15 kHz | 5 | -86.5 - ΔOTAREFSENS dBm / 4.5 MHz |
| 30 kHz | 10 | -83.6 - ΔOTAREFSENS dBm / 8.64 MHz |
| SAN type 2-O (Note 5) | 120 kHz | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 46.08 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.43 in table 4.6-1 and clause 10.1.  NOTE 2: The AWGN power level contains an AWGN offset of 16dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 16dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level.  NOTE 3: ΔFR2\_REFSENS = -3 dB as described in clause 10.1, since the OTA REFSENS reference direction (as declared in D.54 in table 4.6-1) is used for testing.  NOTE 4: EISREFSENS\_50M as declared in D.xx in table 4.6-1.  NOTE 5: The AWGN power level contains an AWGN offset of 15dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 15dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level. | | | |

8) The signal generator sends a test pattern with pattern outlined in figure 11.3.3.1.4.2-1. The following statistics are kept: the number of ACK bits detected in the idle periods and the number of missed ACKs.

****

**Figure 11.3.3.1.4.2-1: Test signal pattern for PUCCH format 2 demodulation tests**

11.3.3.1.5 Test requirement

11.3.3.1.5.1 Requirements for SAN type 1-O

The fraction of falsely detected ACKs shall be less than 1% and the fraction of correctly detected ACKs shall be larger than 99% for the SNR listed in table 11.3.3.1.5.1-1 and table 11.3.3.1.5.1-2.

**Table 11.3.3.1.5.1-1: Required SNR for PUCCH format 2 with 15 kHz SCS 5MHz channel bandwidth**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Number of**  **TX antennas** | **Number of demodulation branches** | **Cyclis Prefix** | **Propagation conditions and**  **correlation matrix (Annex X)** | **SNR (dB)** |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 15.2 |
| 2 | Normal | NTN-TDLA100-200 Low | 5.3 |

**Table 11.3.3.1.5.1-2: Required SNR for PUCCH format 2 with 30 kHz SCS 10MHz channel bandwidth**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Number of**  **TX antennas** | **Number of demodulation branches** | **Cyclis Prefix** | **Propagation conditions and**  **correlation matrix (Annex X)** | **SNR (dB)** |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 12.6 |
| 2 | Normal | NTN-TDLA100-200 Low | 5.0 |

11.3.3.1.5.2 Requirements for SAN type 2-O

The fraction of falsely detected ACKs shall be less than 1% and the fraction of correctly detected ACKs shall be larger than 99% for the SNR listed in table 11.3.3.1.5.2-1.

**Table 11.3.3.1.5.2-1: Required SNR for PUCCH format 2 with 120 kHz SCS 50MHz channel bandwidth**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Number of**  **TX antennas** | **Number of demodulation branches** | **Cyclis Prefix** | **Propagation conditions and**  **correlation matrix (Annex G)** | **SNR (dB)** |
| 1 | 1 | Normal | NTN-TDLC5-1200 Low | [5.6] |
| 2 | Normal | NTN-TDLC5-1200 Low | [0.9] |

11.3.3.2 UCI BLER performance requirements

11.3.3.2.1 Definition and applicability

The UCI block error probability is defined as the probability of incorrectly decoding the UCI information when the UCI information is sent. The UCI information does not contain CSI part 1 and part 2.

Which specific test(s) are applicable to SAN is based on the test applicability rules defined in clause 11.1.3.

The transient period as specified in TS 38.101-5 [12] clause 6.3.3 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the CC center, i.e., intra-slot frequency hopping is enabled.

11.3.3.2.2 Minimum Requirement

For *SAN type 1-O*, the minimum requirement is in TS 38.108 [2] clause 11.3.1.4.

For *SAN type 2-O*, the minimum requirement is in TS 38.108 [2] clause [11.3.2.4].

11.3.3.2.3 Test Purpose

The test shall verify the receiver's ability to detect UCI under multipath fading propagation conditions for a given SNR.

11.3.3.2.4 Method of test

11.3.3.2.4.1 Initial conditions

Test environment: Normal, see Annex B.2.

RF channels to be tested for single carrier: M; see clause 4.9.1

Direction to be tested: OTA REFSENS *receiver target reference direction* (see D.44 in table 4.6-1).

11.3.3.2.4.2 Procedure

1) Place the SAN with its manufacturer declared coordinate system reference point in the same place as calibrated point in the test system, as shown in annex D.7.

2) Align the manufacturer declared coordinate system orientation of the SAN with the test system.

3) Set the SAN in the declared direction to be tested.

4) Connect the SAN tester generating the wanted signal, multipath fading simulators and AWGN generators to a test antenna via a combining network in OTA test setup, as shown in annex D.7. Each of the demodulation branches signals should be transmitted on each polarization of the test antenna(s).

5) The characteristics of the wanted signal shall be configured according to TS 38.211 [8], and according to additional test parameters listed in table 11.3.3.2.4.2-1.

**Table 11.3.3.2.4.2-1: Test parameters**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Value** | |
| **SAN type 1-O** | **SAN type 2-O** |
| Modulation order | QPSK | |
| First PRB prior to frequency hopping | 0 | |
| Intra-slot frequency hopping | enabled | |
| First PRB after frequency hopping | The largest PRB index - (Number of PRBs-1) | |
| Number of PRBs | 9 | |
| Number of symbols | 2 | |
| The number of UCI information bits | 22 | |
| First symbol | 12 | |
| DM-RS sequence generation | *NID*0=0 | |

6) The multipath fading emulators shall be configured according to the corresponding channel model defined in annex G.2.

7) Adjust the test signal mean power so the calibrated radiated SNR value at the SAN receiver is as specified in clause 11.3.3.2.5.1 and 11.3.3.2.5.2 for *SAN type 1-O* and *SAN type 2-O* respectively, and that the SNR at the SAN receiver is not impacted by the noise floor.

The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level in table 11.3.3.2.4.2-2.

**Table 11.3.3.2.4.2-2: AWGN power level at the SAN input**

|  |  |  |  |
| --- | --- | --- | --- |
| **SAN type** | **Sub-carrier spacing**  **(kHz)** | **Channel bandwidth**  **(MHz)** | **AWGN power level** |
| SAN type 1-O (Note 2) | 15 kHz | 5 | -86.5 - ΔOTAREFSENS dBm / 4.5 MHz |
| 30 kHz | 10 | -83.6 - ΔOTAREFSENS dBm / 8.64 MHz |
| SAN type 2-O (Note 5) | 120 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 46.08 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.43 in table 4.6-1 and clause 10.1.  NOTE 2: The AWGN power level contains an AWGN offset of 16dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 16dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level.  NOTE 3: ΔFR2\_REFSENS = -3 dB as described in clause 10.1, since the OTA REFSENS reference direction (as declared in D.54 in table 4.6-1) is used for testing.  NOTE 4: EISREFSENS\_50M as declared in D.xx in table 4.6-1.  NOTE 5: The AWGN power level contains an AWGN offset of 15dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 15dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level. | | | |

8) The signal generator sends a test pattern with the pattern outlined in figure 11.3.3.2.4.2-1. The following statistics are kept: the number of incorrectly decoded UCI.

****

**Figure 11.3.3.2.4.2-1: Test signal pattern for PUCCH format 2 demodulation tests**

11.3.3.2.5 Test requirement

11.3.3.2.5.1 Requirements for SAN type 1-O

The fraction of incorrectly decoded UCI shall be less than 1% for the SNR listed in table 11.3.3.2.5.1-1 and table 11.3.3.2.5.1-2.

**Table 11.3.3.2.5.1-1: Required SNR for PUCCH format 2 with 15 kHz SCS 5MHz channel bandwidth**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Number of**  **TX antennas** | **Number of demodulation branches** | **Cyclis Prefix** | **Propagation conditions and**  **correlation matrix (Annex X)** | **SNR (dB)** |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 6.9 |
| 2 | Normal | NTN-TDLA100-200 Low | 1.4 |

**Table 11.3.3.2.5.1-2: Required SNR for PUCCH format 2 with 30 kHz SCS 10MHz channel bandwidth**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Number of**  **TX antennas** | **Number of demodulation branches** | **Cyclis Prefix** | **Propagation conditions and**  **correlation matrix (Annex X)** | **SNR (dB)** |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 7.0 |
| 2 | Normal | NTN-TDLA100-200 Low | 1.1 |

11.3.3.2.5.2 Requirements for SAN type 2-O

The fraction of incorrectly decoded UCI shall be less than 1% for the SNR listed in table 11.3.3.2.5.2-1.

**Table 11.3.3.2.5.2-1: Required SNR for PUCCH format 2 with 120 kHz SCS 50MHz channel bandwidth**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Number of**  **TX antennas** | **Number of demodulation branches** | **Cyclis Prefix** | **Propagation conditions and**  **correlation matrix (Annex G)** | **SNR (dB)** |
| 1 | 1 | Normal | NTN-TDLC5-1200 Low | [4.8] |
| 2 | Normal | NTN-TDLC5-1200 Low | [-1.0] |

11.3.4 Performance requirements for PUCCH format 3

11.3.4.1 Definition and applicability

The performance is measured by the required SNR at UCI block error probability not exceeding 1%.

The UCI block error probability is defined as the conditional probability of incorrectly decoding the UCI information when the UCI information is sent. The UCI information does not contain CSI part 1 and part 2.

The transient period as specified in TS 38.101-5 [12] clause 6.3.3 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the CC center, i.e. intra-slot frequency hopping is enabled.

Which specific test(s) are applicable to SAN is based on the test applicability rules defined in clause 11.1.3.

11.3.4.2 Minimum requirement

For *SAN type 1-O*, the minimum requirement is in TS 38.108 [2], clause 11.3.1.5.

For *SAN type 2-O*, the minimum requirement is in TS 38.108 [2], clause [11.3.2.5].

11.3.4.3 Test purpose

The test shall verify the receiver's ability to detect UCI under multipath fading propagation conditions for a given SNR.

11.3.4.4 Method of test

11.3.4.4.1 Initial conditions

Test environment: Normal, see Annex B.2.

RF channels to be tested for single carrier: M; see clause 4.9.1

Direction to be tested:

- OTA REFSENS *receiver target reference direction* (see D.44 in table 4.6-1).

11.3.4.4.2 Procedure

1) Place the SAN with its manufacturer declared coordinate system reference point in the same place as calibrated point in the test system, as shown in annex D.7.

2) Align the manufacturer declared coordinate system orientation of the SAN with the test system.

3) Set the SAN in the declared direction to be tested.

4) Connect the SAN tester generating the wanted signal, multipath fading simulators and AWGN generators to a test antenna via a combining network in OTA test setup, as shown in annex D.7. Each of the demodulation branch signals should be transmitted on one polarization of the test antenna(s).

5) The characteristics of the wanted signal shall be configured according to TS 38.211 [8], and according to additional test parameters listed in table 11.3.4.4.2-1.

**Table 11.3.4.4.2-1: Test parameters**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Test** | |
| **SAN type 1-O** | **SAN type 2-O** |
| Modulation order | QPSK | |
| First PRB prior to frequency hopping | 0 | |
| Intra-slot frequency hopping | enabled | |
| First PRB after frequency hopping | The largest PRB index – (Number of PRBs – 1) | |
| Group and sequence hopping | neither | |
| Hopping ID | 0 | |
| Number of PRBs | 1 | |
| Number of symbols | 14 | |
| The number of UCI information bits | 16 | |
| First symbol | 0 | |

6) The multipath fading emulators shall be configured according to the corresponding channel model defined in annex G.2.

7) Adjust the test signal mean power so the calibrated radiated SNR value at the SAN receiver is as specified in clause 11.3.4.5.1 and 11.3.4.5.2 for *SAN type 1-O* and *SAN type 2-O* respectively, and the SNR at the SAN receiver is not impacted by the noise floor.

The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level in table 11.3.4.4.2-2.

**Table 11.3.4.4.2-2: AWGN power level at the SAN input**

|  |  |  |  |
| --- | --- | --- | --- |
| **SAN type** | **Subcarrier spacing**  **(kHz)** | **Channel bandwidth (MHz)** | **AWGN power level** |
| SAN type 1-O (Note 2) | 15 | 5 | -86.5 - ΔOTAREFSENS dBm / 4.5MHz |
| 30 | 10 | -83.6 - ΔOTAREFSENS dBm / 8.64MHz |
| SAN type 2-O (Note 5) | 120 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 46.08 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.43 in table 4.6-1 and clause 10.1.  NOTE 2: The AWGN power level contains an AWGN offset of 16dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 16dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level.  NOTE 3: ΔFR2\_REFSENS = -3 dB as described in clause 10.1, since the OTA REFSENS reference direction (as declared in D.54 in table 4.6-1) is used for testing.  NOTE 4: EISREFSENS\_50M as declared in D.xx in table 4.6-1.  NOTE 5: The AWGN power level contains an AWGN offset of 15dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 15dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level. | | | |

11.3.4.5 Test requirement

11.3.4.5.1 Test requirement for *SAN type 1-O*

The fraction of incorrectly decoded UCI shall be less than 1% for the SNR listed in table 11.3.4.5.1-1 and table 11.3.4.5.1-2.

**Table 11.3.4.5.1-1: Required SNR for PUCCH format 3 with 15 kHz SCS 5MHz channel bandwidth**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of**  **TX antennas** | **Number of demodulation branches** | **Cyclis Prefix** | **Propagation conditions and**  **correlation matrix (Annex X)** | **Additioan DM-RS configuration** | **SNR (dB)** |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | No additional DM-RS | 7.2 |
| Additional DM-RS | 7.0 |
| 2 | Normal | NTN-TDLA100-200 Low | No additional DM-RS | 0.9 |
| Additional DM-RS | 0.6 |

**Table 11.3.4.5.1-2: Required SNR for PUCCH format 3 with 30 kHz SCS 10MHz channel bandwidth**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of**  **TX antennas** | **Number of demodulation branches** | **Cyclis Prefix** | **Propagation conditions and**  **correlation matrix (Annex X)** | **Additioan DM-RS configuration** | **SNR (dB)** |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | No additional DM-RS | 9.8 |
| Additional DM-RS | 9.2 |
| 2 | Normal | NTN-TDLA100-200 Low | No additional DM-RS | 2.2 |
| Additional DM-RS | 1.9 |

11.3.4.5.2 Test requirement for *SAN type 2-O*

The fraction of incorrectly decoded UCI shall be less than 1% for the SNR listed in table 11.3.4.5.2-1.

**Table 11.3.4.5.2-1: Required SNR for PUCCH format 3 with 120 kHz SCS 50MHz channel bandwidth**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of**  **TX antennas** | **Number of demodulation branches** | **Cyclis Prefix** | **Propagation conditions and**  **correlation matrix (Annex G)** | **Additioan DM-RS configuration** | **SNR (dB)** |
| 1 | 1 | Normal | NTN-TDLC5-1200 Low | No additional DM-RS | [2.5] |
| Additional DM-RS | [2.0] |
| 2 | Normal | NTN-TDLC5-1200 Low | No additional DM-RS | [-1.4] |
| Additional DM-RS | [-2.0] |

11.3.5 Performance requirements for PUCCH format 4

11.3.5.1 Definition and applicability

The performance is measured by the required SNR at UCI block error probability not exceeding 1%.

The UCI block error probability is defined as the conditional probability of incorrectly decoding the UCI information when the UCI information is sent. The UCI information does not contain CSI part 1 and part 2.

The transient period as specified in TS 38.101-5 [12] clause 6.3.3 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the CC center, i.e., intra-slot frequency hopping is enabled.

Which specific test(s) are applicable to SAN is based on the test applicability rules defined in clause 11.1.3.

11.3.5.2 Minimum requirement

For *SAN type 1-O*, the minimum requirement is in TS 38.108 [2], clause 11.3.1.6.

For *SAN type 2-O*, the minimum requirement is in TS 38.108 [2], clause [11.3.2.6].

11.3.5.3 Test purpose

The test shall verify the receiver's ability to detect UCI under multipath fading propagation conditions for a given SNR.

11.3.5.4 Method of test

11.3.5.4.1 Initial conditions

Test environment: Normal, see Annex B.2.

RF channels to be tested for single carrier: M; see clause 4.9.1

Direction to be tested:

- OTA REFSENS *receiver target reference direction* (see D.44 in table 4.6-1).

11.3.5.4.2 Procedure

1) Place the SAN with its manufacturer declared coordinate system reference point in the same place as calibrated point in the test system, as shown in annex D.7.

2) Align the manufacturer declared coordinate system orientation of the SAN with the test system.

3) Set the SAN in the declared direction to be tested.

4) Connect the SAN tester generating the wanted signal, multipath fading simulators and AWGN generators to a test antenna via a combining network in OTA test setup, as shown in annex D.7. Each of the demodulation branch signals should be transmitted on one polarization of the test antenna(s).

5) The characteristics of the wanted signal shall be configured according to TS 38.211 [8], and according to additional test parameters listed in table 11.3.4.4.2-1.

**Table 11.3.5.4.2-1: Test parameters**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Value** | |
| **SAN type 1-O** | **SAN type 2-O** |
| Modulation order | QPSK | |
| First PRB prior to frequency hopping | 0 | |
| Number of PRBS | 1 | |
| Intra-slot frequency hopping | enabled | |
| First PRB after frequency hopping | The largest PRB index - (Number of PRBS - 1) | |
| Group and sequence hopping | neither | |
| Hopping ID | 0 | |
| Number of symbols | 14 | |
| The number of UCI information bits | 22 | |
| First symbol | 0 | |
| Length of the orthogonal cover code | n2 | |
| Index of the orthogonal cover code | n0 | |

6) The multipath fading emulators shall be configured according to the corresponding channel model defined in annex G.2.

7) Adjust the test signal mean power so the calibrated radiated SNR value at the SAN receiver is as specified in clause 11.3.5.5.1 and 11.3.5.5.2 for *SAN type 1-O* and *SAN type 2-O* respectively, and that the SNR at the SAN receiver is not impacted by the noise floor.

The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level in table 11.3.5.4.2-2.

**Table 11.3.5.4.2-2: AWGN power level at the SAN input**

|  |  |  |  |
| --- | --- | --- | --- |
| **SAN type** | **Subcarrier spacing**  **(kHz)** | **Channel bandwidth (MHz)** | **AWGN power level** |
| SAN type 1-O (Note 2) | 15 | 5 | -86.5 - ΔOTAREFSENS dBm / 4.5MHz |
| 30 | 10 | -83.6 - ΔOTAREFSENS dBm / 8.64MHz |
| SAN type 2-O (Note 5) | 120 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 46.08 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.43 in table 4.6-1 and clause 10.1.  NOTE 2: The AWGN power level contains an AWGN offset of 16dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 16dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level.  NOTE 3: ΔFR2\_REFSENS = -3 dB as described in clause 10.1, since the OTA REFSENS reference direction (as declared in D.54 in table 4.6-1) is used for testing.  NOTE 4: EISREFSENS\_50M as declared in D.xx in table 4.6-1.  NOTE 5: The AWGN power level contains an AWGN offset of 15dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 15dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level. | | | |

11.3.5.5 Test requirement

11.3.5.5.1 Test requirement for *SAN type 1-O*

The fraction of incorrectly decoded UCI shall be less than 1% for the SNR listed in table 11.3.5.5.1-1 and table 11.3.5.5.1-2.

**Table 11.3.5.5.1-1: Required SNR for PUCCH format 4 with 15 kHz SCS 5MHz channel bandwidth**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of**  **TX antennas** | **Number of demodulation branches** | **Cyclis Prefix** | **Propagation conditions and**  **correlation matrix (Annex G)** | **Additioan DM-RS configuration** | **SNR (dB)** |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | No additional DM-RS | 9.5 |
| Additional DM-RS | 9.2 |
| 2 | Normal | NTN-TDLA100-200 Low | No additional DM-RS | 3.1 |
| Additional DM-RS | 2.8 |

**Table 11.3.5.5.1-2: Required SNR for PUCCH format 4 with 30 kHz SCS 10MHz channel bandwidth**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of**  **TX antennas** | **Number of demodulation branches** | **Cyclis Prefix** | **Propagation conditions and**  **correlation matrix (Annex G)** | **Additioan DM-RS configuration** | **SNR (dB)** |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | No additional DM-RS | 11.1 |
| Additional DM-RS | 11.1 |
| 2 | Normal | NTN-TDLA100-200 Low | No additional DM-RS | 4.1 |
| Additional DM-RS | 3.9 |

11.3.5.5.2 Test requirement for *SAN type 2-O*

The fraction of incorrectly decoded UCI shall be less than 1% for the SNR listed in table 11.3.5.5.2-1.

**Table 11.3.5.5.2-1: Required SNR for PUCCH format 4 with 120 kHz SCS 50MHz channel bandwidth**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of**  **TX antennas** | **Number of demodulation branches** | **Cyclis Prefix** | **Propagation conditions and**  **correlation matrix (Annex G)** | **Additioan DM-RS configuration** | **SNR (dB)** |
| 1 | 1 | Normal | NTN-TDLC5-1200 Low | No additional DM-RS | TBD |
| Additional DM-RS | TBD |
| 2 | Normal | NTN-TDLC5-1200 Low | No additional DM-RS | [0.4] |
| Additional DM-RS | [-0.1] |

################## Start of Change #6 R4-2409870 ######################

################## Start of Change #7 R4-2409864 ######################

### 11.4.1 PRACH false alarm probability and missed detection

#### 11.4.1.1 Definition and applicability

The performance requirement of PRACH for preamble detection is determined by the two parameters: total probability of false detection of the preamble (Pfa) and the probability of detection of preamble (Pd). The performance is measured by the required SNR at probability of detection, Pd of 99%. Pfa shall be 0.1% or less.

Pfa is defined as a conditional total probability of erroneous detection of the preamble (i.e. erroneous detection from any detector) when input is only noise.

Pd is defined as conditional probability of detection of the preamble when the signal is present. The erroneous detection consists of several error cases – detecting only different preamble(s) than the one that was sent, not detecting any preamble at all, or detecting the correct preamble but with the out-of-bounds timing estimation value. For AWGN, NTN-TDLA100, and NTN-TDLC5-1200, a timing estimation error occurs if the estimation error of the timing of the strongest path is larger than the time error tolerance values given in table 11.4.1.1-1.

Table 11.4.1.1-1: Time error tolerance for AWGN, NTN-TDLA100, and NTN-TDLC5-1200

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| PRACH | PRACH SCS | Time error tolerance | | |
| preamble | (kHz) | AWGN | NTN-TDLA100 | NTN-TDLC5-1200 |
| 0 | 1.25 | 1.04 us | 1.324 us | N/A |
| 2 | 1.25 | 1.04 us | 1.324 us | N/A |
| B4, C2 | 15 | 0.52 us | 0.804 us | N/A |
| 30 | 0.26 us | 0.544 us | N/A |
| 120 | N/A | N/A | 0.13 us |

The test preambles are listed in table A.4. Which specific test(s) are applicable to SAN is based on the test applicability rules defined in clause 11.1.3.

#### 11.4.1.2 Minimum requirement

For *SAN type 1-O*, the minimum requirement is in TS 38.108 [2] clause 11.4.1.1 and 11.4.1.2.

For *SAN type 2-O*, the minimum requirement is in TS 38.108 [2] clause 11.4.2.1 and 11.4.2.2.

#### 11.4.1.3 Test purpose

The test shall verify the receiver's ability to detect PRACH preamble under static conditions and multipath fading propagation conditions for a given SNR.

#### 11.4.1.4 Method of test

##### 11.4.1.4.1 Initial conditions

Test environment: Normal, see clause B.2.

RF channels to be tested for single carrier: M, see clause 4.9.1.

Direction to be tested: OTA REFSENS *receiver target reference direction* (see D.44 in table 4.6-1).

##### 11.4.1.4.2 Procedure

1) Place the SAN with its manufacturer declared coordinate system reference point in the same place as calibrated point in the test system, as shown in annex D.7.

2) Align the manufacturer declared coordinate system orientation of the SAN with the test system.

3) Set the SAN in the declared direction to be tested.

4) Connect the SAN tester generating the wanted signal, multipath fading simulators and AWGN generators to a test antenna via a combining network in OTA test setup, as shown in annex D.7. Each of the demodulation branch signals should be transmitted on one polarization of the test antenna(s).

5) The characteristics of the wanted signal shall be configured according to the corresponding UL reference measurement channel defined in annex A and the test parameter *msg1-FrequencyStart* is set to 0.

6) The multipath fading emulators shall be configured according to the corresponding channel model defined in annex G.

7) Adjust the AWGN generator, according to the SCS and channel bandwidth. The power level for the transmission may be set such that the AWGN level at the RIB is equal to the AWGN level in table 11.4.1.4.2-1.

Table 11.4.1.4.2-1: AWGN power level at the SAN input

|  |  |  |  |
| --- | --- | --- | --- |
| SAN type | Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| SAN type 1-O (Note 2) | 15 | 5 | -83.5 - ΔOTAREFSENS dBm / 4.5MHz |
| 30 | 10 | -80.6 - ΔOTAREFSENS dBm / 8.64MHz |
| SAN type 2-O (Note 5) | 120 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 46.08 MHz |
| NOTE 1: ΔOTAREFSENS as declared in D.43 in table 4.6-1 and clause 10.1.  NOTE 2: The AWGN power level contains an AWGN offset of 16dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 16dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level.  NOTE 3: ΔFR2\_REFSENS = -3 dB as described in clause 10.1, since the OTA REFSENS receiver target reference direction (as declared in D.44 in table 4.6-1) is used for testing.  NOTE 4: EISREFSENS\_50M as declared in D.53 in table 4.6-1.  NOTE 5: The AWGN power level contains an AWGN offset of 15dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 15dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level. | | | |

8) Adjust the frequency offset of the test signal according to table 11.4.1.5.1-1 or 11.4.1.5.1-2 or 11.4.1.5.1-3 or 11.4.1.5.2-1.

9) Adjust the equipment so that the SNR specified in table 11.4.1.5.1-1 or 11.4.1.5.1-2 or 11.4.1.5.1-3 or 11.4.1.5.2-1is achieved at the SAN input during the PRACH preambles.

10) The test signal generator sends a preamble and the receiver tries to detect the preamble. This pattern is repeated as illustrated in figure 11.4.1.4.2-1. The preambles are sent with certain timing offsets as described below. The following statistics are kept: the number of preambles detected in the idle period and the number of missed preambles.



Figure 11.4.1.4.2-1: PRACH preamble test pattern

Unless otherwise stated, the timing offset base value for PRACH preamble format 0 and 2 is set to 50% of Ncs. This offset is increased within the loop, by adding in each step a value of 0.1us, until the end of the tested range, which is 0.9us. Then the loop is being reset and the timing offset is set again to 50% of Ncs. The timing offset scheme for PRACH preamble format 0 and 2 is presented in Figure 11.4.1.4.2-2.



Figure 11.4.1.4.2-2: Timing offset scheme for PRACH preamble format 0 and 2

Unless otherwise stated, the timing offset base value for PRACH preamble format B4 and C2 is set to 0. This offset is increased within the loop, by adding in each step a value of 0.1us, until the end of the tested range, which is 0.8us. Then the loop is being reset and the timing offset is set again to 0. The timing offset scheme for PRACH preamble format B4 and C2 is presented in Figure 11.4.1.4.2-3.



Figure 11.4.1.4.2-3: Timing offset scheme for PRACH preamble format B4 and C2

#### 11.4.1.5 Test requirement

##### 11.4.1.5.1 Test requirement for SAN *type 1-O*

Pfa shall not exceed 0.1%. Pd shall not be below 99% for the SNRs in tables 11.4.1.5.1-1 to 11.4.1.5.1-3.

Table 11.4.1.5.1-1: PRACH missed detection test requirements, 1.25 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (annex G) | Frequency offset | SNR (dB) | |
| Burst format 0 | Burst format 2 |
| 1 | 1 | AWGN | 0 | -11.7 | -17.1 |
| NTN-TDLA100 Low | 200 Hz | 1.3 | -9.1 |
| 2 | AWGN | 0 | -14.2 | -19.5 |
| NTN-TDLA100 Low | 200 Hz | -6.2 | -14.3 |

Table 11.4.1.5.1-2: PRACH missed detection test requirements, 15 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of TX** **antennas** | **Number of demodulation** **branches** | **Propagation conditions and** **correlation matrix (annex G)** | **Frequency offset** | **SNR (dB)** | |
| **Burst format B4** | **Burst format C2** |
| 1 | 1 | AWGN | 0 | -14.3 | -8.9 |
| NTN-TDLA100 Low | 200 Hz | -2.1 | 2.5 |
| 2 | AWGN | 0 | -16.5 | -12.2 |
| NTN-TDLA100 Low | 200 Hz | -8.4 | -4.2 |

Table 11.4.1.5.1-3: PRACH missed detection test requirements, 30 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (annex G) | Frequency offset | SNR (dB) | |
| Burst format B4 | Burst format C2 |
| 1 | 1 | AWGN | 0 | -14.1 | -8.9 |
| NTN-TDLA100 Low | 200 Hz | -3.7 | 0.7 |
| 2 | AWGN | 0 | -16.2 | -11.6 |
| NTN-TDLA100 Low | 200 Hz | -9.4 | -5.2 |

##### 11.4.1.5.2 Test requirement for SAN *type 2-O*

Pfa shall not exceed 0.1%. Pd shall not be below 99% for the SNRs in table 11.4.1.5.2-1.

Table 11.4.1.5.2-1: PRACH missed detection test requirements, 120 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Number of TX** **antennas** | **Number of demodulation** **branches** | **Propagation conditions and** **correlation matrix (annex G)** | **Frequency offset** | **SNR (dB)** | |
| **Burst format B4** | **Burst format C2** |
| 1 | 1 | NTN-TDLC5-1200 Low | 3000 Hz | [-5.7] | [-2.7] |
| 2 | NTN-TDLC5-1200 Low | 3000 Hz | [-11.3] | [-8.0] |

################## End of Change #7 R4-2409864 ######################

################## Start of Change #8 R4-2409865 ######################

# A.3 Fixed Reference Channels for performance requirements (QPSK, R=308/1024)

The parameters for the reference measurement channels are specified in table A.3-1 to table A.3-4 for FR1 PUSCH performance requirements:

- FRC parameters are specified in table A.3-1 for FR1 PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer.

- FRC parameters are specified in table A.3-2 for FR1 PUSCH with transform precoding enabled, additional DM-RS position = pos1 and 1 transmission layer.

- FRC parameters are specified in table A.3-3 for FR1 PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer.

* FRC parameters are specified in table A.3-4 for FR1-NTN PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer.

Table A.3-1: FRC parameters for FR1 PUSCH performance requirements, transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer (QPSK, R=308/1024)

|  |  |  |
| --- | --- | --- |
| Reference channel | G-FR1-A3-1 | G-FR1-A3-2 |
| Subcarrier spacing (kHz) | 15 | 30 |
| Allocated resource blocks | 25 | 24 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 |
| MCS table | 64QAM | 64QAM |
| Modulation | QPSK | QPSK |
| Code rate (Note 2) | 308/1024 | 308/1024 |
| Payload size (bits) | 2152 | 2088 |
| Transport block CRC (bits) | 16 | 16 |
| Code block CRC size (bits) | - | - |
| Number of code blocks - C | 1 | 1 |
| Code block size including CRC (bits) (Note 2) | 2168 | 2104 |
| Total number of bits per slot | 7200 | 6912 |
| Total symbols per slot | 3600 | 3456 |
| NOTE 1: DM-RS configuration type = 1 with DM-RS duration = single-symbol DM-RS and the number of DM-RS CDM groups without data is 2, Additional DM-RS position = pos1, and l0= 2 or 3 for PUSCH mapping type A, as per table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [7]. | | |

Table A.3-2: FRC parameters for FR1 PUSCH performance requirements, transform precoding enabled, additional DM-RS position = pos1 and 1 transmission layer (QPSK, R=308/1024)

|  |  |  |
| --- | --- | --- |
| Reference channel | G-FR1-A3-3 | G-FR1-A3-4 |
| Subcarrier spacing (kHz) | 15 | 30 |
| Allocated resource blocks | 25 | 24 |
| MCS table | 64QAM | 64QAM |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 |
| Modulation | QPSK | QPSK |
| Code rate (Note 2) | 308/1024 | 308/1024 |
| Payload size (bits) | 2152 | 2088 |
| Transport block CRC (bits) | 16 | 16 |
| Code block CRC size (bits) | - | - |
| Number of code blocks - C | 1 | 1 |
| Code block size including CRC (bits) (Note 2) | 2168 | 2104 |
| Total number of bits per slot | 7200 | 6912 |
| Total symbols per slot | 3600 | 3456 |
| NOTE 1: DM-RS configuration type = 1 with DM-RS duration = single-symbol DM-RS and the number of DM-RS CDM groups without data is 2, Additional DM-RS position = pos1, and l0= 2 or 3 for PUSCH mapping type A, as per table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [7]. | | |

Table A.3-3: FRC parameters for FR1 PUSCH performance requirements, transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer (QPSK, R=308/1024)

|  |  |  |
| --- | --- | --- |
| Reference channel | G-FR1-A3-5 | G-FR1-A3-6 |
| Subcarrier spacing (kHz) | 15 | 30 |
| Allocated resource blocks | 12 | 12 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 |
| MCS table | 64QAM | 64QAM |
| Modulation | QPSK | QPSK |
| Code rate (Note 2) | 308/1024 | 308/1024 |
| Payload size (bits) | 1032 | 1032 |
| Transport block CRC (bits) | 16 | 16 |
| Code block CRC size (bits) | - | - |
| Number of code blocks - C | 1 | 1 |
| Code block size including CRC (bits) (Note 2) | 1048 | 1048 |
| Total number of bits per slot | 3456 | 3456 |
| Total symbols per slot | 1728 | 1728 |
| NOTE 1: DM-RS configuration type = 1 with DM-RS duration = single-symbol DM-RS and the number of DM-RS CDM groups without data is 2, Additional DM-RS position = pos1, and l0= 2 or 3 for PUSCH mapping type A, as per table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [7]. | | |

Table A.3-4: FRC parameters for FR1-NTN PUSCH performance requirements, transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer (QPSK, R=308/1024)

|  |  |  |
| --- | --- | --- |
| Reference channel | G-FR1-NTN-A3-7 | G-FR1-NTN-A3-8 |
| Subcarrier spacing (kHz) | 15 | 30 |
| Allocated resource blocks | 6 | 6 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 |
| MCS table | 64QAM | 64QAM |
| Modulation | QPSK | QPSK |
| Code rate (Note 2) | 308/1024 | 308/1024 |
| Payload size (bits) | 528 | 528 |
| Transport block CRC (bits) | 16 | 16 |
| Code block CRC size (bits) | - | - |
| Number of code blocks - C | 1 | 1 |
| Code block size including CRC (bits) (Note 2) | 544 | 544 |
| Total number of bits per slot | 1728 | 1728 |
| Total symbols per slot | 864 | 864 |
| NOTE 1: DM-RS configuration type = 1 with DM-RS duration = single-symbol DM-RS and the number of DM-RS CDM groups without data is 2, Additional DM-RS position = pos1, and l0= 2 and l = 11 for PUSCH mapping type A and l0= 0 and l = 10 for PUSCH mapping type B, as per table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [7]. | | |

A.3A Fixed Reference Channels for performance requirements (QPSK, R=99/1024)

The parameters for the reference measurement channel are specified in table A.3A-1 for FR1 PUSCH performance requirements:

- FRC parameters are specified in table A.3A-1 for FR1 PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer.

The parameters for the reference measurement channel are specified in table A.3A-2 for FR2-NTN PUSCH performance requirements:

* FRC parameters are specified in table A.3A-2 for FR2-NTN PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer.

Table A.3A-1: FRC parameters for FR1 PUSCH performance requirements, transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer (QPSK, R=99/1024)

|  |  |  |
| --- | --- | --- |
| Reference channel | G-FR1-A3A-1 | G-FR1-A3A-3 |
| Subcarrier spacing (kHz) | 15 | 30 |
| Allocated resource blocks | 25 | 24 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 |
| MCS table | 64QAMLowSE | 64QAMLowSE |
| Modulation | QPSK | QPSK |
| Code rate (Note 2) | 99/1024 | 99/1024 |
| Payload size (bits) | 704 | 672 |
| Transport block CRC (bits) | 16 | 16 |
| Code block CRC size (bits) | - | - |
| Number of code blocks - C | 1 | 1 |
| Code block size including CRC (bits) (Note 2) | 720 | 688 |
| Total number of bits per slot | 7200 | 6912 |
| Total symbols per slot | 3600 | 3456 |
| NOTE 1: DM-RS configuration type = 1 with DM-RS duration = single-symbol DM-RS and the number of DM-RS CDM groups without data is 2, Additional DM-RS position = pos2, and l0= 2 or 3 for PUSCH mapping type A, as per table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [7]. | | |

Table A.3A-2: FRC parameters for FR2-NTN PUSCH performance requirements, transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer (QPSK, R=99/1024)

|  |  |
| --- | --- |
| Reference channel | G-FR2-NTN-A3A-1 |
| Subcarrier spacing (kHz) | 120 |
| Allocated resource blocks | 32 |
| CP-OFDM Symbols per slot (Note 1) | 8 |
| MCS table | 64QAMLowSE |
| Modulation | QPSK |
| Code rate (Note 2) | 99/1024 |
| Payload size (bits) | 608 |
| Transport block CRC (bits) | 16 |
| Code block CRC size (bits) | - |
| Number of code blocks - C | 1 |
| Code block size including CRC (bits) (Note 2) | 624 |
| Total number of bits per slot | 6144 |
| Total symbols per slot | 3072 |
| NOTE 1: DM-RS configuration type = 1 with DM-RS duration = single-symbol DM-RS and the number of DM-RS CDM groups without data is 2, Additional DM-RS position = pos1, and l0= 0 and l = 8 for PUSCH mapping type B, as per table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [7]. | |

# A.4 PRACH test preambles

Table A.4-1 Test preambles in FR1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Burst format | SCS (kHz) | Ncs | Logical sequence index | v |
| 0 | 1.25 | 13 | 22 | 32 |
| 2 | 1.25 | 13 | 22 | 32 |
| B4, C2 | 15 | 23 | 0 | 0 |
| 30 | 46 | 0 | 0 |

Table A.4-2 Test preambles in FR2-NTN

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Burst format | SCS (kHz) | Ncs | Logical sequence index | v |
| B4, C2 | 120 | 69 | 0 | 0 |

# A.5 Fixed Reference Channels for performance requirements (QPSK, R=193/1024)

The parameters for the reference measurement channels are specified in table A.5-1 to table A.5-2 for FR2-NTN PUSCH performance requirements:

- FRC parameters are specified in table A.5-1 for FR2-NTN PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer.

- FRC parameters are specified in table A.5-2 for FR2-NTN PUSCH with transform precoding enabled, additional DM-RS position = pos1 and 1 transmission layer.

Table A.5-1: FRC parameters for FR2-NTN PUSCH performance requirements, transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer (QPSK, R=193/1024)

|  |  |
| --- | --- |
| Reference channel | G-FR2-NTN-A5-1 |
| Subcarrier spacing (kHz) | 120 |
| Allocated resource blocks | 32 |
| CP-OFDM Symbols per slot (Note 1) | 8 |
| MCS table | 64QAM |
| Modulation | QPSK |
| Code rate (Note 2) | 193/1024 |
| Payload size (bits) | 1160 |
| Transport block CRC (bits) | 16 |
| Code block CRC size (bits) | - |
| Number of code blocks - C | 1 |
| Code block size including CRC (bits) (Note 2) | 1176 |
| Total number of bits per slot | 6144 |
| Total symbols per slot | 3072 |
| NOTE 1: DM-RS configuration type = 1 with DM-RS duration = single-symbol DM-RS and the number of DM-RS CDM groups without data is 2, Additional DM-RS position = pos1, and l0= 0 and l = 8 for PUSCH mapping type B, as per table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [7]. | |

Table A.5-2: FRC parameters for FR2-NTN PUSCH performance requirements, transform precoding enabled, additional DM-RS position = pos1 and 1 transmission layer (QPSK, R=193/1024)

|  |  |
| --- | --- |
| Reference channel | G-FR2-NTN-A5-2 |
| Subcarrier spacing (kHz) | 120 |
| Allocated resource blocks | 30 |
| DFT-s-OFDM Symbols per slot (Note 1) | 8 |
| MCS table | 64QAM |
| Modulation | QPSK |
| Code rate (Note 2) | 193/1024 |
| Payload size (bits) | 1128 |
| Transport block CRC (bits) | 16 |
| Code block CRC size (bits) | - |
| Number of code blocks - C | 1 |
| Code block size including CRC (bits) (Note 2) | 1144 |
| Total number of bits per slot | 5760 |
| Total symbols per slot | 2880 |
| NOTE 1: DM-RS configuration type = 1 with DM-RS duration = single-symbol DM-RS and the number of DM-RS CDM groups without data is 2, Additional DM-RS position = pos1, and l0= 0 and l = 8 for PUSCH mapping type B, as per table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [7]. | |

# A.6 Fixed Reference Channels for performance requirements (16QAM, R=434/1024)

The parameters for the reference measurement channels are specified in table A.6-1 for FR2-NTN PUSCH performance requirements:

- FRC parameters are specified in table A.6-1 for FR2-NTN PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer.

Table A.6-1: FRC parameters for FR2-NTN PUSCH performance requirements, transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer (16QAM, R=434/1024)

|  |  |
| --- | --- |
| Reference channel | G-FR2-NTN-A6-1 |
| Subcarrier spacing (kHz) | 120 |
| Allocated resource blocks | 32 |
| CP-OFDM Symbols per slot (Note 1) | 8 |
| MCS table | 64QAM |
| Modulation | 16QAM |
| Code rate (Note 2) | 434/1024 |
| Payload size (bits) | 5248 |
| Transport block CRC (bits) | 24 |
| Code block CRC size (bits) | - |
| Number of code blocks - C | 1 |
| Code block size including CRC (bits) (Note 2) | 5272 |
| Total number of bits per slot | 12288 |
| Total symbols per slot | 3072 |
| NOTE 1: DM-RS configuration type = 1 with DM-RS duration = single-symbol DM-RS and the number of DM-RS CDM groups without data is 2, Additional DM-RS position = pos1, and l0= 0 and l = 8 for PUSCH mapping type B, as per table 6.4.1.1.3-3 of TS 38.211 [8].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [7]. | |

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

################## End of Change #8 R4-2409865 ######################

################## Start of Change #9 R4-2409865 ######################

# C.3 Measurement of performance requirements

Table C.3-1: Derivation of Test Requirements (Performance tests)

|  |  |  |  |
| --- | --- | --- | --- |
| Test | Minimum Requirement in TS 38.108 [2] | Test Tolerance (TT) | Test requirement in the present document |
| 8.2.1 Performance requirements for PUSCH with transform precoding disabled | SNRs as specified | [0.6] dB for 1Tx cases | Formula: SNR + TT  T-put limit unchanged |
| 8.2.2 Performance requirements for PUSCH with transform precoding enabled | SNRs as specified | [0.6] dB | Formula: SNR + TT  T-put limit unchanged |
| 8.2.3 Performance requirements for UL timing adjustment | SNRs as specified | [0.3] dB for AWGN | Formula: SNR + TT  T-put limit unchanged |
| 8.2.4 Performance requirements for PUSCH repetition Type A | SNRs as specified | [0.6] dB | Formula: SNR + TT  T-put limit unchanged |
| 8.2.5 Performance requirements for PUSCH with DM-RS bundling | SNRs as specified | [0.6] dB | Formula: SNR + TT  T-put limit unchanged |
| 8.3.1 Performance requirements for PUCCH format 0 | SNRs as specified | [0.6] dB | Formula: SNR + TT  False ACK limit unchanged  Correct ACK limit unchanged |
| 8.3.2 Performance requirements for PUCCH format 1 | SNRs as specified | [0.6] dB | Formula: SNR + TT  False ACK limit unchanged  False NACK limit unchanged  Correct ACK limit unchanged |
| 8.3.3 Performance requirements for PUCCH format 2 | SNRs as specified | [0.6] dB | Formula: SNR + TT  False ACK limit unchanged  Correct ACK limit unchanged  UCI BLER limit unchanged |
| 8.3.4 Performance requirements for PUCCH format 3 | SNRs as specified | [0.6] dB | Formula: SNR + TT  UCI BLER limit unchanged |
| 8.3.5 Performance requirements for PUCCH format 4 | SNRs as specified | [0.6] dB | Formula: SNR + TT  UCI BLER limit unchanged |
| 8.4.1 PRACH false alarm probability and missed detection | SNRs as specified | [0.6] dB for fading cases  [0.3] dB for AWGN cases | Formula: SNR + TT  PRACH false detection limit unchanged  PRACH detection limit unchanged |

Table C.3-2: Derivation of test requirements (FR1-NTN OTA performance tests)

|  |  |  |  |
| --- | --- | --- | --- |
| Test | Minimum Requirement in TS 38.108 [2] | Test Tolerance (TTOTA) | Test requirement in the present document |
| 11.2.1 Performance requirements for PUSCH with transform precoding disabled | See clause 11.2.1.1 | [0.6] dB | Formula: SNR + TTOTA  T-put limit unchanged |
| 11.2.2 Performance requirements for PUSCH with transform precoding enabled | See clause 11.2.1.2 | [0.6] dB | Formula: SNR + TTOTA  T-put limit unchanged |
| 11.2.3 Performance requirements for UL timing adjustment | See clause 11.2.1.3 | [0.3] dB for AWGN cases | Formula: SNR + TTOTA  T-put limit unchanged |
| 11.2.4 Performance requirements for PUSCH repetition Type A | See clause 11.2.1.4 | [0.6] dB | Formula: SNR + TTOTA  BLER limit unchanged |
| 11.2.5 Performance requirements for PUSCH with DM-RS bundling | See clause 11.2.1.5 | [0.6] dB | Formula: SNR + TTOTA  BLER limit unchanged |
| 11.3.1 Performance requirements for PUCCH format 0 | See clause 11.3.1.1 | [0.6] dB | Formula: SNR + TTOTA  False ACK limit unchanged  Correct ACK limit unchanged |
| 11.3.2 Performance requirements for PUCCH format 1 | See clause 11.3.1.3 | [0.6] dB | Formula: SNR + TTOTA  False ACK limit unchanged  False NACK limit unchanged  Correct ACK limit unchanged |
| 11.3.3 Performance requirements for PUCCH format 2 | See clause 11.3.1.4 | [0.6] dB | Formula: SNR + TTOTA  False ACK limit unchanged  Correct ACK limit unchanged  UCI BLER limit unchanged |
| 11.3.4 Performance requirements for PUCCH format 3 | See clause 11.3.1.5 | [0.6] dB | Formula: SNR + TTOTA  UCI BLER limit unchanged |
| 11.3.5 Performance requirements for PUCCH format 4 | See clause 11.3.1.6 | [0.6] dB | Formula: SNR + TTOTA  UCI BLER limit unchanged |
| 11.4.1 PRACH false alarm probability and missed detection | See clause 11.4.1 | [0.6] dB for fading cases  [0.3] dB for AWGN cases | Formula: SNR + TTOTA  PRACH False detection limit unchanged  PRACH detection limit unchanged |
| NOTE: TT values are applicable for normal condition unless otherwise stated. | | | |

Table C.3-3: Derivation of test requirements (FR2-NTN OTA performance tests)

|  |  |  |  |
| --- | --- | --- | --- |
| Test | Minimum Requirement in TS 38.108 [2] | Test Tolerance (TTOTA) | Test requirement in the present document |
| 11.2.1 Performance requirements for PUSCH with transform precoding disabled | See clause [11.2.2.1] | [0.6] dB | Formula: SNR + TTOTA  T-put limit unchanged |
| 11.2.2 Performance requirements for PUSCH with transform precoding enabled | See clause [11.2.2.2] | [0.6] dB | Formula: SNR + TTOTA  T-put limit unchanged |
| 11.2.3 Performance requirements for PUSCH repetition Type A | See clause [11.2.2.3] | [0.6] dB | Formula: SNR + TTOTA  BLER limit unchanged |
| 11.3.1 Performance requirements for PUCCH format 0 | See clause [11.3.2.1] | [0.6] dB | Formula: SNR + TTOTA  False ACK limit unchanged  Correct ACK limit unchanged |
| 11.3.2 Performance requirements for PUCCH format 1 | See clause [11.3.2.3] | [0.6] dB | Formula: SNR + TTOTA  False ACK limit unchanged  False NACK limit unchanged  Correct ACK limit unchanged |
| 11.3.3 Performance requirements for PUCCH format 2 | See clause [11.3.2.4] | [0.6] dB | Formula: SNR + TTOTA  False ACK limit unchanged  Correct ACK limit unchanged  UCI BLER limit unchanged |
| 11.3.4 Performance requirements for PUCCH format 3 | See clause [11.3.2.5] | [0.6] dB | Formula: SNR + TTOTA  UCI BLER limit unchanged |
| 11.3.5 Performance requirements for PUCCH format 4 | See clause [11.3.2.6] | [0.6] dB | Formula: SNR + TTOTA  UCI BLER limit unchanged |
| 11.4.1 PRACH false alarm probability and missed detection | See clause [11.4.2] | [0.6] dB for fading cases | Formula: SNR + TTOTA  PRACH False detection limit unchanged  PRACH detection limit unchanged |
| NOTE: TT values are applicable for normal condition unless otherwise stated. | | | |

################## End of Change #9 R4-2409865 ######################

################## Start of Change #10 R4-2409865 ######################

# D.7 SAN type 1-O and 2-O performance requirements

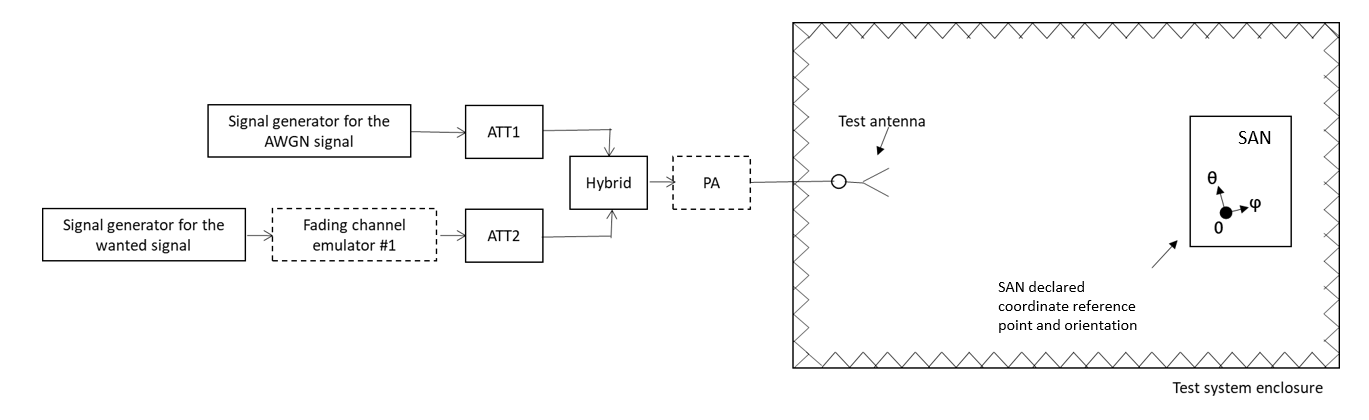


Figure D.7-1: Measurement set up for single TX, single demodulation branch radiated performance requirements

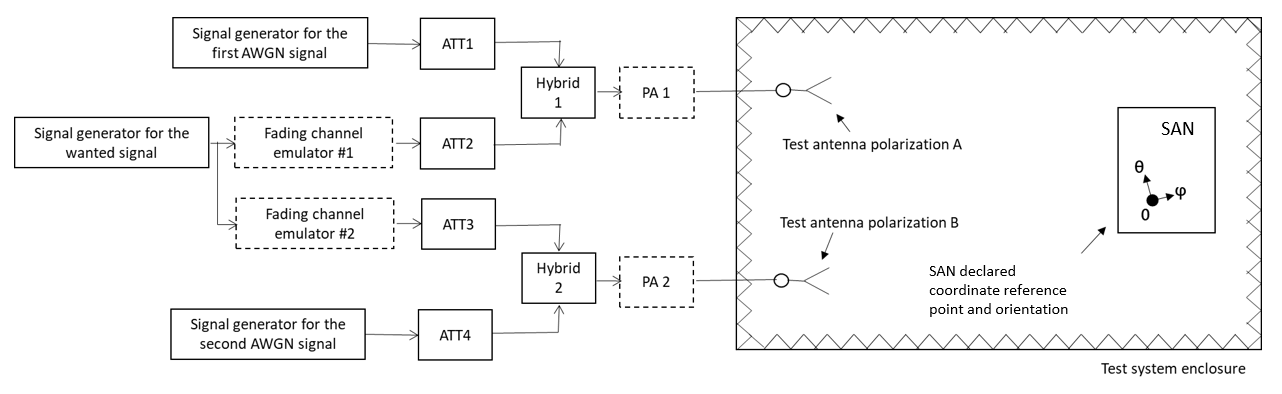


Figure D.7-2: Measurement set up for single TX, dual polarization radiated performance requirements

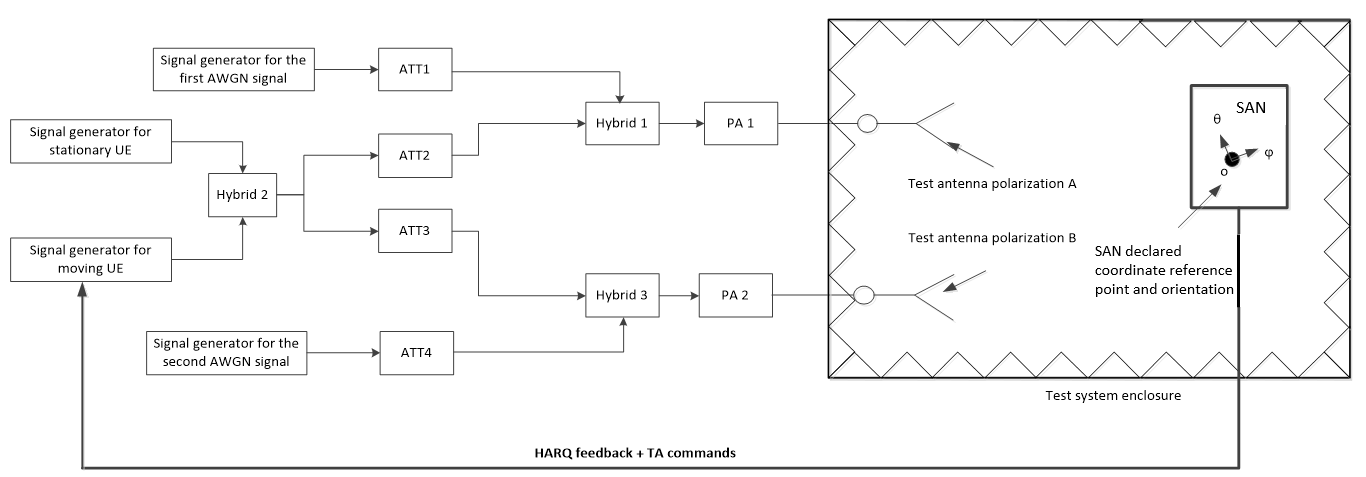


Figure D.7-3: Measurement set up for UL timing adjustment, single TX, dual polarization radiated performance requirements

The OTA chambers shown in figures D.7-1, D.7-2, D.7-3 and D.7-4 are intended to be generic and can be replaced with any suitable OTA chamber (e.g. far field anechoic chamber, CATR, etc.). The PA(s) depicted in figures D.7-1, D.7-2, and D.7-3 is optional. Fading channel emulators are included when needed according to the requirement description.

NOTE: The HARQ Feedback (only for PUSCH) could be done as an RF feedback or as a digital feedback. The HARQ Feedback should be error free.

################## End of Change #10 R4-2409865 ######################

################## Start of Change #11 R4-2409865 ######################

# G.1 Static propagation condition

The propagation for the static performance measurement is an Additive White Gaussian Noise (AWGN) environment. No fading or multi-paths exist for this propagation model.

# G.2 Multi-path fading propagation conditions

The multipath propagation conditions consist of several parts:

- A delay profile in the form of a "tapped delay-line", characterized by a number of taps at fixed positions on a sampling grid. The profile can be further characterized by the r.m.s. delay spread and the maximum delay spanned by the taps.

- A combination of channel model parameters that include the Delay profile and the Doppler spectrum that is characterized by a classical spectrum shape and a maximum Doppler frequency.

## G.2.1 Delay profiles

The delay profiles are simplified from the TR 38.811 [17] TDL models. The simplification steps are shown below for information. These steps are only used when new delay profiles are created. Otherwise, the delay profiles specified in G.2.1.1 can be used as such.

- Step 1: Use the original TDL model from TR 38.811 [17].

- Step 2: Re-order the taps in ascending delays

- Step 3: Perform delay scaling according to the procedure described in clause 7.7.2 in TR 38.901 [11].

- Step 4: Apply the quantization to the delay resolution 5 ns. This is done simply by rounding the tap delays to the nearest multiple of the delay resolution.

- Step 5: If multiple Rayleigh taps are rounded to the same delay bin, merge them by calculating their linear power sum.

- Step 6: If there is a LOS path in the model, the power for all paths could be slightly adjusted to keep the RMS delay spread is close to target delay spread and mean power is 0dB.

- Step 7: Round the amplitudes of taps to one decimal (e.g. -8.78 dB 🡪 -8.8 dB)

- Step 8: If the delay spread has slightly changed due to the tap merge, adjust the final delay spread by increasing or decreasing the power of the last tap so that the delay spread is corrected.

- Step 9: Re-normalize the highest Rayleigh tap to 0 dB when there is no LOS path in the model.

Note 1: Some values of the delay profile created by the simplification steps may differ from the values in tables G.2.1.1-2, G.2.1.1-3 and G.2.1.2-2 for the corresponding model.

Note 2: For Step 5 and Step 6, the power values are expressed in the linear domain using 6 digits of precision. The operations are in the linear domain.

### G.2.1.1 Delay profiles for FR1

The delay profiles for FR1 are selected to be representative of NLOS and LOS scenarios. The resulting model parameters are specified in G.2.1.1-1 and the tapped delay line models are specified in tables G.2.1.1-2 and table G.2.1.1-3.

Table G.2.1.1-1: Delay profiles for SAN channel models

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Model | Number of  channel taps | Delay spread  (r.m.s.) | Maximum excess tap delay (span) | Delay resolution |
| NTN-TDLA100 | 3 | 100 ns | 285 ns | 5 ns |
| NTN-TDLC5 | 2 | 5 ns | 60 ns | 5 ns |

Table G.2.1.1-2: NTN-TDLA100 (DS = 100 ns)

|  |  |  |  |
| --- | --- | --- | --- |
| Tap # | Delay (ns) | Power (dB) | Fading distribution |
| 1 | 0 | 0 | Rayleigh |
| 2 | 110 | -4.7 |
| 3 | 285 | -6.5 |

Table G.2.1.1-3: NTN-TDLC5 (DS = 5 ns)

|  |  |  |  |
| --- | --- | --- | --- |
| Tap # | Delay (ns) | Power (dB) | Fading distribution |
| 1 | 0 | -0.6 | LOS path |
| 0 | -8.9 | Rayleigh |
| 2 | 60 | -21.5 | Rayleigh |
| NOTE: The first tap follows a Rician distribution with a K-factor of K1 = 8.05 dB and a mean power of 0dB | | | |

### G.2.1.2 Delay profiles for FR2-NTN

The delay profiles for FR2-NTN are selected to be representative of LOS scenarios. The resulting model parameters are specified in G.2.1.2-1 and the tapped delay line models are specified in tables G.2.1.2-2.

Table G.2.1.2-1: Delay profiles for SAN channel models

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Model | Number of  channel taps | Delay spread  (r.m.s.) | Maximum excess tap delay (span) | Delay resolution |
| NTN-TDLC5 | 2 | 5 ns | 60 ns | 5 ns |

Table G.2.1.2-2: NTN-TDLC5 (DS = 5 ns)

|  |  |  |  |
| --- | --- | --- | --- |
| Tap # | Delay (ns) | Power (dB) | Fading distribution |
| 1 | 0 | -0.6 | LOS path |
| 0 | -8.9 | Rayleigh |
| 2 | 60 | -21.5 | Rayleigh |
| NOTE: The first tap follows a Rician distribution with a K-factor of K1 = 8.05 dB and a mean power of 0dB | | | |

## G.2.2 Combinations of channel model parameters

The propagation conditions used for the performance measurements in multi-path fading environment are indicated as a combination of a channel model name and a maximum Doppler frequency, i.e., NTN-TDLA<DS>-<Doppler> or NTN-TDLC<DS>-<Doppler> where '<DS>' indicates the desired delay spread and '<Doppler>' indicates the maximum Doppler frequency (Hz).

Table G.2.2-1 show the propagation conditions that are used for the performance measurements in multi-path fading environment for low, medium and high Doppler frequencies for FR1.

Table G.2.2-2 show the propagation conditions that are used for the performance measurements in multi-path fading environment for low, medium and high Doppler frequencies for FR2-NTN.

Table G.2.2-1: Channel model parameters for FR1

|  |  |  |
| --- | --- | --- |
| Combination name | Model | Maximum Doppler frequency |
| NTN-TDLA100-200 | NTN-TDLA100 | 200 Hz |
| NTN-TDLC5-200 | NTN-TDLC5 | 200 Hz |

Table G.2.2-2: Channel model parameters for FR2-NTN

|  |  |  |
| --- | --- | --- |
| Combination name | Model | Maximum Doppler frequency |
| NTN-TDLC5-1200 | NTN-TDLC5 | 1200 Hz |

## G.2.3 MIMO channel correlation matrices

################## End of Change #11 R4-2409865 ######################