**3GPP TSG-RAN WG4 Meeting # 111 *R4-2409864***

**Fukuoka, JP, May.20 - May.24, 2024**

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| *CR-Form-v12.3* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.181** | **CR** | **draftCR** | **rev** | **1** | **Current version:** | **18.1.0** |  |
|  | | | | | | | | |
| *For* ***HE******LP*** *on using this form: comprehensive instructions can be found at  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:*** | Draft CR for TS 38.181, Introduction on OTA performance requirement for PRACH | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | CATT | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_NTN\_enh-Perf | | | | |  | ***Date:*** | | | 2024-05-1 |
|  |  | | | |  | |  | | |  |
| ***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. | | | | | | | | *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:*** | | To introduce the FR2 OTA performance requirement for PRACH. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | 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 | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | The FR2 OTA performance requirement for PRACH of SAN would be missing. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 11.4, New 11.4.1.5.1, New 11.4.1.5.2 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **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:*** | | Revised from R4-2407510 | | | | | | | | |

<Start of Change >

### 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 11.4.1.5.2-1 is 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 >