**3GPP TSG-RAN WG4 Meeting #104-bis-e *R4-221xxxx***

**Electronic, , 10th - 19th October 2022**

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
|  |
|  | **38.141-2** | **CR** | **DRAFT** | **rev** | **1** | **Current version:** | **17.7.0** |  |
|  |
| *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:***  | Draft CR 38.141-2: PRACH requirements for FR2-2 |
|  |  |
| ***Source to WG:*** | Nokia, Nokia Shanghai Bell |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_ext\_to\_71GHz-Perf |  | ***Date:*** | 2022-30-09 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***Release:*** | Rel-17 |
|  | *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 canbe 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-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
|  |  |
| ***Reason for change:*** | Introduction of the structure of the PRACH requirements for FR2-2 |
|  |  |
| ***Summary of change:*** | Proposal for scheleton of PRACH requirements |
|  |  |
| ***Consequences if not approved:*** | No PRACH requirements for FR2-2 |
|  |  |
| ***Clauses affected:*** | 8.4.1.4.2, 8.4.1.5.2, 8.4.1.7.x (new) |
|  |  |
|  | **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:*** | New clause 8.4.1.7.x would be preferably implemented as 8.4.1.7.2. |
|  |  |
| ***This CR's revision history:*** | Revision of R4-2216577 and R4-2212681 endorsed during RAN4 #104 |

### <Start of Change 1>

## 8.4 OTA performance requirements for PRACH

### 8.4.1 PRACH false alarm probability and missed detection

#### 8.4.1.1 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, TDLC300-100, TDLA30-10, TDLA30-300, and TDLA10-650, 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 8.4.1.1-1.

Table 8.4.1.1-1: Time error tolerance for AWGN, TDLC300-100, TDLA30-10, and TDLA30-300

|  |  |  |
| --- | --- | --- |
| PRACH | PRACH SCS | Time error tolerance |
| preamble | (kHz) | AWGN | TDLC300-100 | TDLA30-10 | TDLA30-300 | TDLA10-650 |
| 0 | 1.25 | 1.04 us | 2.55 us | N/A | N/A | N/A |
| A1, A2, A3, B4, C0, C2 | 15 | 0.52 us | 2.03 us | 0.67 us | N/A | N/A |
|  | 30 | 0.26 us | 1.77 us | 0.41 us | N/A | N/A |
|  | 60 (FR2) | 0.13 us | N/A | N/A | 0.28 us | N/A |
|  | 120 | 0.07 us | N/A | N/A | 0.22 us | N/A |
|  | 480 | 18 ns | N/A | N/A | N/A | 68 ns |

The test preambles for normal mode are listed in table A.6-1 and A.6-2. The test preambles for high speed train restricted set type A are listed in table A.6-3 and the test preambles for high speed train restricted set type B are listed in table A.6-4. The test preambles for high speed train short formats are listed in table A.6-5.

### <End of Change 1>

### <Start of Change 2>

##### 8.4.1.4.2 Procedure

1) Place the BS with its manufacturer declared coordinate system reference point in the same place as calibrated point in the test system, as shown in annex E.3.

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

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

4) Connect the BS 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 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 J.

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 8.4.1.4.2-1.

Table 8.4.1.4.2-1: AWGN power level at the BS input

|  |  |  |  |
| --- | --- | --- | --- |
| BS type | Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| BS type 1-O (Note 4) | 15 | 5 | -83.5 - ΔOTAREFSENS dBm / 4.5MHz |
|  |  | 10 | -80.3 - ΔOTAREFSENS dBm / 9.36MHz |
|  |  | 20 | -77.2 - ΔOTAREFSENS dBm / 19.08MHz |
|  | 30 | 10 | -80.6 - ΔOTAREFSENS dBm / 8.64MHz |
|  |  | 20 | -77.4 - ΔOTAREFSENS dBm / 18.36MHz |
|  |  | 40 | -74.2 - ΔOTAREFSENS dBm / 38.16MHz |
|  |  | 100 | -70.1 - ΔOTAREFSENS dBm / 98.28MHz |
| BS type 2-O (Note 5) | 60 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 47.52 MHz |
|  |  | 100 | EISREFSENS\_50M + ΔFR2\_REFSENS + 18 dBm / 95.04 MHz |
|  | 120 | 50 | EISREFSENS\_50M + ΔFR2\_REFSENS + 15 dBm / 46.08 MHz |
|  |  | 100 | EISREFSENS\_50M + ΔFR2\_REFSENS + 18 dBm / 95.04 MHz |
|  |  | 200 | EISREFSENS\_50M + ΔFR2\_REFSENS + 21 dBm / 190.08 MHz |
|  |  | 400 | FFS |
|  | 480 | 400 | FFS |
|  |  | FFS | FFS |
| NOTE 1: ΔOTAREFSENS as declared in D.53 in table 4.6-1 and clause 7.1.NOTE 2: ΔFR2\_REFSENS = -3 dB as described in clause 7.1, since the OTA REFSENS receiver target reference direction (as declared in D.54 in table 4.6-1) is used for testing.NOTE 3: EISREFSENS\_50M as declared in D.28 in table 4.6-1.NOTE 4: 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 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 8.4.1.5.1-1 or 8.4.1.5.1-2 or 8.4.1.5.1-3 or 8.4.1.6.1-1 or 8.4.1.6.1-2 or 8.4.1.6.1-3 or 8.4.1.6.1-4 or 8.4.1.5.2-1 or 8.4.1.5.2-2 or 8.4.1.5.2-3 or 8.4.1.5.2-4 or 8.4.1.5.2-5 or 8.4.1.7.1-1 or 8.4.1.7.1-2 or 8.4.1.6.2-1 or 8.4.1.7.x-1 or 8.4.1.7.x-2 or 8.4.1.7.x-3.

9) Adjust the equipment so that the SNR specified in table 8.4.1.5.1-1 or 8.4.1.5.1-2 or 8.4.1.5.1-3 or 8.4.1.6.1-1 or 8.4.1.6.1-2 or 8.4.1.6.1-3 or 8.4.1.6.1-4 or 8.4.1.5.2-1 or 8.4.1.5.2-2 or 8.4.1.5.2-3 or 8.4.1.5.2-4 or 8.4.1.5.2-5 or 8.4.1.7.1-1 or 8.4.1.7.1-2 or 8.4.1.6.2-1 or 8.4.1.7.x-1 or 8.4.1.7.x-2 or 8.4.1.7.x-3 is achieved at the BS 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 8.4.1.4.2-1. 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 8.4.1.4.2-1: PRACH preamble test pattern

Unless otherwise stated, the timing offset base value for PRACH preamble format 0 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 is presented in Figure 8.4.1.4.2-2.



Figure 8.4.1.4.2-2: Timing offset scheme for PRACH preamble format 0

Unless otherwise stated, the timing offset base value for PRACH preamble format A1, A2, A3, B4, C0 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 A1, A2, A3, B4, C0 and C2 is presented in Figure 8.4.1.4.2-3 for 15 kHz, 30 kHz, 60 kHz, and 120 kHz SCS.



Figure 8.4.1.4.2-3: Timing offset scheme for PRACH preamble format A1 A2, A3, B4, C0 and C2 using 15 kHz, 30 kHz, 60 kHz, and 120 kHz SCS

For test requirement specified in Table 8.4.1.6.2-1, the timing offset base value for PRACH preamble format C2 is set to 0. This offset is increased within the loop, by adding in each step a value of 0.48us, until the end of the tested range, which is 4.8us. Then the loop is being reset and the timing offset is set again to 0. The timing offset scheme for PRACH preamble format C2 is presented in Figure 8.4.1.4.2-4.



Figure 8.4.1.4.2-4: Timing offset scheme for PRACH preamble format C2

For test requirements with 480 kHz SCS, the timing offset base value for PRACH preamble format A2, 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 A2, B4, and C2 is presented in Figure 8.4.1.4.2-x.



Figure 8.4.1.4.2-x: Timing offset scheme for PRACH preamble format A2, B4, and C2 using 480 kHz SCS

### <End of Change 2>

### <Start of Change 3>

##### 8.4.1.5.2 Test requirement for *BS type 2-O*

Pfa shall not exceed 0.1%. Pd shall not be below 99% for the SNRs in tables 8.4.1.5.2-1 to 8.4.1.5.2-5.

Table 8.4.1.5.2-1: PRACH missed detection test requirements for Normal Mode, 60 kHz SCS in FR2-1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number | Number of | Propagation | Frequency | SNR (dB) |
| of TX antennas | demodulation branches | conditions and correlation matrix (annex J) | offset | Burst format A1 | Burst format A2 | Burst format A3 | Burst format B4 | Burst format C0 | Burst format C2 |
| 1 | 2 | AWGN | 0 | -8.6 | -11.6 | -13.2 | -15.5 | -5.7 | -11.5 |
|  |  | TDLA30-300 Low | 4000 Hz | -1.0 | -3.2 | -4.2 | -6.3 | 1.7 | -3.3 |

Table 8.4.1.5.2-2: PRACH missed detection test requirements for Normal Mode, 120 kHz SCS in FR2-1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number | Number of | Propagation | Frequency | SNR (dB) |
| of TX antennas | demodulation branches | conditions and correlation matrix (annex J) | offset | Burst format A1 | Burst format A2 | Burst format A3 | Burst format B4 | Burst format C0 | Burst format C2 |
| 1 | 2 | AWGN | 0 | -8.4 | -11.2 | -13.0 | -15.5 | -5.5 | -11.1 |
|  |  | TDLA30-300 Low | 4000 Hz | -1.1 | -3.8 | -5.2 | -6.9 | 1.8 | -3.6 |

Table 8.4.1.5.2-3: PRACH missed detection test requirements for Normal Mode, 120 kHz SCS in FR2-2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of  | Number of | Propagation | Frequency | SNR (dB) |
| TX antennas | demodulation branches | conditions and correlation matrix (Annex G) | offset | Burst format A2 | Burst format B4 | Burst format C2 |
| 1 | 2 | AWGN | 0 | FFS | FFS | FFS |
|  |  | TDLA30-650 Low | 7100 | FFS | FFS | FFS |

Table 8.4.1.5.2-4: PRACH missed detection test requirements for Normal Mode, 480 kHz SCS in FR2-2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of  | Number of | Propagation | Frequency | SNR (dB) |
| TX antennas | demodulation branches | conditions and correlation matrix (Annex G) | offset | Burst format A2 | Burst format B4 | Burst format C2 |
| 1 | 2 | AWGN | 0 | FFS | FFS | FFS |
|  |  | TDLA10-650 Low | 7100 | FFS | FFS | FFS |

### <End of Change 3>

### <Start of Change 4>

#### 8.4.1.7 Test requirement for PRACH with LRA=1151 and LRA=571

##### 8.4.1.7.1 Test requirement for *BS type 1-O*

Pfa shall not exceed 0.1%. Pd shall not be below 99% for the SNRs in tables 8.4.1.7.1-1 to 8.4.1.7.1-4.

Table 8.4.1.7.1-1: Missed detection requirements for PRACH with LRA=1151, 15 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of  | Number of | Propagation | Frequency | SNR (dB) |
| TX antennas | demodulation branches | conditions and correlation matrix (Annex G) | offset | Burst format A2 | Burst format B4 | Burst format C2 |
| 1 | 2 | AWGN | 0 | -20.8 | -24.8 | -20.8 |
|  |  | TDLA30-10 Low | 400 Hz | -14.5 | -17.7 | -14.6 |

Table 8.4.1.7.1-2: Missed detection requirements for PRACH with LRA=571, 30 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of  | Number of | Propagation | Frequency | SNR (dB) |
| TX antennas | demodulation branches | conditions and correlation matrix (Annex G) | offset | Burst format A2 | Burst format B4 | Burst format C2 |
| 1 | 2 | AWGN | 0 | -17.8 | -21.7 | -17.8 |
|  |  | TDLA30-10 Low | 400 Hz | -11.5 | -15.2 | -11.5 |

##### 8.4.1.7.x Test requirement for *BS type 2-O*

Pfa shall not exceed 0.1%. Pd shall not be below 99% for the SNRs in tables 8.4.1.7.x-1 to 8.4.1.7.x-3.

Table 8.4.1.7.x-1: Missed detection requirements for PRACH with LRA=571, 120 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of  | Number of | Propagation | Frequency | SNR (dB) |
| TX antennas | demodulation branches | conditions and correlation matrix (Annex G) | offset | Burst format A2 | Burst format B4 | Burst format C2 |
| 1 | 2 | AWGN | 0 | FFS | FFS | FFS |
|  |  | TDLA30-650 Low | 7100 | FFS | FFS | FFS |

Table 8.4.1.7.x-2: Missed detection requirements for PRACH with LRA=1151, 120 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of  | Number of | Propagation | Frequency | SNR (dB) |
| TX antennas | demodulation branches | conditions and correlation matrix (Annex G) | offset | Burst format A2 | Burst format B4 | Burst format C2 |
| 1 | 2 | AWGN | 0 | FFS | FFS | FFS |
|  |  | TDLA30-650 Low | 7100 | FFS | FFS | FFS |

Table 8.4.1.7.x-3: Missed detection requirements for PRACH with LRA=571, 480 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of  | Number of | Propagation | Frequency | SNR (dB) |
| TX antennas | demodulation branches | conditions and correlation matrix (Annex G) | offset | Burst format A2 | Burst format B4 | Burst format C2 |
| 1 | 2 | AWGN | 0 | FFS | FFS | FFS |
|  |  | TDLA10-650 Low | 7100 | FFS | FFS | FFS |

Annex A (normative):
Reference measurement channels

### <End of Change 4>