**3GPP TSG-RAN WG4 Meeting #102-e R4-220xxxxx**

**Electronic Meeting, 21st Feb – 3rd Mar, 2022**

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
|  |
|  | **38.141-2** | **CR** | **DRAFT** | **rev** | **-** | **Current version:** | **17.4.0** |  |
|  |
| *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 on PRACH test requirement for high speed train (38.141-2) |
|  |  |
| ***Source to WG:*** | Huawei, HiSilicon |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_HST\_FR2-Perf |  | ***Date:*** | 2022-02-25 |
|  |  |  |  |  |
| ***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-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
|  |  |
| ***Reason for change:*** | Provide initial draft CR for NR HST FR2 PRACH test requirement for high speed train as per work split. |
|  |  |
| ***Summary of change:*** | For introducing HST FR2 PRACH test requirement for high speed train, update clause 8.4. |
|  |  |
| ***Consequences if not approved:*** | There will be inconsistence between the specification 38.141-2 and RAN 4 agreements. |
|  |  |
| ***Clauses affected:*** | 8.4 |
|  |  |
|  | **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 THE 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, and TDLA30-300, 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** |
| 0 | 1.25 | 1.04 us | 2.55 us | N/A | N/A |
| A1, A2, A3, B4, C0, C2 | 15 | 0.52 us | 2.03 us | 0.67 us | N/A |
|  | 30 | 0.26 us | 1.77 us | 0.41 us | N/A |
|  | 60 (FR2) | 0.13 us | N/A | N/A | 0.28 us |
|  | 120 | 0.07 us | N/A | N/A | 0.22 us |

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.

Which specific test(s) are applicable to BS is based on the test applicability rules defined in clause 8.1.2. The performance requirements for high speed train (table 8.4.1.6.1-1 to 8.4.1.6.1-4 and table 8.4.1.6.2-1) are optional. The test preambles for PRACH with LRA=1151 and LRA=571 are listed in table A.6-6.

8.4.1.2 Minimum requirement

For *BS type 1-O*, the minimum requirement is in TS 38.104 [2] clause 11.4.1.1 and 11.4.1.2.

For *BS type 2-O*, the minimum requirement is in TS 38.104 [2] clause 11.4.2.1 and 11.4.2.2.

8.4.1.3 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.

8.4.1.4 Method of test

8.4.1.4.1 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.54 in table 4.6-1).

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 |
| 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 8.4.1.7.1-1 or 8.4.1.7.1-2 or 8.4.1.6.2-1.

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 8.4.1.7.1-1 or 8.4.1.7.1-2 or 8.4.1.6.2-1 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.

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**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.

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**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.

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**Figure 8.4.1.4.2-3: Timing offset scheme for PRACH preamble format A1 A2, A3, B4, C0 and C2**

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

8.4.1.5 Test requirement for Normal Mode

8.4.1.5.1 Test requirement for *BS type 1-O*

Pfa shall not exceed 0.1%. Pd shall not be below 99% for the SNRs in tables 8.4.1.5.1-1 to 8.4.1.5.1-3.

**Table 8.4.1.5.1-1: PRACH missed detection test requirements for Normal Mode, 1.25 kHz SCS**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Number of TX** | **Number of demodulation** | **Propagation conditions and** | **Frequency offset** | **SNR (dB)** |
| **antennas** | **branches** | **correlation matrix (annex J)** |  | **Burst format 0** |
| 1 | 2 | AWGN | 0 | -14.2 |
|  |  | TDLC300-100 Low | 400 Hz  | -6.0 |

**Table 8.4.1.5.1-2: PRACH missed detection test requirements for Normal Mode, 15 kHz SCS**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **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 | -9.0 | -12.3 | -13.9 | -16.5 | -6.0 | -12.2 |
|  |  | TDLC300-100 Low | 400 Hz | -1.5 | -4.2 | -6.0 | -8.2 | 1.4 | -4.3 |

**Table 8.4.1.5.1-3: PRACH missed detection test requirements for Normal Mode, 30 kHz SCS**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **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 | -8.8 | -11.7 | -13.5 | -16.2 | -5.8 | -11.6 |
|  |  | TDLC300-100 Low | 400 Hz | -2.2 | -5.1 | -6.8 | -9.3 | 0.7 | -5.0 |

**Table 8.4.1.5.1-4: Void**

**Table 8.4.1.5.1-5: Void**

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 8.4.1.5.2-2.

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **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**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **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 |

8.4.1.6 Test requirement for high speed train

8.4.1.6.1 Test requirement for *BS type 1-O*

Pfa shall not exceed 0.1%. Pd shall not be below 99% for the SNRs in tables 8.4.1.6.1-1 to 8.4.1.6.1-4.

**Table 8.4.1.6.1-1: PRACH missed detection requirements for high speed train, burst format 0, restricted set type A, 1.25 kHz SCS**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation** | **Propagation conditions and correlation matrix (annex J)** | **Frequency offset** | **SNR (dB)** |
|  | **branches** |  |  | **Burst format 0** |
| 1 | 2 | AWGN | 625 Hz | -11.7 |
|  |  | AWGN | 1340 Hz | -13.5 |
|  |  | TDLC300-100 Low | 0 Hz | -5.7 |

**Table 8.4.1.6.1-2: PRACH missed detection requirements for high speed train, burst format 0, restricted set type B, 1.25 kHz SCS**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Number of TX antennas** | **Number of demodulation** | **Propagation conditions and correlation matrix (annex J)** | **Frequency offset** | **SNR (dB)** |
|  | **branches** |  |  | **Burst format 0** |
| 1 | 2 | AWGN | 625 Hz | -11.3 |
|  |  | AWGN | 2334 Hz | -12.8 |
|  |  | TDLC300-100 Low | 0 Hz | -5.4 |

**Table 8.4.1.6.1-3: PRACH missed detection requirements for high speed train, 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 | 1740 Hz | -11.0 | -14.0 | -10.8 |

**Table 8.4.1.6.1-4: PRACH missed detection requirements for high speed train, 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 | 3334 Hz | -10.9 | -14.3 | -10.7 |

8.4.1.6.2 Test requirement for *BS type 2-O*

Pfa shall not exceed 0.1%. Pd shall not be below 99% for the SNRs in Table 8.4.1.6.2-1.

**Table 8.4.1.6.2-1: PRACH missed detection requirements for high speed train, 120 kHz SCS**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Number of****TX antennas** | **Number of****RX antennas** | **Propagation****conditions (Annex G)** | **Frequency****offset** | **SNR (dB)** |
| **Burst format C2** |
| 1 | 2 | AWGN | 19444 Hz | [-9.8] |

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 |

*<END OF THE CHANGE 1>*