**3GPP TSG-RAN WG4 Meeting #97-e *R4-2017522***

**Electronic Meeting, 2nd – 13th Nov, 2020**

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
|  |
|  | **38.141-2** | **CR** | **0239** | **rev** | **1** | **Current version:** | **16.5.0** |  |
|  |
| *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:***  | CR to TS 38.141-2: Addition of BS conformance testing for FR2 URLLC PUSCH repetition Type A |
|  |  |
| ***Source to WG:*** | Huawei, HiSilicon NTT DOCOMO, INC |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_L1enh\_URLLC-Perf |  | ***Date:*** | 2020-10-20 |
|  |  |  |  |  |
| ***Category:*** | B |  | ***Release:*** | Rel-16 |
|  | *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:*** | PUSCH repetition Type A was agreed to be introduced as the new feature for URLLC FR2 to improve the high reliability for PUSCH performance. In order to verify the demodulation performance for PUSCH repetition Type A, the new demodulation requirements are defined. |
|  |  |
| ***Summary of change:*** | New PUSCH performance requirements are introduced in section 8.2.7 and C.3 |
|  |  |
| ***Consequences if not approved:*** | New requirement for FR2 PUSCH with aggregation factor configured cannot be verified.  |
|  |  |
| ***Clauses affected:*** | 8.2.7 C.3 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **x** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** | **x** |  |  Test specifications | TS 38.141-2 |
| ***(show related CRs)*** |  | **x** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** | R4-2014820 is merged in this CR. |
|  |  |
| ***This CR's revision history:*** | R4-2015626 |

*<Start of the change 1>*

### 8.2.7 Performance requirements for PUSCH repetition Type A

#### 8.2.7.1 Definition and applicability

The performance requirement of PUSCH repetition Type A is determined by block error probability (BLER). The performance is measured by the required SNR at block error probability of PUSCH data not exceeding 1 %. The performance requirements assume HARQ re-transmissions.

Which specific test(s) are applicable to BS is based on the test applicability rules defined in subclause 8.1.2.1.

#### 8.2.7.2 Minimum Requirement

For *BS type 1-O*, the minimum requirement is in TS 38.104 [2], clause 11.2.1.7.

For *BS type 2-O*, the minimum requirement is in TS 38.104 [2], clause 11.2.2.7.

#### 8.2.7.3 Test purpose

The test shall verify the receiver's ability to achieve target block error probability of PUSCH repetition Type A under multipath fading propagation conditions for a given SNR.

#### 8.2.7.4 Method of test

##### 8.2.7.4.1 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.

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

##### 8.2.7.4.2 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 according to additional test parameters listed in table 8.2.7.4.2-1.

Table 8.2.7.4.2-1: Test parameters for testing PUSCH repetition Type A

|  |  |  |
| --- | --- | --- |
| **Parameter** | ***BS type 1-O*** | ***BS type 2-O*** |
| Transform precoding | Disabled |
| Default TDD UL-DL pattern (Note 1) | 15 kHz SCS:3D1S1U, S=10D:2G:2U30 kHz SCS:7D1S2U, S=6D:4G:4U | DDDSU, S=10D:2G:2U |
| HARQ | Maximum number of HARQ transmissions | 4 |
| RV sequence | {0,3,0,3} (Note 2) |
| 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}, {0,1} |
| DM-RS sequence generation | *NID0*=0, *nSCID*=0 |
| Time domain resource assignment | PUSCH mapping type | A, B | B |
| Start symbol | 0 | 0 |
| Allocation length | 14 | 10 |
| PUSCH aggregation factor | 15kHz SCS: n2 for FDD and n8 for TDD30kHz SCS: n2(Note 3) | n8 (Note 4) |
| Frequency domain resource assignment | RB assignment | Full applicable test bandwidth |
| Frequency hopping | Disabled |
| Code block group based PUSCH transmission | Disabled | Disabled |
| PTRS configuration | Frequency density (*KPT-RS*) | N.A. | TBD |
| Time density (*LPT-RS*) | N.A. | TBD |
| Note 1: The same requirements are applicable to TDD with different UL-DL patterns and different aggregation factor configurations under assumption that two effective transmissions of the transport block are generated for BS type 2-O.Note 2: The effective RV sequence is {0,2,3,1} with slot aggregationNote 3: The intention of this configuration is to have two effective transmissions of the transport block. To achieve this for the standard TDD pattern captured in this table, a value of n8 is necessary, while for FDD a value of n2 is necessary.Note 4: The intention of this configuration is to have two effective transmissions of the transport block. To achieve this for the standard TDD pattern captured in this table, a value of n8 is necessary. |

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 BS receiver is as specified in clause 8.2.7.5.1 and clause 8.2.7.5.2 for *BS type 1-O* and *BS type 2-O* respectively, and that the SNR at the BS 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 8.2.7.4.2-2.

Table 8.2.7.4.2-2: AWGN power level at the BS input

|  |  |  |  |
| --- | --- | --- | --- |
| BS type | Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| BS type 1-O | 15  | 5 | -86.5 - ΔOTAREFSENS dBm / 4.5 MHz |
|  |  | 10 | -83.3 - ΔOTAREFSENS dBm / 9.36 MHz |
|  | 30  | 10 | -83.6 - ΔOTAREFSENS dBm / 8.64 MHz |
|  |  | 40 | -77.2 - ΔOTAREFSENS dBm / 38.16 MHz |
| BS type 2-O | 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 |
| 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 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. |

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

#### 8.2.1.5 Test Requirement

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

The block error probability (BLER) measured according to clause 8.2.7.4.2 shall not exceed 1% for the SNR levels specified in table 8.2.7.5.1-1 to table 8.2.7.5.1-8 for 1Tx.

Table 8.2.7.5.1-1: Test requirements for PUSCH, 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 J) | Target BLER | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | TDLB100-400 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 8.2.7.5.1-2: Test requirements for PUSCH, Type A, 10 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (annex J) | Target BLER | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 1% (Note 1) | G-FR1-A3A-2 | pos1 | [-8.7] |
| 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 8.2.7.5.1-3: Test requirements for PUSCH, 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 J) | Target BLER | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 1% (Note 1) | G-FR1-A3A-3 | pos1 | [-7.6] |
| 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 8.2.7.5.1-4: Test requirements for PUSCH, Type A, 40 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (annex J) | Target BLER | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 1% (Note 1) | G-FR1-A3A-4 | pos1 | [-9.7] |
| 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 8.2.7.5.1-5: Test requirements for PUSCH, 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 J) | Target BLER | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 1% (Note 1) | G-FR1-A3A-1 | pos1 | [-7.6] |
| 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 8.2.7.5.1-6: Test requirements for PUSCH, Type B, 10 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (annex J) | Target BLER | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 1% (Note 1) | G-FR1-A3A-2 | pos1 | [-9.2] |
| 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 8.2.7.5.1-7: Test requirements for PUSCH, 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 J) | Target BLER | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 1% (Note 1) | G-FR1-A3A-3 | pos1 | [-7.6] |
| Note 1: Calculate the target BLER after all HARQ transmission(s) for one TB. |

Table 8.2.7.5.1-8: Test requirements for PUSCH, Type B, 40 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (annex J) | Target BLER | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 1% (Note 1) | G-FR1-A3A-4 | pos1 | [-9.6] |
| Note 1: Calculate the target BLER after all HARQ transmission(s) for one TB. |

NOTE: If the above Test Requirement differs from the Minimum Requirement then the Test Tolerance applied for this test is non-zero. The Test Tolerance for this test and the explanation of how the Minimum Requirement has been relaxed by the Test Tolerance is given in annex C.

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

The block error probability (BLER) measured according to clause 8.2.7.4.2 shall not exceed 1% for the SNR levels specified in table 8.2.7.5.2-1 to 8.2.7.5.2-7.

Table 8.2.7.5.2-1: Test requirements for PUSCH with 1% BLER, 50 MHz Channel Bandwidth, 60 kHz SCS

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (annex J) | BLER | FRC(annex A) | Additional DM-RS position | PT-RS | SNR(dB) |
| 1 | 2 | Normal | TBD | 1 % | TBD | pos1 | TBD | TBD |

Table 8.2.7.5.2-2: Test requirements for PUSCH with 1% BLER, 100 MHz Channel Bandwidth, 60 kHz SCS

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (annex J) | BLER | FRC(annex A) | Additional DM-RS position | PT-RS | SNR(dB) |
| 1 | 2 | Normal | TBD | 1 % | TBD | pos1 | TBD | TBD |

Table 8.2.7.5.2-3: Test requirements for PUSCH with 1% BLER, 50 MHz Channel Bandwidth, 120 kHz SCS

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | BLER | FRC(annex A) | Additional DM-RS position | PT-RS | SNR(dB) |
| 1 | 2 | Normal | TBD | 1 % | TBD | pos1 | TBD | TBD |

Table 8.2.7.5.2-4: Test requirements for PUSCH with 1% BLER, 100 MHz Channel Bandwidth, 120 kHz SCS

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | BLER | FRC(annex A) | Additional DM-RS position | PT-RS | SNR(dB) |
| 1 | 2 | Normal | TBD | 1 % | TBD | pos1 | TBD | TBD |

NOTE: If the above Test Requirement differs from the Minimum Requirement then the Test Tolerance applied for this test is non-zero. The Test Tolerance for this test and the explanation of how the Minimum Requirement has been relaxed by the Test Tolerance is given in annex C.

*<End of the change 1>*

*<Start of the change 2>*

# C.3 Measurement of performance requirements

Table C.3-1: Derivation of test requirements (FR1 OTA performance tests)

|  |  |  |  |
| --- | --- | --- | --- |
| Test  | Minimum Requirement in TS 38.104 [2] | Test Tolerance(TTOTA) | Test requirement in the present document |
| 8.2.1 Performance requirements for PUSCH with transform precoding disabled | See clause 11.2.1.1 | 0.6 dB | Formula: SNR + TTOTAT-put limit unchanged |
| 8.2.2 Performance requirements for PUSCH with transform precoding enabled | See clause 11.2.1.2 | 0.6 dB | Formula: SNR + TTOTAT-put limit unchanged |
| 8.2.3 Performance requirements for UCI multiplexed on PUSCH  | See clause 11.2.1.3 | 0.6 dB | Formula: SNR + TTOTABLER limit unchanged |
| 8.2.4 Performance requirements for PUSCH for high speed train | SNRs as specified | 0.3 dB | Formula: SNR + TTT-put limit unchanged |
| 8.2.7 Performance requirements for PUSCH repetition Type A | See clause 11.2.1.7 | 0.6 dB | Formula: SNR + TTOTABLER limit unchanged |
| 8.3.1 Performance requirements for PUCCH format 0 | See clause 11.3.1.2 | 0.6 dB | Formula: SNR + TTOTAFalse ACK limit unchangedCorrect ACK limit unchanged |
| 8.3.2 Performance requirements for PUCCH format 1 | See clause 11.3.1.3  | 0.6 dB | Formula: SNR + TTOTAFalse ACK limit unchanged False NACK limit unchangedCorrect ACK limit unchanged |
| 8.3.3 Performance requirements for PUCCH format 2 | See clause 11.3.1.4  | 0.6 dB | Formula: SNR + TTOTAFalse ACK limit unchangedCorrect ACK limit unchangedUCI BLER limit unchanged |
| 8.3.4 Performance requirements for PUCCH format 3 | See clause 11.3.1.5  | 0.6 dB | Formula: SNR + TTOTAUCI BLER limit unchanged |
| 8.3.5 Performance requirements for PUCCH format 4 | See clause 11.3.1.6  | 0.6 dB | Formula: SNR + TTOTAUCI BLER limit unchanged |
| 8.3.6 Performance requirements for multi-slot PUCCH | See clause 11.3.1.7 | 0.6 dB | Formula: SNR + TTOTAFalse ACK limit unchangedFalse NACK limit unchangedCorrect ACK limit unchanged |
| 8.4.1 PRACH false alarm probability and missed detection | See clause 11.4.1 | 0.6 dB for fading cases0.3 dB for AWGN cases | Formula: SNR + TTOTAPRACH False detection limit unchangedPRACH detection limit unchanged  |
| 8.4.2 Performance requirements for PRACH for high speed train | SNRs as specified | 0.6 dB for fading cases0.3 dB for AWGN cases | Formula: SNR + TTPRACH False detection limit unchangedPRACH detection limit unchanged |
| 8.2.5 Performance requirements for UL timing adjustment | See clause 11.2.1.5 | 0.3 dB for AWGN cases | Formula: SNR + TTOTAT-put limit unchanged |
| NOTE: TT values are applicable for normal condition unless otherwise stated. |

Table C.3-2: Derivation of test requirements (FR2 OTA performance tests)

|  |  |  |  |
| --- | --- | --- | --- |
| Test  | Minimum requirement in TS 38.104 [2] | Test Tolerance(TTOTA) | Test requirement in the present document |
| 8.2.1 Performance requirements for PUSCH with transform precoding disabled | See clause 11.2.2.1 | 0.6 dB | Formula: SNR + TTOTAT-put limit unchanged |
| 8.2.2 Performance requirements for PUSCH with transform precoding enabled | See clause 11.2.2.2 | 0.6 dB | Formula: SNR + TTOTAT-put limit unchanged |
| 8.2.3 Performance requirements for UCI multiplexed on PUSCH  | See clause 11.2.2.3 | 0.6 dB | Formula: SNR + TTOTABLER limit unchanged |
| 8.2.7 Performance requirements for PUSCH repetition Type A | See clause 11.2.2.4 | 0.6 dB | Formula: SNR + TTOTABLER limit unchanged |
| 8.3.1 Performance requirements for PUCCH format 0 | See clause 11.3.2.2 | 0.6 dB | Formula: SNR + TTOTAFalse ACK limit unchangedCorrect ACK limit unchanged |
| 8.3.2 Performance requirements for PUCCH format 1 | See clause 11.3.2.3  | 0.6 dB | Formula: SNR + TTOTAFalse ACK limit unchanged False NACK limit unchangedCorrect ACK limit unchanged |
| 8.3.3 Performance requirements for PUCCH format 2 | See clause 11.3.2.4  | 0.6 dB | Formula: SNR + TTOTAFalse ACK limit unchangedCorrect ACK limit unchangedUCI BLER limit unchanged |
| 8.3.4 Performance requirements for PUCCH format 3 | See clause 11.3.2.5  | 0.6 dB | Formula: SNR + TTOTAUCI BLER limit unchanged |
| 8.3.5 Performance requirements for PUCCH format 4 | See clause 11.3.2.6  | 0.6 dB | Formula: SNR + TTOTAUCI BLER limit unchanged |
| 8.4.1 PRACH false alarm probability and missed detection | See clause 11.4.2 | 0.6 dB for fading cases0.3 dB for AWGN cases | Formula: SNR + TTOTAPRACH False detection limit unchangedPRACH detection limit unchanged  |
| NOTE: TT values are applicable for normal condition unless otherwise stated. |

*<End of the change 2>*