**3GPP TSG-RAN WG4 Meeting #97-e R4-2017528**

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

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| *CR-Form-v12.1* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.141-1** | **CR** | **0162** | **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 38.141-1: Addition of BS conformance testing for URLLC demodulation requirements with higher BLER | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Huawei, HiSilicon | | | | | | | | | |
| ***Source to TSG:*** | RAN4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***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 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-15 (Release 15) Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | PUSCH repetition Type A was defined as the new feature to improve the high reliability for PUSCH performance. PUSCH mapping Type B with low number of symbols was agreed to be configured to reduce latency. In order to verify these two features for URLLC, the demodulation requirements are defined and should be introduced in this specification. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Demodulation requirements for PUSCH repetition Type A are introduced in section 8.2.7.  Demodulation requirements for PUSCH mapping Type B with 2 symbol length allocated are introduced in section 8.2.8.  The measurement of performance requirements for these two demodulation requirements are added in Annex C.3. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | New requirements for PUSCH repetition Type A and PUSCH mapping Type B with 2 symbol length allocated cannot be verified. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 8.2.7, 8.2.8, Annex 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:*** | | Resubmission of endorsed draftCR R4-2012656 | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | | R4-2015624 | | | | | | | | |

*<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 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 BS is based on the test applicability rules defined in clause 8.1.2.1.

#### 8.2.7.2 Minimum Requirement

The minimum requirement is in TS 38.104 [2] clause 8.2.7.

#### 8.2.7.3 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.

#### 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.

#### 8.2.7.4.2 Procedure

1) Connect the BS tester generating the wanted signal, multipath fading simulators and AWGN generators to all BS antenna connectors for diversity reception via a combining network as shown in annex D.5 and D.6 for *BS type 1-C* and *type 1-H* respectively.

2) Adjust the AWGN generator, according to the channel bandwidth, defined in table 8.2.7.4.2-1.

Table 8.2.7.4.2-1: AWGN power level at the BS input

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

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 8.2.7.4.2-2.

Table 8.2.7.4.2-2: Test parameters for testing PUSCH repetition Type A

|  |  |  |
| --- | --- | --- |
| Parameter | | Value |
| Transform precoding | | Disabled |
| Default TDD UL-DL pattern (Note 1) | | 15 kHz SCS:  3D1S1U, S=10D:2G:2U  30 kHz SCS:  7D1S2U, S=6D:4G:4U |
| 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 | 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 | 30 kHz SCS: n2  15 kHz SCS: n2 for FDD and n8 for TDD [Note 3] |
| Frequency domain resource assignment | RB assignment | Full applicable test bandwidth |
| Frequency hopping | Disabled |
| Code block group based PUSCH transmission | | Disabled |
| Note 1: The same requirements are applicable to FDD and TDD with different UL-DL pattern.  Note 2: The effective RV sequence is {0, 2, 3, 1} with slot aggregation.  Note 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. | | |

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

5) Adjust the equipment so that required SNR specified in table 8.2.7.5-1 to 8.2.7.5-8 is achieved at the BS input.

6) For each of the reference channels in table 8.2.7.5-1 to 8.2.7.5-8 applicable for the base station, measure the BLER.

#### 8.2.7.5 Test Requirement

The BLER measured according to clause 8.2.7.4.2 shall not be above the limits for the SNR levels specified in table 8.2.7.5-1 to 8.2.7.5-14.

Table 8.2.7.5-1: 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) | 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 8.2.7.5-2: Minimum requirements for PUSCH, Type A, 10 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (Annex G) | 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 8.2.7.5-3: 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) | 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 8.2.7.5-4: Minimum requirements for PUSCH, Type A, 40 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (Annex G) | 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: 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 8.2.7.5-5: 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) | 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 8.2.7.5-6: Minimum requirements for PUSCH, Type B, 10 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (Annex G) | 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 8.2.7.5-7: 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) | 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 8.2.7.5-8: Minimum requirements for PUSCH, Type B, 40 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (Annex G) | 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: 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 the change 1>*

*<Start of the change 2>*

### 8.2.8 Performance requirements for PUSCH Mapping Type B with non-slot transmission

#### 8.2.8.1 Definition and applicability

The performance requirement of PUSCH mapping Type B 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.

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

#### 8.2.8.2 Minimum Requirement

The minimum requirement is in TS 38.104 [2] clause 8.2.8.

#### 8.2.8.3 Test Purpose

The test shall verify the receiver's ability to achieve throughput for PUSCH mapping Type B with 2 symbol length allocated in time domain under multipath fading propagation conditions for a given SNR.

#### 8.2.8.4 Method of test

#### 8.2.8.4.1 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.

#### 8.2.8.4.2 Procedure

1) Connect the BS tester generating the wanted signal, multipath fading simulators and AWGN generators to all BS antenna connectors for diversity reception via a combining network as shown in annex D.5 and D.6 for *BS type 1-C* and *type 1-H* respectively.

2) Adjust the AWGN generator, according to the channel bandwidth, defined in table 8.2.8.4.2-1.

Table 8.2.8.4.2-1: AWGN power level at the BS input

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

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 8.2.8.4.2-2.

Table 8.2.8.4.2-2: Test parameters for testing PUSCH Mapping Type B with non-slot transmission

|  |  |  |
| --- | --- | --- |
| Parameter | | Value |
| Transform precoding | | Disabled |
| Default TDD UL-DL pattern (Note 1) | | 15 kHz SCS:  3D1S1U, S=10D:2G:2U  30 kHz SCS:  7D1S2U, S=6D:4G:4U |
| HARQ | Maximum number of HARQ transmissions | 1 |
| RV sequence | 0 |
| DM-RS | DM-RS configuration type | 1 |
| DM-RS duration | single-symbol DM-RS |
| Number of additional DM-RS | 0 |
| 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 | B |
| Start symbol | 0 |
| Allocation length | 2 |
| PUSCH aggregation factor | 1 |
| Frequency domain resource assignment | RB assignment | Full applicable test bandwidth |
| Frequency hopping | Disabled |
| Code block group based PUSCH transmission | | Disabled |
| Note 1: The same requirements are applicable to FDD and TDD with different UL-DL pattern. | | |

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

5) Adjust the equipment so that required SNR specified in table 8.2.8.5-1 to 8.2.8.5-4 is achieved at the BS input.

6) For each of the reference channels in table 8.2.8.5-1 to 8.2.8.5-8 applicable for the base station, measure the throughput.

#### 8.2.8.5 Test Requirement

The throughput measured according to clause 8.2.8.4.2 shall not be below the limits for the SNR levels specified in table 8.2.8.5-1 to 8.2.8.5-4.

Table 8.2.8.5-1: 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) | SNR  (dB) |
| 1 | 2 | Normal | TDLC300-100 Low | 70% | G-FR1-A3B-1 | [1.2] |

Table 8.2.8.5-2: Minimum requirements for PUSCH, Type B, 10 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) | SNR  (dB) |
| 1 | 2 | Normal | TDLC300-100 Low | 70% | G-FR1- A3B -2 | [0.8] |

Table 8.2.8.5-3: 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) | SNR  (dB) |
| 1 | 2 | Normal | TDLC300-100 Low | 70% | G-FR1- A3B -3 | [1.0] |

Table 8.2.8.5-4: Minimum requirements for PUSCH, Type B, 40 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) | SNR  (dB) |
| 1 | 2 | Normal | TDLC300-100 Low | 70% | G-FR1- A3B -4 | [0.5] |

*<End of the change 2>*

*<Start of the change 3>*

C.3 Measurement of performance requirements

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

|  |  |  |  |
| --- | --- | --- | --- |
| **Test** | **Minimum Requirement in TS 38.104 [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  0.8 dB for 2Tx 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 |
| 8.2.7 Performance requirements for PUSCH repetition Type A | SNRs as specified | 0.6 dB | Formula: SNR + TT  BLER limit unchanged |
| 8.2.8 Performance requirements for PUSCH Mapping Type B with non-slot transmission | 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  Correct ACK limit unchanged  Correct NACK 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  Correct UCI limit unchanged |
| 8.3.4 Performance requirements for PUCCH format 3 | SNRs as specified | 0.6 dB | Formula: SNR + TT  Correct UCI limit unchanged |
| 8.3.5 Performance requirements for PUCCH format 4 | SNRs as specified | 0.6 dB | Formula: SNR + TT  Correct UCI 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 |

*<End of the change 3>*