**3GPP TSG-RAN WG4 Meeting #94-e****R4-2002398**

**Online, 24th February- 6th March, 2020**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *CR-Form-v12.0* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.104** | **CR** | **0130** | **rev** | **1** | **Current version:** |  |  |
|  | | | | | | | | |
| *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 for TS38.104: Introduce PUSCH performance requirements at 30% throughput testing point | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | CATT | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_perf\_enh-Perf | | | | |  | ***Date:*** | | | 2020-02-14 |
|  |  | | | |  | |  | | |  |
| ***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-12 (Release 12)* *Rel-13 (Release 13) Rel-14 (Release 14) Rel-15 (Release 15) Rel-16 (Release 16)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | PUSCH performance requirements at 30% throughput testing point should be added to the specification. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Add PUSCH performance requirements at 30% throughput testing point. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | PUSCH performance requirements would be incomplete. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 8.2.1.2, 11.2.2.1.2 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **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:*** | |  | | | | | | | | |

<Start of Change 1>

### 8.2.1 Requirements for PUSCH with transform precoding disabled

#### 8.2.1.1 General

The performance requirement of PUSCH 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. The performance requirements assume HARQ retransmissions.

Table: 8.2.1.1-1 Test parameters for testing PUSCH

|  |  |  |
| --- | --- | --- |
| 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, 2, 3, 1 |
| 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}, {0, 1} |
| DM-RS sequence generation | NID0=0, nSCID =0 |
| Time domain resource assignment | PUSCH mapping type | A, B |
| Start symbol | 0 |
| Allocation length | 14 |
| Frequency domain resource assignment | RB assignment | Full applicable test bandwidth |
| Frequency hopping | Disabled |
| TPMI index for 2Tx two-layer spatial multiplexing transmission | | 0 |
| Code block group based PUSCH transmission | | Disabled |
| Note 1: The same requirements are applicable to FDD and TDD with different UL-DL pattern. | | |

#### 8.2.1.2 Minimum requirements

The throughput shall be equal to or larger than the fraction of maximum throughput for the FRCs stated in tables 8.2.1.2-1 to 8.2.1.2-14 at the given SNR for 1Tx or for 2Tx two-layer spatial multiplexing transmission. FRCs are defined in annex A.

Table 8.2.1.2-1: Minimum requirements for PUSCH, Type A, 5 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditionsand correlation matrix (Annex G) | Fraction of maximum throughput | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-8 | pos1 | -2.3 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-8 | pos1 | 10.1 |
| 30 % | G-FR1-A4-8 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-8 | pos1 | 12.3 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-8 | pos1 | -5.8 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-8 | pos1 | 6.2 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-8 | pos1 | 8.8 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-8 | pos1 | -8.7 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-8 | pos1 | 3.0 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-8 | pos1 | 5.6 |
| 2 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-22 | pos1 | 1.0 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-22 | pos1 | 18.2 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-22 | pos1 | -2.3 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-22 | pos1 | 11.0 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-22 | pos1 | -5.3 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-22 | pos1 | 6.8 |

Table 8.2.1.2-2: Minimum requirements for PUSCH, Type A, 10 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditionsand correlation matrix (Annex G) | Fraction of maximum throughput | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-9 | pos1 | -2.5 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-9 | pos1 | 10.2 |
| 30 % | G-FR1-A4-8 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-9 | pos1 | 12.2 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-9 | pos1 | -6.0 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-9 | pos1 | 6.3 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-9 | pos1 | 8.6 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-9 | pos1 | -8.7 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-9 | pos1 | 3.1 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-9 | pos1 | 5.5 |
| 2 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-23 | pos1 | 1.7 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-23 | pos1 | 18.3 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-23 | pos1 | -2.0 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-23 | pos1 | 11.2 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-23 | pos1 | -5.5 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-23 | pos1 | 6.8 |

Table 8.2.1.2-3: Minimum requirements for PUSCH, Type A, 20 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditionsand correlation matrix (Annex G) | Fraction of maximum throughput | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-10 | pos1 | -2.1 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-10 | pos1 | 10.0 |
| 30 % | G-FR1-A4-8 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-10 | pos1 | 12.4 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-10 | pos1 | -5.5 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-10 | pos1 | 6.2 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-10 | pos1 | 8.6 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-10 | pos1 | -8.5 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-10 | pos1 | 3.0 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-10 | pos1 | 5.5 |
| 2 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-24 | pos1 | 2.1 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-24 | pos1 | 18.3 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-24 | pos1 | -1.8 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-24 | pos1 | 11.1 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-24 | pos1 | -5.3 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-24 | pos1 | 6.9 |

Table 8.2.1.2-4: Minimum requirements for PUSCH, Type A, 10 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditionsand correlation matrix (Annex G) | Fraction of maximum throughput | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-11 | pos1 | -2.3 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-11 | pos1 | 10.2 |
| 30 % | G-FR1-A4-11 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-11 | pos1 | 12.8 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-11 | pos1 | -5.6 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-11 | pos1 | 6.4 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-11 | pos1 | 8.6 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-11 | pos1 | -8.6 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-11 | pos1 | 3.3 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-11 | pos1 | 5.5 |
| 2 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-25 | pos1 | 1.3 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-25 | pos1 | 18.4 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-25 | pos1 | -2.2 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-25 | pos1 | 11.2 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-25 | pos1 | -5.2 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-25 | pos1 | 7.0 |

Table 8.2.1.2-5: Minimum requirements for PUSCH, Type A, 20 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditionsand correlation matrix (Annex G) | Fraction of maximum throughput | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-12 | pos1 | -2.9 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-12 | pos1 | 10.2 |
| 30 % | G-FR1-A4-11 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-12 | pos1 | 12.5 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-12 | pos1 | -6.0 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-12 | pos1 | 6.4 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-12 | pos1 | 8.6 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-12 | pos1 | -8.8 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-12 | pos1 | 3.2 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-12 | pos1 | 5.5 |
| 2 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-26 | pos1 | 1.3 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-26 | pos1 | 18.1 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-26 | pos1 | -2.2 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-26 | pos1 | 11.3 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-26 | pos1 | -5.3 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-26 | pos1 | 6.9 |

Table 8.2.1.2-6: Minimum requirements for PUSCH, Type A, 40 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditionsand correlation matrix (Annex G) | Fraction of maximum throughput | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-13 | pos1 | -2.5 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-13 | pos1 | 10.0 |
| 30 % | G-FR1-A4-11 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-13 | pos1 | 12.4 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-13 | pos1 | -5.8 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-13 | pos1 | 6.3 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-13 | pos1 | 8.5 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-13 | pos1 | -8.7 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-13 | pos1 | 3.1 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-13 | pos1 | 5.4 |
| 2 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-27 | pos1 | 1.3 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-27 | pos1 | 19.5 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-27 | pos1 | -2.3 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-27 | pos1 | 11.3 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-27 | pos1 | -5.2 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-27 | pos1 | 6.9 |

Table 8.2.1.2-7: Minimum requirements for PUSCH, Type A, 100 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditionsand correlation matrix (Annex G) | Fraction of maximum throughput | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-14 | pos1 | -2.8 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-14 | pos1 | 10.2 |
| 30 % | G-FR1-A4-11 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-14 | pos1 | 13.0 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-14 | pos1 | -5.8 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-14 | pos1 | 6.5 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-14 | pos1 | 9.0 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-14 | pos1 | -8.7 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-14 | pos1 | 3.2 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-14 | pos1 | 5.8 |
| 2 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-28 | pos1 | 1.4 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-28 | pos1 | 19.2 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-28 | pos1 | -2.2 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-28 | pos1 | 11.6 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-28 | pos1 | -5.2 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-28 | pos1 | 7.1 |

Table 8.2.1.2-8: Minimum requirements for PUSCH, Type B, 5 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditionsand correlation matrix (Annex G) | Fraction of maximum throughput | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-8 | pos1 | -2.3 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-8 | pos1 | 10.2 |
| 30 % | G-FR1-A4-8 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-8 | pos1 | 12.5 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-8 | pos1 | -5.7 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-8 | pos1 | 6.3 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-8 | pos1 | 8.9 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-8 | pos1 | -8.7 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-8 | pos1 | 3.0 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-8 | pos1 | 5.7 |
| 2 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-22 | pos1 | 1.5 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-22 | pos1 | 18.3 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-22 | pos1 | -2.3 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-22 | pos1 | 11.1 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-22 | pos1 | -5.4 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-22 | pos1 | 6.8 |

Table 8.2.1.2-9: Minimum requirements for PUSCH, Type B, 10 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditionsand correlation matrix (Annex G) | Fraction of maximum throughput | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-9 | pos1 | -2.3 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-9 | pos1 | 10.5 |
| 30 % | G-FR1-A4-8 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-9 | pos1 | 12.6 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-9 | pos1 | -5.7 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-9 | pos1 | 6.5 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-9 | pos1 | 8.9 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-9 | pos1 | -9.0 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-9 | pos1 | 3.2 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-9 | pos1 | 5.8 |
| 2 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-23 | pos1 | 2.0 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-23 | pos1 | 18.7 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-23 | pos1 | -2.3 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-23 | pos1 | 11.3 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-23 | pos1 | -5.2 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-23 | pos1 | 7.0 |

Table 8.2.1.2-10: Minimum requirements for PUSCH, Type B, 20 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditionsand correlation matrix (Annex G) | Fraction of maximum throughput | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-10 | pos1 | -2.1 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-10 | pos1 | 10.4 |
| 30 % | G-FR1-A4-8 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-10 | pos1 | 12.3 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-10 | pos1 | -5.7 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-10 | pos1 | 6.3 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-10 | pos1 | 8.8 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-10 | pos1 | -8.5 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-10 | pos1 | 3.1 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-10 | pos1 | 5.7 |
| 2 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-24 | pos1 | 1.6 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-24 | pos1 | 18.1 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-24 | pos1 | -2.0 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-24 | pos1 | 11.2 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-24 | pos1 | -5.3 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-24 | pos1 | 6.9 |

Table 8.2.1.2-11: Minimum requirements for PUSCH, Type B, 10 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditionsand correlation matrix (Annex G) | Fraction of maximum throughput | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-11 | pos1 | -2.4 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-11 | pos1 | 10.1 |
| 30 % | G-FR1-A4-11 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-11 | pos1 | 12.5 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-11 | pos1 | -5.7 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-11 | pos1 | 6.4 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-11 | pos1 | 8.6 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-11 | pos1 | -8.8 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-11 | pos1 | 3.2 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-11 | pos1 | 5.6 |
| 2 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-25 | pos1 | 1.1 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-25 | pos1 | 18.5 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-25 | pos1 | -2.5 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-25 | pos1 | 11.3 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-25 | pos1 | -5.6 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-25 | pos1 | 7.0 |

Table 8.2.1.2-12: Minimum requirements for PUSCH, Type B, 20 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditionsand correlation matrix (Annex G) | Fraction of maximum throughput | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-12 | pos1 | -2.9 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-12 | pos1 | 10.1 |
| 30 % | G-FR1-A4-11 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-12 | pos1 | 12.5 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-12 | pos1 | -6.0 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-12 | pos1 | 6.3 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-12 | pos1 | 8.6 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-12 | pos1 | -9.0 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-12 | pos1 | 3.1 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-12 | pos1 | 5.6 |
| 2 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-26 | pos1 | 1.3 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-26 | pos1 | 18.2 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-26 | pos1 | -2.3 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-26 | pos1 | 11.2 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-26 | pos1 | -5.4 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-26 | pos1 | 7.0 |

Table 8.2.1.2-13: Minimum requirements for PUSCH, Type B, 40 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditionsand correlation matrix (Annex G) | Fraction of maximum throughput | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-13 | pos1 | -2.5 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-13 | pos1 | 10.0 |
| 30 % | G-FR1-A4-11 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-13 | pos1 | 12.5 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-13 | pos1 | -5.8 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-13 | pos1 | 6.2 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-13 | pos1 | 8.7 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-13 | pos1 | -8.8 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-13 | pos1 | 3.0 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-13 | pos1 | 5.5 |
| 2 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-27 | pos1 | 1.7 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-27 | pos1 | 18.7 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-27 | pos1 | -2.1 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-27 | pos1 | 11.2 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-27 | pos1 | -5.2 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-27 | pos1 | 6.9 |

Table 8.2.1.2-14: Minimum requirements for PUSCH, Type B, 100 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditionsand correlation matrix (Annex G) | Fraction of maximum throughput | FRC (Annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-14 | pos1 | -2.5 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-14 | pos1 | 10.1 |
| 30 % | G-FR1-A4-11 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-14 | pos1 | 13.1 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-14 | pos1 | -5.8 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-14 | pos1 | 6.3 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-14 | pos1 | 9.2 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-14 | pos1 | -8.7 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-14 | pos1 | 3.1 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-14 | pos1 | 5.9 |
| 2 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-28 | pos1 | 1.6 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-28 | pos1 | 19.3 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-28 | pos1 | -2.2 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-28 | pos1 | 11.6 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-28 | pos1 | -5.3 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-28 | pos1 | 7.1 |

<End of Change 1>

<Start of Change 2>

### 11.2.2 Requirements for *BS type 2-O*

#### 11.2.2.1 Requirements for PUSCH with transform precoding disabled

##### 11.2.2.1.1 General

The performance requirement of PUSCH 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. The performance requirements assume HARQ retransmissions.

Table 11.2.2.1.1-1: Test parameters for testing PUSCH

|  |  |  |
| --- | --- | --- |
| Parameter | | Value |
| Transform precoding | | Disabled |
| Default TDD UL-DL pattern (Note 1) | | 60 kHz and 120kHz SCS:  3D1S1U, S=10D:2G:2U |
| HARQ | Maximum number of HARQ transmissions | 4 |
| RV sequence | 0, 2, 3, 1 |
| DM-RS | DM-RS configuration type | 1 |
| DM-RS duration | single-symbol DM-RS |
| Additional DM-RS symbols | pos0, 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 | NID=0, nSCID =0 |
| Time domain resource | PUSCH mapping type | B |
| Start symbol index | 0 |
| Allocation length | 10 |
| Frequency domain resource | RB assignment | Full applicable test bandwidth |
| Frequency hopping | Disabled |
| TPMI index for 2Tx two-layer spatial multiplexing transmission | | 0 |
| Code block group based PUSCH transmission | | Disabled |
| PT-RS configuration | Frequency density (*KPT-RS*) | 2 |
| Time density (*LPT-RS*) | 1 |
| NOTE 1: The same requirements are applicable to TDD with different UL-DL patterns | | |

##### 11.2.2.1.2 Minimum requirements

The throughput shall be equal to or larger than the fraction of maximum throughput stated in the tables 11.2.2.1.2-1 to 11.2.2.1.2-5 at the given SNR for 1Tx and for 2Tx two-layer spatial multiplexing transmission.

Table 11.2.2.1.2-1: Minimum requirements for PUSCH, 50 MHz channel bandwidth, 60 kHz SCS

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditionsand correlation matrix (Annex G) | Fraction of maximum throughput | FRC (Annex A) | Additional DM-RS position | PT-RS | SNR  (dB) |
| 1 | 2 | Normal | TDLA30-300 Low | 70 % | G-FR2-A3-1 | pos0 | No | -2.0 |
| G-FR2-A3-13 | pos1 | No | -2.2 |
| Normal | TDLA30-300 Low | 70 % | G-FR2-A4-1 | pos0 | Yes | 12.0 |
| No | 11.5 |
| G-FR2-A4-11 | pos1 | Yes | 10.7 |
| No | 10.7 |
| 30 % | G-FR2-A4-1 | pos0 | Yes | [TBD] |
| No | [TBD] |
| G-FR2-A4-11 | pos1 | Yes | [TBD] |
| No | [TBD] |
| Normal | TDLA30-75 Low | 70 % | G-FR2-A5-1 | pos0 | Yes | 13.7 |
| No | 13.1 |
| G-FR2-A5-6 | pos1 | Yes | 13.4 |
| No | 12.9 |
| 2 | Normal | TDLA30-300 Low | 70 % | G-FR2-A3-6 | pos0 | No | 1.5 |
| G-FR2-A3-18 | pos1 | No | 1.2 |
| G-FR2-A4-16 | pos1 | Yes | 19.6 |
| No | 18.1 |

Table 11.2.2.1.2-2: Minimum requirements for PUSCH, 100 MHz channel bandwidth, 60 kHz SCS

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditionsand correlation matrix (Annex G) | Fraction of maximum throughput | FRC (Annex A) | Additional DM-RS position | PT-RS | SNR  (dB) |
| 1 | 2 | Normal | TDLA30-300 Low | 70 % | G-FR2-A3-2 | pos0 | No | -2.1 |
| G-FR2-A3-14 | pos1 | No | -2.4 |
| Normal | TDLA30-300 Low | 70 % | G-FR2-A4-2 | pos0 | Yes | 12.2 |
| No | 11.2 |
| G-FR2-A4-12 | pos1 | Yes | 11.2 |
| No | 10.6 |
| 30 % | G-FR2-A4-1 | pos0 | Yes | [TBD] |
| No | [TBD] |
| G-FR2-A4-11 | pos1 | Yes | [TBD] |
| No | [TBD] |
| Normal | TDLA30-75 Low | 70 % | G-FR2-A5-2 | pos0 | Yes | 14.2 |
| No | 13.3 |
| G-FR2-A5-7 | pos1 | Yes | 13.7 |
| No | 13.1 |
| 2 | Normal | TDLA30-300 Low | 70 % | G-FR2-A3-7 | pos0 | No | 1.5 |
| G-FR2-A3-19 | pos1 | No | 1.2 |
| G-FR2-A4-17 | pos1 | Yes | 18.8 |
| No | 18.3 |

Table 11.2.2.1.2-3: Minimum requirements for PUSCH, 50 MHz channel bandwidth, 120 kHz SCS

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditionsand correlation matrix (Annex G) | Fraction of maximum throughput | FRC (Annex A) | Additional DM-RS position | PT-RS | SNR  (dB) |
| 1 | 2 | Normal | TDLA30-300 Low | 70 % | G-FR2-A3-3 | pos0 | No | -1.8 |
| G-FR2-A3-15 | pos1 | No | -2.1 |
| Normal | TDLA30-300 Low | 70 % | G-FR2-A4-3 | pos0 | Yes | 11.6 |
| No | 10.9 |
| G-FR2-A4-13 | pos1 | Yes | 10.9 |
| No | 10.5 |
| 30 % | G-FR2-A4-3 | pos0 | Yes | [TBD] |
| No | [TBD] |
| G-FR2-A4-13 | pos1 | Yes | [TBD] |
| No | [TBD] |
| Normal | TDLA30-75 Low | 70 % | G-FR2-A5-3 | pos0 | Yes | 13.7 |
| No | 13.1 |
| G-FR2-A5-8 | pos1 | Yes | 13.2 |
| No | 13.0 |
| 2 | Normal | TDLA30-300 Low | 70 % | G-FR2-A3-8 | pos0 | No | 1.4 |
| G-FR2-A3-20 | pos1 | No | 1.3 |
| Normal | TDLA30-300 Low | 70 % | G-FR2-A4-8 | pos0 | Yes | 21.1 |
| No | 18.6 |
| G-FR2-A4-18 | pos1 | Yes | 19.6 |
| No | 17.6 |

Table 11.2.2.1.2-4: Minimum requirements for PUSCH, 100 MHz channel bandwidth, 120 kHz SCS

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditionsand correlation matrix (Annex G) | Fraction of maximum throughput | FRC (Annex A) | Additional DM-RS position | PT-RS | SNR  (dB) |
| 1 | 2 | Normal | TDLA30-300 Low | 70 % | G-FR2-A3-4 | pos0 | No | -2.4 |
| G-FR2-A3-16 | pos1 | No | -2.5 |
| Normal | TDLA30-300 Low | 70 % | G-FR2-A4-4 | pos0 | Yes | 11.9 |
| No | 10.5 |
| G-FR2-A4-14 | pos1 | Yes | 11.1 |
| No | 10.5 |
| 30 % | G-FR2-A4-3 | pos0 | Yes | [TBD] |
| No | [TBD] |
| G-FR2-A4-13 | pos1 | Yes | [TBD] |
| No | [TBD] |
| Normal | TDLA30-75 Low | 70 % | G-FR2-A5-4 | pos0 | Yes | 13.5 |
| No | 12.9 |
| G-FR2-A5-9 | pos1 | Yes | 13.4 |
| No | 12.8 |
| 2 | Normal | TDLA30-300 Low | 70 % | G-FR2-A3-9 | pos0 | No | 1.4 |
| G-FR21-A3-21 | pos1 | No | 1.2 |
| Normal | TDLA30-300 Low | 70 % | G-FR2-A4-9 | pos0 | Yes | 20.8 |
| No | 19.4 |
| G-FR2-A4-19 | pos1 | Yes | 18.5 |
| No | 18.0 |

Table 11.2.2.1.2-5: Minimum requirements for PUSCH, 200 MHz channel bandwidth, 120 kHz SCS

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Cyclic prefix | Propagation conditionsand correlation matrix (Annex G) | Fraction of maximum throughput | FRC (Annex A) | Additional DM-RS position | PT-RS | SNR  (dB) |
| 1 | 2 | Normal | TDLA30-300 Low | 70 % | G-FR2-A3-5 | pos0 | No | -2.1 |
| G-FR2-A3-17 | pos1 | No | -2.4 |
| Normal | TDLA30-300 Low | 70 % | G-FR2-A4-5 | pos0 | Yes | 11.3 |
| No | 10.9 |
| G-FR2-A4-15 | pos1 | Yes | 11.2 |
| No | 10.7 |
| 30 % | G-FR2-A4-3 | pos0 | Yes | [TBD] |
| No | [TBD] |
| G-FR2-A4-13 | pos1 | Yes | [TBD] |
| No | [TBD] |
| Normal | TDLA30-75 Low | 70 % | G-FR2-A5-5 | pos0 | Yes | 14.1 |
| No | 13.4 |
| G-FR2-A5-10 | pos1 | Yes | 13.7 |
| No | 13.3 |
| 2 | Normal | TDLA30-300 Low | 70 % | G-FR2-A3-10 | pos0 | No | 1.4 |
| G-FR2-A3-22 | pos1 | No | 1.1 |
| Normal | TDLA30-300 Low | 70 % | G-FR2-A4-10 | pos0 | Yes | 21.5 |
| No | 20.2 |
| G-FR2-A4-20 | pos1 | Yes | 19.0 |
| No | 18.2 |

<End of Change 2>