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

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

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **TS38.141-2** | **CR** | **DRAFT** | **rev** | **-** | **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)*.* | | | | | | | | |
|  | | | | | | | | |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network | **x** | Core Network |  |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | | | | | | | | |
| ***Title:*** | Draft CR for FRC table for FR2-2 PUSCH demodulation requirement | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Ericsson | | | | | | | | | |
| ***Source to TSG:*** | RAN4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_ext\_to\_71GHz-Perf | | | | |  | ***Date:*** | | | 2022-09-18 |
|  |  | | | |  | |  | | |  |
| ***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 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-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | The FR2-2 PUSCH demodulation requirements are agreed to be introduced for Rel-17. The FRC table for PUSCH requirements should be added according to agreed resource allocations. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Following changes are added:   1. Adding FRC tables for 120kHz and 480kHz SCS with MCS4, DM-RS additional pos0 and pos1, 1 layer and precoding disabled/enabled. 2. Adding FRC tables for 120kHz and 480kHz SCS with MCS4, DM-RS additional pos0 and pos1, 2 layers and precoding disabled. 3. Adding FRC tables for 480kHz SCS with MCS16, DM-RS additional pos0 and pos1, 1 layer and precoding disabled. 4. Adding FRC tables for 480kHz SCS with MCS16, DM-RS additional pos0 and pos1, 2 layers and precoding disabled. 5. Adding FRC tables for 480kHz SCS with MCS20, DM-RS additional pos0 and pos1, 1 layer and precoding disabled. 6. Corrections on the values in previous draft CR. 7. Modify “FR2” to “FR2-1” and “FR2-2” seperately in table titles. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | There will be no FRC table for FR2-2 PUSCH demodulation requirments. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | A.3B, A.4, A.5 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **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:*** | | Revised from R4-2215659. | | | | | | | | |

########################## Start of change #1 ############################

# A.3B Fixed Reference Channels for performance requirements (QPSK, R=308/1024)

The parameters for the reference measurement channels are specified in table A.3B-1 for FR1 PUSCH performance requirements:

- FRC parameters are specified in table A.3B-1 for FR1 PUSCH with transform precoding disabled, no additional DM-RS and 1 transmission layer.

The parameters for the reference measurement channel are specified in table A.3B-2 to table A.3B-7 for FR2-2 PUSCH performance requirements:

- FRC parameters are specified in table A.3B-2 for FR2-2 PUSCH with transform precoding disabled, *Additional DM-RS position = pos0* and 1 transmission layer.

- FRC parameters are specified in table A.3B-3 for FR2-2 PUSCH with transform precoding disabled, *Additional DM-RS position = pos1* and 1 transmission layer.

- FRC parameters are specified in table A.3B-4 for FR2-2 PUSCH with transform precoding enabled, *Additional DM-RS position = pos0* and 1 transmission layer.

- FRC parameters are specified in table A.3B-5 for FR2-2 PUSCH with transform precoding enabled, *Additional DM-RS position = pos1* and 1 transmission layer.

- FRC parameters are specified in table A.3B-6 for FR2-2 PUSCH with transform precoding disabled, *Additional DM-RS position = pos0* and 2 transmission layers.

- FRC parameters are specified in table A.3B-7 for FR2-2 PUSCH with transform precoding disabled, *Additional DM-RS position = pos1* and 2 transmission layers.

Table A.3B-1: FRC parameters for FR1 PUSCH performance requirements, transform precoding disabled, no additional DM-RS and 1 transmission layer (QPSK, R=308/1024)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Reference channel | G-FR1-A3B-1 | G-FR1-A3B-2 | G-FR1-A3B-3 | G-FR1-A3B-4 |
| Subcarrier spacing [kHz] | 15 | 15 | 30 | 30 |
| Allocated resource blocks | 25 | 52 | 24 | 106 |
| CP-OFDM Symbols per slot (Note 1) | 1 | 1 | 1 | 1 |
| Modulation | QPSK | QPSK | QPSK | QPSK |
| Code rate (Note 2) | 308/1024 | 308/1024 | 308/1024 | 308/1024 |
| Payload size (bits) | 176 | 368 | 168 | 768 |
| Transport block CRC (bits) | 16 | 16 | 16 | 16 |
| Code block CRC size (bits) | - | - | - | - |
| Number of code blocks - C | 1 | 1 | 1 | 1 |
| Code block size including CRC (bits) (Note 2) | 192 | 384 | 184 | 784 |
| Total number of bits per slot | 600 | 1248 | 576 | 2544 |
| Total symbols per slot | 300 | 624 | 288 | 1272 |
| NOTE 1: DM-RS configuration type= 1 with DM-RS duration = single-symbol DM-RS and the number of DM-RS CDM groups without data is 2, additional DM-RS position = pos0, *l0*= 0 as per table 6.4.1.1.3-3 of TS 38.211 [20].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [19]. | | | | |

Table A.3B-2: FRC parameters for FR2-2 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos0* and 1 transmission layer (QPSK, R=308/1024)

|  |  |  |  |
| --- | --- | --- | --- |
| Reference channel | G-FR2-A3B-5 | G-FR2-A3B-6 | G-FR2-A3B-7 |
| Subcarrier spacing [kHz] | 120 | 120 | 480 |
| Allocated resource blocks | 66 | 264 | 66 |
| CP-OFDM Symbols per slot (Note 1) | 9 | 9 | 9 |
| Modulation | QPSK | QPSK | QPSK |
| Code rate (Note 2) | 308/1024 | 308/1024 | 308/1024 |
| Payload size (bits) | 4224 | 16896 | 4224 |
| Transport block CRC (bits) | 24 | 24 | 24 |
| Code block CRC size (bits) | - | 24 | - |
| Number of code blocks - C | 1 | 3 | 1 |
| Code block size including CRC (bits) (Note 2) | 4248 | 5664 | 4248 |
| Total number of bits per slot without PT-RS | 14256 | 57024 | 14256 |
| Total number of bits per slot with PT-RS (Note 4) | 13662 | 54648 | 13662 |
| Total symbols per slot without PT-RS | 7128 | 28512 | 7128 |
| Total symbols per slot with PT-RS (Note 4) | 6831 | 27324 | 6831 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos0* with *l0*= 0 as per Table 6.4.1.1.3-3 of TS 38.211 [9].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [15].  NOTE 3: The calculation of the “Total number of bits per slot” and “Total symbols per slot” fields include the REs taken up by CSI part 1 and CSI part 2, if present.  NOTE 4: PT-RS configuration *KPT-RS =2, LPT-RS =1*. | | | |

Table A.3B-3: FRC parameters for FR2-2 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos1* and 1 transmission layer (QPSK, R=308/1024)

|  |  |  |  |
| --- | --- | --- | --- |
| Reference channel | G-FR2-A3B-8 | G-FR2-A3B-9 | G-FR2-A3B-10 |
| Subcarrier spacing [kHz] | 120 | 120 | 480 |
| Allocated resource blocks | 66 | 264 | 66 |
| CP-OFDM Symbols per slot (Note 1) | 8 | 8 | 8 |
| Modulation | QPSK | QPSK | QPSK |
| Code rate (Note 2) | 308/1024 | 308/1024 | 308/1024 |
| Payload size (bits) | 3824 | 15112 | 3824 |
| Transport block CRC (bits) | 16 | 24 | 16 |
| Code block CRC size (bits) | - | 24 | - |
| Number of code blocks - C | 1 | 2 | 1 |
| Code block size including CRC (bits) (Note 2) | 3840 | 7592 | 3840 |
| Total number of bits per slot without PT-RS | 12672 | 50688 | 12672 |
| Total number of bits per slot with PT-RS (Note 4) | 12144 | 48576 | 12144 |
| Total symbols per slot without PT-RS | 6336 | 25344 | 6336 |
| Total symbols per slot with PT-RS (Note 4) | 6072 | 24288 | 6072 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos1* with *l0*= 0 and *l* =8 as per Table 6.4.1.1.3-3 of TS 38.211 [9].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [15].  NOTE 3: The calculation of the “Total number of bits per slot” and “Total symbols per slot” fields include the REs taken up by CSI part 1 and CSI part 2, if present.  NOTE 4: PT-RS configuration *KPT-RS =2, LPT-RS =1*. | | | | |

Table A.3B-4: FRC parameters for FR2-2 PUSCH performance requirements, transform precoding enabled, *Additional DM-RS position = pos0* and 1 transmission layer (QPSK, R=308/1024)

|  |  |  |
| --- | --- | --- |
| Reference channel | G-FR2-A3B-11 | G-FR2-A3B-12 |
| Subcarrier spacing [kHz] | 120 | 480 |
| Allocated resource blocks | 64 | 64 |
| DFT-s-OFDM Symbols per slot (Note 1) | 9 | 9 |
| Modulation | QPSK | QPSK |
| Code rate (Note 2) | 308/1024 | 308/1024 |
| Payload size (bits) | 4096 | 4096 |
| Transport block CRC (bits) | 24 | 24 |
| Code block CRC size (bits) | - | - |
| Number of code blocks - C | 1 | 1 |
| Code block size including CRC (bits) (Note 2) | 4120 | 4120 |
| Total number of bits per slot without PT-RS | 13824 | 13824 |
| Total number of bits per slot with PT-RS (Note 4) | 13248 | 13248 |
| Total symbols per slot without PT-RS | 6912 | 6912 |
| Total symbols per slot with PT-RS (Note 4) | 6624 | 6624 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos0* with *l0*= 0 as per Table 6.4.1.1.3-3 of TS 38.211 [9].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [15].  NOTE 3: The calculation of the “Total number of bits per slot” and “Total symbols per slot” fields include the REs taken up by CSI part 1 and CSI part 2, if present.  NOTE 4: PT-RS configuration *KPT-RS =2, LPT-RS =1*. | | |

Table A.3B-5: FRC parameters for FR2-2 PUSCH performance requirements, transform precoding enabled, *Additional DM-RS position = pos1* and 1 transmission layer (QPSK, R=308/1024)

|  |  |  |
| --- | --- | --- |
| Reference channel | G-FR2-A3B-13 | G-FR2-A3B-14 |
| Subcarrier spacing [kHz] | 120 | 480 |
| Allocated resource blocks | 64 | 64 |
| DFT-s-OFDM Symbols per slot (Note 1) | 8 | 8 |
| Modulation | QPSK | QPSK |
| Code rate (Note 2) | 308/1024 | 308/1024 |
| Payload size (bits) | 3624 | 3624 |
| Transport block CRC (bits) | 16 | 16 |
| Code block CRC size (bits) | - | - |
| Number of code blocks - C | 1 | 1 |
| Code block size including CRC (bits) (Note 2) | 3640 | 3640 |
| Total number of bits per slot without PT-RS | 12288 | 12288 |
| Total number of bits per slot with PT-RS (Note 4) | 11776 | 11776 |
| Total symbols per slot without PT-RS | 6144 | 6144 |
| Total symbols per slot with PT-RS (Note 4) | 5888 | 5888 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos1* with *l0*= 0 and *l* =8 as per Table 6.4.1.1.3-3 of TS 38.211 [9].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [15].  NOTE 3: The calculation of the “Total number of bits per slot” and “Total symbols per slot” fields include the REs taken up by CSI part 1 and CSI part 2, if present.  NOTE 4: PT-RS configuration *KPT-RS =2, LPT-RS =1*. | | | |

Table A.3B-6: FRC parameters for FR2-2 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos0* and 2 transmission layers (QPSK, R=308/1024)

|  |  |  |  |
| --- | --- | --- | --- |
| Reference channel | G-FR2-A3B-15 | G-FR2-A3B-16 | G-FR2-A3B-17 |
| Subcarrier spacing [kHz] | 120 | 120 | 480 |
| Allocated resource blocks | 66 | 264 | 66 |
| CP-OFDM Symbols per slot (Note 1) | 9 | 9 | 9 |
| Modulation | QPSK | QPSK | QPSK |
| Code rate (Note 2) | 308/1024 | 308/1024 | 308/1024 |
| Payload size (bits) | 8456 | 33816 | 8456 |
| Transport block CRC (bits) | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 |
| Number of code blocks - C | 2 | 5 | 2 |
| Code block size including CRC (bits) (Note 2) | 4264 | 6792 | 4264 |
| Total number of bits per slot without PT-RS | 28512 | 114048 | 28512 |
| Total number of bits per slot with PT-RS (Note 4) | 27324 | 109296 | 27324 |
| Total symbols per slot without PT-RS | 14256 | 57024 | 14256 |
| Total symbols per slot with PT-RS (Note 4) | 13662 | 54648 | 13662 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos0* with *l0*= 0 as per Table 6.4.1.1.3-3 of TS 38.211 [9].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [15].  NOTE 3: The calculation of the “Total number of bits per slot” and “Total symbols per slot” fields include the REs taken up by CSI part 1 and CSI part 2, if present.  NOTE 4: PT-RS configuration *KPT-RS =2, LPT-RS =1*. | | | |

Table A.3B-7: FRC parameters for FR2-2 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos1* and 2 transmission layers (QPSK, R=308/1024)

|  |  |  |  |
| --- | --- | --- | --- |
| Reference channel | G-FR2-A3B-18 | G-FR2-A3B-19 | G-FR2-A3B-20 |
| Subcarrier spacing [kHz] | 120 | 120 | 480 |
| Allocated resource blocks | 66 | 264 | 66 |
| CP-OFDM Symbols per slot (Note 1) | 8 | 8 | 8 |
| Modulation | QPSK | QPSK | QPSK |
| Code rate (Note 2) | 308/1024 | 308/1024 | 308/1024 |
| Payload size (bits) | 7552 | 30728 | 7552 |
| Transport block CRC (bits) | 24 | 24 | 24 |
| Code block CRC size (bits) | - | 24 | - |
| Number of code blocks - C | 1 | 4 | 1 |
| Code block size including CRC (bits) (Note 2) | 7576 | 7712 | 7576 |
| Total number of bits per slot without PT-RS | 25344 | 101376 | 25344 |
| Total number of bits per slot with PT-RS (Note 4) | 24288 | 97152 | 24288 |
| Total symbols per slot without PT-RS | 12672 | 50688 | 12672 |
| Total symbols per slot with PT-RS (Note 4) | 12144 | 48576 | 12144 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos1* with *l0*= 0 and *l* =8 as per Table 6.4.1.1.3-3 of TS 38.211 [9].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [15].  NOTE 3: The calculation of the “Total number of bits per slot” and “Total symbols per slot” fields include the REs taken up by CSI part 1 and CSI part 2, if present.  NOTE 4: PT-RS configuration *KPT-RS =2, LPT-RS =1*. | | | | |

# A.4 Fixed Reference Channels for performance requirements (16QAM, R=658/1024)

The parameters for the reference measurement channels are specified in table A.4-2, table A.4-2A, table A.4-2B and table A.4-4 for FR1 PUSCH performance requirements:

- FRC parameters are specified in table A.4-2 for FR1 PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer.

- FRC parameters are specified in table A.4-2A for FR1 PUSCH with transform precoding disabled, additional DM-RS position = pos 2 and 1 transmission layer.

- FRC parameters are specified in table A.4-2B for FR1 UL timing adjustment, PUSCH with transform precoding disabled, additional DM-RS position = pos2 and 1 transmission layer.

- FRC parameters are specified in table A.4-4 for FR1 PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 2 transmission layers.

The parameters for the reference measurement channels are specified in table A.4-5 to table A.4-8 for FR2-1 PUSCH performance requirements:

- FRC parameters are specified in table A.4-5 for FR2-1 PUSCH with transform precoding disabled, additional DM-RS position = pos0 and 1 transmission layer.

- FRC parameters are specified in table A.4-6 for FR2-1 PUSCH with transform precoding disabled, additional DM-RS position = pos0 and 2 transmission layers.

- FRC parameters are specified in table A.4-7 for FR2-1 PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer.

- FRC parameters are specified in table A.4-8 for FR2-1 PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 2 transmission layers.

The parameters for the reference measurement channels are specified in table A.4-5A to table A.4-8A for FR2-2 PUSCH performance requirements:

- FRC parameters are specified in table A.4-5A for FR2-2 PUSCH with transform precoding disabled, additional DM-RS position = pos0 and 1 transmission layer.

- FRC parameters are specified in table A.4-6A for FR2-2 PUSCH with transform precoding disabled, additional DM-RS position = pos0 and 2 transmission layers.

- FRC parameters are specified in table A.4-7A for FR2-2 PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer.

- FRC parameters are specified in table A.4-8A for FR2-2 PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 2 transmission layers.

Table A.4-1: Void

Table A.4-2: FRC parameters for FR1 PUSCH performance requirements, transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer (16QAM, R=658/1024)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Reference channel | G-FR1-A4-8 | G-FR1-A4-9 | G-FR1-A4-10 | G-FR1-A4-11(Note 3) | G-FR1-A4-12 | G-FR1-A4-13 | G-FR1-A4-14 |
| Subcarrier spacing (kHz) | 15 | 15 | 15 | 30 | 30 | 30 | 30 |
| Allocated resource blocks | 25 | 52 | 106 | 24 | 51 | 106 | 273 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Modulation | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Code rate (Note 2) | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 |
| Payload size (bits) | 9224 | 19464 | 38936 | 8968 | 18960 | 38936 | 100392 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of code blocks - C | 2 | 3 | 5 | 2 | 3 | 5 | 12 |
| Code block size including CRC (bits) (Note 2) | 4648 | 6520 | 7816 | 4520 | 6352 | 7816 | 8392 |
| Total number of bits per slot | 14400 | 29952 | 61056 | 13824 | 29376 | 61056 | 157248 |
| Total symbols per slot | 3600 | 7488 | 15264 | 3456 | 7344 | 15264 | 39312 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos1*, *l0*= 2 and *l*=11 for PUSCH mapping type A, *l0*= 0 and *l* =10 for PUSCH mapping type B as per table 6.4.1.1.3-3 of TS 38.211 [5].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [15].  NOTE 3: The calculation of the “Total number of bits per slot” and “Total symbols per slot” fields include the REs taken up by CSI part 1 and CSI part 2, if present. | | | | | | | |

Table A.4-2A: FRC parameters for FR1 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos2* and 1 transmission layer (16QAM, R=658/1024)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Reference channel | G-FR1-A4-29 | G-FR1-A4-29A | G-FR1-A4-30 | G-FR1-A4-30A |
| Subcarrier spacing [kHz] | 15 | 15 | 30 | 30 |
| Allocated resource blocks | 52 | 25 | 106 | 24 |
| Data bearing CP-OFDM Symbols per slot (Note 1) | 11 | 11 | 11 | 11 |
| Modulation | 16QAM | 16QAM | 16QAM | 16QAM |
| Code rate (Note 2) | 658/1024 | 658/1024 | 658/1024 | 658/1024 |
| Payload size (bits) | 17424 | 8456 | 35856 | 8064 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 | - |
| Number of code blocks - C | 3 | 2 | 5 | 1 |
| Code block size including CRC (bits) (Note 2) | 5840 | 4264 | 7200 | 8080 |
| Total number of bits per slot | 27456 | 13200 | 55968 | 12672 |
| Total resource elements per slot | 6846 | 3300 | 13992 | 3168 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos2*, and *l0*= 2 or 3 for PUSCH mapping type A, as per table 6.4.1.1.3-3 of TS 38.211 [20].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [19]. | | | | |

Table A.4-2B: FRC parameters for FR1 UL timing adjustment, PUSCH with transform precoding disabled, *Additional DM-RS position = pos2* and 1 transmission layer (16QAM, R=658/1024)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Reference channel | G-FR1-A4-31A | G-FR1-A4-31 | G-FR1-A4-32A | G-FR1-A4-32 |
| Subcarrier spacing [kHz] | 15 | 15 | 30 | 30 |
| Allocated resource blocks | 12 | 25 | 12 | 50 |
| Data bearing CP-OFDM Symbols per slot (Note 1) | 11 | 11 | 11 | 11 |
| Modulation | 16QAM | 16QAM | 16QAM | 16QAM |
| Code rate (Note 2) | 658/1024 | 658/1024 | 658/1024 | 658/1024 |
| Payload size (bits) | 4032 | 8456 | 4032 | 16896 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | - | 24 | - | 24 |
| Number of code blocks - C | 1 | 2 | 1 | 3 |
| Code block size including CRC (bits) (Note 2) | 4056 | 4264 | 4056 | 5664 |
| Total number of bits per slot | 6336 | 13200 | 6336 | 26400 |
| Total data bearing resource elements per slot | 1584 | 3300 | 1584 | 6600 |
| NOTE 1: *DM-RS configuration type*  = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos2*, and *l0* = 2 for PUSCH mapping type A, *l0* = 0 for PUSCH mapping type B, as per table 6.4.1.1.3-3 of TS 38.211 [5].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [15]. | | | | |

Table A.4-3: Void

Table A.4-4: FRC parameters for FR1 PUSCH performance requirements, transform precoding disabled, additional DM-RS position = pos1 and 2 transmission layers (16QAM, R=658/1024)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Reference channel | G-FR1-A4-22 | G-FR1-A4-23 | G-FR1-A4-24 | G-FR1-A4-25 | G-FR1-A4-26 | G-FR1-A4-27 | G-FR1-A4-28 |
| Subcarrier spacing (kHz) | 15 | 15 | 15 | 30 | 30 | 30 | 30 |
| Allocated resource blocks | 25 | 52 | 106 | 24 | 51 | 106 | 273 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Modulation | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Code rate (Note 2) | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 |
| Payload size (bits) | 18432 | 38936 | 77896 | 17928 | 37896 | 77896 | 200808 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of code blocks - C | 3 | 5 | 10 | 3 | 5 | 10 | 24 |
| Code block size including CRC (bits) (Note 2) | 6176 | 7816 | 7816 | 6008 | 7608 | 7816 | 8392 |
| Total number of bits per slot | 28800 | 59904 | 122112 | 27648 | 58752 | 122112 | 314496 |
| Total symbols per slot | 7200 | 14976 | 30528 | 6912 | 14688 | 30528 | 78624 |
| NOTE 1: DM-RS configuration type = 1 with DM-RS duration = single-symbol DM-RS and the number of DM-RS CDM groups without data is 2, additional DM-RS position = pos1, *l0* = 2 and *l* = 11 for PUSCH mapping type A, *l0* = 0 and *l* = 10 for PUSCH mapping type B as per table 6.4.1.1.3-3 of TS 38.211 [20].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [19]. | | | | | | | |

Table A.4-5: FRC parameters for FR2-1 PUSCH performance requirements, transform precoding disabled, additional DM-RS position = pos0 and 1 transmission layer (16QAM, R=658/1024)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Reference channel | G-FR2-A4-1 | G-FR2-A4-2 | G-FR2-A4-3(Note 3) | G-FR2-A4-4 | G-FR2-A4-5 |
| Subcarrier spacing (kHz) | 60 | 60 | 120 | 120 | 120 |
| Allocated resource blocks | 66 | 132 | 32 | 66 | 132 |
| CP-OFDM Symbols per slot (Note 1) | 9 | 9 | 9 | 9 | 9 |
| Modulation | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Code rate (Note 2) | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 |
| Payload size (bits) | 18432 | 36896 | 8968 | 18432 | 36896 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 | 24 | 24 |
| Number of code blocks - C | 3 | 5 | 2 | 3 | 5 |
| Code block size including CRC (bits) (Note 2) | 6176 | 7408 | 4520 | 6176 | 7408 |
| Total number of bits per slot without PT-RS | 28512 | 57024 | 13824 | 28512 | 57024 |
| Total number of bits per slot with PT-RS (Note 4) | 27324 | 54648 | 13248 | 27324 | 54648 |
| Total symbols per slot without PT-RS | 7128 | 14256 | 3456 | 7128 | 14256 |
| Total symbols per slot with PT-RS (Note 4) | 6831 | 13662 | 3312 | 6831 | 13662 |
| NOTE 1: DM-RS configuration type = 1 with DM-RS duration = single-symbol DM-RS and the number of DM-RS CDM groups without data is 2, additional DM-RS position = pos0 with *l0*= 0 as per table 6.4.1.1.3-3 of TS 38.211 [20].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [15].  NOTE 3: The calculation of the “Total number of bits per slot” and “Total symbols per slot” fields include the REs taken up by CSI part 1 and CSI part 2, if present.  NOTE 4: PT-RS configuration *KPT-RS =2, LPT-RS =1*. | | | | | |

Table A.4-5A: FRC parameters for FR2-2 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos0* and 1 transmission layer (16QAM, R=658/1024)

|  |  |  |  |
| --- | --- | --- | --- |
| Reference channel | G-FR2-A4-21 | G-FR2-A4-22 | G-FR2-A4-23 |
| Subcarrier spacing [kHz] | 120 | 120 | 480 |
| Allocated resource blocks | 66 | 264 | 66 |
| CP-OFDM Symbols per slot (Note 1) | 9 | 9 | 9 |
| Modulation | 16QAM | 16QAM | 16QAM |
| Code rate (Note 2) | 658/1024 | 658/1024 | 658/1024 |
| Payload size (bits) | 18432 | 73776 | 18432 |
| Transport block CRC (bits) | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 |
| Number of code blocks - C | 3 | 9 | 3 |
| Code block size including CRC (bits) (Note 2) | 6176 | 8224 | 6176 |
| Total number of bits per slot without PT-RS | 28512 | 114048 | 28512 |
| Total number of bits per slot with PT-RS (Note 4) | 27324 | 109296 | 27324 |
| Total symbols per slot without PT-RS | 7128 | 28512 | 7128 |
| Total symbols per slot with PT-RS (Note 4) | 6831 | 27324 | 6831 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos0* with *l0*= 0 as per Table 6.4.1.1.3-3 of TS 38.211 [9].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [15].  NOTE 3: The calculation of the “Total number of bits per slot” and “Total symbols per slot” fields include the REs taken up by CSI part 1 and CSI part 2, if present.  NOTE 4: PT-RS configuration *KPT-RS =2, LPT-RS =1*. | | | |

Table A.4-6: FRC parameters for FR2-1 PUSCH performance requirements, transform precoding disabled, additional DM-RS position = pos0 and 2 transmission layers (16QAM, R=658/1024)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Reference channel | G-FR2-A4-6 | G-FR2-A4-7 | G-FR2-A4-8 | G-FR2-A4-9 | G-FR2-A4-10 |
| Subcarrier spacing (kHz) | 60 | 60 | 120 | 120 | 120 |
| Allocated resource blocks | 66 | 132 | 32 | 66 | 132 |
| CP-OFDM Symbols per slot (Note 1) | 9 | 9 | 9 | 9 | 9 |
| Modulation | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Code rate (Note 2) | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 |
| Payload size (bits) | 36896 | 73776 | 17928 | 36896 | 73776 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 | 24 | 24 |
| Number of code blocks - C | 5 | 9 | 3 | 5 | 9 |
| Code block size including CRC (bits) (Note 2) | 7408 | 8224 | 6008 | 7408 | 8224 |
| Total number of bits per slot without PT-RS | 57024 | 114048 | 27648 | 57024 | 114048 |
| Total number of bits per slot with PT-RS (Note 3) | 54648 | 109296 | 26496 | 54648 | 109296 |
| Total symbols per slot without PT-RS | 14256 | 28512 | 6912 | 14256 | 28512 |
| Total symbols per slot with PT-RS (Note 3) | 13662 | 27324 | 6624 | 13662 | 27324 |
| NOTE 1: DM-RS configuration type = 1 with DM-RS duration = single-symbol DM-RS and the number of DM-RS CDM groups without data is 2, additional DM-RS position = pos0 with *l0*= 0 as per table 6.4.1.1.3-3 of TS 38.211 [20].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [15].  NOTE 3: PT-RS configuration *KPT-RS =2, LPT-RS =1*. | | | | | |

Table A.4-6A: FRC parameters for FR2-2 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos0* and 2 transmission layers (16QAM, R=658/1024)

|  |  |  |  |
| --- | --- | --- | --- |
| Reference channel | G-FR2-A4-24 | G-FR2-A4-25 | G-FR2-A4-26 |
| Subcarrier spacing [kHz] | 120 | 120 | 480 |
| Allocated resource blocks | 66 | 264 | 66 |
| CP-OFDM Symbols per slot (Note 1) | 9 | 9 | 9 |
| Modulation | 16QAM | 16QAM | 16QAM |
| Code rate (Note 2) | 658/1024 | 658/1024 | 658/1024 |
| Payload size (bits) | 36896 | 147576 | 36896 |
| Transport block CRC (bits) | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 |
| Number of code blocks - C | 5 | 18 | 5 |
| Code block size including CRC (bits) (Note 2) | 7408 | 8224 | 7408 |
| Total number of bits per slot without PT-RS | 57024 | 228096 | 57024 |
| Total number of bits per slot with PT-RS (Note 4) | 54648 | 218592 | 54648 |
| Total symbols per slot without PT-RS | 14256 | 57024 | 14256 |
| Total symbols per slot with PT-RS (Note 4) | 13662 | 54648 | 13662 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos0* with *l0*= 0 as per Table 6.4.1.1.3-3 of TS 38.211 [9].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [15].  NOTE 3: The calculation of the “Total number of bits per slot” and “Total symbols per slot” fields include the REs taken up by CSI part 1 and CSI part 2, if present.  NOTE 4: PT-RS configuration *KPT-RS =2, LPT-RS =1*. | | | |

Table A.4-7: FRC parameters for FR2-1 PUSCH performance requirements, transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer (16QAM, R=658/1024)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Reference channel | G-FR2-A4-11 | G-FR2-A4-12 | G-FR2-A4-13 | G-FR2-A4-14 | G-FR2-A4-15 |
| Subcarrier spacing (kHz) | 60 | 60 | 120 | 120 | 120 |
| Allocated resource blocks | 66 | 132 | 32 | 66 | 132 |
| CP-OFDM Symbols per slot (Note 1) | 8 | 8 | 8 | 8 | 8 |
| Modulation | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Code rate (Note 2) | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 |
| Payload size (bits) | 16392 | 32776 | 7936 | 16392 | 32776 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | - | 24 | 24 |
| Number of code blocks - C | 2 | 4 | 1 | 2 | 4 |
| Code block size including CRC (bits) (Note 2) | 8232 | 8224 | 7960 | 8232 | 8224 |
| Total number of bits per slot without PT-RS | 25344 | 50688 | 12288 | 25344 | 50688 |
| Total number of bits per slot with PT-RS (Note 4) | 24288 | 48576 | 11776 | 24288 | 48576 |
| Total symbols per slot without PT-RS | 6336 | 12672 | 3072 | 6336 | 12672 |
| Total symbols per slot with PT-RS (Note 4) | 6072 | 12144 | 2944 | 6072 | 12144 |
| NOTE 1: DM-RS configuration type = 1 with DM-RS duration = single-symbol DM-RS and the number of DM-RS CDM groups without data is 2, additional DM-RS position = pos1 with *l0* = 0 and *l* = 8 as per table 6.4.1.1.3-3 of TS 38.211 [20].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [19].  NOTE 3: The calculation of the “Total number of bits per slot” and “Total symbols per slot” fields include the REs taken up by CSI part 1 and CSI part 2, if present.  NOTE 4: PT-RS configuration *KPT-RS =2, LPT-RS =1*. | | | | | |

Table A.4-7A: FRC parameters for FR2-2 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos1* and 1 transmission layer (16QAM, R=658/1024)

|  |  |  |  |
| --- | --- | --- | --- |
| Reference channel | G-FR2-A4-27 | G-FR2-A4-28 | G-FR2-A4-29 |
| Subcarrier spacing [kHz] | 120 | 120 | 480 |
| Allocated resource blocks | 66 | 264 | 66 |
| CP-OFDM Symbols per slot (Note 1) | 8 | 8 | 8 |
| Modulation | 16QAM | 16QAM | 16QAM |
| Code rate (Note 2) | 658/1024 | 658/1024 | 658/1024 |
| Payload size (bits) | 16392 | 65576 | 16392 |
| Transport block CRC (bits) | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 |
| Number of code blocks - C | 2 | 8 | 2 |
| Code block size including CRC (bits) (Note 2) | 8232 | 8224 | 8232 |
| Total number of bits per slot without PT-RS | 25344 | 101376 | 25344 |
| Total number of bits per slot with PT-RS (Note 4) | 24288 | 97152 | 24288 |
| Total symbols per slot without PT-RS | 6336 | 25344 | 6336 |
| Total symbols per slot with PT-RS (Note 4) | 6072 | 24288 | 6072 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos1* with *l0*= 0 and *l* =8 as per Table 6.4.1.1.3-3 of TS 38.211 [9].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [15].  NOTE 3: The calculation of the “Total number of bits per slot” and “Total symbols per slot” fields include the REs taken up by CSI part 1 and CSI part 2, if present.  NOTE 4: PT-RS configuration *KPT-RS =2, LPT-RS =1*. | | | |

Table A.4-8: FRC parameters for FR2-1 PUSCH performance requirements, transform precoding disabled, additional DM-RS position = pos1 and 2 transmission layers (16QAM, R=658/1024)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Reference channel | G-FR2-A4-16 | G-FR2-A4-17 | G-FR2-A4-18 | G-FR2-A4-19 | G-FR2-A4-20 |
| Subcarrier spacing (kHz) | 60 | 60 | 120 | 120 | 120 |
| Allocated resource blocks | 66 | 132 | 32 | 66 | 132 |
| CP-OFDM Symbols per slot (Note 1) | 8 | 8 | 8 | 8 | 8 |
| Modulation | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Code rate (Note 2) | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 |
| Payload size (bits) | 32776 | 65576 | 15880 | 32776 | 65576 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 | 24 | 24 |
| Number of code blocks - C | 4 | 8 | 2 | 4 | 8 |
| Code block size including CRC (bits) (Note 2) | 8224 | 8224 | 7976 | 8224 | 8224 |
| Total number of bits per slot without PT-RS | 50688 | 101376 | 24576 | 50688 | 101376 |
| Total number of bits per slot with PT-RS (Note 3) | 48576 | 97152 | 23552 | 48576 | 97152 |
| Total symbols per slot without PT-RS | 12672 | 25344 | 6144 | 12672 | 25344 |
| Total symbols per slot with PT-RS (Note 3) | 12144 | 24288 | 5888 | 12144 | 24288 |
| NOTE 1: DM-RS configuration type = 1 with DM-RS duration = single-symbol DM-RS and the number of DM-RS CDM groups without data is 2, additional DM-RS position = pos1 with *l0* = 0 and *l* = 8 as per table 6.4.1.1.3-3 of TS 38.211 [20].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [19].  NOTE 3: PT-RS configuration *KPT-RS =2, LPT-RS =1*. | | | | | |

Table A.4-8A: FRC parameters for FR2-2 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos1* and 2 transmission layers (16QAM, R=658/1024)

|  |  |  |  |
| --- | --- | --- | --- |
| Reference channel | G-FR2-A4-30 | G-FR2-A4-31 | G-FR2-A4-32 |
| Subcarrier spacing [kHz] | 120 | 120 | 480 |
| Allocated resource blocks | 66 | 264 | 66 |
| CP-OFDM Symbols per slot (Note 1) | 8 | 8 | 8 |
| Modulation | 16QAM | 16QAM | 16QAM |
| Code rate (Note 2) | 658/1024 | 658/1024 | 658/1024 |
| Payload size (bits) | 32776 | 131176 | 32776 |
| Transport block CRC (bits) | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 |
| Number of code blocks - C | 4 | 16 | 4 |
| Code block size including CRC (bits) (Note 2) | 8224 | 8224 | 8224 |
| Total number of bits per slot without PT-RS | 50688 | 202752 | 50688 |
| Total number of bits per slot with PT-RS (Note 4) | 48576 | 194304 | 48576 |
| Total symbols per slot without PT-RS | 12672 | 50688 | 12672 |
| Total symbols per slot with PT-RS (Note 4) | 12144 | 48576 | 12144 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos1* with *l0*= 0 and *l* =8 as per Table 6.4.1.1.3-3 of TS 38.211 [9].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [15].  NOTE 3: The calculation of the “Total number of bits per slot” and “Total symbols per slot” fields include the REs taken up by CSI part 1 and CSI part 2, if present.  NOTE 4: PT-RS configuration *KPT-RS =2, LPT-RS =1*. | | | |

# A.5 Fixed Reference Channels for performance requirements (64QAM, R=567/1024)

The parameters for the reference measurement channels are specified in table A.5-2 for FR1 PUSCH performance requirements with transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer.

The parameters for the reference measurement channels are specified in table A.5-3 to table A.5-4 for FR2-1 PUSCH performance requirements:

- FRC parameters are specified in table A.5-3 for FR2-1 PUSCH with transform precoding disabled, additional DM-RS position = pos0 and 1 transmission layer.

- FRC parameters are specified in table A.5-4 for FR2-1 PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer.

The parameters for the reference measurement channels are specified in table A.5-3A to table A.5-7 for FR2-2 PUSCH performance requirements:

- FRC parameters are specified in table A.5-3A for FR2-2 PUSCH with transform precoding disabled, additional DM-RS position = pos0 and 1 transmission layer.

- FRC parameters are specified in table A.5-4A for FR2-2 PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer.

- FRC parameters are specified in table A.5-6 for FR2-2 PUSCH with transform precoding disabled, *Additional DM-RS position = pos0* and 2 transmission layers.

- FRC parameters are specified in table A.5-7 for FR2-2 PUSCH with transform precoding disabled, *Additional DM-RS position = pos1* and 2 transmission layers.

Table A.5-1: Void

Table A.5-2: FRC parameters for FR1 PUSCH performance requirements, transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer (64QAM, R=567/1024)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Reference channel | G-FR1-A5-8 | G-FR1-A5-9 | G-FR1-A5-10 | G-FR1-A5-11 | G-FR1-A5-12 | G-FR1-A5-13 | G-FR1-A5-14 |
| Subcarrier spacing (kHz) | 15 | 15 | 15 | 30 | 30 | 30 | 30 |
| Allocated resource blocks | 25 | 52 | 106 | 24 | 51 | 106 | 273 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Modulation | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Code rate (Note 2) | 567/1024 | 567/1024 | 567/1024 | 567/1024 | 567/1024 | 567/1024 | 567/1024 |
| Payload size (bits) | 12040 | 25104 | 50184 | 11528 | 24576 | 50184 | 131176 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of code blocks - C | 2 | 3 | 6 | 2 | 3 | 6 | 16 |
| Code block size including CRC (bits) (Note 2) | 6056 | 8400 | 8392 | 5800 | 8224 | 8392 | 8224 |
| Total number of bits per slot | 21600 | 44928 | 91584 | 20736 | 44064 | 91584 | 235872 |
| Total symbols per slot | 3600 | 7488 | 15264 | 3456 | 7344 | 15264 | 39312 |
| NOTE 1: DM-RS configuration type = 1 with DM-RS duration = single-symbol DM-RS and the number of DM-RS CDM groups without data is 2, additional DM-RS position = pos1, *l0* = 2 and *l* = 11 for PUSCH mapping type A, *l0* = 0 and *l* = 10 for PUSCH mapping type B as per table 6.4.1.1.3-3 of TS 38.211 [20].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [19]. | | | | | | | |

Table A.5-3: FRC parameters for FR2-1 PUSCH performance requirements, transform precoding disabled, additional DM-RS position = pos0 and 1 transmission layer (64QAM, R=567/1024)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Reference channel | G-FR2-A5-1 | G-FR2-A5-2 | G-FR2-A5-3 | G-FR2-A5-4 | G-FR2-A5-5 |
| Subcarrier spacing (kHz) | 60 | 60 | 120 | 120 | 120 |
| Allocated resource blocks | 66 | 132 | 32 | 66 | 132 |
| CP-OFDM Symbols per slot (Note 1) | 9 | 9 | 9 | 9 | 9 |
| Modulation | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Code rate (Note 2) | 567/1024 | 567/1024 | 567/1024 | 567/1024 | 567/1024 |
| Payload size (bits) | 23568 | 47112 | 11528 | 23568 | 47112 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 | 24 | 24 |
| Number of code blocks - C | 3 | 6 | 2 | 3 | 6 |
| Code block size including CRC (bits) (Note 2) | 7888 | 7880 | 5800 | 7888 | 7880 |
| Total number of bits per slot without PT-RS | 42768 | 85536 | 20736 | 42768 | 85536 |
| Total number of bits per slot with PT-RS (Note 3) | 40986 | 81972 | 19872 | 40986 | 81972 |
| Total symbols per slot without PT-RS | 7128 | 14256 | 3456 | 7128 | 14256 |
| Total symbols per slot with PT-RS (Note 3) | 6831 | 13662 | 3312 | 6831 | 13662 |
| NOTE 1: DM-RS configuration type = 1 with DM-RS duration = single-symbol DM-RS and the number of DM-RS CDM groups without data is 2, additional DM-RS position = pos0 with *l0*= 0 as per table 6.4.1.1.3-3 of TS 38.211 [20].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [19].  NOTE 3: PT-RS configuration *KPT-RS =2, LPT-RS =1*. | | | | | |

Table A.5-3A: FRC parameters for FR2-2 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos0* and 1 transmission layer (64QAM, R=567/1024)

|  |  |  |  |
| --- | --- | --- | --- |
| Reference channel | G-FR2-A5-17 | G-FR2-A5-18 | G-FR2-A5-19 |
| Subcarrier spacing [kHz] | 120 | 120 | 480 |
| Allocated resource blocks | 66 | 264 | 66 |
| CP-OFDM Symbols per slot (Note 1) | 9 | 9 | 9 |
| Modulation | 64QAM | 64QAM | 64QAM |
| Code rate (Note 2) | 567/1024 | 567/1024 | 567/1024 |
| Payload size (bits) | 23568 | 94248 | 23568 |
| Transport block CRC (bits) | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 |
| Number of code blocks - C | 3 | 12 | 3 |
| Code block size including CRC (bits) (Note 2) | 7888 | 7880 | 7888 |
| Total number of bits per slot without PT-RS | 42768 | 171072 | 42768 |
| Total number of bits per slot with PT-RS (Note 3) | 40986 | 163944 | 40986 |
| Total symbols per slot without PT-RS | 7128 | 28512 | 7128 |
| Total symbols per slot with PT-RS (Note 3) | 6831 | 27324 | 6831 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos0* with *l0*= 0 as per Table 6.4.1.1.3-3 of TS 38.211 [9].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [15].  NOTE 3: PT-RS configuration *KPT-RS =2, LPT-RS =1*. | | | |

Table A.5-4: FRC parameters for FR2-1 PUSCH performance requirements, transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer (64QAM, R=567/1024)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Reference channel | G-FR2-A5-6 | G-FR2-A5-7 | G-FR2-A5-8 | G-FR2-A5-9 | G-FR2-A5-10 |
| Subcarrier spacing (kHz) | 60 | 60 | 120 | 120 | 120 |
| Allocated resource blocks | 66 | 132 | 32 | 66 | 132 |
| CP-OFDM Symbols per slot (Note 1) | 8 | 8 | 8 | 8 | 8 |
| Modulation | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Code rate (Note 2) | 567/1024 | 567/1024 | 567/1024 | 567/1024 | 567/1024 |
| Payload size (bits) | 21000 | 42016 | 10248 | 21000 | 42016 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 | 24 | 24 |
| Number of code blocks - C | 3 | 5 | 2 | 3 | 5 |
| Code block size including CRC (bits) (Note 2) | 7032 | 8432 | 5160 | 7032 | 8432 |
| Total number of bits per slot without PT-RS | 38016 | 76032 | 18432 | 38016 | 76032 |
| Total number of bits per slot with PT-RS (Note 3) | 36432 | 72864 | 17664 | 36432 | 72864 |
| Total symbols per slot without PT-RS | 6336 | 12672 | 3072 | 6336 | 12672 |
| Total symbols per slot with PT-RS (Note 3) | 6072 | 12144 | 2944 | 6072 | 12144 |
| NOTE 1: DM-RS configuration type = 1 with DM-RS duration = single-symbol DM-RS and the number of DM-RS CDM groups without data is 2, additional DM-RS position = pos1 with *l0* = 0 and *l* = 8 as per table 6.4.1.1.3-3 of TS 38.211 [20].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [19].  NOTE 3: PT-RS configuration *KPT-RS =2, LPT-RS =1*. | | | | | |

Table A.5-4A: FRC parameters for FR2-2 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos1* and 1 transmission layer (64QAM, R=567/1024)

|  |  |  |  |
| --- | --- | --- | --- |
| Reference channel | G-FR2-A5-20 | G-FR2-A5-21 | G-FR2-A5-22 |
| Subcarrier spacing [kHz] | 120 | 120 | 480 |
| Allocated resource blocks | 66 | 66 | 66 |
| CP-OFDM Symbols per slot (Note 1) | 8 | 8 | 8 |
| Modulation | 64QAM | 64QAM | 64QAM |
| Code rate (Note 2) | 567/1024 | 567/1024 | 567/1024 |
| Payload size (bits) | 21000 | 83976 | 21000 |
| Transport block CRC (bits) | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 |
| Number of code blocks - C | 3 | 10 | 3 |
| Code block size including CRC (bits) (Note 2) | 7032 | 8424 | 7032 |
| Total number of bits per slot without PT-RS | 38016 | 152064 | 38016 |
| Total number of bits per slot with PT-RS (Note 3) | 36432 | 145728 | 36432 |
| Total symbols per slot without PT-RS | 6336 | 25344 | 6336 |
| Total symbols per slot with PT-RS (Note 3) | 6072 | 24288 | 6072 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos1* with *l0*= 0 and *l* =8 as per Table 6.4.1.1.3-3 of TS 38.211 [9].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [15].  NOTE 3: PT-RS configuration *KPT-RS =2, LPT-RS =1*. | | | |

Table A.5-5: FRC parameters for FR1interlaced PUSCH performance requirements, transform precoding disabled, *additional DM-RS position = pos1* and 1 transmission layer (64QAM, R=567/1024)

|  |  |  |
| --- | --- | --- |
| Reference channel | G-FR1-A5-15 | G-FR1-A5-16 |
| Subcarrier spacing [kHz] | 15 | 30 |
| Allocated resource blocks | 11 | 11 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 |
| Modulation | 64QAM | 64QAM |
| Code rate | 567/1024 | 567/1024 |
| Payload size (bits) | 5248 | 5248 |
| Transport block CRC (bits) | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 |
| Number of code blocks - C | 1 | 1 |
| Code block size including CRC (bits) (Note 2) | 5272 | 5272 |
| Total number of bits per slot (Note 3) | 9504 | 9504 |
| Total symbols per slot (Note 3) | 1584 | 1584 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos1*, *l0*= 2 and *l* =11 for PUSCH mapping type A, *l0*= 0 and *l* =10 for PUSCH mapping type B as per table 6.4.1.1.3-3 of TS 38.211 [5].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [15].  NOTE 3: The calculation of the “Total number of bits per slot” and “Total symbols per slot” fields include the REs taken up by CG-UCI, if present. | | |

Table A.5-6: FRC parameters for FR2-2 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos0* and 2 transmission layer (64QAM, R=567/1024)

|  |  |  |  |
| --- | --- | --- | --- |
| Reference channel | G-FR2-A5-23 | G-FR2-A5-24 | G-FR2-A5-25 |
| Subcarrier spacing [kHz] | 120 | 120 | 480 |
| Allocated resource blocks | 66 | 264 | 66 |
| CP-OFDM Symbols per slot (Note 1) | 9 | 9 | 9 |
| Modulation | 64QAM | 64QAM | 64QAM |
| Code rate (Note 2) | 567/1024 | 567/1024 | 567/1024 |
| Payload size (bits) | 47112 | 188576 | 47112 |
| Transport block CRC (bits) | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 |
| Number of code blocks - C | 6 | 23 | 6 |
| Code block size including CRC (bits) (Note 2) | 7880 | 8224 | 7880 |
| Total number of bits per slot without PT-RS | 85536 | 342144 | 85536 |
| Total number of bits per slot with PT-RS (Note 3) | 81972 | 327888 | 81972 |
| Total symbols per slot without PT-RS | 14256 | 57024 | 14256 |
| Total symbols per slot with PT-RS (Note 3) | 13662 | 54648 | 13662 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos0* with *l0*= 0 as per Table 6.4.1.1.3-3 of TS 38.211 [9].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [15].  NOTE 3: PT-RS configuration *KPT-RS =2, LPT-RS =1*. | | | |

Table A.5-7: FRC parameters for FR2-2 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos1* and 2 transmission layer (64QAM, R=567/1024)

|  |  |  |  |
| --- | --- | --- | --- |
| Reference channel | G-FR2-A5-26 | G-FR2-A5-27 | G-FR2-A5-28 |
| Subcarrier spacing [kHz] | 120 | 120 | 480 |
| Allocated resource blocks | 66 | 264 | 66 |
| CP-OFDM Symbols per slot (Note 1) | 8 | 8 | 8 |
| Modulation | 64QAM | 64QAM | 64QAM |
| Code rate (Note 2) | 567/1024 | 567/1024 | 567/1024 |
| Payload size (bits) | 42016 | 167976 | 42016 |
| Transport block CRC (bits) | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 |
| Number of code blocks - C | 5 | 20 | 5 |
| Code block size including CRC (bits) (Note 2) | 8432 | 8424 | 8432 |
| Total number of bits per slot without PT-RS | 76032 | 304128 | 76032 |
| Total number of bits per slot with PT-RS (Note 3) | 72864 | 291456 | 72864 |
| Total symbols per slot without PT-RS | 12672 | 50688 | 12672 |
| Total symbols per slot with PT-RS (Note 3) | 12144 | 48576 | 12144 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos0* with *l0*= 0 as per Table 6.4.1.1.3-3 of TS 38.211 [9].  NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [15].  NOTE 3: PT-RS configuration *KPT-RS =2, LPT-RS =1*. | | | |

# A.6 PRACH Test preambles

########################## End of change #1 ############################