**3GPP TSG- Meeting #**

**, , May 20 - May 24 2024**

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| *CR-Form-v12.3* |
| **CHANGE REQUEST** |
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|  |  | **CR** |  | **rev** |  | **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:***  | [NR\_NTN\_enh-Perf] draftCR on propagation conditions and channels for 38.108 |
|  |  |
| ***Source to WG:*** |  |
| ***Source to TSG:*** |  |
|  |  |
| ***Work item code:*** |  |  | ***Date:*** |  |
|  |  |  |  |  |
| ***Category:*** |  |  | ***Release:*** |  |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19) Rel-20 (Release 20)* |
|  |  |
| ***Reason for change:*** | Introduction of new FRCs and Propagation Conditions |
|  |  |
| ***Summary of change:*** | New clauses added in Annex A and D |
|  |  |
| ***Consequences if not approved:*** | FRCs and Propagation Conditions will not be introduced |
|  |  |
| ***Clauses affected:*** | Annex A and D |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** | **X** |  |  Test specifications | TS/TR .38.181.. CR ...  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** | Revised R4-2407147 |

***<Start of change 1>***

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

The parameters for the reference measurement channel are specified in table A.3-1 to table A.3-4 for FR1 PUSCH performance requirements:

- FRC parameters are specified in table A.3-1 for FR1 PUSCH with transform precoding disabled, additional DM-RS position = pos0 and 1 transmission layer.

- FRC parameters are specified in table A.3-2 for FR1 PUSCH with transform precoding enabled, additional DM-RS position = pos0 and 1 transmission layer.

- FRC parameters are specified in table A.3-3 for FR1 PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer.

* FRC parameters are specified in table A.3-4 for FR1-NTN PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer.

Table A.3-1: FRC parameters for FR1 PUSCH performance requirements, transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer (QPSK, R=308/1024)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Reference channel | G-FR1-A3-1 | G-FR1-A3-2 | G-FR1-A3-3 | G-FR1-A3-4 |
| Subcarrier spacing (kHz) | 15 | 15 | 30 | 30 |
| Allocated resource blocks | 25 | 12 | 24 | 12 |
| Data bearing CP-OFDM Symbols per slot (Note 1) | 12 | 12 | 12 | 12 |
| Modulation | QPSK | QPSK | QPSK | QPSK |
| Code rate (Note 2) | 308/1024 | 308/1024 | 308/1024 | 308/1024 |
| Payload size (bits) | 2152 | 1032 | 2024 | 1032 |
| 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) | 2168 | 1048 | 2040 | 1048 |
| Total number of bits per slot | 7200 | 3456 | 6912 | 3456 |
| Total resource elements per slot | 3600 | 1728 | 3456 | 1728 |
| 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 [10]. |

Table A.3-2: FRC parameters for FR1 PUSCH performance requirements, transform precoding enabled, additional DM-RS position = pos1 and 1 transmission layer (QPSK, R=308/1024)

|  |  |  |
| --- | --- | --- |
| Reference channel | G-FR1-A3-5 | G-FR1-A3-6 |
| Subcarrier spacing (kHz) | 15 | 30 |
| Allocated resource blocks | 25 | 24 |
| Data bearing CP-OFDM Symbols per slot (Note 1) | 12 | 12 |
| Modulation | QPSK | QPSK |
| Code rate (Note 2) | 308/1024 | 308/1024 |
| Payload size (bits) | 2152 | 2088 |
| 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) | 2168 | 2104 |
| Total number of bits per slot | 7200 | 6912 |
| Total resource elements per slot | 3600 | 3456 |
| 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 [10]. |

Table A.3-3: FRC parameters for FR1 PUSCH performance requirements, transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer (QPSK, R=308/1024)

|  |  |  |
| --- | --- | --- |
| Reference channel | G-FR1-A3-5 | G-FR1-A3-6 |
| Subcarrier spacing (kHz) | 15 | 30 |
| Allocated resource blocks | 12 | 12 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 |
| MCS table | 64QAM | 64QAM |
| Modulation | QPSK | QPSK |
| Code rate (Note 2) | 308/1024 | 308/1024 |
| Payload size (bits) | 1032 | 1032 |
| 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) | 1048 | 1048 |
| Total number of bits per slot | 3456 | 3456 |
| Total symbols per slot | 1728 | 1728 |
| 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, and l0= 2 or 3 for PUSCH mapping type A, as per table 6.4.1.1.3-3 of TS 38.211 [8].NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [7]. |

Table A.3-4: FRC parameters for FR1-NTN PUSCH performance requirements, transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer (QPSK, R=308/1024)

|  |  |  |
| --- | --- | --- |
| Reference channel | G-FR1-NTN-A3-7 | G-FR1-NTN-A3-8 |
| Subcarrier spacing (kHz) | 15 | 30 |
| Allocated resource blocks | 6 | 6 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 |
| MCS table | 64QAM | 64QAM |
| Modulation | QPSK | QPSK |
| Code rate (Note 2) | 308/1024 | 308/1024 |
| Payload size (bits) | 528 | 528 |
| 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) | 544 | 544 |
| Total number of bits per slot | 1728 | 1728 |
| Total symbols per slot | 864 | 864 |
| 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, and l0= 2 and l = 11 for PUSCH mapping type A and l0= 0 and l = 10 for PUSCH mapping type B, as per table 6.4.1.1.3-3 of TS 38.211 [8].NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [7]. |

# A.3A Fixed Reference Channels for performance requirements (QPSK, R=99/1024)

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

- FRC parameters are specified in table A.3A-1 for FR1 PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer.

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

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

Table A.3A-1: FRC parameters for FR1 PUSCH performance requirements, transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer (QPSK, R=99/1024)

|  |  |  |
| --- | --- | --- |
| Reference channel | G-FR1-A3A-1 | G-FR1-A3A-2 |
| Subcarrier spacing (kHz) | 15 | 30 |
| Allocated resource blocks | 25 | 24 |
| Data beraing CP-OFDM Symbols per slot (Note 1) | 12 | 12 |
| Modulation | QPSK | QPSK |
| Code rate (Note 2) | 99/1024 | 99/1024 |
| Payload size (bits) | 704 | 672 |
| 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) | 720 | 688 |
| Total number of bits per slot | 7200 | 6912 |
| Total resource elements per slot | 3600 | 3456 |
| 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 [10]. |

Table A.3A-2: FRC parameters for FR2-NTN PUSCH performance requirements, transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer (QPSK, R=99/1024)

|  |  |
| --- | --- |
| Reference channel | G-FR2-NTN-A3A-3 |
| Subcarrier spacing (kHz) | 120 |
| Allocated resource blocks | 32 |
| CP-OFDM Symbols per slot (Note 1) | 8 |
| MCS table | 64QAMLowSE |
| Modulation | QPSK |
| Code rate (Note 2) | 99/1024 |
| Payload size (bits) | 608 |
| Transport block CRC (bits) | 16 |
| Code block CRC size (bits) | - |
| Number of code blocks - C | 1 |
| Code block size including CRC (bits) (Note 2) | 624 |
| Total number of bits per slot | 6144 |
| Total symbols per slot | 3072 |
| 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, and l0= 0 and l = 8 for PUSCH mapping type B, as per table 6.4.1.1.3-3 of TS 38.211 [8].NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [7]. |

# A.4 PRACH test preambles

Table A.4-1 Test preambles in FR1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Burst format | SCS (kHz) | Ncs | Logical sequence index | v |
| 0 | 1.25 | 13 | 22 | 32 |
| 2 | 1.25 | 13 | 22 | 32 |
| B4, C2 | 15 | 23 | 0 | 0 |
| 30 | 46 | 0 | 0 |

Table A.4-2 Test preambles in FR2-NTN

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Burst format | SCS (kHz) | Ncs | Logical sequence index | v |
| B4, C2 | 120 | 69 | 0 | 0 |

# A.5 Fixed Reference Channels for performance requirements (QPSK, R=193/1024)

The parameters for the reference measurement channels are specified in table A.5-1 to table A.5-2 for FR2-NTN PUSCH performance requirements:

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

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

Table A.5-1: FRC parameters for FR2-NTN PUSCH performance requirements, transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer (QPSK, R=193/1024)

|  |  |
| --- | --- |
| Reference channel | G-FR2-NTN-A5-1 |
| Subcarrier spacing (kHz) | 120 |
| Allocated resource blocks | 32 |
| CP-OFDM Symbols per slot (Note 1) | 8 |
| MCS table | 64QAM |
| Modulation | QPSK |
| Code rate (Note 2) | 193/1024 |
| Payload size (bits) | 1160 |
| Transport block CRC (bits) | 16 |
| Code block CRC size (bits) | - |
| Number of code blocks - C | 1 |
| Code block size including CRC (bits) (Note 2) | 1176 |
| Total number of bits per slot | 6144 |
| Total symbols per slot | 3072 |
| 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, and l0= 0 and l = 8 for PUSCH mapping type B, as per table 6.4.1.1.3-3 of TS 38.211 [8].NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [7]. |

Table A.5-2: FRC parameters for FR2-NTN PUSCH performance requirements, transform precoding enabled, additional DM-RS position = pos1 and 1 transmission layer (QPSK, R=193/1024)

|  |  |
| --- | --- |
| Reference channel | G-FR2-NTN-A5-2 |
| Subcarrier spacing (kHz) | 120 |
| Allocated resource blocks | 30 |
| DFT-s-OFDM Symbols per slot (Note 1) | 8 |
| MCS table | 64QAM |
| Modulation | QPSK |
| Code rate (Note 2) | 193/1024 |
| Payload size (bits) | 1128 |
| Transport block CRC (bits) | 16 |
| Code block CRC size (bits) | - |
| Number of code blocks - C | 1 |
| Code block size including CRC (bits) (Note 2) | 1144 |
| Total number of bits per slot | 5760 |
| Total symbols per slot | 2880 |
| 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, and l0= 0 and l = 8 for PUSCH mapping type B, as per table 6.4.1.1.3-3 of TS 38.211 [8].NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [7]. |

# A.6 Fixed Reference Channels for performance requirements (16QAM, R=434/1024)

The parameters for the reference measurement channels are specified in table A.6-1 for FR2-NTN PUSCH performance requirements:

- FRC parameters are specified in table A.6-1 for FR2-NTN PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer.

Table A.6-1: FRC parameters for FR2-NTN PUSCH performance requirements, transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer (16QAM, R=434/1024)

|  |  |
| --- | --- |
| Reference channel | G-FR2-NTN-A6-1 |
| Subcarrier spacing (kHz) | 120 |
| Allocated resource blocks | 32 |
| CP-OFDM Symbols per slot (Note 1) | 8 |
| MCS table | 64QAM |
| Modulation | 16QAM |
| Code rate (Note 2) | 434/1024 |
| Payload size (bits) | 5248 |
| Transport block CRC (bits) | 24 |
| Code block CRC size (bits) | - |
| Number of code blocks - C | 1 |
| Code block size including CRC (bits) (Note 2) | 5272 |
| Total number of bits per slot | 12288 |
| Total symbols per slot | 3072 |
| 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, and l0= 0 and l = 8 for PUSCH mapping type B, as per table 6.4.1.1.3-3 of TS 38.211 [8].NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [7]. |

Table A.5-1 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-NTN-A5-1 | G-FR1-NTN-A5-2(Note 3) |
| Subcarrier spacing [kHz] | 15 | 30 |
| Allocated resource blocks | 25 | 24 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 |
| Modulation | 16QAM | 16QAM |
| Code rate (Note 2) | 658/1024 | 658/1024 |
| Payload size (bits) | 9224 | 8968 |
| Transport block CRC (bits) | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 |
| Number of code blocks - C | 2 | 2 |
| Code block size including CRC (bits) (Note 2) | 4648 | 4520 |
| Total number of bits per slot | 14400 | 13824 |
| Total symbols per slot | 3600 | 3456 |
| 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 [9].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.5-2: FRC parameters for FR2-NTN PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos1* and 1 transmission layer (16QAM, R=658/1024)

|  |  |
| --- | --- |
| Reference channel | G-FR2-NTN-A5-1 |
| Subcarrier spacing [kHz] | 120 |
| Allocated resource blocks | 32 |
| CP-OFDM Symbols per slot (Note 1) | 8 |
| Modulation | 16QAM |
| Code rate (Note 2) | 658/1024 |
| Payload size (bits) | 7936 |
| Transport block CRC (bits) | 24 |
| Code block CRC size (bits) | - |
| Number of code blocks - C | 1 |
| Code block size including CRC (bits) (Note 2) | 7960 |
| Total number of bits per slot | 12288 |
| Total symbols per slot | 11776 |
| 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.6 Fixed Reference Channels for performance requirements (64QAM, R=567/1024)

The parameters for the reference measurement channels are specified in table A.6-1 for FR1 PUSCH performance requirements:

- FRC parameters are specified in table A.6-1 for FR1 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.6-2 for FR2-NTN PUSCH performance requirements:

- 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.

Table A.6-1: 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-NTN-A6-1 | G-FR1-NTN-A6-2 |
| Subcarrier spacing [kHz] | 15 | 30 |
| Allocated resource blocks | 25 | 24 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 |
| Modulation | 64QAM | 64QAM |
| Code rate (Note 2) | 567/1024 | 567/1024 |
| Payload size (bits) | 12040 | 11528 |
| Transport block CRC (bits) | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 |
| Number of code blocks - C | 2 | 2 |
| Code block size including CRC (bits) (Note 2) | 6056 | 5800 |
| Total number of bits per slot | 21600 | 20736 |
| Total symbols per slot | 3600 | 3456 |
| 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 [9].NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [15]. |

Table A.6-2: FRC parameters for FR2-NTN PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos1* and 1 transmission layer (64QAM, R=567/1024)

|  |  |
| --- | --- |
| Reference channel | G-FR2-NTN-A6-1 |
| Subcarrier spacing [kHz] | 120 |
| Allocated resource blocks | 32 |
| CP-OFDM Symbols per slot (Note 1) | 8 |
| Modulation | 64QAM |
| Code rate (Note 2) | 567/1024 |
| Payload size (bits) | 10248 |
| Transport block CRC (bits) | 24 |
| Code block CRC size (bits) | 24 |
| Number of code blocks - C | 2 |
| Code block size including CRC (bits) (Note 2) | 5160 |
| Total number of bits per slot | 18432 |
| Total symbols per slot | 17664 |
| 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*. |

***<End of change 1>***

***<Start of change 2>***

# D.2 Multi-path fading propagation conditions

The multipath propagation conditions consist of several parts:

- A delay profile in the form of a "tapped delay-line", characterized by a number of taps at fixed positions on a sampling grid. The profile can be further characterized by the r.m.s. delay spread and the maximum delay spanned by the taps.

- A combination of channel model parameters that include the Delay profile and the Doppler spectrum that is characterized by a classical spectrum shape and a maximum Doppler frequency.

## D.2.1 Delay profiles

The delay profiles are simplified from the TR 38.811 [13] TDL models. The simplification steps are shown below for information. These steps are only used when new delay profiles are created. Otherwise, the delay profiles specified in G.2.1.1 can be used as such.

- Step 1: Use the original TDL model from TR 38.811 [13].

- Step 2: Re-order the taps in ascending delays

- Step 3: Perform delay scaling according to the procedure described in clause 7.7.2 in TR 38.901 [12].

- Step 4: Apply the quantization to the delay resolution 5 ns. This is done simply by rounding the tap delays to the nearest multiple of the delay resolution.

- Step 5: If multiple Rayleigh taps are rounded to the same delay bin, merge them by calculating their linear power sum.

- Step 6: If there is a LOS path in the model, the power for all paths could be slightly adjusted to keep the RMS delay spread is close to target delay spread and mean power is 0dB.

- Step 7: Round the amplitudes of taps to one decimal (e.g. -8.78 dB 🡪 -8.8 dB)

- Step 8: If the delay spread has slightly changed due to the tap merge, adjust the final delay spread by increasing or decreasing the power of the last tap so that the delay spread is corrected.

- Step 9: Re-normalize the highest Rayleigh tap to 0 dB when there is no LOS path in the model.

Note 1: Some values of the delay profile created by the simplification steps may differ from the values in tables G.2.1.1-2 and G.2.1.1-3 for the corresponding model.

Note 2: For Step 5 and Step 6, the power values are expressed in the linear domain using 6 digits of precision. The operations are in the linear domain.

### D.2.1.1 Delay profiles for FR1

The delay profiles for FR1 are selected to be representative of low, medium and high delay spread environment. The resulting model parameters are specified in table D.2.1.1-1 and the tapped delay line models are specified in tables D.2.1.1-2 ~ D.2.1.1-4.

Table D.2.1.1-1: Delay profiles for NR channel models

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Model | Number of channel taps | Delay spread(r.m.s.) | Maximum excess tap delay (span) | Delay resolution |
| NTN-TDLA100 | 3 | 100 ns | 285 | 5ns |
| NTN-TDLC5 | 2 | 5 ns | 60 | 5ns |

Table D.2.1.1-2: NTN-TDLA100 (DS = 100 ns)

|  |  |  |  |
| --- | --- | --- | --- |
| Tap # | Delay (ns) | Power (dB) | Fading distribution |
| 1 | 0 | 0 | Rayleigh |
| 2 | 110 | -4.7 | Rayleigh |
| 3 | 285 | -6.5 | Rayleigh |

Table D.2.1.1-3: NTN-TDLC5 (DS = 5 ns)

|  |  |  |  |
| --- | --- | --- | --- |
| Tap # | Delay (ns) | Power (dB) | Fading distribution |
| 1 | 0 | -0.6 | LOS path |
| 0 | -8.9 | Rayleigh |
| 2 | 60 | -21.5 | Rayleigh |

### D.2.1.2 Delay profiles for FR2-NTN

The delay profiles for FR2 are selected to be representative of low, medium and high delay spread environment. The resulting model parmeters are specified in table D.2.1.2-1 and the tapped delay line models are specified in tables D.2.1.2-2.

Table D.2.1.2-1: Delay profiles for NR channel models

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Model | Number of channel taps | Delay spread(r.m.s.) | Maximum excess tap delay (span) | Delay resolution |
| NTN-TDLC5 | 2 | 5 ns | 60 ns | 5 ns |

Table D.2.1.2-2: NTN-TDLC5 (DS = 5 ns)

|  |  |  |  |
| --- | --- | --- | --- |
| Tap # | Delay (ns) | Power (dB) | Fading distribution |
| 1 | 0 | -0.6 | LOS path |
| 0 | -8.9 | Rayleigh |
| 2 | 60 | -21.5 | Rayleigh |

## D.2.2 Combinations of channel model parameters

The propagation conditions used for the performance measurements in multi-path fading environment are indicated as a combination of a channel model name and a maximum Doppler frequency, i.e., NTN-TDLA<DS>-<Doppler> or NTN-TDLC<DS>-<Doppler> where '<DS>' indicates the desired delay spread and '<Doppler>' indicates the maximum Doppler frequency (Hz).

Table D.2.2-1 show the propagation conditions that are used for the performance measurements in multi-path fading environment.

Table D.2.2-2 shows the propagation conditions that are used for the performance measurements in multi-path fading environment for low, medium and high Doppler frequencies for FR2-NTN.

Table D.2.2-1: Channel model parameters for FR1

|  |  |  |
| --- | --- | --- |
| Combination name | Tapped delay line model | Maximum Doppler frequency |
| NTN-TDLA100-200 | NTN-TDLA100 | 200 Hz |
| NTN-TDLC5-200 | NTN-TDLC5 | 200 Hz |

Table D.2.2-2: Channel model parameters for FR2-NTN

|  |  |  |
| --- | --- | --- |
| Combination name | Model | Maximum Doppler frequency |
| NTN-TDLC5-1200 | NTN-TDLC5 | 1200 Hz |

***<End of change 2>***