**3GPP TSG-RAN4 Meeting # 111 *R4-2409865***

 **Fukuoka City, Fukuoka, Japan, May 20th – 24th 2024**

|  |
| --- |
| *CR-Form-v12.3* |
| **CHANGE REQUEST** |
|  |
|  | **38.181** | **CR** | **Draft** | **rev** | **-**  | **Current version:** | **18.1.0** |  |
|  |
| *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:***  |  |
|  |  |
| ***Source to WG:*** | Ericsson |
| ***Source to TSG:*** | RAN4 |
|  |  |
| ***Work item code:*** | NR\_NTN\_enh-Perf |  | ***Date:*** | 2024-05-13 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***Release:*** | Rel-18 |
|  | *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:*** | The discussion on the Rel-18 NR NTN enhancement demodulation requirements have achieved good progress and most of open issues are settled. It is time to deliver draft CR for specification change. |
|  |  |
| ***Summary of change:*** | Following corrections are added for FR2-NTN demodulation requirements and FR1-NTN DM-RS bundling requirements.* Add FRC tables for FR2-NTN
	+ MCS 2 with 1 layer for precoding disabled and enabled
	+ MCS 12 with 1 layer for precoding disabled
	+ MCS 5 (in table 3) for PUSCH repetition typa A
* Add FRC table for FR1-NTN DM-RS bundling
	+ MCS 4 with 1 layer
* Add PRACH preamble configurations.
* Add Test tolerance and derivation of test requirements for FR1-NTN PUSCH with DM-RS bundling and FR2-NTN demodulaiton requirements
* Add measurement system set-up for SAN-2O
* Add propagation conditions for FR2-NTN
* Add suffix “NTN” to frequency range abbservation “FR1” and “FR2” to “FR1-NTN” and “FR2-NTN”.
 |
|  |  |
| ***Consequences if not approved:*** | There is no FRC tables, measurement tolerances and test setup informations for NTN demodulation requirements.. |
|  |  |
| ***Clauses affected:*** | A.3, A.3A, A.4, A.5 (new), A.6 (new), C3, G.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:*** | Revised from R4-2408341. |

################## Start of Change #1 ######################

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

The parameters for the reference measurement channels 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 = pos1 and 1 transmission layer.

- FRC parameters are specified in table A.3-2 for FR1 PUSCH with transform precoding enabled, additional DM-RS position = pos1 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 |
| Subcarrier spacing (kHz) | 15 | 30 |
| Allocated resource blocks | 25 | 24 |
| 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) | 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 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, 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.3-2: 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-A3-3 | G-FR1-A3-4 |
| Subcarrier spacing (kHz) | 15 | 30 |
| Allocated resource blocks | 25 | 24 |
| MCS table | 64QAM | 64QAM |
| 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 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, 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.3-3: 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-3 |
| Subcarrier spacing (kHz) | 15 | 30 |
| Allocated resource blocks | 25 | 24 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 |
| MCS table | 64QAMLowSE | 64QAMLowSE |
| 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 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 = pos2, 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.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-1 |
| 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]. |

Annex B (informative):
Environmental requirements for the SAN equipment

################## End of Change #1 ######################

################## Start of Change #2 ######################

# C.3 Measurement of performance requirements

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

|  |  |  |  |
| --- | --- | --- | --- |
| Test  | Minimum Requirement in TS 38.108 [2] | Test Tolerance(TT) | Test requirement in the present document |
| 8.2.1 Performance requirements for PUSCH with transform precoding disabled | SNRs as specified | [0.6] dB for 1Tx cases | Formula: SNR + TTT-put limit unchanged |
| 8.2.2 Performance requirements for PUSCH with transform precoding enabled | SNRs as specified | [0.6] dB | Formula: SNR + TTT-put limit unchanged |
| 8.2.3 Performance requirements for UL timing adjustment | SNRs as specified  | [0.3] dB for AWGN | Formula: SNR + TTT-put limit unchanged |
| 8.2.4 Performance requirements for PUSCH repetition Type A | SNRs as specified | [0.6] dB | Formula: SNR + TTT-put limit unchanged |
| 8.2.5 Performance requirements for PUSCH with DM-RS bundling | SNRs as specified | [0.6] dB | Formula: SNR + TTT-put limit unchanged |
| 8.3.1 Performance requirements for PUCCH format 0 | SNRs as specified | [0.6] dB | Formula: SNR + TTFalse ACK limit unchangedCorrect ACK limit unchanged  |
| 8.3.2 Performance requirements for PUCCH format 1  | SNRs as specified | [0.6] dB | Formula: SNR + TTFalse ACK limit unchangedFalse NACK limit unchangedCorrect ACK limit unchanged |
| 8.3.3 Performance requirements for PUCCH format 2  | SNRs as specified | [0.6] dB | Formula: SNR + TTFalse ACK limit unchangedCorrect ACK limit unchanged UCI BLER limit unchanged |
| 8.3.4 Performance requirements for PUCCH format 3 | SNRs as specified | [0.6] dB | Formula: SNR + TT UCI BLER limit unchanged |
| 8.3.5 Performance requirements for PUCCH format 4 | SNRs as specified | [0.6] dB | Formula: SNR + TT UCI BLER limit unchanged |
| 8.4.1 PRACH false alarm probability and missed detection | SNRs as specified | [0.6] dB for fading cases[0.3] dB for AWGN cases | Formula: SNR + TTPRACH false detection limit unchangedPRACH detection limit unchanged  |

Table C.3-2: Derivation of test requirements (FR1-NTN OTA performance tests)

|  |  |  |  |
| --- | --- | --- | --- |
| Test  | Minimum Requirement in TS 38.108 [2] | Test Tolerance(TTOTA) | Test requirement in the present document |
| 11.2.1 Performance requirements for PUSCH with transform precoding disabled | See clause 11.2.1.1 | [0.6] dB | Formula: SNR + TTOTAT-put limit unchanged |
| 11.2.2 Performance requirements for PUSCH with transform precoding enabled | See clause 11.2.1.2 | [0.6] dB | Formula: SNR + TTOTAT-put limit unchanged |
| 11.2.3 Performance requirements for UL timing adjustment | See clause 11.2.1.3 | [0.3] dB for AWGN cases | Formula: SNR + TTOTAT-put limit unchanged |
| 11.2.4 Performance requirements for PUSCH repetition Type A | See clause 11.2.1.4 | [0.6] dB | Formula: SNR + TTOTABLER limit unchanged |
| 11.2.5 Performance requirements for PUSCH with DM-RS bundling | See clause 11.2.1.5 | [0.6] dB | Formula: SNR + TTOTABLER limit unchanged |
| 11.3.1 Performance requirements for PUCCH format 0 | See clause 11.3.1.1 | [0.6] dB | Formula: SNR + TTOTAFalse ACK limit unchangedCorrect ACK limit unchanged |
| 11.3.2 Performance requirements for PUCCH format 1 | See clause 11.3.1.3  | [0.6] dB | Formula: SNR + TTOTAFalse ACK limit unchanged False NACK limit unchangedCorrect ACK limit unchanged |
| 11.3.3 Performance requirements for PUCCH format 2 | See clause 11.3.1.4  | [0.6] dB | Formula: SNR + TTOTAFalse ACK limit unchangedCorrect ACK limit unchangedUCI BLER limit unchanged |
| 11.3.4 Performance requirements for PUCCH format 3 | See clause 11.3.1.5  | [0.6] dB | Formula: SNR + TTOTAUCI BLER limit unchanged |
| 11.3.5 Performance requirements for PUCCH format 4 | See clause 11.3.1.6  | [0.6] dB | Formula: SNR + TTOTAUCI BLER limit unchanged |
| 11.4.1 PRACH false alarm probability and missed detection | See clause 11.4.1 | [0.6] dB for fading cases[0.3] dB for AWGN cases | Formula: SNR + TTOTAPRACH False detection limit unchangedPRACH detection limit unchanged  |
| NOTE: TT values are applicable for normal condition unless otherwise stated. |

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

|  |  |  |  |
| --- | --- | --- | --- |
| Test  | Minimum Requirement in TS 38.108 [2] | Test Tolerance(TTOTA) | Test requirement in the present document |
| 11.2.1 Performance requirements for PUSCH with transform precoding disabled | See clause [11.2.2.1] | [0.6] dB | Formula: SNR + TTOTAT-put limit unchanged |
| 11.2.2 Performance requirements for PUSCH with transform precoding enabled | See clause [11.2.2.2] | [0.6] dB | Formula: SNR + TTOTAT-put limit unchanged |
| 11.2.3 Performance requirements for PUSCH repetition Type A | See clause [11.2.2.3] | [0.6] dB | Formula: SNR + TTOTABLER limit unchanged |
| 11.3.1 Performance requirements for PUCCH format 0 | See clause [11.3.2.1] | [0.6] dB | Formula: SNR + TTOTAFalse ACK limit unchangedCorrect ACK limit unchanged |
| 11.3.2 Performance requirements for PUCCH format 1 | See clause [11.3.2.3]  | [0.6] dB | Formula: SNR + TTOTAFalse ACK limit unchanged False NACK limit unchangedCorrect ACK limit unchanged |
| 11.3.3 Performance requirements for PUCCH format 2 | See clause [11.3.2.4]  | [0.6] dB | Formula: SNR + TTOTAFalse ACK limit unchangedCorrect ACK limit unchangedUCI BLER limit unchanged |
| 11.3.4 Performance requirements for PUCCH format 3 | See clause [11.3.2.5]  | [0.6] dB | Formula: SNR + TTOTAUCI BLER limit unchanged |
| 11.3.5 Performance requirements for PUCCH format 4 | See clause [11.3.2.6]  | [0.6] dB | Formula: SNR + TTOTAUCI BLER limit unchanged |
| 11.4.1 PRACH false alarm probability and missed detection | See clause [11.4.2] | [0.6] dB for fading cases | Formula: SNR + TTOTAPRACH False detection limit unchangedPRACH detection limit unchanged  |
| NOTE: TT values are applicable for normal condition unless otherwise stated. |

################## End of Change #2 ######################

################## Start of Change #3 ######################

# D.7 SAN type 1-O and 2-O performance requirements



Figure D.7-1: Measurement set up for single TX, single demodulation branch radiated performance requirements



Figure D.7-2: Measurement set up for single TX, dual polarization radiated performance requirements



Figure D.7-3: Measurement set up for UL timing adjustment, single TX, dual polarization radiated performance requirements

The OTA chambers shown in figures D.7-1, D.7-2, D.7-3 and D.7-4 are intended to be generic and can be replaced with any suitable OTA chamber (e.g. far field anechoic chamber, CATR, etc.). The PA(s) depicted in figures D.7-1, D.7-2, and D.7-3 is optional. Fading channel emulators are included when needed according to the requirement description.

NOTE: The HARQ Feedback (only for PUSCH) could be done as an RF feedback or as a digital feedback. The HARQ Feedback should be error free.

################## End of Change #3 ######################

################## Start of Change #4 ######################

# G.1 Static propagation condition

The propagation for the static performance measurement is an Additive White Gaussian Noise (AWGN) environment. No fading or multi-paths exist for this propagation model.

# G.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.

## G.2.1 Delay profiles

The delay profiles are simplified from the TR 38.811 [17] 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 [17].

- 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 [11].

- 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, G.2.1.1-3 and G.2.1.2-2 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.

### G.2.1.1 Delay profiles for FR1

The delay profiles for FR1 are selected to be representative of NLOS and LOS scenarios. The resulting model parameters are specified in G.2.1.1-1 and the tapped delay line models are specified in tables G.2.1.1-2 and table G.2.1.1-3.

Table G.2.1.1-1: Delay profiles for SAN 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 ns | 5 ns |
| NTN-TDLC5 | 2 | 5 ns | 60 ns | 5 ns |

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

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

Table G.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 |
| NOTE: The first tap follows a Rician distribution with a K-factor of K1 = 8.05 dB and a mean power of 0dB |

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

The delay profiles for FR2-NTN are selected to be representative of LOS scenarios. The resulting model parameters are specified in G.2.1.2-1 and the tapped delay line models are specified in tables G.2.1.2-2.

Table G.2.1.2-1: Delay profiles for SAN 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 G.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 |
| NOTE: The first tap follows a Rician distribution with a K-factor of K1 = 8.05 dB and a mean power of 0dB |

## G.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 G.2.2-1 show the propagation conditions that are used for the performance measurements in multi-path fading environment for low, medium and high Doppler frequencies for FR1.

Table G.2.2-2 show 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 G.2.2-1: Channel model parameters for FR1

|  |  |  |
| --- | --- | --- |
| Combination name | Model | Maximum Doppler frequency |
| NTN-TDLA100-200 | NTN-TDLA100 | 200 Hz |
| NTN-TDLC5-200 | NTN-TDLC5 | 200 Hz |

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

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

## G.2.3 MIMO channel correlation matrices

################## End of Change #4 ######################