**3GPP TSG- Meeting # *R4-2412294***

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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:***  |  |
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| ***Source to WG:*** | , Samsung |
| ***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:*** | In RAN4#111 meeting, companies agree to use “FRx-NTN” for NR NTN demodulation FRC table to differenciate NTN deployment bands, and also differenciate from different deployment scenarios to avoid misunderstanding of FRC table naming, such as TN and NTN deployment. In Rel-18 specifications, FR2-NTN part have been updated and it is reasonable to update FR1-NTN part as well. The propagation condition and correlation matrix are captured in Annex D but requirement sections take “Annex G” which is not correct.  |
|  |  |
| ***Summary of change:*** | * Change “FR1” to “FR1-NTN” in all statements and tables.
* Change Propagation condition Annex index
* Correct some editorial errors and adjust table format.
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|  |  |
| ***Consequences if not approved:*** | It will not be aligned between Rel-17 and Rel-18 specifications and it would cause misunderstanding for TE vendors to implement FRC tables. The reference Annex index is wrong for propagation condition and correlation matrix. |
|  |  |
| ***Clauses affected:*** | 8.2, 8.3, 8.4, A3, A3A, D.2 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **x** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** | **x** |  |  Test specifications | TS38.181  |
| ***(show related CRs)*** |  | **x** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** | Revised from R4-2412294. |

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

# 8 Conducted performance requirements

## 8.1 General

Conducted performance requirements specify the ability of the *SAN type 1-H* to correctly transmit and receive signals in various conditions and configurations. Conducted performance requirements are specified at the *TAB connector(s)* (for *SAN type 1-H*).

Conducted performance requirements for the SAN are specified for the fixed reference channels defined in annex A and for the propagation conditions defined in Recommendation ITU-R P.618 (*Propagation data and prediction methods required for the design of Earth-space telecommunication systems*).

Unless stated otherwise, performance requirements apply for a single carrier only. Performance requirements for a SAN supporting *carrier aggregation* are defined in terms of single carrier requirements.

For FDD operation the requirements in clause 8 shall be met with the transmitter units associated with *TAB connectors* (for *SAN type 1-H*) in the *operating* *band* turned ON.

NOTE: In normal operating conditions, *TAB connectors* (for *SAN type 1-H*) in FDD operation are configured to transmit and receive at the same time. The associated transmitter unit(s) may be OFF for some of the tests as specified in TS 38.181 [3].

The SNR used in this clause is specified based on a single carrier and defined as:

SNR = S / N

Where:

*S* is the total signal power in the slot on a single on a single *TAB connector* (for *SAN type 1-H*).

*N* is the noise density integrated in a bandwidth corresponding to the *transmission bandwidth* over the same duration where signal energy exists on a single *TAB connector* (for *SAN type 1-H)*.

## 8.2 Performance requirements for PUSCH

### 8.2.1 Requirements for PUSCH with transform precoding disabled

#### 8.2.1.1 General

The performance requirement of PUSCH is determined by a minimum required throughput for a given SNR. The required throughput is expressed as a fraction of maximum throughput for the FRCs listed in annex A. The performance requirements assume HARQ retransmissions.

Table: 8.2.1.1-1 Test parameters for testing PUSCH

|  |  |
| --- | --- |
| Parameter | Value |
| Transform precoding | Disabled |
| HARQ | Maximum number of HARQ transmissions | 4 |
| RV sequence | 0, 2, 3, 1 |
| DM-RS | DM-RS configuration type | 1 |
| DM-RS duration | single-symbol DM-RS |
| Additional DM-RS position | pos1 |
| Number of DM-RS CDM group(s) without data | 2 |
| Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB |
| DM-RS port | {0} |
| DM-RS sequence generation | NID0=0, nSCID =0 |
| Time domain resource assignment | PUSCH mapping type | A, B |
| Start symbol | 0  |
| Allocation length | 14  |
| Frequency domain resource assignment | RB assignment | Full applicable test bandwidth |
| Frequency hopping | Disabled |
| Code block group based PUSCH transmission | Disabled |

#### 8.2.1.2 Minimum requirements

The throughput shall be equal to or larger than the fraction of maximum throughput for the FRCs stated in tables 8.2.1.2-1 to 8.2.1.2-4 at the given SNR. FRCs are defined in annex A.

Table 8.2.1.2-1: Minimum requirements for PUSCH with 70% of maximum throughput, Type A, 5 MHz channel bandwidth, 15 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (Annex D) | Fraction of maximum throughput | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-1 | pos1 | 3.2 |
| Normal | NTN-TDLC5-200 Low | 70 % | G-FR1-NTN-A3-1 | pos1 | 1.6 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-1 | pos1 | -0.7 |
| Normal | NTN-TDLC5-200 Low | 70 % | G-FR1-NTN-A3-1 | pos1 | -1.2 |

Table 8.2.1.2-2: Minimum requirements for PUSCH with 70% of maximum throughput, Type A, 10 MHz channel bandwidth, 30 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (Annex D) | Fraction of maximum throughput | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-3 | pos1 | 2.9 |
| Normal | NTN-TDLC5-200 Low | 70 % | G-FR1-NTN-A3-3 | pos1 | 1.4 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-3 | pos1 | -1.0 |
| Normal | NTN-TDLC5-200 Low | 70 % | G-FR1-NTN-A3-3 | pos1 | -1.4 |

Table 8.2.1.2-3: Minimum requirements for PUSCH with 70% of maximum throughput, Type B, 5 MHz channel bandwidth, 15 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (Annex D) | Fraction of maximum throughput | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-1 | pos1 | 3.3 |
| Normal | NTN-TDLC5-200 Low | 70 % | G-FR1-NTN-A3-1 | pos1 | 1.6 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-1 | pos1 | -0.6 |
| Normal | NTN-TDLC5-200 Low | 70 % | G-FR1-NTN-A3-1 | pos1 | -1.2 |

Table 8.2.1.2-4: Minimum requirements for PUSCH with 70% of maximum throughput, Type B, 10 MHz channel bandwidth, 30 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (Annex D) | Fraction of maximum throughput | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-3 | pos1 | 2.9 |
| Normal | NTN-TDLC5-200 Low | 70 % | G-FR1-NTN-A3-3 | pos1 | 1.3 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % | G-FR1-NTN-A3-3 | pos1 | -1.0 |
| Normal | NTN-TDLC5-200 Low | 70 % | G-FR1-NTN-A3-3 | pos1 | -1.4 |

### 8.2.2 Requirements for PUSCH with transform precoding enabled

#### 8.2.2.1 General

The performance requirement of PUSCH is determined by a minimum required throughput for a given SNR. The required throughput is expressed as a fraction of maximum throughput for the FRCs listed in annex A. The performance requirements assume HARQ retransmissions.

Table 8.2.2.1-1: Test parameters for testing PUSCH

|  |  |
| --- | --- |
| Parameter | Value |
| Transform precoding | Enabled |
| HARQ | Maximum number of HARQ transmissions | 4 |
| RV sequence | 0, 2, 3, 1 |
| DM-RS | DM-RS configuration type | 1 |
| DM-RS duration | single-symbol DM-RS |
| Additional DM-RS position | pos1 |
| Number of DM-RS CDM group(s) without data | 2 |
| Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB |
| DM-RS port | {0} |
| DM-RS sequence generation | NID0=0, group hopping and sequence hopping are disabled |
| Time domain resource assignment | PUSCH mapping type | A, B |
| Start symbol | 0  |
| Allocation length | 14  |
| Frequency domain resource assignment | RB assignment | Full applicable test bandwidth |
| Frequency hopping | Disabled |
| Code block group based PUSCH transmission | Disabled |

#### 8.2.2.2 Minimum requirements

The throughput shall be equal to or larger than the fraction of maximum throughput for the FRCs stated in tables 8.2.2.2-1 to 8.2.2.2-4 at the given SNR. FRCs are defined in annex A.

Table 8.2.2.2-1: Minimum requirements for PUSCH with 70% of maximum throughput, PUSCH mapping Type A, 5 MHz channel bandwidth, 15 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (Annex D) | Fraction of maximum throughput | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % |  G-FR1-NTN-A3-5 | pos1 | 3.7 |
| Normal | NTN-TDLC5-200 Low | 70 % |  G-FR1-NTN-A3-5 | pos1 | 1.6 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % |  G-FR1-NTN-A3-5 | pos1 | -0.5 |
| Normal | NTN-TDLC5-200 Low | 70 % |  G-FR1-NTN-A3-5 | pos1 | -1.2 |

Table 8.2.2.2-2: Minimum requirements for PUSCH with 70% of maximum throughput, PUSCH mapping Type A, 10 MHz channel bandwidth, 30 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (Annex D) | Fraction of maximum throughput | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % |  G-FR1-NTN-A3-6 | pos1 | 3.5 |
| Normal | NTN-TDLC5-200 Low | 70 % |  G-FR1-NTN-A3-6 | pos1 | 1.3 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % |  G-FR1-NTN-A3-6 | pos1 | -0.7 |
| Normal | NTN-TDLC5-200 Low | 70 % |  G-FR1-NTN-A3-6 | pos1 | -1.4 |

Table 8.2.2.2-3: Minimum requirements for PUSCH with 70% of maximum throughput, PUSCH mapping Type B, 5 MHz channel bandwidth, 15 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (Annex D) | Fraction of maximum throughput | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % |  G-FR1-NTN-A3-5 | pos1 | 3.7 |
| Normal | NTN-TDLC5-200 Low | 70 % |  G-FR1-NTN-A3-5 | pos1 | 1.6 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % |  G-FR1-NTN-A3-5 | pos1 | -0.5 |
| Normal | NTN-TDLC5-200 Low | 70 % |  G-FR1-NTN-A3-5 | pos1 | -1.2 |

Table 8.2.2.2-4: Minimum requirements for PUSCH with 70% of maximum throughput, PUSCH mapping Type B, 10 MHz channel bandwidth, 30 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (Annex D) | Fraction of maximum throughput | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 70 % |  G-FR1-NTN-A3-6 | pos1 | 3.5 |
| Normal | NTN-TDLC5-200 Low | 70 % |  G-FR1-NTN-A3-6 | pos1 | 1.3 |
| 2 | Normal | NTN-TDLA100-200 Low | 70 % |  G-FR1-NTN-A3-6 | pos1 | -0.7 |
| Normal | NTN-TDLC5-200 Low | 70 % |  G-FR1-NTN-A3-6 | pos1 | -1.4 |

### 8.2.3 Requirements for UL timing adjustment

The performance requirement of UL timing adjustment is determined by a minimum required throughput for the moving UE at given SNR. The performance requirements assume HARQ retransmissions.

In the tests for UL timing adjustment, two signals are configured, one being transmitted by a moving UE and the other being transmitted by a stationary UE. The transmission of SRS from UE is optional. FRC parameters in Table A.3-1 are applied for both UEs. The received power for both UEs is the same. The resource blocks allocated for both UEs are consecutive.

Table 8.2.3-1 Test parameters for testing UL timing adjustment

|  |  |
| --- | --- |
| Parameter | Value |
| Transform precoding | Disabled |
| HARQ | Maximum number of HARQ transmissions | 4 |
| RV sequence | 0, 2, 3, 1 |
| DM-RS | DM-RS configuration type | 1 |
| DM-RS duration | single-symbol DM-RS |
| Additional DM-RS position | pos1 |
| Number of DM-RS CDM group(s) without data | 2 |
| Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB |
| DM-RS port | {0} |
| DM-RS sequence generation | NID0=0, nSCID =0 for moving UENID0=1, nSCID =1 for stationary UE |
| Time domain resource assignment | PUSCH mapping type | A, B |
| Start symbol | 0  |
| Allocation length | 14  |
| Frequency domain resourceassignment | RB assignment | 12 RB for each UE |
| Starting PRB index | Moving UE: 0Stationary UE: 12 |
| Frequency hopping | Disabled |
| SRS resource allocation | Slots in which sounding RS is transmitted (Note 1) | slot #1 in radio frames |
| SRS resource allocation | CSRS = 5, BSRS =0, for 20 RB |
| Code block group based PUSCH transmission | Disabled |
| NOTE 1: The transmission of SRS is optional. The transmission comb is configured as KTC = 2. The SRS periodic is configured as TSRS = 10 for 15kHz SCS and 20 for 30kHz SCS respectively. |

#### 8.2.3.2 Minimum requirements

The throughput shall be ≥ 70% of the maximum throughput of the reference measurement channel as specified in Annex A for the moving UE at the SNR given in table 8.2.3.2-1 to table 8.2.3.2-4.

Table 8.2.3.2-1: Minimum requirements for UL timing adjustment with 70% of maximum throughput, PUSCH mapping Type A, 5 MHz channel bandwidth, 15 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (Annex D) | Fraction of maximum throughput | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 1 | Normal | Scenario X | 70 % | G-FR1-NTN-A3-2 | pos1 | 4.1 |
| 2 | Normal | Scenario X | 70 % | G-FR1-NTN-A3-2 | pos1 | -0.3 |

Table 8.2.3.2-2: Minimum requirements for UL timing adjustment with 70% of maximum throughput, PUSCH mapping Type A, 10 MHz channel bandwidth, 30 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (Annex D) | Fraction of maximum throughput | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 1 | Normal | Scenario X | 70 % | G-FR1-NTN-A3-4 | pos1 | 3.6 |
| 2 | Normal | Scenario X | 70 % | G-FR1-NTN-A3-4 | pos1 | -0.5 |

Table 8.2.3.2-3: Minimum requirements for UL timing adjustment with 70% of maximum throughput, PUSCH mapping Type B, 5 MHz channel bandwidth, 15 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (Annex D) | Fraction of maximum throughput | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 1 | Normal | Scenario X | 70 % | G-FR1-NTN-A3-2 | pos1 | 4.2 |
| 2 | Normal | Scenario X | 70 % | G-FR1-NTN-A3-2 | pos1 | -0.3 |

Table 8.2.3.2-4: Minimum requirements for UL timing adjustment with 70% of maximum throughput, PUSCH mapping Type B, 10 MHz channel bandwidth, 30 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (Annex D) | Fraction of maximum throughput | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 1 | Normal | Scenario X | 70 % | G-FR1-NTN-A3-4 | pos1 | 3.6 |
| 2 | Normal | Scenario X | 70 % | G-FR1-NTN-A3-4 | pos1 | -0.4 |

### 8.2.4 Requirements for PUSCH repetition Type A

#### 8.2.4.1 General

The performance requirement of PUSCH is determined by a maximum block error probability (BLER) for a given SNR. The BLER is defined as the probability of incorrectly decoding the PUSCH information when the PUSCH information is sent. The performance requirements assume HARQ re-transmissions.

Table: 8.2.4.1-1 Test parameters for testing PUSCH repetition Type A

|  |  |
| --- | --- |
| Parameter | Value |
| Transform precoding | Disabled |
| Channel bandwidth | 15kHz SCS: 5MHz30kHz SCS: 10MHz |
| HARQ | Maximum number of HARQ transmissions | 4 |
| RV sequence | 0, 3, 0, 3 [Note 1] |
| DM-RS | DM-RS configuration type | 1 |
| DM-RS duration | single-symbol DM-RS |
| Additional DM-RS position | pos1 |
| Number of DM-RS CDM group(s) without data | 2 |
| Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB |
| DM-RS port | {0} |
| DM-RS sequence generation | NID0=0, nSCID =0 |
| Time domainresourceassignment | PUSCH mapping type | A, B |
| Start symbol | 0  |
| Allocation length | 14  |
| PUSCH aggregation factor | n2 |
| Frequency domain resource assignment | RB assignment | Full applicable test bandwidth |
| Frequency hopping | Disabled |
| Code block group based PUSCH transmission | Disabled |
| Note 1: The effective RV sequence is {0, 2, 3, 1} with slot aggregation. |

#### 8.2.4.2 Minimum requirements

The BLER shall be equal to or smaller than the required target BLER for the FRCs stated in tables 8.2.4.2-1 to 8.2.4.2-4 at the given SNR. FRCs are defined in annex A.

Table 8.2.4.2-1: Minimum requirements for PUSCH repetition TypeA, PUSCH mapping Type A, 5 MHz channel bandwidth, 15 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (Annex D) | Target BLER | FRC(Annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 1% (Note 1) | G-FR1-NTN-A3A-1 | pos1 | -5.1 |
| 2 | Normal | NTN-TDLA100-200 Low | 1% (Note 1) | G-FR1-NTN-A3A-1 | pos1 | -8.5 |
| Note 1: BLER is defined as residual BLER; i.e. ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block. |

Table 8.2.4.2-2: Minimum requirements for PUSCH, PUSCH mapping Type A, 10 MHz channel bandwidth, 30 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (Annex D) | Target BLER | FRC(Annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 1% (Note 1) | G-FR1-NTN-A3A-2 | pos1 | -5.1 |
| 2 | Normal | NTN-TDLA100-200 Low | 1% (Note 1) | G-FR1-NTN-A3A-2 | pos1 | -8.5 |
| Note 1: BLER is defined as residual BLER; i.e. ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block. |

Table 8.2.4.2-3: Minimum requirements for PUSCH, PUSCH mapping Type B, 5 MHz channel bandwidth, 15 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (Annex D) | Target BLER | FRC(Annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 1% (Note 1) | G-FR1-NTN-A3A-1 | pos1 | -5.1 |
| 2 | Normal | NTN-TDLA100-200 Low | 1% (Note 1) | G-FR1-NTN-A3A-1 | pos1 | -8.5 |
| Note 1: BLER is defined as residual BLER; i.e. ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block. |

Table 8.2.4.2-4: Minimum requirements for PUSCH, PUSCH mapping Type B, 10 MHz channel bandwidth, 30 kHz SCS in FR1-NTN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (Annex D) | Target BLER | FRC(Annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 1% (Note 1) | G-FR1-NTN-A3A-2 | pos1 | -5.1 |
| 2 | Normal | NTN-TDLA100-200 Low | 1% (Note 1) | G-FR1-NTN-A3A-2 | pos1 | -8.5 |
| Note 1: BLER is defined as residual BLER; i.e. ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block. |

## 8.3 Performance requirements for PUCCH

### 8.3.1 DTX to ACK probability

#### 8.3.1.1 General

The DTX to ACK probability, i.e. the probability that ACK is detected when nothing was sent:

 $Prob\left(PUCCH DTX\rightarrow Ack bits\right)= \frac{\#(false ACK bits)}{\#\left(PUCCH DTX\right)\*\#(ACK/NACK bits)}$

where:

- #(false ACK bits) denotes the number of detected ACK bits.

- #(ACK/NACK bits) denotes the number of encoded bits per slot

- #(PUCCH DTX) denotes the number of DTX occasions

#### 8.3.1.2 Minimum requirement

The DTX to ACK probability shall not exceed 1% for all PUCCH formats carrying ACK/NACK bits:

 $Prob\left(PUCCH DTX\rightarrow Ack bits\right) \leq 10^{-2}$

### 8.3.2 Performance requirements for PUCCH format 0

#### 8.3.2.1 General

The ACK missed detection probability is the probability of not detecting an ACK when an ACK was sent.

Table 8.3.2.1-1: Test Parameters

|  |  |
| --- | --- |
| Parameter | Test |
| Number of UCI information bits | 1 |
| Number of PRBs | 1 |
| First PRB prior to frequency hopping | 0 |
| Intra-slot frequency hopping | Enabled |
| First PRB after frequency hopping | the largest PRB index – (nrofPRBs – 1) |
| Group and sequence hopping | neither |
| Hopping ID | 0 |
| Initial cyclic shift | 0 |
| First symbol | 12 for 2 symbols |

The transient period as specified in TS 38.101-5 [11] clause 6.3.3 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the CC centre, i.e. intra-slot frequency hopping is enabled.

#### 8.3.2.2 Minimum requirements

The ACK missed detection probability shall not exceed 1% at the SNR given in table 8.3.2.2-1 and in table 8.3.2.2-2.

Table 8.3.2.2-1: Minimum requirements for PUCCH format 0, 15 kHz SCS and 5MHz channel bandwidth in FR1-NTN

|  |  |  |  |
| --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Propagation conditions andcorrelation matrix (Annex D) | SNR (dB) |
| 1 | 1 | NTN-TDLA100-200 Low | 8.9 |
| 2 | NTN-TDLA100-200 Low | 3.3 |

Table 8.3.2.2-2: Minimum requirements for PUCCH format 0, 30 kHz SCS and 10MHz channel bandwidth in FR1-NTN

|  |  |  |  |
| --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Propagation conditions andcorrelation matrix (Annex D) | SNR (dB) |
| 1 | 1 | NTN-TDLA100-200 Low | 11.1 |
| 2 | NTN-TDLA100-200 Low | 4.8 |

### 8.3.3 Performance requirements for PUCCH format 1

#### 8.3.3.1 NACK to ACK requirements

##### 8.3.3.1.1 General

The NACK to ACK detection probability is the probability that an ACK bit is falsely detected when an NACK bit was sent on the particular bit position, where the NACK to ACK detection probability is defined as follows:

 **,

where:

- denotes the total number of NACK bits transmitted

- denotes the number of NACK bits decoded as ACK bits at the receiver, i.e. the number of received ACK bits

- NACK bits in the definition do not contain the NACK bits which are mapped from DTX, i.e. NACK bits received when DTX is sent should not be considered.

Random codeword selection is assumed.

Table 8.3.3.1.1-1: Test Parameters

|  |  |
| --- | --- |
| Parameter | Test |
| Number of information bits | 2 |
| Number of PRBs | 1 |
| Number of symbols | 14 |
| First PRB prior to frequency hopping | 0 |
| Intra-slot frequency hopping | enabled |
| First PRB after frequency hopping | The largest PRB index – (nrofPRBs – 1) |
| Group and sequence hopping | neither |
| Hopping ID | 0 |
| Initial cyclic shift | 0 |
| First symbol | 0 |
| Index of orthogonal cover code (*timeDomainOCC*) | 0 |

The transient period as specified in TS 38.101-5 [11] clause 6.3.3 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the CC centre, i.e. intra-slot frequency hopping is enabled.

##### 8.3.3.1.2 Minimum requirements

The NACK to ACK probability shall not exceed 0.1% at the SNR given in table 8.3.3.1.2-1 and table 8.3.3.1.2-2.

Table 8.3.3.1.2-1: Minimum requirements for PUCCH format 1, 15 kHz SCS and 5MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic Prefix | Propagation conditions andcorrelation matrix (Annex D) | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 2.2 |
| 2 | Normal | NTN-TDLA100-200 Low | -4.1 |

Table 8.3.3.1.2-2: Minimum requirements for PUCCH format 1, 30 kHz SCS and 10MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic Prefix | Propagation conditions andcorrelation matrix (Annex D) | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 3.0 |
| 2 | Normal | NTN-TDLA100-200 Low | -3.5 |

#### 8.3.3.2 ACK missed detection requirements

##### 8.3.3.2.1 General

The ACK missed detection probability is the probability of not detecting an ACK when an ACK was sent. The test parameters in table 8.3.3.1.1-1 are configured.

The transient period as specified in TS 38.101-5 [11] clause 6.3.3 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the centre, i.e. intra-slot frequency hopping is enabled.

##### 8.3.3.2.2 Minimum requirements

The ACK missed detection probability shall not exceed 1% at the SNR given in table 8.3.3.2.2-1 and in table 8.3.3.2.2-2.

Table 8.3.3.2.2-1: Minimum requirements for PUCCH format 1, 15 kHz SCS and 5MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic Prefix | Propagation conditions andcorrelation matrix (Annex D) | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 1.5 |
| 2 | Normal | NTN-TDLA100-200 Low | -4.6 |

Table 8.3.3.2.2-2: Minimum requirements for PUCCH format 1, 30 kHz SCS and 10MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic Prefix | Propagation conditions andcorrelation matrix (Annex D) | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 3.1 |
| 2 | Normal | NTN-TDLA100-200 Low | -3.4 |

### 8.3.4 Performance requirements for PUCCH format 2

#### 8.3.4.1 ACK missed detection requirements

##### 8.3.4.1.1 General

The ACK missed detection probability is the probability of not detecting an ACK when an ACK was sent.

The ACK missed detection requirement only applies to the PUCCH format 2 with 4 UCI bits.

Table 8.3.4.1.1-1: Test Parameters

|  |  |
| --- | --- |
| Parameter | Value |
| Modulation order | QSPK |
| First PRB prior to frequency hopping | 0 |
| Intra-slot frequency hopping | N/A  |
| First PRB after frequency hopping | N/A |
| Number of PRBs | 4 |
| Number of symbols  | 1 |
| The number of UCI information bits | 4 |
| First symbol | 13 |
| DM-RS sequence generation | *NID*0=0 |

The transient period as specified in TS 38.101-5 [11] clause 6.3.3 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the CC center, i.e. intra-slot frequency hopping is enabled.

##### 8.3.4.1.2 Minimum requirements

The ACK missed detection probability shall not exceed 1% at the SNR given in table 8.3.4.1.2-1 and table 8.3.4.1.2-2 for 4 UCI bits.

Table 8.3.4.1.2-1: Minimum requirements for PUCCH format 2, 15 kHz SCS and 5MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic Prefix | Propagation conditions andcorrelation matrix (Annex D) | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 14.6 |
| 2 | Normal | NTN-TDLA100-200 Low | 4.7 |

Table 8.3.4.1.2-2: Minimum requirements for PUCCH format 2, 30 kHz SCS and 10MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic Prefix | Propagation conditions andcorrelation matrix (Annex D) | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 12.0 |
| 2 | Normal | NTN-TDLA100-200 Low | 4.4 |

#### 8.3.4.2 UCI BLER performance requirements

##### 8.3.4.2.1 General

The UCI block error probability (BLER) is defined as the probability of incorrectly decoding the UCI information when the UCI information is sent. The UCI information does not contain CSI part 2.

The transient period as specified in TS 38.101-5 [11] clause 6.3.3 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the CC centre, i.e. intra-slot frequency hopping is enabled.

The UCI block error probability performance requirement only applies to the PUCCH format 2 with 22 UCI bits.

Table 8.3.4.2.1-1: Test Parameters

|  |  |
| --- | --- |
| Parameter | Value  |
| Modulation order | QSPK |
| First PRB prior to frequency hopping | 0 |
| Intra-slot frequency hopping | enabled |
| Frist PRB after frequency hopping | The largest PRB index – (Number of PRBs – 1) |
| Number of PRBs | 9 |
| Number of symbols | 2 |
| The number of UCI information bits | 22 |
| First symbol | 12 |
| DM-RS sequence generation | *NID*0=0 |

##### 8.3.4.2.2 Minimum requirements

The UCI block error probability shall not exceed 1% at the SNR given in table 8.3.4.2.2-1 and table 8.3.4.2.2-2 for 22 UCI bits.

Table 8.3.4.2.2-1: Minimum requirements for PUCCH format 2, 15 kHz SCS and 5MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic Prefix | Propagation conditions andcorrelation matrix (Annex D) | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 6.3 |
| 2 | Normal | NTN-TDLA100-200 Low | 0.8 |

Table 8.3.4.2.2-2: Minimum requirements for PUCCH format 2, 30 kHz SCS and 10MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic Prefix | Propagation conditions andcorrelation matrix (Annex D) | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 6.4 |
| 2 | Normal | NTN-TDLA100-200 Low | 0.5 |

### 8.3.5 Performance requirements for PUCCH format 3

#### 8.3.5.1 General

The performance is measured by the required SNR at UCI block error probability not exceeding 1%.

The UCI block error probability is defined as the conditional probability of incorrectly decoding the UCI information when the UCI information is sent. The UCI information does not contain CSI part 2.

The transient period as specified in TS 38.101-5 [11] clause 6.3.3 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the centre, i.e. intra-slot frequency hopping is enabled.

Table 8.3.5.1-1: Test Parameters

|  |  |
| --- | --- |
| Parameter | Test  |
| Modulation order | QPSK |
| First PRB prior to frequency hopping | 0 |
| Intra-slot frequency hopping | enabled |
| First PRB after frequency hopping | The largest PRB index – (Number of PRBs – 1) |
| Group and sequence hopping | neither |
| Hopping ID | 0 |
| Number of PRBs | 1 |
| Number of symbols | 14 |
| The number of UCI information bits | 16 |
| First symbol | 0 |

#### 8.3.5.2 Minimum requirements

The UCI block error probability shall not exceed 1% at the SNR given in Table 8.3.5.2-1 and Table 8.3.5.2-2.

Table 8.3.5.2-1: Minimum requirements for PUCCH format 3, 15 kHz SCS and 5MHz channel bandwidth

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic Prefix | Propagation conditions andcorrelation matrix (Annex D) | Additional DM-RS configuration | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | No additional DM-RS | 6.6 |
| Additional DM-RS | 6.4 |
| 2 | Normal | NTN-TDLA100-200 Low | No additional DM-RS | 0.3 |
| Additional DM-RS | 0.0 |

Table 8.3.5.2-2: Minimum requirements for PUCCH format 3, 30 kHz SCS and 10MHz channel bandwidth

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic Prefix | Propagation conditions andcorrelation matrix (Annex D) | Additional DM-RS configuration | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | No additional DM-RS | 9.2 |
| Additional DM-RS | 8.6 |
| 2 | Normal | NTN-TDLA100-200 Low | No additional DM-RS | 1.6 |
| Additional DM-RS | 1.5 |

### 8.3.6 Performance requirements for PUCCH format 4

#### 8.3.6.1 General

The performance is measured by the required SNR at UCI block error probability not exceeding 1%.

The UCI block error probability is defined as the conditional probability of incorrectly decoding the UCI information when the UCI information is sent. The UCI information does not contain CSI part 2.

The transient period as specified in TS 38.101-5 [11] clause 6.3.3 is not taken into account for performance requirement testing, where the RB hopping is symmetric to the centre, i.e. intra-slot frequency hopping is enabled.

Table 8.3.6.1-1: Test parameters

|  |  |
| --- | --- |
| Parameter | Value |
| Modulation order | QPSK |
| First PRB prior to frequency hopping | 0 |
| Number of PRBs | 1 |
| Intra-slot frequency hopping | enabled |
| First PRB after frequency hopping | The largest PRB index – (Number of PRBs – 1) |
| Group and sequence hopping | neither |
| Hopping ID | 0 |
| Number of symbols | 14 |
| The number of UCI information bits | 22 |
| First symbol | 0 |
| Length of the orthogonal cover code | n2 |
| Index of the orthogonal cover code | n0 |

#### 8.3.6.2 Minimum requirement

The UCI block error probability shall not exceed 1% at the SNR given in Table 8.3.6.2-1 and Table 8.3.6.2-2.

Table 8.3.6.2-1: Minimum requirements for PUCCH format 4, 15 kHz SCS and 5MHz channel bandwidth

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic Prefix | Propagation conditions andcorrelation matrix (Annex D) | Additional DM-RS configuration | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | No additional DM-RS | 8.9 |
| Additional DM-RS | 8.6 |
| 2 | Normal | NTN-TDLA100-200 Low | No additional DM-RS | 2.5 |
| Additional DM-RS | 2.2 |

Table 8.3.6.2-2: Minimum requirements for PUCCH format 4, 30 kHz SCS and 10MHz channel bandwidth

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic Prefix | Propagation conditions andcorrelation matrix (Annex D) | Additional DM-RS configuration | SNR (dB) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | No additional DM-RS | 10.5 |
| Additional DM-RS | 10.5 |
| 2 | Normal | NTN-TDLA100-200 Low | No additional DM-RS | 3.5 |
| Additional DM-RS | 3.3 |

### 8.3.7 Performance requirements for multi-slot PUCCH

#### 8.3.7.1 General

#### 8.3.7.2 Performance requirements for multi-slot PUCCH format 1

##### 8.3.7.2.1 NACK to ACK requirements

###### 8.3.7.2.1.1 General

The NACK to ACK detection probability is the probability that an ACK bit is falsely detected when a NACK bit was sent on the particular bit position, where the NACK to ACK detection probability is defined as follows:

 **,

where:

- denotes the total number of NACK bits transmitted

- denotes the number of NACK bits decoded as ACK bits at the receiver, i.e., the number of received ACK bits

- NACK bits in the definition do not contain the NACK bits which are mapped from DTX, i.e., NACK bits received when DTX is sent should not be considered.

Random codeword selection is assumed.

Table 8.3.7.2.1.1-1: Test Parameters for multi-slot PUCCH format 1

|  |  |
| --- | --- |
| Parameter | Test |
| Number of information bits | 2 |
| Number of PRBs | 1 |
| Number of symbols | 14 |
| First PRB prior to frequency hopping | 0 |
| Intra-slot frequency hopping | disabled |
| Inter-slot frequency hopping  | enabled |
| First PRB after frequency hopping | The largest PRB index – (nrofPRBs – 1) |
| Group and sequence hopping | neither |
| Hopping ID | 0 |
| Initial cyclic shift | 0 |
| First symbol | 0 |
| Index of orthogonal cover code (*timeDomainOCC*) | 0 |
| Number of slots for PUCCH repetition | 2 |

###### 8.3.7.2.1.2 Minimum requirements

The multi-slot NACK to ACK probability shall not exceed 0.1% at the SNR given in table 8.3.7.2.1.2-1 and 8.3.7.2.1.2-2.

Table 8.3.7.2.1.2-1: Minimum requirements for multi-slot PUCCH format 1 with 15kHz SCS 5MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of TX | Number of RX | Cyclic Prefix | Propagation conditions and correlation matrix | SNR (dB) |
| antennas | antennas |  | (Annex D) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 0.6 |
| 2 | Normal | NTN-TDLA100-200 Low | -6.6 |

Table 8.3.7.2.1.2-2: Minimum requirements for multi-slot PUCCH format 1 with 30kHz SCS 10MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of TX | Number of RX | Cyclic Prefix | Propagation conditions and correlation matrix | SNR (dB) |
| antennas | antennas |  | (Annex D) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | 1.2 |
| 2 | Normal | NTN-TDLA100-200 Low | -5.6 |

##### 8.3.7.2.2 ACK missed detection requirements

###### 8.3.7.2.2.1 General

The ACK missed detection probability is the probability of not detecting an ACK when an ACK was sent. The test parameters in table 8.3.7.2.1.1-1 are configured.

###### 8.3.7.2.2.2 Minimum requirements

The multi-slot ACK missed detection probability shall not exceed 1% at the SNR given in table 8.3.7.2.2.2-1 and 8.3.7.2.2.2-2.

Table 8.3.7.2.2.2-1: Minimum requirements for multi-slot PUCCH format 1 with 15kHz SCS 5MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of TX | Number of RX | Cyclic Prefix | Propagation conditions and correlation matrix | SNR (dB) |
| antennas | antennas |  | (Annex D) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | -1.9 |
| 2 | Normal | NTN-TDLA100-200 Low | -8.0 |

Table 8.3.7.2.2.2-2: Minimum requirements for multi-slot PUCCH format 1 with 30kHz SCS 10MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of TX | Number of RX | Cyclic Prefix | Propagation conditions and correlation matrix | SNR (dB) |
| antennas | antennas |  | (Annex D) |
| 1 | 1 | Normal | NTN-TDLA100-200 Low | -1.2 |
| 2 | Normal | NTN-TDLA100-200 Low | -7.6 |

## 8.4 Performance requirements for PRACH

### 8.4.1 PRACH False alarm probability

#### 8.4.1.1 General

The false alarm requirement is valid for any number of receive antennas, for any channel bandwidth.

The false alarm probability is the conditional total probability of erroneous detection of the preamble (i.e. erroneous detection from any detector) when input is only noise.

#### 8.4.1.2 Minimum requirement

The false alarm probability shall be less than or equal to 0.1%.

### 8.4.2 PRACH detection requirements

#### 8.4.2.1 General

The probability of detection is the conditional probability of correct detection of the preamble when the signal is present. There are several error cases – detecting different preamble than the one that was sent, not detecting a preamble at all or correct preamble detection but with the wrong timing estimation. For AWGN, NTN-TDLA100, a timing estimation error occurs if the estimation error of the timing of the strongest path is larger than the time error tolerance given in Table 8.4.2.1-1.

Table 8.4.2.1-1: Time error tolerance for AWGN, NTN-TDLA100-200

|  |  |  |
| --- | --- | --- |
| PRACH | PRACH SCS | Time error tolerance |
| preamble | (kHz) | AWGN | NTN-TDLA100 |
| 0 | 1.25 | 1.04 us | 1.324 us |
| 2 | 1.25 | 1.04 us | 1.324 us |
| B4, C2 | 15 | 0.52 us | 0.804 us |
| 30 | 0.26 us | 0.544 us |

The test preambles are listed in table A.4 and the test parameter *msg1-FrequencyStart* is set to 0.

#### 8.4.2.2 Minimum requirements

The probability of detection shall be equal to or exceed 99% for the SNR levels listed in Tables 8.4.2.2-1 to 8.4.2.2-3.

Table 8.4.2.2-1: PRACH missed detection test requirements, 1.25 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (annex D) | Frequency offset | SNR (dB) |
| Burst format 0 | Burst format 2 |
| 1 | 1 | AWGN | 0 | -12.0 | -17.4 |
| NTN-TDLA100-200 Low | 200 Hz  | 0.7 | -9.7 |
| 2 | AWGN | 0 | -14.5 | -19.8 |
| NTN-TDLA100-200 Low | 200 Hz  | -6.8 | -14.9 |

Table 8.4.2.2-2: PRACH missed detection test requirements, 15 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (annex D) | Frequency offset | SNR (dB) |
| Burst format B4 | Burst format C2 |
| 1 | 1 | AWGN | 0 | -14.6 | -9.2 |
| NTN-TDLA100-200 Low | 200 Hz  | -2.7 | 1.9 |
| 2 | AWGN | 0 | -16.8 | -12.5 |
| NTN-TDLA100-200 Low | 200 Hz  | -4.8 | -4.8 |

Table 8.4.2.2-3: PRACH missed detection test requirements, 30 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of TX antennas | Number of demodulation branches | Propagation conditions and correlation matrix (annex D) | Frequency offset | SNR (dB) |
| Burst format B4 | Burst format C2 |
| 1 | 1 | AWGN | 0 | -14.4 | -9.2 |
| NTN-TDLA100-200 Low | 200 Hz  | -4.3 | 0.1 |
| 2 | AWGN | 0 | -16.5 | -11.9 |
| NTN-TDLA100-200 Low | 200 Hz  | -10.0 | -5.8 |

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

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

# 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 for FR1-NTN PUSCH performance requirements:

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

Table A.3-1: 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-A3-1 | G-FR1-NTN-A3-2 | G-FR1-NTN-A3-3 | G-FR1-NTN-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-NTN PUSCH performance requirements, transform precoding enabled, additional DM-RS position = pos1 and 1 transmission layer (QPSK, R=308/1024)

|  |  |  |
| --- | --- | --- |
| Reference channel | G-FR1-NTN-A3-5 | G-FR1-NTN-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]. |

# 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-NTN PUSCH performance requirements:

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

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

|  |  |  |
| --- | --- | --- |
| Reference channel | G-FR1-NTN-A3A-1 | G-FR1-NTN-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]. |

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

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

Annex D (Normative):
Propagation conditions

# D.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.

# 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-NTN

The delay profiles for FR1-NTN 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.2.2 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.2.2-1: Channel model parameters for FR1-NTN

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

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