**3GPP TSG-RAN WG4 Meeting #104-e R4-2214xxx**

**Electronic Meeting, 15 – 26 August, 2022**

|  |
| --- |
| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
|  |
|  | **38.141-1** | **CR** | **XXX** | **rev** | **-** | **Current version:** | **16.12.0** |  |
|  |
| *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:***  | Big CR for TS 38.141-1 Maintenance Demod part (Rel-16, CAT F) |
|  |  |
| ***Source to WG:*** | MCC, Huawei, HiSilicon |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_newRAT-Perf |  | ***Date:*** | 2022-08-30 |
|  |  |  |  |  |
| ***Category:*** | **F** |  | ***Release:*** | Rel-16 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories 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-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
|  |  |
| ***Reason for change:*** | This big CR merges the following endorsed draft CRs. The reason for change in each endorsed draft CR is copied below:* R4-2213919

SNR description in Clause 8 General section has mis-leading expression which could leads to higher SNR than defined requirement. For N (noise energy) to calculate SNR, it needs to take noise energy where wanted signal (S) exists. However, current text can be interpret as total noise energy of entire one slot which, in some cases, is longer period than where wanted signal exists especially cases like PRACH as example. This interpretation makes noise energy density lower than defined requirement.* R4-2214831

Applicability rule for PRACH requirement tests for high speed train PRACH formats (D.110) is not defined.At RAN4#103-e at was agreed that corrections in SRS configuration in UL timing adjustment requirements parameters are needed [R4-2210655]:Issue 3-1-2: SRS Transmission periodicityAgreementsThe intention of the prior agreements was to have SRS sent once per radio frame, in the last symbol of the first special slot of the radio frame.The slot-based value of TSRS in NOTE1 of the “Test parameters for testing UL timing adjustment” table shall be scaled accordingly with the SCS, i.e., 15 kHz: TSRS =10, 30 kHz: TSRS =20, 60 kHz: TSRS =40, 120 kHz: TSRS =80.It is recommended to also add this correction in Rel-16 maintenance.* R4-2213825

There is no intra slot frequency hopping configured in PF2 test with ACK miss detection requirements, but the test parameters of intra slot hopping are still existing.* R4-2214857

Correct reference in FRC |
|  |  |
| ***Summary of change:*** | The summary of change in each each endorsed draft CR is copied below:* R4-2213919: Description of N is updated to clarify noise energy to calculate SNR is where wanted signal energy exists in time domain as well as frequency domain.
* R4-2214831:
	+ Applicability rule for PRACH requirement test for is speed train is added.
	+ Updated the SRS TSRS in test parameters for testing UL timing adjustment
* R4-2213825: Delate all the test parameters and description about intra slot frequency hopping for PF2 test with ACK miss detection requirements.
* R4-2214857: For reference correction, update clause A.1, A.2, A.4, A.5.
 |
|  |  |
| ***Consequences if not approved:*** | The consequences if not approved for each endorsed draft CR are coppied below:* R4-2213919: Without this clarification, it’s possible to misinterpret requirement then resulted noise density lower than requirement value (higher SNR)
* R4-2214831: Wrong UL timing adjustment requirements paramters; Unclarities in the applicability rules for high speed train.
* R4-2213825: The test parameters of PF2 are confusing.
* R4-2214857: There will be still inconsistance between RAN4 agreement and specification
 |
|  |  |
| ***Clauses affected:*** | 8.1.1, 8.1.2.3, 8.2.5, 8.3.3, A.1, A.2, A.4, A.5 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **x** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** | **x** |  |  Test specifications | TS 38.141-2 |
| ***(show related CRs)*** |  | **x** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

*<START OF THE CHANGE 1 from R4-2213919>*

### 8.1.1 Scope and definitions

Conducted performance requirements specify the ability of the *BS type 1-C* or *BS type 1-H* to correctly demodulate signals in various conditions and configurations. Conducted performance requirements are specified at the *antenna connector(s)* (for *BS type 1-C*) and at the *TAB connector(s)* (for *BS type 1-H*).

Conducted performance requirements for the BS are specified for the fixed reference channels and the propagation conditions defined in TS 38.104 [2] annex A and annex H, respectively. The requirements only apply to those FRCs that are supported by the BS.

Unless stated otherwise, performance requirements apply for a single carrier only. Performance requirements for a BS supporting CA 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 *antenna connectors* (for *BS type 1-C*) or *TAB connectors* (for *BS type 1-H*) in the *operating* *band* turned ON.

NOTE: In normal operating conditions *antenna connectors* (for *BS type 1-C*) or *TAB connectors* (for *BS 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.

In tests performed with signal generators a synchronization signal may be provided between the BS and the signal generator, to enable correct timing of the wanted signal.

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 energy in a slot on a single *antenna connector* (for *BS type 1-C*) or on a single *TAB connector* (for *BS type 1-H*).

N is the noise energy in a bandwidth corresponding to the transmission bandwidth over the same duration where signal energy exists.

*<END OF THE CHANGE 1 from R4-2213919>*

*<START OF THE CHANGE 2 from R4-2214831>*

Start of Change#1

#### 8.1.2.3 Applicability of PRACH performance requirements

##### 8.1.2.3.1 Applicability of requirements for different formats

Unless otherwise stated, PRACH requirement tests shall apply only for each PRACH format declared to be supported (see D.103 in table 4.6-1).

Unless otherwise stated, PRACH requirement tests for high speed train shall apply only for each PRACH formats declared to be supported (see D.110 in table 4.6-1).

##### 8.1.2.3.2 Applicability of requirements for different subcarrier spacings

Unless otherwise stated, for each PRACH format with short sequence declared to be supported, for each FR, the tests shall apply only for the smallest supported subcarrier spacing in the FR (see D.103 in table 4.6-1).

##### 8.1.2.3.3 Applicability of requirements for different channel bandwidths

Unless otherwise stated, for the subcarrier spacing to be tested, the test requirements shall apply only for anyone channel bandwidth declared to be supported (see D.14 in table 4.6-1).

##### 8.1.2.3.4 Applicability of requirements for different restricted set types of long PRACH format 0

Unless otherwise stated, PRACH requirement tests for long PRACH preamble format 0 with restricted set Type A and B shall apply only for the restricted set type declared to be supported (see D.110 in table 4.6-1). If both restricted set type A and type B are declared to be supported, the tests shall be done for type B; the same chosen mapping type shall then be used for all tests.

End of Change#1

Start of Change#2

### 8.2.5 Performance requirements for UL timing adjustment

#### 8.2.5.1 Definition and applicability

The performance requirement of UL timing adjustment is determined by a minimum required throughput measured for the moving UE at given SNR. The performance requirements assume HARQ retransmissions. The performance requirements for UL timing adjustment scenario Y and scenario Z defined in Annex G.4 are optional.

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.4-2B are applied for both UEs. The received power for both UEs is the same. The resource blocks allocated for both UEs are consecutive. In Scenario Y and Scenario Z, Doppler shift is not taken into account.

Which specific test(s) are applicable to BS is based on the test applicability rules defined in clause 8.1.2.1.

#### 8.2.5.2 Minimum Requirement

The minimum requirement is in TS 38.104 [2] clause 8.2.5.

#### 8.2.5.3 Test Purpose

The test shall verify the receiver's ability to achieve throughput measured for the moving UE at given SNR under moving propagation conditions.

#### 8.2.5.4 Method of test

##### 8.2.5.4.1 Initial Conditions

Test environment: Normal, see annex B.2.

RF channels to be tested: M; see clause 4.9.1.

RF channels to be tested for carrier aggregation: MBW Channel CA; see clause 4.9.1.

##### 8.2.5.4.2 Procedure

1) Connect the BS tester generating the wanted signal, multipath fading simulators and AWGN generators to all BS antenna connectors for diversity reception via a combining network as shown in annex D.5 and D.6 for BS type 1-C and type 1-H respectively.

2) Adjust the AWGN generator, according to combination of SCS and channel bandwidth defined in table 8.2.5.4.2-1.

Table 8.2.5.4.2-1: AWGN power level at the BS input

|  |  |  |
| --- | --- | --- |
| Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| 15 | 5 | -86.5 dBm / 4.5MHz |
|  | 10 | -83.3 dBm / 9.36MHz |
| 30 | 10 | -83.6 dBm / 8.64MHz |
|  | 40 | -77.2 dBm / 38.16MHz |
| NOTE: The AWGN power level contains an AWGN offset of 16dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 16dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level. |

3) The characteristics of the wanted signals (transmitted by moving UE) shall be configured according to the corresponding UL reference measurement channel defined in annex A and the test parameters in Table 8.2.5.4.2-2.

Table 8.2.5.4.2-2 Test parameters for testing UL timing adjustment

|  |  |
| --- | --- |
| Parameter | Value |
| Transform precoding | Disabled |
| Uplink-downlink allocation for TDD (Note1) | 15 kHz SCS:3D1S1U, S=10D:2G:2U30 kHz SCS:7D1S2U, S=6D:4G:4U |
| HARQ | Maximum number of HARQ transmissions | 4 |
|  | RV sequence | 0, 2, 3, 1 |
| DM-RS | DM-RS configuration type | 1 |
|  | DM-RS duration | single-symbol DM-RS |
|  | Additional DM-RS position | Pos2 |
|  | Number of DM-RS CDM group(s) without data | 2 |
|  | Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB |
|  | DM-RS port(s) | {0} |
|  | 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 |
|  | Allocation length | 14 |
| Frequency domain resource assignment | RB assignment | 5 MHz CBW/15kHz SCS: 12 RB for each UE10MHz CBW/15kHz SCS: 25 RB for each UE10MHz CBW/30kHz SCS: 12 RB for each UE 40MHz CBW/30kHz SCS: 50 RB for each UE |
|  | Starting PRB index | Moving UE: 0 Stationary UE: 12 for 5MHz CBW/15kHz SCS,25 for 10 MHz CBW/15kHz SCS, 12 for 10MHz CBW/30kHz SCS and 50 for 40 MHz CBW/30kHz SCS |
|  | Frequency hopping | Disabled |
| SRS resource allocation | Slots in which sounding RS is transmitted (Note2) | For FDD: slot #1 in radio framesFor TDD: last symbol in slot #3 in radio frames for 15kHzlast symbol in slot #7 in radio frames for 30kHz |
|  | SRS resource allocation | 15 kHz SCS:CSRS =5, BSRS =0, for 20 RBCSRS = 11, BSRS =0, for 40 RB30 kHz SCS:CSRS =5, BSRS =0, for 20 RBCSRS = 21, BSRS =0, for 80 RB |
| NOTE 1: The same requirements are applicable to FDD and TDD with different UL-DL patterns. NOTE 2: The transmission of SRS is optional. And the transmission comb and SRS periodicity are configured as KTC = 2, and TSRS = 10 for 15 kHz SCS, TSRS = 20 for 30 kHz SCS respectively. |

4) The multipath fading emulators shall be configured according to the corresponding channel model defined in annex G.4.

5) Adjust the equipment so that required SNR specified in Table 8.2.5.5-1 to Table 8.2.5.5-2 is achieved at the BS input for high speed train.

 Adjust the equipment so that required SNR specified in Table 8.2.5.6-1 to Table 8.2.5.6-2 is achieved at the BS input for normal mode.

6) For each of the reference channels in Table 8.2.5.5-1 to Table 8.2.5.5-2 applicable for the base station, measure the throughput for high speed train.

 For each of the reference channels in Table 8.2.5.6-1 to Table 8.2.5.6-2 applicable for the base station, measure the throughput for normal mode.

#### End of Change#2

#### Start of Change#3

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Reference channel | G-FR1-A4-29 | G-FR1-A4-29A | G-FR1-A4-30 | G-FR1-A4-30A |
| Subcarrier spacing (kHz)) | 15 | 15 | 30 | 30 |
| Allocated resource blocks | 52 | 25 | 106 | 24 |
| Data bearing CP-OFDM Symbols per slot (Note 1) | 11 | 11 | 11 | 11 |
| Modulation | 16QAM | 16QAM | 16QAM | 16QAM |
| Code rate (Note 2) | 658/1024 | 658/1024 | 658/1024 | 658/1024 |
| Payload size (bits) | 17424 | 8456 | 35856 | 8064 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 | - |
| Number of code blocks - C | 3 | 2 | 5 | 1 |
| Code block size including CRC (bits) (Note 2) | 5840 | 4264 | 7200 | 8088 |
| Total number of bits per slot | 27456 | 13200 | 55968 | 12672 |
| Total resource elements per slot | 6846 | 3300 | 13992 | 3168 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos2*, and *l0*= 2 or 3 for PUSCH mapping type A, as per table 6.4.1.1.3-3 of TS 38.211 [17].NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [16]. |

End of Change#3

*<END OF THE CHANGE 2 from R4-2214831>*

*<START OF THE CHANGE 3 from R4-2213825>*

### 8.3.3 Performance requirements for PUCCH format 2

#### 8.3.3.1 ACK missed detection

##### 8.3.3.1.1 Definition and applicability

The performance requirement of PUCCH format 2 for ACK missed detection is determined by the two parameters: probability of false detection of the ACK and the probability of detection of ACK. The performance is measured by the required SNR at probability of detection equal to 0.99. The probability of false detection of the ACK shall be 0.01 or less.

The probability of false detection of the ACK is defined as a probability of erroneous detection of the ACK when input is only noise.

The probability of detection of ACK is defined as probability of detection of the ACK when the signal is present.

Which specific test(s) are applicable to BS is based on the test applicability rules defined in clause 8.1.2.

##### 8.3.3.1.2 Minimum requirements

The minimum requirements are in TS 38.104 [2] clause 8.3.4.

##### 8.3.3.1.3 Test purpose

The test shall verify the receiver's ability to detect ACK bits under multipath fading propagation conditions for a given SNR.

##### 8.3.3.1.4 Method of test

###### 8.3.3.1.4.1 Initial Condition

Test environment: Normal, see annex B.2.

RF channels to be tested for single carrier; M; see clause 4.9.1

###### 8.3.3.1.4.2 Procedure

1) Connect the BS tester generating the wanted signal, multipath fading simulators and AWGN generators to all BS antenna connectors for diversity reception via a combining network as shown in annex D.5 and D.6 for BS type 1-C and *type 1-H* respectively.

2) Adjust the AWGN generator, according to the channel bandwidth defined in table 8.3.3.1.4.2-1.

Table 8.3.3.1.4.2-1: AWGN power level at the BS input

|  |  |  |
| --- | --- | --- |
| Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| 15  | 5 | -83.5 dBm / 4.5 MHz |
|  | 10 | -80.3 dBm / 9.36 MHz |
|  | 20 | -77.2 dBm / 19.08MHz  |
| 30  | 10 | -80.6 dBm / 8.64 MHz |
|  | 20 | -77.4 dBm / 18.36 MHz |
|  | 40 | -74.2 dBm / 38.16 MHz |
|  | 100 | -70.1 dBm / 98.28 MHz |
| NOTE: The AWGN power level contains an AWGN offset of 16dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 16dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level. |

3) The characteristics of the wanted signal shall be configured according to TS 38.211 [17], and the specific test parameters are configured as blow:

Table 8.3.3.1.4.2-2: Test parameters

|  |  |
| --- | --- |
| Parameter | Values |
| Modulation order | QPSK |
| Starting RB location  | 0 |
| Intra-slot 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 |

4) The multipath fading emulators shall be configured according to the corresponding channel model defined in annex G.

5) Adjust the equipment so that the SNR specified in table 8.3.3.1.5-1 and table 8.3.3.1.5-2 is achieved at the BS input during the UCI transmissions.

6) The signal generator sends a test pattern with the pattern outlined in figure 8.3.3.1.4.2-1. The following statistics are kept: the number of ACKs detected in the idle periods and the number of missed ACKs.



Figure 8.3.3.1.4.2-1: Test signal pattern for PUCCH format 2 demodulation tests

##### 8.3.3.1.5 Test requirements

The fraction of falsely detected ACKs shall be less than 1% and the fraction of correctly detected ACKs shall be larger than 99% for the SNR listed in table 8.3.3.1.5-1 and table 8.3.3.1.5-2.

Table 8.3.3.1.5-1: Required SNR for PUCCH format 2 with 15 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of TX | Number of RX | Cyclic Prefix | Propagation | Channel bandwidth / SNR (dB) |
| antennas | antennas |  | conditions and correlation matrix (annex G) | 5 MHz | 10 MHz | 20 MHz |
|  | 2 | Normal | TDLC300-100 Low | 6.4 | 6.2 | 6.5 |
| 1 | 4 | Normal | TDLC300-100 Low | 1.0 | 1.1 | 0.9 |
|  | 8 | Normal | TDLC300-100 Low | -2.9 | -2.9 | -2.9 |

Table 8.3.3.1.5-2: Required SNR for PUCCH format 2 with 30 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of TX | Number of RX | Cyclic Prefix | Propagation | Channel bandwidth / SNR (dB) |
| antennas | antennas |  | conditions and correlation matrix (annex G) | 10MHz | 20MHz | 40MHz | 100MHz |
|  | 2 | Normal | TDLC300-100 Low | 6.1 | 6.2 | 6.1 | 6.3 |
| 1 | 4 | Normal | TDLC300-100 Low | 0.9 | 0.8 | 0.9 | 1.0 |
|  | 8 | Normal | TDLC300-100 Low | -3.0 | -3.0 | -2.9 | -2.7 |

*<END OF THE CHANGE 3 from R4-2213825>*

*<START OF THE CHANGE 4 from R4-2214857>*

Start of Change#1

A.1 Fixed Reference Channels for reference sensitivity level, ACS, in-band blocking, out-of-band blocking, receiver intermodulation and in-channel selectivity (QPSK, R=1/3)

The parameters for the reference measurement channels are specified in table A.1-1 for FR1 reference sensitivity level, ACS, in-band blocking, out-of-band blocking, receiver intermodulation and in-channel selectivity. The parameters for the band n46 and n96 reference measurement channels are specified in table A.1-1a for reference sensitivity level, ACS, in-band blocking, out-of-band blocking, receiver intermodulation, in-channel selectivity.

**Table A.1-1: FRC parameters for FR1 reference sensitivity level, ACS, in-band blocking, out-of-band blocking, receiver intermodulation and in-channel selectivity**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Reference channel** | **G-FR1-A1-1** | **G-FR1-A1-2** | **G-FR1-A1-3** | **G-FR1-A1-4** | **G-FR1-A1-5** | **G-FR1-A1-6** | **G-FR1-A1-7** | **G-FR1-A1-8** | **G-FR1-A1-9** | **G-FR1-A1-10** | **G-FR1-A1-11** |
| Subcarrier spacing (kHz) | 15  | 30 | 60 | 15 | 30 | 60 | 15 | 30 | 60 | 15 | 15 |
| Allocated resource blocks | 25 | 11 | 11 | 106 | 51 | 24 | 15 | 6 | 6 | 24 | 105 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Modulation | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK |
| Code rate (Note 2) | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 |
| Payload size (bits) | 2152 | 984 | 984 | 9224 | 4352 | 2088 | 1320 | 528 | 528 | [2088] | [8968] |
| Transport block CRC (bits) | 16 | 16 | 16 | 24 | 24 | 16 | 16 | 16 | 16 | 16 | 24 |
| Code block CRC size (bits) | - | - | - | 24 | - | - | - | - | - | - | 24 |
| Number of code blocks - C | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
| Code block size including CRC (bits) (Note 3) | 2168 | 1000 | 1000 | 4648 | 4376 | 2104 | 1336 | 544 | 544 | [2104] | [4520] |
| Total number of bits per slot | 7200 | 3168 | 3168 | 30528 | 14688 | 6912 | 4320 | 1728 | 1728 | [6912] | [30240] |
| Total symbols per slot | 3600 | 1584 | 1584 | 15264 | 7344 | 3456 | 2160 | 864 | 864 | [3456] | [15120] |
| NOTE 1: DM-RS configuration type = 1 with DM-RS duration = single-symbol DM-RS, additional DM-RS position = pos1 with *l0* = 2, *l* = 11 as per table 6.4.1.1.3-3 of TS 38.211 [17].NOTE 2: MCS index 4 and target coding rate = 308/1024 are adopted to calculate payload size.NOTE 3: Code block size including CRC (bits) equals to *K'* in TS 38.212 [16], clause 5.2.2. |

**Table A.1-1a: FRC parameters for band n46 and n96 reference sensitivity level, ACS, in-band blocking, out-of-band blocking, receiver intermodulation, in-channel selectivity**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Reference channel** | **G-FR1-A1-12** | **G-FR1-A1-13** | **G-FR1-A1-14** | **G-FR1-A1-15** | **G-FR1-A1-16** | **G-FR1-A1-17** | **G-FR1-A1-18** | **G-FR1-A1-19** |
| Channel bandwidth (MHz) | 10 | 10 | 20 | 20 | 40 | 40 | 60 | 80 |
| Subcarrier spacing (kHz) | 15 | 30 | 15 | 30 | 15 | 30 | 30 | 30 |
| Allocated resource blocks | 5 | 4 | 10 | 10 | 21 | 21 | 32 | 43 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Modulation | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK |
| Code rate (Note 2) | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 |
| Payload size (bits) | 432 | 352 | 888 | 888 | 1864 | 1864 | 2792 | 3752 |
| Transport block CRC (bits) | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 |
| Code block CRC size (bits) | - | - | - | - | - | - | - | - |
| Number of code blocks - C | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Code block size including CRC (bits) (Note 3) | 448 | 368 | 904 | 904 | 1880 | 1880 | 2808 | 3768 |
| Total number of bits per slot | 1440 | 1152 | 2880 | 2880 | 6048 | 6048 | 9216 | 12384 |
| Total symbols per slot | 720 | 576 | 1440 | 1440 | 3024 | 3024 | 4608 | 6192 |
| NOTE 1: *UL-DMRS-config-type* = 1 with *UL-DMRS-max-len* = 1, *UL-DMRS-add-pos* = 1 with = 2, = 11 as per table 6.4.1.1.3-3 of TS 38.211 [17].NOTE 2: MCS index 4 and target coding rate = 308/1024 are adopted to calculate payload size for receiver sensitivity and in-channel selectivityNOTE 3: Code block size including CRC (bits) equals to  in sub-clause 5.2.2 of TS 38.212 [16].NOTE 4: For reference channel A1-12, the allocated RB’s are uniformly spaced over the channel bandwidth at RB index N, N+10, N+20, N+30, N+40 where N={0,1,2,3,4,…,9}. NOTE 5: For reference channel A1-13, the allocated RB’s are uniformly spaced over the channel bandwidth at RB index N, N+5, N+10, N+15 where N={0,1,2,3,4}.NOTE 7: For reference channel A1-14, the allocated RB’s are uniformly spaced over the channel bandwidth at RB index N, N+10,N+20,..N+90 where N={0,1,2,3,...,9}.NOTE 8: For reference channel A1-15, the allocated RB’s are uniformly spaced over the channel bandwidth at RB index N, N+5,N+10,..,N+45 where N={0,1,2,3,4}.NOTE 10: For reference channel A1-16, the allocated RB’s are uniformly spaced over the channel bandwidth at RB index N, N+10,N+20,...,N+200 where N={0,1,2,3,4,...,9}.NOTE 11: For reference channel A1-17, the allocated RB’s are uniformly spaced over the channel bandwidth at RB index N, N+5, N+10, ..., N+100 where N={0,1,2,3,4}.NOTE 12: For reference channel A1-18, the allocated RB’s are uniformly spaced over the channel bandwidth at RB index N, N+5,N+10,...,N+155 where N={0,1,2,3,4}.NOTE 13: For reference channel A1-19, the allocated RB’s are uniformly spaced over the channel bandwidth at RB index N, N+5,N+10,...,N+210 where N={0,1,2,3,4}. |

End of Change#1

Start of Change#2

A.2 Fixed Reference Channels for dynamic range (16QAM, R=2/3)

The parameters for the reference measurement channels are specified in table A.2-1 for FR1 dynamic range. The parameters for the band n46 and n96 reference measurement channels are specified in table A.2-1a and A.2-1b for band n46 and n96 dynamic range.

**Table A.2-1: FRC parameters for FR1 dynamic range**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Reference channel** | **G-FR1-A2-1** | **G-FR1-A2-2** | **G-FR1-A2-3** | **G-FR1-A2-4** | **G-FR1-A2-5** | **G-FR1-A2-6** |
| Subcarrier spacing (kHz) | 15 | 30 | 60 | 15 | 30 | 60 |
| Allocated resource blocks | 25 | 11 | 11 | 106 | 51 | 24 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 | 12 | 12 | 12 | 12 |
| Modulation | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Code rate (Note 2) | 2/3 | 2/3 | 2/3 | 2/3 | 2/3 | 2/3 |
| Payload size (bits) | 9224 | 4032 | 4032 | 38936 | 18960 | 8968 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | - | - | 24 | 24 | 24 |
| Number of code blocks - C | 2 | 1 | 1 | 5 | 3 | 2 |
| Code block size including CRC (bits)(Note 3) | 4648 | 4056 | 4056 | 7816 | 6352 | 4520 |
| Total number of bits per slot | 14400 | 6336 | 6336 | 61056 | 29376 | 13824 |
| Total symbols per slot | 3600 | 1584 | 1584 | 15264 | 7344 | 3456 |
| NOTE 1: DM-RS configuration type = 1 with DM-RS duration = single-symbol DM-RS, additional DM-RS position = pos1 with *l0* = 2, *l* = 11 as per table 6.4.1.1.3-3 of TS 38.211 [17].NOTE 2: MCS index 16 and target coding rate = 658/1024 are adopted to calculate payload size.NOTE 3: Code block size including CRC (bits) equals to *K'* in TS 38.212 [16], clause 5.2.2. |

**Table A.2-1a: FRC parameters for dynamic range for band n46 and n96**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Reference channel** | **G-FR1-A2-7** | **G-FR1-A2-8** | **G-FR1-A2-9** | **G-FR1-A2-10** | **G-FR1-A2-11** | **G-FR1-A2-12** | **G-FR1-A2-13** | **G-FR1-A2-14** |
| Channel bandwidth (MHz) | 10 | 10 | 20 | 20 | 40 | 40 | 60 | 80 |
| Subcarrier spacing (kHz) | 15 | 30 | 15 | 30 | 15 | 30 | 30 | 30 |
| Allocated resource blocks | 5 | 4 | 10 | 10 | 21 | 21 | 32 | 43 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Modulation | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Code rate (Note 2) | 2/3 | 2/3 | 2/3 | 2/3 | 2/3 | 2/3 | 2/3 | 2/3 |
| Payload size (bits) | 1864 | 1480 | 3752 | 3752 | 7808 | 7808 | 11784 | 15880 |
| Transport block CRC (bits) | 16 | 16 | 16 | 16 | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | - | - | - | - | - | - | 24 | 24 |
| Number of code blocks - C | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| Code block size including CRC (bits) (Note 3) | 1880 | 1496 | 3768 | 3768 | 7832 | 7832 | 5928 | 7976 |
| Total number of bits per slot | 2880 | 2304 | 5760 | 5760 | 12096 | 12096 | 18432 | 24768 |
| Total symbols per slot | 720 | 576 | 1440 | 1440 | 3024 | 3024 | 4608 | 6192 |
| NOTE 1: DM-RS configuration type = 1 with DM-RS duration = single-symbol DM-RS, additional DM-RS position = pos1 with l0= 2, l = 11 as per table 6.4.1.1.3-3 of TS 38.211 [17].NOTE 2: MCS index 16 and target coding rate = 658/1024 are adopted to calculate payload size.NOTE 3: Code block size including CRC (bits) equals to K' in sub-clause 5.2.2 of TS 38.212 [16].NOTE 4: For reference channel A2-7, the allocated RB’s are uniformly spaced over the channel bandwidth at RB index N, N+10, N+20, N+30, N+40 where N={0,1,2,3,4,5,6,7,8,9}. NOTE 5: For reference channel A2-8, the allocated RB’s are uniformly spaced over the channel bandwidth at RB index N, N+5, N+10, N+15 where N={0,1,2,3,4}.NOTE 6: For reference channel A2-9, the allocated RB’s are uniformly spaced over the channel bandwidth at RB index N, N+10,N+20,..N+90 where N={0,1,2,3,...,9}.NOTE 7: For reference channel A2-10, the allocated RB’s are uniformly spaced over the channel bandwidth at RB index N, N+5,N+10,.., N+45 where N={0,1,2,3,4}.NOTE 8: For reference channel A2-11, the allocated RB’s are uniformly spaced over the channel bandwidth at RB index N, N+10,N+20,...,N+200 where N={0,1,2,3,4,...,9}.NOTE 9: For reference channel A2-12, the allocated RB’s are uniformly spaced over the channel bandwidth at RB index N, N+5, N+10, ..., N+100 where N={0,1,2,3,4}.NOTE 10: For reference channel A2-13, the allocated RB’s are uniformly spaced over the channel bandwidth at RB index N, N+5,N+10,..., N+155 where N={0,1,2,3,4}.NOTE 11: For reference channel A2-14, the allocated RB’s are uniformly spaced over the channel bandwidth at RB index N, N+5,N+10,..., N+210 where N={0,1,2,3,4}. |

End of Change#2

Start of Change#3

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

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

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

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

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

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

**Table A.4-1: Void**

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

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Reference channel** | **G-FR1-A4-8** | **G-FR1-A4-9** | **G-FR1-A4-10** | **G-FR1-A4-11** | **G-FR1-A4-12** | **G-FR1-A4-13** | **G-FR1-A4-14** |
| Subcarrier spacing (kHz) | 15 | 15 | 15 | 30 | 30 | 30 | 30 |
| Allocated resource blocks | 25 | 52 | 106 | 24 | 51 | 106 | 273 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Modulation | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Code rate (Note 2) | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 |
| Payload size (bits) | 9224 | 19464 | 38936 | 8968 | 18960 | 38936 | 100392 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of code blocks - C | 2 | 3 | 5 | 2 | 3 | 5 | 12 |
| Code block size including CRC (bits) (Note 2) | 4648 | 6520 | 7816 | 4520 | 6352 | 7816 | 8392 |
| Total number of bits per slot | 14400 | 29952 | 61056 | 13824 | 29376 | 61056 | 157248 |
| Total symbols per slot | 3600 | 7488 | 15264 | 3456 | 7344 | 15264 | 39312 |
| NOTE 1: DM-RS configuration type = 1 with DM-RS duration = single-symbol DM-RS and the number of DM-RS CDM groups without data is 2, additional DM-RS position = pos1, *l0* = 2 and *l* = 11 for PUSCH mapping type A, *l0* = 0 and *l* = 10 for PUSCH mapping type B as per table 6.4.1.1.3-3 of TS 38.211 [17].NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [16]. |

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Reference channel** | **G-FR1-A4-29** | **G-FR1-A4-29A** | **G-FR1-A4-30** | **G-FR1-A4-30A** |
| Subcarrier spacing (kHz)) | 15 | 15 | 30 | 30 |
| Allocated resource blocks | 52 | 25 | 106 | 24 |
| Data bearing CP-OFDM Symbols per slot (Note 1) | 11 | 11 | 11 | 11 |
| Modulation | 16QAM | 16QAM | 16QAM | 16QAM |
| Code rate (Note 2) | 658/1024 | 658/1024 | 658/1024 | 658/1024 |
| Payload size (bits) | 17424 | 8456 | 35856 | 8064 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 | - |
| Number of code blocks - C | 3 | 2 | 5 | 1 |
| Code block size including CRC (bits) (Note 2) | 5840 | 4264 | 7200 | 8080 |
| Total number of bits per slot | 27456 | 13200 | 55968 | 12672 |
| Total resource elements per slot | 6846 | 3300 | 13992 | 3168 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos2*, and *l0*= 2 or 3 for PUSCH mapping type A, as per table 6.4.1.1.3-3 of TS 38.211 [17].NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [16]. |

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Reference channel** | **G-FR1-A4-31A** | **G-FR1-A4-31** | **G-FR1-A4-32A** | **G-FR1-A4-32** |
| Subcarrier spacing [kHz] | 15 | 15 | 30 | 30 |
| Allocated resource blocks | 12 | 25 | 12 | 50 |
| CP-OFDM Symbols per slot (Note 1) | 11 | 11 | 11 | 11 |
| Modulation | 16QAM | 16QAM | 16QAM | 16QAM |
| Code rate (Note 2) | 658/1024 | 658/1024 | 658/1024 | 658/1024 |
| Payload size (bits) | 4032 | 8456 | 4032 | 16896 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | - | 24 | - | 24 |
| Number of code blocks - C | 1 | 2 | 1 | 3 |
| Code block size including CRC (bits) (Note 2) | 4056 | 4264 | 4056 | 5664 |
| Total number of bits per slot | 6336 | 13200 | 6336 | 26400 |
| Total symbols per slot | 1584 | 3300 | 1584 | 6600 |
| NOTE 1: *DM-RS configuration type*  = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos2*, *l0* = 2 for PUSCH mapping type A, *l0* = 2 for PUSCH mapping type B, as per table 6.4.1.1.3-3 of TS 38.211 [17].NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [16]. |

**Table A.4-3: Void**

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

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Reference channel** | **G-FR1-A4-22** | **G-FR1-A4-23** | **G-FR1-A4-24** | **G-FR1-A4-25** | **G-FR1-A4-26** | **G-FR1-A4-27** | **G-FR1-A4-28** |
| Subcarrier spacing (kHz) | 15 | 15 | 15 | 30 | 30 | 30 | 30 |
| Allocated resource blocks | 25 | 52 | 106 | 24 | 51 | 106 | 273 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Modulation | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Code rate (Note 2) | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 |
| Payload size (bits) | 18432 | 38936 | 77896 | 17928 | 37896 | 77896 | 200808 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of code blocks - C | 3 | 5 | 10 | 3 | 5 | 10 | 24 |
| Code block size including CRC (bits) (Note 2) | 6176 | 7816 | 7816 | 6008 | 7608 | 7816 | 8392 |
| Total number of bits per slot | 28800 | 59904 | 122112 | 27648 | 58752 | 122112 | 314496 |
| Total symbols per slot | 7200 | 14976 | 30528 | 6912 | 14688 | 30528 | 78624 |
| NOTE 1: DM-RS configuration type= 1 with DM-RS duration = single-symbol DM-RS and the number of DM-RS CDM groups without data is 2, additional DM-RS position = pos1, *l0* = 2 and *l* = 11 for PUSCH mapping type A, *l0* = 0 and *l* = 10 for PUSCH mapping type B as per table 6.4.1.1.3-3 of TS 38.211 [17].NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [16]. |

End of Change#3

Start of Change#4

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

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

**Table A.5-1: Void**

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

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Reference channel** | **G-FR1-A5-8** | **G-FR1-A5-9** | **G-FR1-A5-10** | **G-FR1-A5-11** | **G-FR1-A5-12** | **G-FR1-A5-13** | **G-FR1-A5-14** |
| Subcarrier spacing (kHz) | 15 | 15 | 15 | 30 | 30 | 30 | 30 |
| Allocated resource blocks | 25 | 52 | 106 | 24 | 51 | 106 | 273 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Modulation | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Code rate (Note 2) | 567/1024 | 567/1024 | 567/1024 | 567/1024 | 567/1024 | 567/1024 | 567/1024 |
| Payload size (bits) | 12040 | 25104 | 50184 | 11528 | 24576 | 50184 | 131176 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of code blocks - C | 2 | 3 | 6 | 2 | 3 | 6 | 16 |
| Code block size including CRC (bits) (Note 2) | 6056 | 8400 | 8392 | 5800 | 8224 | 8392 | 8224 |
| Total number of bits per slot | 21600 | 44928 | 91584 | 20736 | 44064 | 91584 | 235872 |
| Total symbols per slot | 3600 | 7488 | 15264 | 3456 | 7344 | 15264 | 39312 |
| NOTE 1: DM-RS configuration type = 1 with DM-RS duration = single-symbol DM-RS and the number of DM-RS CDM groups without data is 2, additional DM-RS position = pos1, *l0* = 2 and *l* = 11 for PUSCH mapping type A, *l0* = 0 and *l* = 10 for PUSCH mapping type B as per table 6.4.1.1.3-3 of TS 38.211 [17].NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [16]. |

**Table A.5-3: FRC parameters for FR1 interlaced PUSCH performance requirements, transform precoding disabled, *additional DM-RS position = pos1* and 1 transmission layer (64QAM, R=567/1024)**

|  |  |  |
| --- | --- | --- |
| **Reference channel** | **G-FR1-A5-15** | **G-FR1-A5-16** |
| Subcarrier spacing [kHz] | 15 | 30 |
| Allocated resource blocks | 11 | 11 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 |
| Modulation | 64QAM | 64QAM |
| Code rate  | 567/1024 | 567/1024 |
| Payload size (bits) | 5248 | 5248 |
| Transport block CRC (bits) | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 |
| Number of code blocks - C | 1 | 1 |
| Code block size including CRC (bits) (Note 2) | 5272 | 5272 |
| Total number of bits per slot (Note 3) | 9504 | 9504 |
| Total symbols per slot (Note 3) | 1584 | 1584 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos1*, *l0*= 2 and *l* =11 for PUSCH mapping type A, *l0*= 0 and *l* =10 for PUSCH mapping type B as per table 6.4.1.1.3-3 of TS 38.211 [17].NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [16].NOTE 3: The calculation of the “Total number of bits per slot” and “Total symbols per slot” fields include the REs taken up by CG-UCI, if present. |

End of Change#4

*<END OF THE CHANGE 4 from R4-2214857>*