**3GPP TSG- Meeting #**

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| *CR-Form-v12.2* | | | | | | | | |
| **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 | **x** | Radio Access Network |  | Core Network |  |

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| ***Title:*** |  | | | | | | | | | |
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| ***Source to WG:*** |  | | | | | | | | | |
| ***Source to TSG:*** |  | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_redcap-Perf | | | | |  | ***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 can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | Introduction of RedCap UE and CSI reprting requirements | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | R4-2214807: draft CR: Applicability of RedCap UE demodulation requirements   1. Addition of Noc level for PC7   TS38.101-2 V17.6.0 Table 7.3.2.7-1 specifie REFSENS for PC7. Noc values are derived according TS38.101-4 4.5.3.3:  Noc(PC\_P, Band\_X) = REFSENSPC\_P, Band\_X, 50MHz – 10log10(12 x 120kHz x PRBREFSENS) – SNRREFSENS + Δthermal = REFSENSPC\_P, Band\_X, 50MHz - 69.8  Noc(PC7, Band\_n257) = -85.3 - 69.8 = -155.1  Noc(PC7, Band\_n258) = -85.3 - 69.8 = -155.1  Noc(PC7, Band\_n261) = -85.3 - 69.8 = -155.1   1. Define applicability of UE demodulation requirements for RedCap   R4-2214749: Draft CR PDSCH demodulation requirements for RedCap   * Introducing PDSCH performance requirements for RedCap for 1Rx and 2Rx   R4-2214859: Draft CR to TS38.101-4, addition of PDCCH requirements for RedCap UEs   * Add PDCCH requirements for RedCap UEs.   + Adding new section 5.1.1.1 for 1Rx requirements, including full-duplex FDD and half-duplex FDD.   + Adding new 5.3.1.2.4 and 5.3.2.2.4 for 2Rx requirements for FDD and TDD respectively.   + Introducing REG bundle size 2 for TDD in section 5.3.2.2.   + Adding new reference channel for RedCap TDD due to 20 MHz BW   R4-2214844: Draft CR Introduction of PBCH performamce requirements for RedCap   * Introduced the PBCH performance requirments for RedCap   R4-2214845: draftCR for introduction on sustained downlink data rate provided by lower layers for RedCap   * Introduced the SDR requirments for RedCap   R4-2214808: draft CR: Applicability of RedCap UE CSI reporting requirements   * Define applicability of CSI reporting requirements for RedCap   R4-2214810: Channel quality reporting for RedCap under static condition   * Channel quality reporting definition and test cases under static condition are introduced for 1 Rx and 2 Rx RedCap UEs   R4-2214864: draftCR for RedCapUE CQI Fading Reporting Requirements   * New Sections for RedCap UE CQI Fading Reporting Requirements   R4-2214846: draftCR for introduction on reporting of Precoding Matrix Indicator (PMI) for RedCap   * Introduced the PMI requirments for RedCap   R4-2214811: Rank Indicator reporting for RedCap   * Rank Indicator reporting definition and test cases are introduced for 2 Rx RedCap UEs   R4-2214847: draftCR for introduction on static propagation condition   * Introduced the static propgation condition for RedCap | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | UE features for RedCap UE cannot be verified | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 3.1, 3.3, 4.5.3.2, 5.1.1.11 (new), 5.2.1.1.1 (new), 5.2.1.2.1 (new), 5.2.2.1.16 (new), 5.2.2.2.17 (new), 5.3.1, 5.2.1.1.4 (new), 5.3.2.2, 5.3.2.2.4 (new), 5.4, 5.5.1, 6.1.1.1, 6.1.1.6 (new), 6.2.1, 6.2.2.1.1.4 (new), 6.2.2.2.1.5 (new), 6.2.2.1.2.4 (new), 6.2.2.2.2.4 (new), 6.3.1, 6.3.2.2.7 (new), 6.4.2.1.1 (new), 6.4.2.2.1 (new), 7.1.1, 7.1.1.7 (new), 7.5.1, 8.1.1, 8.1.1.6 (new), Table A.3.2.1.1-3, Table A.3.2.1.1-4, Table A.3.2.2.2-1, Table A.3.2.2.2-3, Table A.3.2.2.2-4, Table A.3.2.2.2-8, Table A.3.2.2.2-26 (new), Table A.3.2.2.2-27 (new), Table A.3.3.2.2-1, Table A.4-1 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **x** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | | **x** |  | Test specifications | | | | TS38. 521-4 | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

 3 Definitions, symbols and abbreviations

## 3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

**DL BWP**: DL bandwidth part as defined in TS 38.213 [11].

**EN-DC**: E-UTRA-NR Dual Connectivity as defined in clause 4.1.2 of TS 37.340 [13].

**Enhanced Receiver Type 1:** SU-MIMO interference mitigation advanced receiver [14]

- R-ML (reduced complexity ML) receiver with enhanced inter-stream interference suppression for SU-MIMO transmissions with rank 2 with 2 RX antennas

- R-ML (reduced complexity ML) receiver with enhanced inter-stream interference suppression for SU-MIMO transmissions with rank 2, 3, and 4 with 4 RX antennas

**FR1**: Frequency range 1 as defined in clause 5.1 of TS 38.101-3 [8].

**FR2**: Frequency range 2 as defined in clause 5.1 of TS 38.101-3 [8].

**RedCap**: A UE with reduced capabilities as defined in clause 4.2 in TS 38.306 [14].

**SSB:** SS/PBCH block as defined in clause 7.8.3 of TS 38.211 [9].

## 3.2 Symbols

For the purposes of the present document, the following symbols apply:

Es The averaged received energy per Hz of the wanted signal during the useful part of the symbol, i.e. excluding the cyclic prefix, at the UE antenna connector; average power is computed within a set of REs used for the transmission of physical, divided transmission bandwidth within the set

 Subcarrier spacing configuration as defined in clause 4.2 of TS 38.211 [9]

 The power spectral density of a white noise source with average power per Hz as defined in Clause 4.4.3 for conducted requirements and Clause 4.5.3 for radiated requirements

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

AGC Automatic Gain Control

CA Carrier Aggregation

CC Component Carrier

CCE Control Channel Element

CORESET Control Resource Set

CP Cyclic Prefix

CSI Channel-State Information

CSI-IM CSI Interference Measurement

CSI-RS CSI Reference Signal

CW Codeword

CQI Channel Quality Indicator

CRC Cyclic Redundancy Check

CRI CSI-RS Resource Indicator

DC Dual Connectivity

DCI Downlink Control Information

DL Downlink

DMRS Demodulation Reference Signal

DPS Dynamic Point Selection

EPRE Energy Per Resource Element

EN-DC E-UTRA-NR Dual Connectivity

FR Frequency Range

FRC Fixed Reference Channel

GNSS Global Navigation Satellite System

HARQ Hybrid Automatic Repeat Request

HD-FDD Half-duplex Frequency Division Duplex

HST High Speed Train

HST-SFN High Speed Train Single Frequency Network

LI Layer Indicator

MAC Medium Access Control

MCS Modulation and Coding Scheme

MIB Master Information Block

NR New Radio

NSA Non-Standalone Operation Mode

OCC Orthogonal Cover Code

OCNG OFDMA Channel Noise Generator

OFDM Orthogonal Frequency Division Multiplexing

OFDMA Orthogonal Frequency Division Multiple Access

PBCH Physical Broadcast Channel

Pcell Primary Cell

PDCCH Physical Downlink Control Channel

PDSCH Physical Downlink Shared Channel

PMI Precoding Matrix Indicator

PRB Physical Resource Block

PRG Physical resource block group

PSBCH Physical Sidelink Broadcast Channel

PSCCH Physical Sidelink Control Channel

PSFCH Physical Sidelink Feedback Channel

PSS Primary Synchronization Signal

PSSCH Physical Sidelink Shared Channel

PTRS Phase Tracking Reference Signal

PUCCH Physical Uplink Control Channel

PUSCH Physical Uplink Shared Channel

QCL Quasi Co-location

RB Resource Block

RBG Resource Block Group

RE Resource Element

REG Resource Element Group

RI Rank Indicator

RRC Radio Resource Control

SA Standalone operation mode

SCI Sidelink Control Information

SCS Subcarrier Spacing

SINR Signal-to-Interference-and-Noise Ratio

SL Sidelink

SLSS Sidelink Synchronization Signal

SNR Signal-to-Noise Ratio

SS Synchronization Signal

SSB Synchronization Signal Block

SSS Secondary Synchronization Signal

TCI Transmission Configuration Indicator

TDM Time division multiplexing

TRxP Transmission and Reception Point

TTI Transmission Time Interval

UL Uplink

V2X Vehicle to Everything

VRB Virtual Resource Block

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----------------------------------------------------- Beginning of Change ------------------------------------------------------------

### 4.5.3 Noc

#### 4.5.3.1 Introduction

For Mode 1 conditions radiated testing of demodulation and CSI requirements it is not feasible in practice to use signal levels high enough to make the noise contribution of the UE negligible. Demodulation requirements are therefore specified with the applied noise higher than the UE peak EIS level in TS 38.101-2 [7] by a defined amount, so that the impact of UE noise floor is limited to no greater than a value **∆BB** at the specified Noc level. As UEs have EIS levels that are dependent on operating band and power class, Noc level is dependent on operating band and power class.

#### 4.5.3.2 Noc for NR operating bands in FR2

Values for Noc according to operating band and power class for single carrier requirements are specified in Table 4.5.3.2-1 for **∆BB** =1dB.

Table 4.5.3.2-1: Noc power level for different UE power classes and frequency bands

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Operating band | UE Power class | | | | | | |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| n257 | -167.3 | -161.8 | -158.1 | -166.8 | -162.4 | -162.4 | -155.1 |
| n258 | -167.3 | -161.8 | -158.1 | -166.8 | -162.6 | -162.6 | -155.1 |
| n259 |  |  | -154.5 |  | -159.5 |  |  |
| n260 | -164.3 |  | -155.5 | -164.8 |  |  |  |
| n261 | -167.3 | -161.8 | -158.1 | -166.8 |  | -162.4 | -155.1 |
| n262 | -162.3 | -156.6 | -152.6 | -160.8 |  |  |  |
| Note 1: Noc levels are specified in dBm/Hz | | | | | | | |

For PC3 multi-band devices, the Noc power level (NocMB) shall increase by multi-band relaxation defined in Table 6.2.1.3-4 of TS 38.101-2 [7]:

NocMB = NocSB + ∆MBP,n

- NocSB is the Noc defined in Table 4.5.3.2-1

- ∆MBP,n values are specified in TS 38.101-2 [7].

For CA case, the Noc power level (NocCA) shall increase by a relaxation factor defined in TS 38.101-2 [7] Table 7.3A.2.1-1:

NocCA = NocSC + ΔRIB

- NocSC is derived by assuming UE supports single carrier.

- ΔRIB values are specified in TS 38.101-2 [7].

#### 4.5.3.3 Derivation of Noc values for NR operating bands in FR2

The Noc values in Table 4.5.3.2-1 are based on REFSENS for the operating band X and on the UE Power class P, derived based on the following equation:

NocPC\_P, Band\_X = REFSENSPC\_P, Band\_X, 50MHz -10Log10(12 x 120kHz x PRBREFSENS) – SNRREFSENS + ∆thermal

where:

- REFSENSPC\_P, Band\_X, 50MHz is the REFSENS value in dBm specified for the Power Class P of UE in Band X for 50MHz Channel bandwidth in clause 7.3.2 of TS 38.101-2 [7].

- 12 is the number of subcarriers in a PRB

- 120 kHz is chosen as a subcarrier spacing to select PRBREFSENS.

- PRBREFSENS is NRB associated with subcarrier spacing 120 kHz for 50MHz in Table 5.3.2-1 of TS 38.101-2 [7] and is 32.

- SNRREFSENS = -1 dB is the SNR used for simulation of REFSENS

- ∆thermal is the amount of dB that the wanted noise is set above UE thermal noise, giving a rise in total noise of **∆BB**. ∆thermal = -10Log10(10^(∆BB/10)-1) = 5.87dB, giving a rise in total noise ∆BB of 1 dB**.**

For example, the calculated Noc value UE Power class 3 in Band n260 to -155.5 dBm/Hz, rounded to 0.1dB.

### 4.5.4 Angle of arrival

Unless otherwise stated, the downlink signal and noise are aligned to the direction with the following criteria:

- Select the known Rx beam peak direction reused from RF testing if available, as far as it satisfies the minimum isolation requirement defined in TS 38.521-4 [16] and rank number in TS 38.521-4 [16] corresponding to the test cases

- Otherwise select one direction which satisfies the REFSENS defined in TS 38.101-2 [7], minimum isolation requirement defined in TS 38.521-4 [16] and rank number in TS 38.521-4 [16] corresponding to the test cases.

4.5.5 Es

For Mode 2 the test system shall transmit the wanted signal with power level Es which is the best achievable power level by the test system.

The test system shall be able to determine achievable Es level and the maximum achievable SNR level

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#### 5.1.1.11 Applicability of requirements for RedCap

The performance requirements in Table 5.1.1.11-1 shall apply for UEs which support optional feature *supportOfRedCap*.

Table 5.1.1.11-1: Requirements applicability for RedCap

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| UE capability | Test type | | Test list | Applicability notes |
| RedCap with 1RX | FR1 FDD and HD-FDD (Note 1) | PDSCH | All tests in Clause 5.2.1.1.1 |  |
|  |  | PDCCH | All tests in Clause 5.3.1.1.1 |  |
|  |  | PBCH | All tests in Clause 5.4.1.1 |  |
|  | FR1 TDD | PDSCH | All tests in Clause 5.2.1.2.1 |  |
|  |  | PDCCH | All tests in Clause 5.3.1.2.1 |  |
|  |  | PBCH | All tests in Clause 5.4.1.2 |  |
|  |  | SDR | Clause 5.5.1 |  |
| RedCap with 2RX | FR1 FDD and HD-FDD (Note 1) | PDSCH | All tests in Clause 5.2.2.1.16 |  |
|  |  | PDCCH | All tests in Clause 5.3.2.1.4 |  |
|  |  | PBCH | Clause 5.4.2.1 (Table 5.4.2.1-2 Test 1)  Clause 5.4.2.1 (Table 5.4.2.1-3 Test 1) |  |
|  | FR1 TDD | PDSCH | All tests in Clause 5.2.2.2.17 |  |
|  |  | PDCCH | All tests in Clause 5.3.2.2.4 |  |
|  |  | PBCH | Clause 5.4.2.2 (Table 5.4.2.2-4 Test 1)  Clause 5.4.2.2 (Table 5.4.2.2-5 Test 1) |  |
|  |  | SDR | Clause 5.5.1 |  |
| Note 1: If UE support only HD-FDD in a FDD band, this UE is tested with HD-FDD mode otherwise UE is tested with full-duplex FDD mode | | | | |

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----------------------------------------------------- Beginning of Change ------------------------------------------------------------

##### 5.2.1.1.1 Minimum requirements for RedCap

The performance requirements are specified in Table 5.2.1.1.1-3, with the addition of test parameters in Table 5.2.1.1.1-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.1.1.1-1.

Table 5.2.1.1.1-1: Tests purpose

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify the PDSCH mapping Type A normal performance under 1 receive antenna conditions and with different channel models and MCSs for RedCap | 1-1, 1-2, 1-3, 1-4 |

Table 5.2.1.1.1-2: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | Value |
| Duplex mode | |  | FDD |
| Active DL BWP index | |  | 1 |
| PDSCH configuration | Mapping type |  | Type A |
|  | k0 |  | 0 |
|  | Starting symbol (S) |  | 2 |
|  | Length (L) |  | 12 |
|  | PDSCH aggregation factor |  | 1 |
|  | PRB bundling type |  | Static |
|  | PRB bundling size |  | 4 for Test 1-1  2 for other tests |
|  | Resource allocation type |  | Type 0 |
|  | RBG size |  | Config2 |
|  | VRB-to-PRB mapping type |  | Non-interleaved |
|  | VRB-to-PRB mapping interleaver bundle size |  | N/A |
| PDSCH DMRS configuration | DMRS Type |  | Type 1 |
|  | Number of additional DMRS |  | 2 for Test 1-1, 1 for other tests |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| CSI-RS for tracking | CSI-RS periodicity | Slots | Table 5.2-1 |
|  | CSI-RS offset | Slots | Table 5.2-1 |
| Number of HARQ Processes | |  | 4 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 2 |

Table 5.2.1.1.1-3: Minimum performance for Rank 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel (Note 1) | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
|  |  |  |  |  |  | Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.1-1.1 FDD  R.PDSCH.X TBD HD-FDD | 10 / 15 | QPSK, 0.30 | TDLB100-400 | 2x1 Low | 70 | [3.7] |
| 1-2 | R.PDSCH.1-2.1 FDD  R.PDSCH.X TBD HD-FDD | 10 / 15 | 16QAM, 0.48 | TDLC300-100 | 2x1 Low | 70 | [12.2] |
| 1-3 | R.PDSCH.1-3.5 FDD  R.PDSCH.X TBD HD-FDD | 10 / 15 | 64QAM, 0.50 | TDLA30-10 | 2x1 Low | 70 | [16.5] |
| 1-4 | R.PDSCH.1-4.2 FDD  R.PDSCH.X TBD HD-FDD | 10 / 15 | 256QAM, 0.67 | TDLA30-10 | 2x1 Low | 70 | TBA |
| Note 1: Applied reference channel depends on the supported operation mode: FDD or HD-FDD. | | | | | | | |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

##### 5.2.1.2.1 Minimum requirements for RedCap

The performance requirements are specified in Table 5.2.1.2.1-3, with the addition of test parameters in Table 5.2.1.2.1-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.1.2.1-1.

Table 5.2.1.2.1-1: Tests purpose

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify the PDSCH mapping Type A normal performance under 2 receive antenna conditions and with different channel models, MCSs for RedCap UEs | 1-1, 1-2, 1-3, 1-4 |

Table 5.2.1.2.1-2: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Value** |
| Duplex mode | |  | TDD |
| Active DL BWP index | |  | 1 |
| PDSCH configuration | Mapping type |  | Type A |
|  | k0 |  | 0 |
|  | Starting symbol (S) |  | 2 |
|  | Length (L) |  | Specific to each Reference channel |
|  | PDSCH aggregation factor |  | 1 |
|  | PRB bundling type |  | Static |
|  | PRB bundling size |  | 4 for Test 1-1,  2 for other tests |
|  | Resource allocation type |  | Type 0 |
|  | RBG size |  | Config2 |
|  | VRB-to-PRB mapping type |  | Non-interleaved |
|  | VRB-to-PRB mapping interleaver bundle size |  | N/A |
| PDSCH DMRS configuration | DMRS Type |  | Type 1 |
|  | Number of additional DMRS |  | 2 for Test 1-1,  1 for other tests |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| CSI-RS for tracking | First OFDM symbol in the PRB used for CSI-RS |  | Table 5.2-1 |
|  | CSI-RS periodicity | Slots | Table 5.2-1 |
|  | CSI-RS offset | Slots | Table 5.2-1 |
|  | Frequency Occupation |  | Table 5.2-1 |
| Number of HARQ Processes | |  | 8 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | Specific to each TDD UL-DL pattern and as defined in Annex A.1.2 |

Table 5.2.1.2.1-3: Minimum performance for Rank 1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL-DL pattern | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.2-1.5 TDD | 20 / 30 | QPSK, 0.30 | FR1.30-1A | TDLB100-400 | 2x1 Low | 70 | [3.8] |
| 1-2 | R.PDSCH.2-26.1 TDD | 20 / 30 | 16QAM, 0.48 | FR1.30-1 | TDLC300-100 | 2x1 Low | 70 | [12.3] |
| 1-3 | R.PDSCH.2-3.5 TDD | 20 / 30 | 64QAM, 0.50 | FR1.30-1 | TDLA30-10 | 2x1 Low | 70 | [17.1] |
| 1-4 | R.PDSCH.2-4.3 TDD | 20 / 30 | 256QAM, 0.67 | FR1.30-1 | TDLA30-10 | 2x1 Low | 70 | TBA |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

##### 5.2.2.1.16 Minimum requirements for RedCap

The performance requirements are specified in Table 5.2.2.1.16-3, with the addition of test parameters in Table 5.2.2.1.16-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.1.16-1.

Table 5.2.2.1.16-1: Tests purpose

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify the PDSCH mapping Type A normal performance under 2 receive antenna conditions and with different channel models, MCSs for RedCap | 1-1, 1-2, 1-3, 2-1 |

Table 5.2.2.1.16-2: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | Value |
| Duplex mode | |  | FDD |
| Active DL BWP index | |  | 1 |
| PDSCH configuration | Mapping type |  | Type A |
|  | k0 |  | 0 |
|  | Starting symbol (S) |  | 2 |
|  | Length (L) |  | 12 |
|  | PDSCH aggregation factor |  | 1 |
|  | PRB bundling type |  | Static |
|  | PRB bundling size |  | 4 for Test 1-1  2 for other tests |
|  | Resource allocation type |  | Type 0 |
|  | RBG size |  | Config2 |
|  | VRB-to-PRB mapping type |  | Non-interleaved |
|  | VRB-to-PRB mapping interleaver bundle size |  | N/A |
| PDSCH DMRS configuration | DMRS Type |  | Type 1 |
|  | Number of additional DMRS |  | 2 for Test 1-1  1 for other tests |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| CSI-RS for tracking | CSI-RS periodicity | Slots | Table 5.2-1 |
|  | CSI-RS offset | Slots | Table 5.2-1 |
| Number of HARQ Processes | |  | 4 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 2 |

Table 5.2.2.1.16-3: Minimum performance for Rank 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel (Note 1) | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
|  |  |  |  |  |  | Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.1-1.1 FDD  R.PDSCH.X TBD HD-FDD | 10 / 15 | QPSK, 0.30 | TDLB100-400 | 2x2, ULA Low | 70 | -0.8 |
| 1-2 | R.PDSCH.1-2.1 FDD  R.PDSCH.X TBD HD-FDD | 10 / 15 | 16QAM, 0.48 | TDLC300-100 | 2x2, ULA Low | 70 | [8.1] |
| 1-3 | R.PDSCH.1-4.1 FDD  R.PDSCH.X TBD HD-FDD | 10 / 15 | 256QAM, 0.82 | TDLA30-10 | 2x2, ULA Low | 70 | 24.6 |
| Note 1: Applied reference channel depends on the supported operation mode: FDD or HD-FDD. | | | | | | | |

Table 5.2.2.1.16-4: Minimum performance for Rank 2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel (Note 1) | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
|  |  |  |  |  |  | Fraction of maximum throughput (%) | SNR (dB) |
| 2-1 | R.PDSCH.1-3.1 FDD  R.PDSCH.X TBD HD-FDD | 10 / 15 | 64QAM, 0.50 | TDLA30-10 | 2x2, ULA Low | 70 | 19.4 |
| Note 1: Applied reference channel depends on the supported operation mode: FDD or HD-FDD. | | | | | | | |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

##### 5.2.2.2.17 Minimum requirements for RedCap

The performance requirements are specified in Table 5.2.2.2.17-3 and Table 5.2.2.2.17-4, with the addition of test parameters in Table 5.2.2.2.17-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.2.17-1.

Table 5.2.2.2.17-1: Tests purpose

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify the PDSCH mapping Type A normal performance under 2 receive antenna conditions and with different channel models, MCSs and number of MIMO layers for RedCap UEs | 1-1, 1-2, 1-3, 2-1 |

Table 5.2.2.2.17-2: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Value** |
| Duplex mode | |  | TDD |
| Active DL BWP index | |  | 1 |
| PDSCH configuration | Mapping type |  | Type A |
|  | k0 |  | 0 |
|  | Starting symbol (S) |  | 2 |
|  | Length (L) |  | Specific to each Reference channel |
|  | PDSCH aggregation factor |  | 1 |
|  | PRB bundling type |  | Static |
|  | PRB bundling size |  | 4 for Test 1-1  2 for other tests |
|  | Resource allocation type |  | Type 0 |
|  | RBG size |  | Config2 |
|  | VRB-to-PRB mapping type |  | Non-interleaved |
|  | VRB-to-PRB mapping interleaver bundle size |  | N/A |
| PDSCH DMRS configuration | DMRS Type |  | Type 1 |
|  | Number of additional DMRS |  | 2 for Test 1-1  1 for other tests |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| CSI-RS for tracking | First OFDM symbol in the PRB used for CSI-RS |  | Table 5.2-1 |
|  | CSI-RS periodicity | Slots | Table 5.2-1 |
|  | CSI-RS offset | Slots | Table 5.2-1 |
|  | Frequency Occupation |  | Table 5.2-1 |
| Number of HARQ Processes | |  | 8 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | Specific to each TDD UL-DL pattern and as defined in Annex A.1.2 |

Table 5.2.2.2.17-3: Minimum performance for Rank 1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL-DL pattern | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.2-1.5 TDD | 20 / 30 | QPSK, 0.30 | FR1.30-1A | TDLB100-400 | 2x2, ULA Low | 70 | [0.2] |
| 1-2 | R.PDSCH.2-4.2 TDD | 20 / 30 | 256QAM, 0.82 | FR1.30-1 | TDLA30-10 | 2x2, ULA Low | 70 | [25.3] |
| 1-3 | R.PDSCH.2-26.1 TDD | 20 / 30 | 16QAM, 0.48 | FR1.30-1 | TDLC300-100 | 2x2, ULA Low | 70 | [8.1] |

Table 5.2.2.2.17-4: Minimum performance for Rank 2

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test num.** | **Reference channel** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **Modulation format and code rate** | **TDD UL-DL pattern** | **Propagation condition** | **Correlation matrix and antenna configuration** | **Reference value** | |
| **Fraction of maximum throughput (%)** | **SNR (dB)** |
| 2-1 | R.PDSCH.2-27.1 TDD | 20 / 30 | 64QAM, 0.50 | FR1.30-1 | TDLA30-10 | 2x2, ULA Low | 70 | [20.1] |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

5.3.1 1RX requirements

5.3.1.1 FDD

The parameters specified in Table 5.3.2.1-1 are valid for all FDD tests unless otherwise stated.

**Table 5.3.1.1-1: Test Parameters**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** |  |
| CCE to REG mapping type |  | nonInterleaved |
| REG bundle size |  | 6 |
| Shift index |  | 0 |

5.3.1.1.1 Minimum requirements for RedCap

For the parameters specified in Table 5.3.1.1-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 5.3.1.1.1-1. The downlink physical setup is in accordance with Annex C.3.1.

**Table 5.3.1.1.1-1: Minimum performance for UE supporting full-duplex FDD or half-duplex FDD**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test number** | **Bandwidth (MHz)** | **CORESET RB** | **CORESET duration** | **Aggregation level** | **Reference Channel** | **Propagation Condition** | **Antenna configuration and correlation Matrix** | **Reference value** | |
| **Pm-dsg (%)** | **SNR (dB)** |
| 1 | 10 | 48 | 1 | 8 | R.PDCCH. 1-1.3 FDD | TDLA30-10 | 2x1 Low | 1 | [5.7] |

5.3.1.2 TDD

The parameters specified in Table 5.3.1.2-1 are valid for all TDD tests unless otherwise stated.

**Table 5.3.1.2-1: Test Parameters**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** |  |
| TDD UL-DL pattern |  | FR1.30-1 |
| CCE to REG mapping type |  | interleaved |
| Interleaver size |  | 3 |
| REG bundle size |  | 2 |
| Shift Index |  | 0 |

5.3.1.2.1 Minimum requirements for RedCap

For the parameters specified in Table 5.3.1.2-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 5.3.1.2.1-1. The downlink physical setup is in accordance with Annex C.3.1.

**Table 5.3.1.2.1-1: Minimum performance for PDCCH with 30 kHz SCS**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test number** | **Bandwidth (MHz)** | **CORESET RB** | **CORESET duration** | **Aggregation level** | **Reference Channel** | **Propagation Condition** | **Antenna configuration and correlation Matrix** | **Reference value** | |
| **Pm-dsg (%)** | **SNR (dB)** |
| 1 | 20 | 48 | 1 | 4 | R.PDCCH. 2-1.5 TDD | TDLC300-100 | 1x1 | 1 | [TBD] |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

 5.3.2.1.4 Minimum requirements for RedCap

For the parameters specified in Table 5.3.2.1-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 5.3.2.1.4-1. The downlink physical setup is in accordance with Annex C.3.1.

**Table 5.3.2.1.4-1: Minimum performance for PDCCH with 15 kHz SCS**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test number** | **Bandwidth (MHz)** | **CORESET RB** | **CORESET duration** | **Aggregation level** | **Reference Channel** | **Propagation Condition** | **Antenna configuration and correlation Matrix** | **Reference value** | |
| **Pm-dsg (%)** | **SNR (dB)** |
| 1 | 10 | 48 | 2 | 4 | R.PDCCH. 1-2.4 FDD | TDLA30-10 | 1x2 Low | 1 | 5.5 |
| 2 | 10 | 48 | 1 | 8 | R.PDCCH. 1-1.3 FDD | TDLA30-10 | 2x2 Low | 1 | -0.2 |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

 5.3.2.2 TDD

The parameters specified in Table 5.3.2.2-1 are valid for all TDD tests unless otherwise stated.

**Table 5.3.2.2-1: Test Parameters**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **1 Tx Antenna** | | | **2 Tx Antenna** |
| TDD UL-DL pattern |  | FR1.30-1 | | | |
| CCE to REG mapping type |  | Test 3: non-interleaved  Other tests: interleaved | | interleaved | |
| Interleaver size |  | 3 | | | |
| REG bundle size |  | Test 3: 6  Other tests: 2 | Test 1 in Table 5.3.2.2.2-1: 6  Other tests: 2 | | |
| Shift Index |  | 0 | | | |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

 5.3.2.2.4 Minimum requirements for RedCap

For the parameters specified in Table 5.3.2.2-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 5.3.2.2.4-1. The downlink physical setup is in accordance with Annex C.3.1.

**Table 5.3.2.2.4-1: Minimum performance for PDCCH with 30 kHz SCS**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test number** | **Bandwidth (MHz)** | **CORESET RB** | **CORESET duration** | **Aggregation level** | **Reference Channel** | **Propagation Condition** | **Antenna configuration and correlation Matrix** | **Reference value** | |
| **Pm-dsg (%)** | **SNR (dB)** |
| 1 | 20 | 48 | 1 | 2 | R.PDCCH. 2-1.5 TDD | TDLC300-100 | 1x2 Low | 1 | [3.2] |
| 2 | 20 | 48 | 1 | 4 | R.PDCCH. 2-1.6 TDD | TDLC300- 100 | 2x2 Low | 1 | [-0.3] |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

## 5.4 PBCH demodulation requirements

The receiver characteristics of PBCH are determined by the probability of miss-detection of the PBCH (Pm-bch), which is defined as

Where A is the number of correctly decoded MIB PDUs and B is the number of transmitted MIB PDUs. The Pm-bch is derived with the assumption UE combines the PBCH symbols of the same SS/PBCH block index within the MIB TTI (80ms).

Table 5.4-1: Common test Parameters

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Single antenna port** |
| Physical Cell ID |  | 0 |
| Cyclic prefix |  | Normal |
| Number of SS/PBCH blocks within an SS burst set periodicity |  | 1 |
| SS/PBCH block index Note1 |  | 0 |
| SS/PBCH block periodicity | ms | 20 |
| Note 1: as specified in clause 4.1 of TS 38.213 [11] | | |

### 5.4.1 1RX requirements

#### 5.4.1.1 FDD

For the parameters specified in Table 5.4-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified values in Table 5.4.1.1-1 in case SS/PBCH block index is not known. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.4.1.1-1: Minimum performance PBCH in case SS/PBCH block index is not known for RedCap

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Test number** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **Reference channel** | **Propagation condition** | **Antenna configuration and correlation matrix** | **Reference value** | |
| **Pm-bch (%)** | **SNR (dB)** |
| 1 | 10 / 15 | R.PBCH.1 | TDLC300-100 | 1 x 1 Low | 1 | -2.5 |

#### 5.4.1.2 TDD

Table 5.4.1.2-1: Test parameters for PBCH

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Single antenna port** |
| TDD UL-DL pattern |  | FR1.30-1 |

For the parameters specified in Table 5.4-1 and Table 5.4.2.2-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified values in Table 5.4.1.2-2 in case SS/PBCH block index is not known. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.4.1.2-2: Minimum performance PBCH in case SS/BPCH block index is not known for RedCap

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Test number** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **Reference channel** | **Propagation condition** | **Antenna configuration and correlation matrix** | **Reference value** | |
| **Pm-bch (%)** | **SNR (dB)** |
| 1 | 20 / 30 | R.PBCH.2 | TDLA30-10 | 1 x 1 Low | 1 | -1.0 |

### 5.4.2 2RX requirements

#### 5.4.2.1 FDD

Table 5.4.2.1-1: Void



For the parameters specified in Table 5.4-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified values in Table 5.4.2.1-2 in case SS/PBCH block index is not known and below the specifies values in Table.5.4.2.1-3 in case SS/PBCH block index is known. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.4.2.1-2: Minimum performance PBCH in case SS/PBCH block index is not known

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Test number** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **Reference channel** | **Propagation condition** | **Antenna configuration and correlation matrix** | **Reference value** | |
| **Pm-bch (%)** | **SNR (dB)** |
| 1 | 10 / 15 | R.PBCH.1 | TDLC300-100 | 1 x 2 Low | 1 | -6.7 |

Table 5.4.2.1-3 Minimum performance PBCH in case SS/PBCH block index is known

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Test number | Bandwidth (MHz) / Subcarrier spacing (kHz) | Reference channel | Propagation condition | Antenna configuration and correlation matrix | Reference value | |
| Pm-bch (%) | SNR (dB) |
| 1 | 10 / 15 | R.PBCH.1 | TDLC300-100 | 1 x 2 Low | 1 | -8.3 |

#### 5.4.2.2 TDD

Table 5.4.2.2-1: Test parameters for PBCH

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Single antenna port** |
| TDD UL-DL pattern |  | FR1.30-1 |

For the parameters specified in Table 5.4-1 and Table 5.4.2.2-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified values in Table 5.4.2.2-2 and Table 5.4.2.2-4 in case SS/PBCH block index is not known and below the specified values in Table.5.4.2.2-3 and Table 5.4.2.2-5 in case SS/PBCH block index is known. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.4.2.2-2: Minimum performance PBCH in case SS/BPCH block index is not known

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Test number** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **Reference channel** | **Propagation condition** | **Antenna configuration and correlation matrix** | **Reference value** | |
| **Pm-bch (%)** | **SNR (dB)** |
| 1 | 40 / 30 | R.PBCH.2 | TDLA30-10 | 1 x 2 Low | 1 | -5.3 |

Table 5.4.2.2-3 Minimum performance PBCH in case SS/BPCH block index is known

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Test number | Bandwidth (MHz) / Subcarrier spacing (kHz) | Reference channel | Propagation condition | Antenna configuration and correlation matrix | Reference value | |
| Pm-bch (%) | SNR (dB) |
| 1 | 40 / 30 | R.PBCH.2 | TDLA30-10 | 1 x 2 Low | 1 | -6.5 |

Table 5.4.2.2-4: Minimum performance PBCH in case SS/BPCH block index is not known for RedCap

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Test number** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **Reference channel** | **Propagation condition** | **Antenna configuration and correlation matrix** | **Reference value** | |
| **Pm-bch (%)** | **SNR (dB)** |
| 1 | 20 / 30 | R.PBCH.2 | TDLA30-10 | 1 x 2 Low | 1 | -5.3 |

Table 5.4.2.2-5 Minimum performance PBCH in case SS/BPCH block index is known for RedCap

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Test number | Bandwidth (MHz) / Subcarrier spacing (kHz) | Reference channel | Propagation condition | Antenna configuration and correlation matrix | Reference value | |
| Pm-bch (%) | SNR (dB) |
| 1 | 20 / 30 | R.PBCH.2 | TDLA30-10 | 1 x 2 Low | 1 | -6.5 |

### 5.4.3 4RX requirements

#### 5.4.3.1 FDD

Table 5.4.3.1-1: Void



For the parameters specified in Table 5.4-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified values in Table 5.4.3.1-2 in case SS/PBCH block index is not known and below the specified values in Table.5.4.3.1-3 in case SS/PBCH block index is known. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.4.3.1-2: Minimum performance PBCH in case SS/PBCH block index is not known

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Test number | Bandwidth (MHz) / Subcarrier spacing (kHz) | Reference channel | Propagation condition | Antenna configuration and correlation matrix | Reference value | |
| Pm-bch (%) | SNR (dB) |
| 1 | 10 / 15 | R.PBCH.1 | TDLC300-100 | 1 x 4 Low | 1 | -8.9 |

Table 5.4.3.1-3: Minimum performance PBCH in case SS/PBCH block index is known

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Test number | Bandwidth (MHz) / Subcarrier spacing (kHz) | Reference channel | Propagation condition | Antenna configuration and correlation matrix | Reference value | |
| Pm-bch (%) | SNR (dB) |
| 1 | 10 / 15 | R.PBCH.1 | TDLC300-100 | 1 x 4 Low | 1 | -10.9 |

#### 5.4.3.2 TDD

Table 5.4.3.2-1: Test parameters for PBCH

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Single antenna port |
| TDD UL-DL pattern |  | FR1.30-1 |

For the parameters specified in Table 5.4-1 and Table 5.4.3.2-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified values in Table 5.4.3.2-2 in case SS/PBCH block index is not known and below the specified values in Table.5.4.3.2-3 in case SS/PBCH block index is known. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.4.3.2-2: Minimum performance PBCH in case SS/BPCH block index is not known

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Test number | Bandwidth (MHz) / Subcarrier spacing (kHz) | Reference channel | Propagation condition | Antenna configuration and correlation matrix | Reference value | |
| Pm-bch (%) | SNR (dB) |
| 1 | 40 / 30 | R.PBCH.2 | TDLA30-10 | 1 x 4 Low | 1 | -8.6 |

Table 5.4.3.2-3: Minimum performance PBCH in case SS/BPCH block index is known

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Test number | Bandwidth (MHz) / Subcarrier spacing (kHz) | Reference channel | Propagation condition | Antenna configuration and correlation matrix | Reference value | |
| Pm-bch (%) | SNR (dB) |
| 1 | 40 / 30 | R.PBCH.2 | TDLA30-10 | 1 x 4 Low | 1 | -9.6 |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

## 5.5 Sustained downlink data rate provided by lower layers

### 5.5.1 FR1 single carrier requirements

The requirements in this clause are applicable to the FR1 single carrier case.

The requirements and procedure defined in Clause 5.5A.1 apply using operating band instead of CA configuration, and bandwidth instead of bandwidth combination.

For RedCap, the requirements and procedure are defined in Clause 5.5A.1 except that the MIMO layers is configured to 2 for UE supporting 2 MIMO layers and 1 for UE supporting 1 MIMO layers for all operating band. Antenna configuration is 1x1 for UE supporting 1 layer and 2x2 for UE supporting 2 layers.

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

### 6.1.1 Applicability of requirements

#### 6.1.1.1 General

The minimum performance requirements are applicable to all FR1 operating bands defined in TS 38.101-1 [6] except for test cases listed in Clause 6.2.2.2.1.4, Clause 6.2.3.2.1.4, Clause 6.2A.3.1.2 and Clause 6.2A.4.1.2 which are only applicable for FR1 bands restricted to operation with shared spectrum.

The minimum performance requirements in Clause 6 are mandatary for UE supporting NR operation, except test cases listed in Clause 6.1.1.3, 6.1.1.4, 6.1.1.5, 6.1.1.6.

If same test is listed for different UE features/capabilities in Clauses 6.1.1.3 and 6.1.1.4, then this test shall apply for UEs which support all corresponding UE features/capabilities.

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

#### 6.1.1.6 Applicability of requirements for RedCap

The performance requirements in Table 6.1.1.6-1 shall apply for UEs which support optional feature *supportOfRedCap*.

Table 6.1.1.6-1: Requirements applicability for RedCap

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| UE capability | Test type | | Test list | Applicability notes |
| RedCap with 1RX | FR1 FDD and HD-FDD (Note 1) | CQI | All tests in Clause 6.2.1.1.1.1  All tests in Clause 6.2.1.1.2.1 |  |
|  |  | PMI | All tests in Clause 6.3.1.1.1 |  |
|  | FR1 TDD | CQI | All tests in Clause 6.2.1.2.1.1  All tests in Clause 6.2.1.2.2.1 |  |
|  |  | PMI | All tests in Clause 6.3.1.2.1 |  |
| RedCap with 2RX | FR1 FDD and HD-FDD (Note 1) | CQI | All tests in Clause 6.2.2.1.1.4  All tests in Clause 6.2.2.1.2.4 |  |
|  |  | PMI | Clause 6.3.2.1.1 (Test 1) |  |
|  |  | RI | Clause 6.4.2.1.1 (Test 1) |  |
|  | FR1 TDD | CQI | All tests in Clause 6.2.2.2.1.5  All tests in Clause 6.2.2.2.2.4 |  |
|  |  | PMI | Clause 6.3.2.2.7 (Test 1) |  |
|  |  | RI | Clause 6.4.2.2.1 (Test 1) |  |
| Note 1: If UE support only HD-FDD in a FDD band, this UE is tested with HD-FDD mode otherwise UE is tested with full-duplex FDD mode | | | | |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

## 6.2 Reporting of Channel Quality Indicator (CQI)

This clause includes the requirements for the reporting of channel quality indicator (CQI).

### 6.2.1 1RX requirements

6.2.1.1 FDD

##### 6.2.1.1.1 CQI reporting definition under AWGN conditions

The reporting accuracy of the channel quality indicator (CQI) under frequency non-selective conditions is determined by the reporting variance and the BLER performance using the transport format indicated by the reported CQI median. The purpose is to verify that the reported CQI values are in accordance with the CQI definition given in TS 38.214 [12]. To account for sensitivity of the input SNR the reporting definition is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

###### 6.2.1.1.1.1 Minimum requirement for periodic CQI reporting for RedCap

For the parameters specified in Table 6.2.1.1.1.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

a) The reported CQI value according to the reference channel shall be in the range of ±1 of the reported median more than 90% of the time.

b) If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 0.1.

Table 6.2.1.1.1.1-1: CQI reporting definition test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Test 1** | | **Test 2** | |
| Bandwidth | | | MHz | 10 | | | |
| Subcarrier spacing | | | kHz | 15 | | | |
| Duplex Mode | | |  | FDD | | | |
| SNR | | | dB | [5] | [6] | [11] | [12] |
| Propagation channel | | |  | AWGN | | | |
| Antenna configuration | | |  | 2×1 with static channel specified in Annex B.1 | | | |
| Beamforming Model | | |  | As specified in Annex B.4.1 | | | |
| ZP CSI-RS configuration | CSI-RS resource Type | |  | Periodic | | | |
| Number of CSI-RS ports (*X*) | |  | 4 | | | |
| CDM Type | |  | FD-CDM2 | | | |
| Density (ρ) | |  | 1 | | | |
| First subcarrier index in the PRB used for CSI-RS (k0) | |  | Row 5,4 | | | |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | 9 | | | |
| CSI-RS  periodicity and offset | | slot | 10/1 | | | |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type | |  | Periodic | | | |
| Number of CSI-RS ports (*X*) | |  | 2 | | | |
| CDM Type | |  | FD-CDM2 | | | |
| Density (ρ) | |  | 1 | | | |
| First subcarrier index in the PRB used for CSI-RS (k0) | |  | Row 3,(6) | | | |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | 13 | | | |
| NZP CSI-RS-timeConfig  periodicity and offset | | slot | 10/1 | | | |
| CSI-IM configuration | CSI-IM resource Type | |  | Periodic | | | |
| CSI-IM RE pattern | |  | 0 | | | |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) | |  | (4, 9) | | | |
| CSI-IM timeConfig  periodicity and offset | | slot | 10/1 | | | |
| ReportConfigType | | |  | Periodic | | | |
| CQI-table | | |  | Table 1 | | | |
| reportQuantity | | |  | cri-RI-PMI-CQI | | | |
| timeRestrictionForChannelMeasurements | | |  | Not configured | | | |
| timeRestrictionForInterferenceMeasurements | | |  | Not configured | | | |
| cqi-FormatIndicator | | |  | Wideband | | | |
| pmi-FormatIndicator | | |  | Wideband | | | |
| Sub-band Size | | | RB | 8 | | | |
| Csi-ReportingBand | | |  | 1111111 | | | |
| CSI-Report periodicity and offset | | | slot | 10/9 | | | |
| aperiodicTriggeringOffset | | |  | Not configured | | | |
| Codebook configuration | | Codebook Type |  | typeI-SinglePanel | | | |
| Codebook Mode |  | 1 | | | |
| (CodebookConfig-N1,CodebookConfig-N2) |  | Not configured | | | |
| CodebookSubsetRestriction |  | 000001 | | | |
| RI Restriction |  | N/A | | | |
| Physical channel for CSI report | | |  | PUCCH | | | |
| CQI/RI/PMI delay | | | ms | [14] | | | |
| Maximum number of HARQ transmission | | |  | 1 | | | |
| Measurement channel | | |  | As specified in Table A.4-1, TBS.1-3 | | | |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

6.2.1.1.2 CQI reporting under fading conditions

6.2.1.1.2.1 Minimum requirement for wideband CQI reporting for RedCap

The purpose of the requirements is to verify that the RedCap UE is tracking the channel variations and selecting the largest transport format possible according to the prevailing channel state for the frequency non-selective scheduling.

The reporting accuracy of CQI under frequency non-selective fading conditions is determined by the reporting variance, the relative increase of the throughput obtained when the transport format is indicated by the reported CQI compared to the throughput obtained when a fixed transport format is configured according to the reported median CQI, and a minimum BLER using the transport formats indicated by the reported CQI. To account for sensitivity of the input SNR the wideband CQI reporting under frequency selective fading conditions is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

For the parameters specified in Table 6.2.1.1.2.1-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

a) A CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least *α*% of the time where *α*% is specified in Table 6.2.1.1.2.1-2;

b) The ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be ≥ *γ*, where *γ* is specified in Table 6.2.1.1.2.1-2;

c) When transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater than or equal to 0.02.

**Table 6.2.1.1.2.1-1: Wideband CQI reporting test under frequency non-selective fading conditions**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Test 1** | | **Test 2** | |
| Bandwidth | | | MHz | 10 | | | |
| Subcarrier spacing | | | kHz | 15 | | | |
| Duplex Mode | | |  | FDD | | | |
| SNR | | | dB | [9] | [10] | [15] | [16] |
| Propagation channel | | |  | TDLA30-5 | | | |
| Antenna configuration | | |  | 2×1 | | | |
| Correlation configuration | | |  | ULA high | | | |
| Beamforming Model | | |  | As specified in Annex B.4.1 | | | |
| ZP CSI-RS configuration | CSI-RS resource Type | |  | Periodic | | | |
| Number of CSI-RS ports (*X*) | |  | 4 | | | |
| CDM Type | |  | FD-CDM2 | | | |
| Density (ρ) | |  | 1 | | | |
| First subcarrier index in the PRB used for CSI-RS (k0) | |  | Row 5,4 | | | |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | 9 | | | |
| CSI-RS  periodicity and offset | | slot | 10/1 | | | |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type | |  | Periodic | | | |
| Number of CSI-RS ports (*X*) | |  | 2 | | | |
| CDM Type | |  | FD-CDM2 | | | |
| Density (ρ) | |  | 1 | | | |
| First subcarrier index in the PRB used for CSI-RS (k0) | |  | Row 3,(6) | | | |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | 13 | | | |
| NZP CSI-RS-timeConfig  periodicity and offset | | slot | 10/1 | | | |
| CSI-IM configuration | CSI-IM resource Type | |  | Periodic | | | |
| CSI-IM RE pattern | |  | 0 | | | |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) | |  | (4, 9) | | | |
| CSI-IM timeConfig  periodicity and offset | | slot | 10/1 | | | |
| ReportConfigType | | |  | Periodic | | | |
| CQI-table | | |  | Table 1 | | | |
| reportQuantity | | |  | cri-RI-PMI-CQI | | | |
| timeRestrictionForChannelMeasurements | | |  | Not configured | | | |
| timeRestrictionForInterferenceMeasurements | | |  | Not configured | | | |
| cqi-FormatIndicator | | |  | Wideband | | | |
| pmi-FormatIndicator | | |  | Wideband | | | |
| Sub-band Size | | | RB | 8 | | | |
| Csi-ReportingBand | | |  | 1111111 | | | |
| CSI-Report periodicity and offset | | | slot | 10/9 | | | |
| aperiodicTriggeringOffset | | |  | Not configured | | | |
| Codebook configuration | | Codebook Type |  | typeI-SinglePanel | | | |
| Codebook Mode |  | 1 | | | |
| (CodebookConfig-N1,CodebookConfig-N2) |  | Not configured | | | |
| CodebookSubsetRestriction |  | 000001 | | | |
| RI Restriction |  | N/A | | | |
| Physical channel for CSI report | | |  | PUCCH | | | |
| CQI/RI/PMI delay | | | ms | [14] | | | |
| Maximum number of HARQ transmission | | |  | 1 | | | |
| Measurement channel | | |  | As specified in Table A.4-1, TBS.1-3 | | | |

**Table 6.2.1.1.2.1-2: Minimum requirements**

|  |  |  |
| --- | --- | --- |
| **Parameters** | **Test 1** | **Test 2** |
| ** [%] | 20 | 20 |
| ** | 1.05 | 1.05 |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

#### 6.2.1.2 TDD

##### 6.2.1.2.1 CQI reporting definition under AWGN conditions

###### 6.2.1.2.1.1 Minimum requirement for periodic CQI reporting for RedCap

The purpose of the requirements is to verify that the reported CQI values are in accordance with the CQI definition given in TS 38.214 [12]. The reporting accuracy of CQI under AWGN condition is determined by the reporting variance and BLER performance using the transport format indicated by the reported CQI median. To account for sensitivity of the input SNR the reporting definition is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

For the parameters specified in Table 6.2.1.2.1.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

a) The reported CQI value according to the reference channel shall be in the range of ±1 of the reported median more than 90% of the time.

b) If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 0.1.

Table 6.2.1.2.1.1-1: CQI reporting definition test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Test 1** | | **Test 2** | |
| Bandwidth | | | MHz | 20 | | | |
| Subcarrier spacing | | | kHz | 30 | | | |
| Duplex Mode | | |  | TDD | | | |
| TDD UL-DL pattern | | |  | FR1.30-1 | | | |
| SNR | | | dB | [5] | [6] | [11] | [12] |
| Propagation channel | | |  | AWGN | | | |
| Antenna configuration | | |  | 2×1 with static channel specified in Annex B.1 | | | |
| Beamforming Model | | |  | As specified in Annex B.4.1 | | | |
| ZP CSI-RS configuration | CSI-RS resource Type | |  | Periodic | | | |
| Number of CSI-RS ports (*X*) | |  | 4 | | | |
| CDM Type | |  | FD-CDM2 | | | |
| Density (ρ) | |  | 1 | | | |
| First subcarrier index in the PRB used for CSI-RS (k0) | |  | Row 5,4 | | | |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | 9 | | | |
| CSI-RS  periodicity and offset | | slot | 10/1 | | | |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type | |  | Periodic | | | |
| Number of CSI-RS ports (*X*) | |  | 2 | | | |
| CDM Type | |  | FD-CDM2 | | | |
| Density (ρ) | |  | 1 | | | |
| First subcarrier index in the PRB used for CSI-RS (k0) | |  | Row 3,(6) | | | |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | 13 | | | |
| NZP CSI-RS-timeConfig  periodicity and offset | | slot | 10/1 | | | |
| CSI-IM configuration | CSI-IM resource Type | |  | Periodic | | | |
| CSI-IM RE pattern | |  | 0 | | | |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) | |  | (4, 9) | | | |
| CSI-IM timeConfig  periodicity and offset | | slot | 10/1 | | | |
| ReportConfigType | | |  | Periodic | | | |
| CQI-table | | |  | Table 1 | | | |
| reportQuantity | | |  | cri-RI-PMI-CQI | | | |
| timeRestrictionForChannelMeasurements | | |  | Not configured | | | |
| timeRestrictionForInterferenceMeasurements | | |  | Not configured | | | |
| cqi-FormatIndicator | | |  | Wideband | | | |
| pmi-FormatIndicator | | |  | Wideband | | | |
| Sub-band Size | | | RB | 16 | | | |
| Csi-ReportingBand | | |  | 1111111 | | | |
| CSI-Report periodicity and offset | | | slot | 10/9 | | | |
| aperiodicTriggeringOffset | | |  | Not configured | | | |
| Codebook configuration | | Codebook Type |  | typeI-SinglePanel | | | |
| Codebook Mode |  | 1 | | | |
| (CodebookConfig-N1,CodebookConfig-N2) |  | Not configured | | | |
| CodebookSubsetRestriction |  | 000001 | | | |
| RI Restriction |  | N/A | | | |
| Physical channel for CSI report | | |  | PUCCH | | | |
| CQI/RI/PMI delay | | | ms | [14] | | | |
| Maximum number of HARQ transmission | | |  | 1 | | | |
| Measurement channel | | |  | As specified in Table A.4-1, TBS.1-5 | | | |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

 6.2.1.2.2 CQI reporting under fading conditions

6.2.1.2.2.1 Minimum requirement for wideband CQI reporting for RedCap

The purpose of the requirements is to verify that the RedCap UE is tracking the channel variations and selecting the largest transport format possible according to the prevailing channel state for the frequency non-selective scheduling.

The reporting accuracy of CQI under frequency non-selective fading conditions is determined by the reporting variance, the relative increase of the throughput obtained when the transport format is indicated by the reported CQI compared to the throughput obtained when a fixed transport format is configured according to the reported median CQI, and a minimum BLER using the transport formats indicated by the reported CQI. To account for sensitivity of the input SNR the reporting definition is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

For the parameters specified in Table 6.2.1.2.2.1-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

a) A CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least *α*% of the time where *α*% is specified in Table 6.2.1.2.2.1-2;

b) The ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be ≥ *γ*, where *γ* is specified in Table 6.2.1.2.2.1-2;

c) When transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater than or equal to 0.02.

**Table 6.2.1.2.2.1-1: Wideband CQI reporting test under frequency non-selective fading conditions**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Test 1** | | **Test 2** | |
| Bandwidth | | | MHz | 20 | | | |
| Subcarrier spacing | | | kHz | 30 | | | |
| Duplex Mode | | |  | TDD | | | |
| TDD UL-DL pattern | | |  | FR1.30-1 | | | |
| SNR | | | dB | [9] | [10] | [15] | [16] |
| Propagation channel | | |  | TDLA30-5 | | | |
| Antenna configuration | | |  | 2×1 | | | |
| Correlation configuration | | |  | ULA high | | | |
| Beamforming Model | | |  | As specified in Annex B.4.1 | | | |
| ZP CSI-RS configuration | CSI-RS resource Type | |  | Periodic | | | |
| Number of CSI-RS ports (*X*) | |  | 4 | | | |
| CDM Type | |  | FD-CDM2 | | | |
| Density (ρ) | |  | 1 | | | |
| First subcarrier index in the PRB used for CSI-RS (k0) | |  | Row 5,4 | | | |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | 9 | | | |
| CSI-RS  periodicity and offset | | slot | 10/1 | | | |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type | |  | Periodic | | | |
| Number of CSI-RS ports (*X*) | |  | 2 | | | |
| CDM Type | |  | FD-CDM2 | | | |
| Density (ρ) | |  | 1 | | | |
| First subcarrier index in the PRB used for CSI-RS (k0) | |  | Row 3,(6) | | | |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | 13 | | | |
| NZP CSI-RS-timeConfig  periodicity and offset | | slot | 10/1 | | | |
| CSI-IM configuration | CSI-IM resource Type | |  | Periodic | | | |
| CSI-IM RE pattern | |  | 0 | | | |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) | |  | (4, 9) | | | |
| CSI-IM timeConfig  periodicity and offset | | slot | 10/1 | | | |
| ReportConfigType | | |  | Periodic | | | |
| CQI-table | | |  | Table 1 | | | |
| reportQuantity | | |  | cri-RI-PMI-CQI | | | |
| timeRestrictionForChannelMeasurements | | |  | Not configured | | | |
| timeRestrictionForInterferenceMeasurements | | |  | Not configured | | | |
| cqi-FormatIndicator | | |  | Wideband | | | |
| pmi-FormatIndicator | | |  | Wideband | | | |
| Sub-band Size | | | RB | 16 | | | |
| Csi-ReportingBand | | |  | 1111111 | | | |
| CSI-Report periodicity and offset | | | slot | 10/9 | | | |
| aperiodicTriggeringOffset | | |  | Not configured | | | |
| Codebook configuration | | Codebook Type |  | typeI-SinglePanel | | | |
| Codebook Mode |  | 1 | | | |
| (CodebookConfig-N1,CodebookConfig-N2) |  | Not configured | | | |
| CodebookSubsetRestriction |  | 000001 | | | |
| RI Restriction |  | N/A | | | |
| Physical channel for CSI report | | |  | PUCCH | | | |
| CQI/RI/PMI delay | | | ms | [14] | | | |
| Maximum number of HARQ transmission | | |  | 1 | | | |
| Measurement channel | | |  | As specified in Table A.4-1, TBS.1-5 | | | |

**Table 6.2.1.2.2.1-2: Minimum requirements**

|  |  |  |
| --- | --- | --- |
| **Parameters** | **Test 1** | **Test 2** |
| ** [%] | 20 | 20 |
| ** | 1.05 | 1.05 |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

###### 6.2.2.1.1.4 Minimum requirement for periodic CQI reporting for RedCap

For the parameters specified in Table 6.2.2.1.1.4-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

a) The reported CQI value according to the reference channel shall be in the range of ±1 of the reported median more than 90% of the time.

b) If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 0.1.

Table 6.2.2.1.1.4-1: CQI reporting definition test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Test 1** | | **Test 2** | |
| Bandwidth | | | MHz | 10 | | | |
| Subcarrier spacing | | | kHz | 15 | | | |
| Duplex Mode | | |  | FDD | | | |
| SNR | | | dB | [8] | [9] | [14] | [15] |
| Propagation channel | | |  | AWGN | | | |
| Antenna configuration | | |  | 2×2 with static channel specified in Annex B.1 | | | |
| Beamforming Model | | |  | As specified in Annex B.4.1 | | | |
| ZP CSI-RS configuration | CSI-RS resource Type | |  | Periodic | | | |
| Number of CSI-RS ports (*X*) | |  | 4 | | | |
| CDM Type | |  | FD-CDM2 | | | |
| Density (ρ) | |  | 1 | | | |
| First subcarrier index in the PRB used for CSI-RS (k0) | |  | Row 5,4 | | | |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | 9 | | | |
| CSI-RS  periodicity and offset | | slot | 10/1 | | | |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type | |  | Periodic | | | |
| Number of CSI-RS ports (*X*) | |  | 2 | | | |
| CDM Type | |  | FD-CDM2 | | | |
| Density (ρ) | |  | 1 | | | |
| First subcarrier index in the PRB used for CSI-RS (k0) | |  | Row 3,(6) | | | |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | 13 | | | |
| NZP CSI-RS-timeConfig  periodicity and offset | | slot | 10/1 | | | |
| CSI-IM configuration | CSI-IM resource Type | |  | Periodic | | | |
| CSI-IM RE pattern | |  | 0 | | | |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) | |  | (4, 9) | | | |
| CSI-IM timeConfig  periodicity and offset | | slot | 10/1 | | | |
| ReportConfigType | | |  | Periodic | | | |
| CQI-table | | |  | Table 1 | | | |
| reportQuantity | | |  | cri-RI-PMI-CQI | | | |
| timeRestrictionForChannelMeasurements | | |  | Not configured | | | |
| timeRestrictionForInterferenceMeasurements | | |  | Not configured | | | |
| cqi-FormatIndicator | | |  | Wideband | | | |
| pmi-FormatIndicator | | |  | Wideband | | | |
| Sub-band Size | | | RB | 8 | | | |
| Csi-ReportingBand | | |  | 1111111 | | | |
| CSI-Report periodicity and offset | | | slot | 10/9 | | | |
| aperiodicTriggeringOffset | | |  | Not configured | | | |
| Codebook configuration | | Codebook Type |  | typeI-SinglePanel | | | |
| Codebook Mode |  | 1 | | | |
| (CodebookConfig-N1,CodebookConfig-N2) |  | Not configured | | | |
| CodebookSubsetRestriction |  | 010000 | | | |
| RI Restriction |  | N/A | | | |
| Physical channel for CSI report | | |  | PUCCH | | | |
| CQI/RI/PMI delay | | | ms | [14] | | | |
| Maximum number of HARQ transmission | | |  | 1 | | | |
| Measurement channel | | |  | As specified in Table A.4-1, TBS.1-4 | | | |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

###### 6.2.2.2.1.5 Minimum requirement for periodic CQI reporting for RedCap

The purpose of the requirements is to verify that the reported CQI values are in accordance with the CQI definition given in TS 38.214 [12]. The reporting accuracy of CQI under AWGN condition is determined by the reporting variance and BLER performance using the transport format indicated by the reported CQI median. To account for sensitivity of the input SNR the reporting definition is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

For the parameters specified in Table 6.2.2.2.1.5-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

a) The reported CQI value according to the reference channel shall be in the range of ±1 of the reported median more than 90% of the time.

b) If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 0.1.

Table 6.2.2.2.1.5-1: CQI reporting definition test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Test 1** | | **Test 2** | |
| Bandwidth | | | MHz | 20 | | | |
| Subcarrier spacing | | | kHz | 30 | | | |
| Duplex Mode | | |  | TDD | | | |
| TDD UL-DL pattern | | |  | FR1.30-1 | | | |
| SNR | | | dB | [8] | [9] | [14] | [15] |
| Propagation channel | | |  | AWGN | | | |
| Antenna configuration | | |  | 2×2 with static channel specified in Annex B.1 | | | |
| Beamforming Model | | |  | As specified in Annex B.4.1 | | | |
| ZP CSI-RS configuration | CSI-RS resource Type | |  | Periodic | | | |
| Number of CSI-RS ports (*X*) | |  | 4 | | | |
| CDM Type | |  | FD-CDM2 | | | |
| Density (ρ) | |  | 1 | | | |
| First subcarrier index in the PRB used for CSI-RS (k0) | |  | Row 5,4 | | | |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | 9 | | | |
| CSI-RS  periodicity and offset | | slot | 10/1 | | | |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type | |  | Periodic | | | |
| Number of CSI-RS ports (*X*) | |  | 2 | | | |
| CDM Type | |  | FD-CDM2 | | | |
| Density (ρ) | |  | 1 | | | |
| First subcarrier index in the PRB used for CSI-RS (k0) | |  | Row 3,(6) | | | |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | 13 | | | |
| NZP CSI-RS-timeConfig  periodicity and offset | | slot | 10/1 | | | |
| CSI-IM configuration | CSI-IM resource Type | |  | Periodic | | | |
| CSI-IM RE pattern | |  | 0 | | | |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) | |  | (4, 9) | | | |
| CSI-IM timeConfig  periodicity and offset | | slot | 10/1 | | | |
| ReportConfigType | | |  | Periodic | | | |
| CQI-table | | |  | Table 1 | | | |
| reportQuantity | | |  | cri-RI-PMI-CQI | | | |
| timeRestrictionForChannelMeasurements | | |  | Not configured | | | |
| timeRestrictionForInterferenceMeasurements | | |  | Not configured | | | |
| cqi-FormatIndicator | | |  | Wideband | | | |
| pmi-FormatIndicator | | |  | Wideband | | | |
| Sub-band Size | | | RB | 16 | | | |
| Csi-ReportingBand | | |  | 1111111 | | | |
| CSI-Report periodicity and offset | | | slot | 10/9 | | | |
| aperiodicTriggeringOffset | | |  | Not configured | | | |
| Codebook configuration | | Codebook Type |  | typeI-SinglePanel | | | |
| Codebook Mode |  | 1 | | | |
| (CodebookConfig-N1,CodebookConfig-N2) |  | Not configured | | | |
| CodebookSubsetRestriction |  | 010000 | | | |
| RI Restriction |  | N/A | | | |
| Physical channel for CSI report | | |  | PUCCH | | | |
| CQI/RI/PMI delay | | | ms | [14] | | | |
| Maximum number of HARQ transmission | | |  | 1 | | | |
| Measurement channel | | |  | As specified in Table A.4-1, TBS.1-6 | | | |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

 6.2.2.1.2.4 Minimum requirement for wideband CQI reporting for RedCap

The purpose of the requirements is to verify that the RedCap UE is tracking the channel variations and selecting the largest transport format possible according to the prevailing channel state for the frequency non-selective scheduling.

The reporting accuracy of CQI under frequency non-selective fading conditions is determined by the reporting variance, the relative increase of the throughput obtained when the transport format is indicated by the reported CQI compared to the throughput obtained when a fixed transport format is configured according to the reported median CQI, and a minimum BLER using the transport formats indicated by the reported CQI. To account for sensitivity of the input SNR the wideband CQI reporting under frequency selective fading conditions is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

For the parameters specified in Table 6.2.2.1.2.4-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

a) A CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least *α*% of the time where *α*% is specified in Table 6.2.2.1.2.4-2;

b) The ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be ≥ *γ*, where *γ* is specified in Table 6.2.2.1.2.4-2;

c) When transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater than or equal to 0.02.

**Table 6.2.2.1.2.4-1: Wideband CQI reporting test under frequency non-selective fading conditions**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Test 1** | |
| Bandwidth | | | MHz | 10 | |
| Subcarrier spacing | | | kHz | 15 | |
| Duplex Mode | | |  | FDD | |
| SNR | | | dB | [6] | [7] |
| Propagation channel | | |  | TDLA30-5 | |
| Antenna configuration | | |  | 2×2 | |
| Correlation configuration | | |  | ULA high | |
| Beamforming Model | | |  | As specified in Annex B.4.1 | |
| ZP CSI-RS configuration | CSI-RS resource Type | |  | Periodic | |
| Number of CSI-RS ports (*X*) | |  | 4 | |
| CDM Type | |  | FD-CDM2 | |
| Density (ρ) | |  | 1 | |
| First subcarrier index in the PRB used for CSI-RS (k0) | |  | Row 5,4 | |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | 9 | |
| CSI-RS  periodicity and offset | | slot | 10/1 | |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type | |  | Periodic | |
| Number of CSI-RS ports (*X*) | |  | 2 | |
| CDM Type | |  | FD-CDM2 | |
| Density (ρ) | |  | 1 | |
| First subcarrier index in the PRB used for CSI-RS (k0) | |  | Row 3,(6) | |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | 13 | |
| NZP CSI-RS-timeConfig  periodicity and offset | | slot | 10/1 | |
| CSI-IM configuration | CSI-IM resource Type | |  | Periodic | |
| CSI-IM RE pattern | |  | 0 | |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) | |  | (4, 9) | |
| CSI-IM timeConfig  periodicity and offset | | slot | 10/1 | |
| ReportConfigType | | |  | Periodic | |
| CQI-table | | |  | Table 1 | |
| reportQuantity | | |  | cri-RI-PMI-CQI | |
| timeRestrictionForChannelMeasurements | | |  | Not configured | |
| timeRestrictionForInterferenceMeasurements | | |  | Not configured | |
| cqi-FormatIndicator | | |  | Wideband | |
| pmi-FormatIndicator | | |  | Wideband | |
| Sub-band Size | | | RB | 8 | |
| Csi-ReportingBand | | |  | 1111111 | |
| CSI-Report periodicity and offset | | | slot | 10/9 | |
| aperiodicTriggeringOffset | | |  | Not configured | |
| Codebook configuration | | Codebook Type |  | typeI-SinglePanel | |
| Codebook Mode |  | 1 | |
| (CodebookConfig-N1,CodebookConfig-N2) |  | Not configured | |
| CodebookSubsetRestriction |  | 000001 | |
| RI Restriction |  | N/A | |
| Physical channel for CSI report | | |  | PUCCH | |
| CQI/RI/PMI delay | | | ms | [14] | |
| Maximum number of HARQ transmission | | |  | 1 | |
| Measurement channel | | |  | As specified in Table A.4-1, TBS.1-4 | |

**Table 6.2.2.1.2.4-2: Minimum requirements**

|  |  |
| --- | --- |
| **Parameters** | **Test 1** |
| ** [%] | 20 |
| ** | 1.05 |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

 6.2.2.2.2.4 Minimum requirement for wideband CQI reporting for RedCap

The purpose of the requirements is to verify that the RedCap UE is tracking the channel variations and selecting the largest transport format possible according to the prevailing channel state for the frequency non-selective scheduling.

The reporting accuracy of CQI under frequency non-selective fading conditions is determined by the reporting variance, the relative increase of the throughput obtained when the transport format is indicated by the reported CQI compared to the throughput obtained when a fixed transport format is configured according to the reported median CQI, and a minimum BLER using the transport formats indicated by the reported CQI. To account for sensitivity of the input SNR the reporting definition is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

For the parameters specified in Table 6.2.2.2.2.4-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

a) A CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least *α*% of the time where *α*% is specified in Table 6.2.2.2.2.4-2;

b) The ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be ≥ *γ*, where *γ* is specified in Table 6.2.2.2.2.4-2;

c) When transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater than or equal to 0.02.

**Table 6.2.2.2.2.4-1: Wideband CQI reporting test under frequency non-selective fading conditions**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Test 1** | |
| Bandwidth | | | MHz | 20 | |
| Subcarrier spacing | | | kHz | 30 | |
| Duplex Mode | | |  | TDD | |
| TDD UL-DL pattern | | |  | FR1.30-1 | |
| SNR | | | dB | [6] | [7] |
| Propagation channel | | |  | TDLA30-5 | |
| Antenna configuration | | |  | 2×2 | |
| Correlation configuration | | |  | ULA high | |
| Beamforming Model | | |  | As specified in Annex B.4.1 | |
| ZP CSI-RS configuration | CSI-RS resource Type | |  | Periodic | |
| Number of CSI-RS ports (*X*) | |  | 4 | |
| CDM Type | |  | FD-CDM2 | |
| Density (ρ) | |  | 1 | |
| First subcarrier index in the PRB used for CSI-RS (k0) | |  | Row 5,4 | |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | 9 | |
| CSI-RS  periodicity and offset | | slot | 10/1 | |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type | |  | Periodic | |
| Number of CSI-RS ports (*X*) | |  | 2 | |
| CDM Type | |  | FD-CDM2 | |
| Density (ρ) | |  | 1 | |
| First subcarrier index in the PRB used for CSI-RS (k0) | |  | Row 3,(6) | |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | 13 | |
| NZP CSI-RS-timeConfig  periodicity and offset | | slot | 10/1 | |
| CSI-IM configuration | CSI-IM resource Type | |  | Periodic | |
| CSI-IM RE pattern | |  | 0 | |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) | |  | (4, 9) | |
| CSI-IM timeConfig  periodicity and offset | | slot | 10/1 | |
| ReportConfigType | | |  | Periodic | |
| CQI-table | | |  | Table 1 | |
| reportQuantity | | |  | cri-RI-PMI-CQI | |
| timeRestrictionForChannelMeasurements | | |  | Not configured | |
| timeRestrictionForInterferenceMeasurements | | |  | Not configured | |
| cqi-FormatIndicator | | |  | Wideband | |
| pmi-FormatIndicator | | |  | Wideband | |
| Sub-band Size | | | RB | 16 | |
| Csi-ReportingBand | | |  | 1111111 | |
| CSI-Report periodicity and offset | | | slot | 10/9 | |
| aperiodicTriggeringOffset | | |  | Not configured | |
| Codebook configuration | | Codebook Type |  | typeI-SinglePanel | |
| Codebook Mode |  | 1 | |
| (CodebookConfig-N1,CodebookConfig-N2) |  | Not configured | |
| CodebookSubsetRestriction |  | 000001 | |
| RI Restriction |  | N/A | |
| Physical channel for CSI report | | |  | PUCCH | |
| CQI/RI/PMI delay | | | ms | [14] | |
| Maximum number of HARQ transmission | | |  | 1 | |
| Measurement channel | | |  | As specified in Table A.4-1, TBS.1-6 | |

**Table 6.2.2.2.2.4-2: Minimum requirements**

|  |  |
| --- | --- |
| **Parameters** | **Test 1** |
| ** [%] | 20 |
| ** | 1.05 |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

## 6.3 Reporting of Precoding Matrix Indicator (PMI)

The minimum performance requirements of PMI reporting are defined based on the precoding gain, expressed as the relative increase in throughput when the transmitter is configured according to the UE reported PMI compared to the case when the transmitter is using random precoding, respectively. When the transmitter uses random precoding, for each PDSCH allocation a precoder is randomly generated with equal propability of each applicable i1 and i2 combination and applied to the PDSCH. A fixed transport format (FRC) is configured for all requirements.

The requirements for transmission scheme 1 with higher layer parameter *codebookType* set to 'typeI-SinglePanel' are specified in terms of the ratio:



In the definition of *γ*, for 4TX, 8TX, 16TX, and 32TX PMI requirements, is 90 % of the maximum throughput obtained at  using the precoders configured according to the UE reports, and is the throughput measured at with random precoding.

The requirements for transmission scheme 1 with higher layer parameter *codebookType* set to 'typeII' or 'typeII-r16' are specified in terms of the ratio:



In the definition of *γ*, for 16TX PMI requirements, is 90 % of the maximum throughput obtained at  using the precoders configured according to the UE reports, and is the throughput measured at with random precoding.

### 6.3.1 1RX requirements

#### 6.3.1.1 FDD

##### 6.3.1.1.1 Single PMI with 4TX TypeI-SinglePanel Codebook

For the parameters specified in Table 6.3.1.1.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.1.1.1-2. The requirements are

Table 6.3.1.1.1-1: Test parameters (single layer)

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Test 1** |
| Bandwidth | | MHz | 10 |
| Subcarrier spacing | | kHz | 15 |
| Duplex Mode | |  | FDD |
| Propagation channel | |  | TDLA30-5 |
| Antenna configuration | |  | High ULA 4 x 1  (N1,N2) = (4,1) |
| Beamforming Model | |  | As specified in Annex B.4.1 |
| ZP CSI-RS configuration | CSI-RS resource Type |  | Periodic |
| Number of CSI-RS ports (*X*) |  | 4 |
| CDM Type |  | FD-CDM2 |
| Density (ρ) |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0) |  | Row 5,(4) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (9) |
| CSI-RS  periodicity and offset | slot | 5/1 |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type |  | Aperiodic |
| Number of CSI-RS ports (*X*) |  | 4 |
| CDM Type |  | FD-CDM2 |
| Density (ρ) |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0) |  | Row 4, (0) |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | (13) |
| CSI-RS  periodicity and offset |  | Not configured |
| aperiodicTriggeringOffset |  | 0 |
| CSI-IM configuration | CSI-IM resource Type |  | Aperiodic |
| CSI-IM RE pattern |  | Pattern 0 |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) |  | (4,9) |
| CSI-IM timeConfig  periodicity and offset | slot | Not configured |
| ReportConfigType | |  | Aperiodic |
| CQI-table | |  | Table 1 |
| reportQuantity | |  | cri-RI-PMI-CQI |
| timeRestrictionForChannelMeasurements | |  | Not configured |
| timeRestrictionForInterferenceMeasurements | |  | Not configured |
| cqi-FormatIndicator | |  | Wideband |
| pmi-FormatIndicator | |  | Wideband |
| Sub-band Size | | RB | 8 |
| csi-ReportingBand | |  | 1111111 |
| CSI-Report periodicity and offset | | slot | Not configured |
| Aperiodic Report Slot Offset | |  | 4 |
| CSI request | |  | 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0 |
| reportTriggerSize | |  | 1 |
| CSI-AperiodicTriggerStateList | |  | One State with one Associated Report Configuration  Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM |
| Codebook configuration | Codebook Type |  | typeI-SinglePanel |
| Codebook Mode |  | 1 |
| (CodebookConfig-N1,CodebookConfig-N2) |  | (2,1) |
| (CodebookConfig-O1,CodebookConfig-O2) |  | (4,1) |
| CodebookSubsetRestriction |  | 11111111 |
| RI Restriction |  | 00000001 |
| Physical channel for CSI report | |  | PUSCH |
| CQI/RI/PMI delay | | ms | 6 |
| Maximum number of HARQ transmission | |  | 4 |
| Measurement channel | |  | R.PDSCH.1-6.1 FDD  R.PDSCH.TBD HD-FDD |
| PDSCH & PDSCH DMRS Precoding configuration for random Precoding | |  | Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i1, i2 combination, and with Wideband granularity |
| Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable i1, i2 combination.  Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-3), this reported PMI cannot be applied at the gNB downlink before slot#(n+3).  Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3. | | | |

Table 6.3.1.1.1-2: Minimum requirement

|  |  |
| --- | --- |
| **Parameter** | **Test 1** |
| ** | 1.3 |

#### 6.3.1.2 TDD

##### 6.3.1.2.1 Single PMI with 4TX TypeI-SinglePanel Codebook

For the parameters specified in Table 6.3.1.2.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.1.2.1-2.

Table 6.3.1.2.1-1: Test parameters (single layer)

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Test 1** |
| Bandwidth | | MHz | 20 |
| Subcarrier spacing | | kHz | 30 |
| Duplex Mode | |  | TDD |
| TDD DL-UL configuration | |  | FR1.30-1 as specified in Annex A |
| Propagation channel | |  | TDLA30-5 |
| Antenna configuration | |  | ULA XP 4 x 1  (N1,N2) = (4,1) |
| Beamforming Model | |  | As specified in Annex B.4.1 |
| ZP CSI-RS configuration | CSI-RS resource Type |  | Periodic |
| Number of CSI-RS ports (*X*) |  | 4 |
| CDM Type |  | FD-CDM2 |
| Density (ρ) |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0) |  | Row 5,(4) |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | (9) |
| CSI-RS  periodicity and offset | slot | 10/1 |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type |  | Aperiodic |
| Number of CSI-RS ports (*X*) |  | 4 |
| CDM Type |  | FD-CDM2 |
| Density (ρ) |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0) |  | Row 4, (0) |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | (13) |
| CSI-RS  periodicity and offset | slot | Not configured |
| aperiodicTriggeringOffset |  | 0 |
| CSI-IM configuration | CSI-IM resource Type |  | Aperiodic |
| CSI-IM RE pattern |  | Pattern 0 |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) |  | (4,9) |
| CSI-IM timeConfig  periodicity and offset | slot | Not configured |
| ReportConfigType | |  | Aperiodic |
| CQI-table | |  | Table 1 |
| reportQuantity | |  | cri-RI-PMI-CQI |
| timeRestrictionForChannelMeasurements | |  | Not configured |
| timeRestrictionForInterferenceMeasurements | |  | Not configured |
| cqi-FormatIndicator | |  | Wideband |
| pmi-FormatIndicator | |  | Wideband |
| Sub-band Size | | RB | 8 |
| csi-ReportingBand | |  | 1111111 |
| CSI-Report periodicity and offset | | slot | Not configured |
| Aperiodic Report Slot Offset | |  | 8 |
| CSI request | |  | 1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0 |
| reportTriggerSize | |  | 1 |
| CSI-AperiodicTriggerStateList | |  | One State with one Associated Report Configuration  Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM |
| Codebook configuration | Codebook Type |  | typeI-SinglePanel |
| Codebook Mode |  | 1 |
| (CodebookConfig-N1,CodebookConfig-N2) |  | (2,1) |
| (CodebookConfig-O1,CodebookConfig-O2) |  | (4,1) |
| CodebookSubsetRestriction |  | 11111111 |
| RI Restriction |  | 00000001 |
| Physical channel for CSI report | |  | PUSCH |
| CQI/RI/PMI delay | | ms | 5.5 |
| Maximum number of HARQ transmission | |  | 4 |
| Measurement channel | |  | R.PDSCH.2-8.4 TDD |
| PDSCH & PDSCH DMRS Precoding configuration for random Precoding | |  | Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i1, i2 combination, and with Wideband granularity |
| Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable i1, i2 combination.  Note 2: If the UE reports in an available uplink reporting instance at slot #n based on PMI estimation at a downlink slot not later than slot#(n-4), this reported PMI cannot be applied at the gNB downlink before slot#(n+4).  Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3. | | | |

Table 6.3.2.2.1-2: Minimum requirement

|  |  |
| --- | --- |
| **Parameter** | **Test 1** |
| ** | 1.3 |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

##### 6.3.2.2.7 Single PMI with 4TX TypeI-SinglePanel Codebook

For the parameters specified in Table 6.3.2.2.7-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.2.7-2.

Table 6.3.2.2.7-1: Test parameters (single layer)

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Test 1** |
| Bandwidth | | MHz | 20 |
| Subcarrier spacing | | kHz | 30 |
| Duplex Mode | |  | TDD |
| TDD DL-UL configuration | |  | FR1.30-1 as specified in Annex A |
| Propagation channel | |  | TDLA30-5 |
| Antenna configuration | |  | High XP 4 x 2  (N1,N2) = (2,1) |
| Beamforming Model | |  | As specified in Annex B.4.1 |
| ZP CSI-RS configuration | CSI-RS resource Type |  | Periodic |
| Number of CSI-RS ports (*X*) |  | 4 |
| CDM Type |  | FD-CDM2 |
| Density (ρ) |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0) |  | Row 5,(4) |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | (9) |
| CSI-RS  periodicity and offset | slot | 10/1 |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type |  | Aperiodic |
| Number of CSI-RS ports (*X*) |  | 4 |
| CDM Type |  | FD-CDM2 |
| Density (ρ) |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0) |  | Row 4, (0) |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | (13) |
| CSI-RS  periodicity and offset | slot | Not configured |
| aperiodicTriggeringOffset |  | 0 |
| CSI-IM configuration | CSI-IM resource Type |  | Aperiodic |
| CSI-IM RE pattern |  | Pattern 0 |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) |  | (4,9) |
| CSI-IM timeConfig  periodicity and offset | slot | Not configured |
| ReportConfigType | |  | Aperiodic |
| CQI-table | |  | Table 1 |
| reportQuantity | |  | cri-RI-PMI-CQI |
| timeRestrictionForChannelMeasurements | |  | Not configured |
| timeRestrictionForInterferenceMeasurements | |  | Not configured |
| cqi-FormatIndicator | |  | Wideband |
| pmi-FormatIndicator | |  | Wideband |
| Sub-band Size | | RB | 8 |
| csi-ReportingBand | |  | 1111111 |
| CSI-Report periodicity and offset | | slot | Not configured |
| Aperiodic Report Slot Offset | |  | 8 |
| CSI request | |  | 1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0 |
| reportTriggerSize | |  | 1 |
| CSI-AperiodicTriggerStateList | |  | One State with one Associated Report Configuration  Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM |
| Codebook configuration | Codebook Type |  | typeI-SinglePanel |
| Codebook Mode |  | 1 |
| (CodebookConfig-N1,CodebookConfig-N2) |  | (2,1) |
| (CodebookConfig-O1,CodebookConfig-O2) |  | (4,1) |
| CodebookSubsetRestriction |  | 11111111 |
| RI Restriction |  | 00000001 |
| Physical channel for CSI report | |  | PUSCH |
| CQI/RI/PMI delay | | ms | 5.5 |
| Maximum number of HARQ transmission | |  | 4 |
| Measurement channel | |  | R.PDSCH.2-8.4 TDD |
| PDSCH & PDSCH DMRS Precoding configuration for random Precoding | |  | Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i1, i2 combination, and with Wideband granularity |
| Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable i1, i2 combination.  Note 2: If the UE reports in an available uplink reporting instance at slot #n based on PMI estimation at a downlink slot not later than slot#(n-4), this reported PMI cannot be applied at the gNB downlink before slot#(n+4).  Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3. | | | |

Table 6.3.2.2.7-2: Minimum requirement

|  |  |
| --- | --- |
| **Parameter** | **Test 1** |
| ** | 1.3 |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

### 6.4.2 2RX requirements

#### 6.4.2.1 FDD

The minimum performance requirement in Table 6.4.2.1-2 is defined as

a) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be ≥ ;

b) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 2 shall be ≥ ;

For the parameters specified in Table 6.4.2.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.4.2.1-2.

Table 6.4.2.1-1: RI Test (FDD)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Test 1** | **Test 2** | **Test 3** |
| Bandwidth | | | MHz | 10 | 10 | 10 |
| Subcarrier spacing | | | kHz | 15 | 15 | 15 |
| Duplex Mode | | |  | FDD | FDD | FDD |
| SNR | | | dB | 0 | 20 | 20 |
| Propagation channel | | |  | TDLA30-5 | TDLA30-5 | TDLA30-5 |
| Antenna configuration | | |  | ULA Low 2x2 | ULA Low 2x2 | ULA High 2x2 |
| Beamforming Model | | |  | As defined in Annex B.4.1 | As defined in Annex B.4.1 | As defined in Annex B.4.1 |
| ZP CSI-RS configuration | CSI-RS resource Type | |  | Periodic | Periodic | Periodic |
| Number of CSI-RS ports (*X*) | |  | 4 | 4 | 4 |
| CDM Type | |  | FD-CDM2 | FD-CDM2 | FD-CDM2 |
| Density (ρ) | |  | 1 | 1 | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0) | |  | Row 5,(4) | Row 5,(4) | Row 5,(4) |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | (9) | (9) | (9) |
| CSI-RS  periodicity and offset | | slot | 5/1 | 5/1 | 5/1 |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type | |  | Periodic | Periodic | Periodic |
| Number of CSI-RS ports (*X*) | |  | 2 | 2 | 2 |
| CDM Type | |  | FD-CDM2 | FD-CDM2 | FD-CDM2 |
| Density (ρ) | |  | 1 | 1 | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0) | |  | Row 3 (6) | Row 3 (6) | Row 3 (6) |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | (13) | (13) | (13) |
| NZP CSI-RS-timeConfig  periodicity and offset | | slot | 5/1 | 5/1 | 5/1 |
| CSI-IM configuration | CSI-IM resource Type | |  | Periodic | Periodic | Periodic |
| CSI-IM RE pattern | |  | Pattern 0 | Pattern 0 | Pattern 0 |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) | |  | (4,9) | (4,9) | (4,9) |
| CSI-IM timeConfig  periodicity and offset | | slot | 5/1 | 5/1 | 5/1 |
| ReportConfigType | | |  | Periodic | Periodic | Periodic |
| CQI-table | | |  | Table 2 | Table 2 | Table 2 |
| reportQuantity | | |  | cri-RI-PMI-CQI | cri-RI-PMI-CQI | cri-RI-PMI-CQI |
| timeRestrictionForChannelMeasurements | | |  | not configured | not configured | not configured |
| timeRestrictionForInterferenceMeasurements | | |  | not configured | not configured | not configured |
| cqi-FormatIndicator | | |  | Wideband | Wideband | Wideband |
| pmi-FormatIndicator | | |  | Wideband | Wideband | Wideband |
| Sub-band Size | | | RB | 8 | 8 | 8 |
| csi-ReportingBand | | |  | 1111111 | 1111111 | 1111111 |
| CSI-Report periodicity and offset | | | slot | 5/0 | 5/0 | 5/0 |
| Codebook configuration | | Codebook Type |  | typeI-SinglePanel | typeI-SinglePanel | typeI-SinglePanel |
| Codebook Mode |  | 1 | 1 | 1 |
| (CodebookConfig-N1,CodebookConfig-N2) |  | N/A | N/A | N/A |
| CodebookSubsetRestriction |  | 010000 for fixed rank 2,  010011 for following rank | 000011 for fixed rank 1,  010011 for following rank | 000011 for fixed rank 1,  010011 for following rank |
| RI Restriction |  | N/A | N/A | N/A |
| Physical channel for CSI report | | |  | PUCCH | PUCCH | PUCCH |
| CQI/RI/PMI delay | | | ms | 8 | 8 | 8 |
| Maximum number of HARQ transmission | | |  | 1 | 1 | 1 |
| RI Configuration | | |  | Fixed RI = 2 and follow RI | Fixed RI = 1 and follow RI | Fixed RI = 1 and follow RI |
| Note 1: Measurements channels are specified in Table A.4-2. TBS.2-1 is used for Rank 1 case. TBS.2-2 is used for Rank 2 case. | | | | | | |

Table 6.4.2.1-2: Minimum requirement (FDD)

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Test 1** | **Test 2** | **Test 3** |
| **1 | N/A | 1.05 | 0.9 |
| **2 | 1.0 | N/A | N/A |

##### 6.4.2.1.1 Minimum requirements for RedCap

The minimum performance requirement in Table 6.4.2.1.1-2 is defined as the ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be ≥ .

For the parameters specified in Table 6.4.2.1.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.4.2.1.1-2.

Table 6.4.2.1.1-1: RI Test (FDD)

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Test 1** |
| Bandwidth | | MHz | 10 |
| Subcarrier spacing | | kHz | 15 |
| Duplex Mode | |  | FDD |
| SNR | | dB | [20] |
| Propagation channel | |  | TDLA30-5 |
| Antenna configuration | |  | ULA Low 2x2 |
| Beamforming Model | |  | As defined in Annex B.4.1 |
| ZP CSI-RS configuration | CSI-RS resource Type |  | Periodic |
| Number of CSI-RS ports (*X*) |  | 4 |
| CDM Type |  | FD-CDM2 |
| Density (ρ) |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0) |  | Row 5,(4) |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | (9) |
| CSI-RS  periodicity and offset | slot | 10/1 |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type |  | Periodic |
| Number of CSI-RS ports (*X*) |  | 2 |
| CDM Type |  | FD-CDM2 |
| Density (ρ) |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0) |  | Row 3 (6) |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | (13) |
| NZP CSI-RS-timeConfig  periodicity and offset | slot | 10/1 |
| CSI-IM configuration | CSI-IM resource Type |  | Periodic |
| CSI-IM RE pattern |  | 0 |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) |  | (4,9) |
| CSI-IM timeConfig  periodicity and offset | slot | 10/1 |
| ReportConfigType | |  | Periodic |
| CQI-table | |  | Table 1 |
| reportQuantity | |  | cri-RI-PMI-CQI |
| timeRestrictionForChannelMeasurements | |  | not configured |
| timeRestrictionForInterferenceMeasurements | |  | not configured |
| cqi-FormatIndicator | |  | Wideband |
| pmi-FormatIndicator | |  | Wideband |
| Sub-band Size | | RB | 8 |
| csi-ReportingBand | |  | 1111111 |
| CSI-Report periodicity and offset | | slot | 10/9 |
| Codebook configuration | Codebook Type |  | typeI-SinglePanel |
| Codebook Mode |  | 1 |
| (CodebookConfig-N1,CodebookConfig-N2) |  | N/A |
| CodebookSubsetRestriction |  | 000011 for fixed rank 1, 010011 for following rank |
| RI Restriction |  | N/A |
| Physical channel for CSI report | |  | PUCCH |
| CQI/RI/PMI delay | | ms | [14] |
| Maximum number of HARQ transmission | |  | 1 |
| RI Configuration | |  | Fixed RI = 1 and follow RI |
| Note 1: Measurement channels are specified in Table A.4-1.  TBS.1-3 is used for Rank 1 case. TBS.1-4 is used for Rank 2 case. | | | |

Table 6.4.2.1.1-2: Minimum requirement (FDD)

|  |  |
| --- | --- |
|  | **Test 1** |
| **1 | 1.05 |

#### 6.4.2.2 TDD

The minimum performance requirement in Table 6.4.2.2-2 is defined as

a) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be ≥ ;

b) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 2 shall be ≥ ;

For the parameters specified in Table 6.4.2.2-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.4.2.2-2.

Table 6.4.2.2-1: RI Test (TDD)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Test 1** | **Test 2** | **Test 3** |
| Bandwidth | | | MHz | 40 | 40 | 40 |
| Subcarrier spacing | | | kHz | 30 | 30 | 30 |
| Duplex Mode | | |  | TDD | TDD | TDD |
| TDD Slot Configuration | | |  | FR1.30-1 | FR1.30-1 | FR1.30-1 |
| SNR | | | dB | 0 | 20 | 20 |
| Propagation channel | | |  | TDLA30-5 | TDLA30-5 | TDLA30-5 |
| Antenna configuration | | |  | ULA Low 2x2 | ULA Low 2x2 | ULA High 2x2 |
| Beamforming Model | | |  | As defined in Annex B.4.1 | As defined in Annex B.4.1 | As defined in Annex B.4.1 |
| ZP CSI-RS configuration | CSI-RS resource Type | |  | Periodic | Periodic | Periodic |
| Number of CSI-RS ports (*X*) | |  | 4 | 4 | 4 |
| CDM Type | |  | FD-CDM2 | FD-CDM2 | FD-CDM2 |
| Density (ρ) | |  | 1 | 1 | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0) | |  | Row 5,(4) | Row 5,(4) | Row 5,(4) |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | (9) | (9) | (9) |
| CSI-RS  periodicity and offset | | slot | 10/1 | 10/1 | 10/1 |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type | |  | Periodic | Periodic | Periodic |
| Number of CSI-RS ports (*X*) | |  | 2 | 2 | 2 |
| CDM Type | |  | FD-CDM2 | FD-CDM2 | FD-CDM2 |
| Density (ρ) | |  | 1 | 1 | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0) | |  | Row 3 (6) | Row 3 (6) | Row 3 (6) |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | (13) | (13) | (13) |
| NZP CSI-RS-timeConfig  periodicity and offset | | slot | 10/1 | 10/1 | 10/1 |
| CSI-IM configuration | CSI-IM resource Type | |  | Periodic | Periodic | Periodic |
| CSI-IM RE pattern | |  | Pattern 0 | Pattern 0 | Pattern 0 |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) | |  | (4,9) | (4,9) | (4,9) |
| CSI-IM timeConfig  periodicity and offset | | slot | 10/1 | 10/1 | 10/1 |
| ReportConfigType | | |  | Periodic | Periodic | Periodic |
| CQI-table | | |  | Table 2 | Table 2 | Table 2 |
| reportQuantity | | |  | cri-RI-PMI-CQI | cri-RI-PMI-CQI | cri-RI-PMI-CQI |
| timeRestrictionForChannelMeasurements | | |  | not configured | not configured | not configured |
| timeRestrictionForInterferenceMeasurements | | |  | not configured | not configured | not configured |
| cqi-FormatIndicator | | |  | Wideband | Wideband | Wideband |
| pmi-FormatIndicator | | |  | Wideband | Wideband | Wideband |
| Sub-band Size | | | RB | 16 | 16 | 16 |
| csi-ReportingBand | | |  | 1111111 | 1111111 | 1111111 |
| CSI-Report periodicity and offset | | | slot | 10/9 | 10/9 | 10/9 |
| Codebook configuration | | Codebook Type |  | typeI-SinglePanel | typeI-SinglePanel | typeI-SinglePanel |
| Codebook Mode |  | 1 | 1 | 1 |
| (CodebookConfig-N1,CodebookConfig-N2) |  | N/A | N/A | N/A |
| CodebookSubsetRestriction |  | 010000 for fixed rank 2,  010011 for following rank | 000011 for fixed rank 1,  010011 for following rank | 000011 for fixed rank 1,  010011 for following rank |
| RI Restriction |  | N/A | N/A | N/A |
| Physical channel for CSI report | | |  | PUCCH | PUCCH | PUCCH |
| CQI/RI/PMI delay | | | ms | 9.5 | 9.5 | 9.5 |
| Maximum number of HARQ transmission | | |  | 1 | 1 | 1 |
| RI Configuration | | |  | Fixed RI = 2 and follow RI | Fixed RI = 1 and follow RI | Fixed RI = 1 and follow RI |
| Note 1: Measurements channels are specified in Table A.4-2. TBS.2-3 is used for Rank 1 case. TBS.2-4 is used for Rank 2 case. | | | | | | |

Table 6.4.2.2-2: Minimum requirement (TDD)

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Test 1** | **Test 2** | **Test 3** |
| **1 | N/A | 1.05 | 0.9 |
| **2 | 1.0 | N/A | N/A |

##### 6.4.2.2.1 Minimum requirements for RedCap

The minimum performance requirement in Table 6.4.2.2.1-2 is defined as the ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be ≥ .

For the parameters specified in Table 6.4.2.2.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.4.2.2.1-2.

Table 6.4.2.2.1-1: RI Test (TDD)

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Test 1** |
| Bandwidth | | MHz | 20 |
| Subcarrier spacing | | kHz | 30 |
| Duplex Mode | |  | TDD |
| TDD Slot Configuration | |  | FR1.30-1 |
| SNR | | dB | [20] |
| Propagation channel | |  | TDLA30-5 |
| Antenna configuration | |  | ULA Low 2x2 |
| Beamforming Model | |  | As defined in Annex B.4.1 |
| ZP CSI-RS configuration | CSI-RS resource Type |  | Periodic |
| Number of CSI-RS ports (*X*) |  | 4 |
| CDM Type |  | FD-CDM2 |
| Density (ρ) |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0) |  | Row 5,(4) |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | (9) |
| CSI-RS  periodicity and offset | slot | 10/1 |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type |  | Periodic |
| Number of CSI-RS ports (*X*) |  | 2 |
| CDM Type |  | FD-CDM2 |
| Density (ρ) |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0) |  | Row 3 (6) |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | (13) |
| NZP CSI-RS-timeConfig  periodicity and offset | slot | 10/1 |
| CSI-IM configuration | CSI-IM resource Type |  | Periodic |
| CSI-IM RE pattern |  | 0 |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) |  | (4,9) |
| CSI-IM timeConfig  periodicity and offset | slot | 10/1 |
| ReportConfigType | |  | Periodic |
| CQI-table | |  | Table 1 |
| reportQuantity | |  | cri-RI-PMI-CQI |
| timeRestrictionForChannelMeasurements | |  | not configured |
| timeRestrictionForInterferenceMeasurements | |  | not configured |
| cqi-FormatIndicator | |  | Wideband |
| pmi-FormatIndicator | |  | Wideband |
| Sub-band Size | | RB | 16 |
| csi-ReportingBand | |  | 1111111 |
| CSI-Report periodicity and offset | | slot | 10/9 |
| Codebook configuration | Codebook Type |  | typeI-SinglePanel |
| Codebook Mode |  | 1 |
| (CodebookConfig-N1,CodebookConfig-N2) |  | N/A |
| CodebookSubsetRestriction |  | 000011 for fixed rank 1, 010011 for following rank |
| RI Restriction |  | N/A |
| Physical channel for CSI report | |  | PUCCH |
| CQI/RI/PMI delay | | ms | [14] |
| Maximum number of HARQ transmission | |  | 1 |
| RI Configuration | |  | Fixed RI = 1 and follow RI |
| Note 1: Measurement channels are specified in Table A.4-1.  TBS.1-5 is used for Rank 1 case. TBS.1-6 is used for Rank 2 case. | | | |

Table 6.4.2.2.1-2: Minimum requirement (TDD)

|  |  |
| --- | --- |
|  | **Test 1** |
| **1 | 1.05 |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

### 7.1.1 Applicability of requirements

#### 7.1.1.1 General

The minimum performance requirements are applicable to the FR2 operating bands defined in TS 38.101-2 [7] with FDL\_high not exceeding 48200 MHz. Additional applicability rules for certain operating bands are specified in Clause 7.1.1.6.

The minimum performance requirements in Clause 7 are mandatary for UE supporting NR operation, except test cases listed in Clause 7.1.1.3, 7.1.1.4, 7.1.1.5, 7.1.1.7.

If same test is listed for different UE features/capabilities in Clauses 7.1.1.3 and 7.1.1.4, then this test shall apply for UEs which support all corresponding UE features/capabilities.

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

7.1.1.7 Applicability of requirements for RedCap

The performance requirements in Table 7.1.1.7-1 shall apply for UEs which support optional feature *supportOfRedCap*.

Table 7.1.1.7-1: Requirements applicability for RedCap

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| UE capability | Test type | | Test list | Applicability notes |
| RedCap with 2RX | FR2 TDD | PDSCH | Clause 7.2.2.2.1 (Tests 1-1, 2-2, and 2-6) |  |
|  |  | PDCCH | Clause 7.3.2.2.1 (Test 1-2)  Clause 7.3.2.2.2 (Test 2-1) |  |
|  |  | PBCH | Clause 7.4.2.2 (Table 7.4.2.2-2 Tests 1 and 2)  Clause 7.4.2.2 (Table 7.4.2.2-3 Tests 1 and 2) |  |
|  |  | SDR | Clause 7.5.1 |  |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

## 7.5 Sustained downlink data rate provided by lower layers

### 7.5.1 FR2 single carrier requirements

The requirements in this clause are applicable to the FR2 single carrier case.

The requirements and procedure defined in Clause 7.5A.1 apply using operating band instead of CA configuration, and bandwidth instead of bandwidth combination.

Table 7.5A.1-1: Test parameters for FR2 TDD

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | | Unit | Value |
| PDSCH transmission scheme | | |  | Transmission scheme 1 |
| PTRS epre-Ratio | | |  | 0 |
| Channel bandwidth | | | MHz | Channel bandwidth from selected CA bandwidth combination |
| Common serving cell parameters | Physical Cell ID | |  | 0 |
| SSB position in burst | |  | First SSB in Slot #0 |
| SSB periodicity | | ms | 20 |
| First DMRS position for Type A PDSCH mapping | |  | 2 |
| Cross carrier scheduling | | |  | Not configured |
| Active DL BWP index | | |  | 1 |
| Actual carrier configuration | Offset between Point A and the lowest usable subcarrier on this carrier (Note 3) | | RBs | 0 |
| Subcarrier spacing | | kHz | 60 or 120 |
| DL BWP configuration #1 | RB Offset | |  | 0 |
| Number of contiguous PRB | |  | Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-2 [7] for tested channel bandwidth and subcarrier spacing |
| Subcarrier spacing | | kHz | 60 or 120 |
| Cyclic prefix | |  | Normal |
| PDCCH configuration | Slots for PDCCH monitoring | |  | Each slot |
| Symbols with PDCCH | |  | Symbols #0 |
| Number of PRBs in CORESET | |  | Table 7.5A.1-2 |
| Number of PDCCH candidates and aggregation levels | |  | 1/8 |
| CCE-to-REG mapping type | |  | Non-interleaved |
| DCI format | |  | 1-1 |
| TCI State | |  | TCI state #1 |
| PDCCH &PDCCH DMRS Precoding configuration | |  | Single Panel Type I, Random per slot with equal probability of precoder index 0 and 2, and with REG bundling granularity for number of Tx larger than 1 |
| PDSCH configuration | Mapping type | |  | Type A |
| k0 | |  | 0 |
| PDSCH aggregation factor | |  | 1 |
| PRB bundling type | |  | Static |
| PRB bundling size | |  | wideband |
| Resource allocation type | |  | Type 0 |
| RBG size | |  | Config2 |
| VRB-to-PRB mapping type | |  | Non-interleaved |
| VRB-to-PRB mapping interleaver bundle size | |  | N/A |
| Starting symbol (S) | |  | 1 |
| Length (L) | |  | 13 |
| PDSCH DMRS configuration | DMRS Type | |  | Type 1 |
| Number of additional DMRS | |  | 1 |
| Length | |  | 1 |
| Antenna ports indexes | |  | {1000} for 1 Layer CCs {1000, 1001} for 2 Layers CCs |
| Number of PDSCH DMRS CDM group(s) without data | |  | 1 |
| PTRS configuration | Frequency density (*KPT-RS*) | |  | 2 |
| Time density (*LPT-RS*) | |  | 1 |
| CSI-RS for tracking | Subcarrier indexes in the PRB used for CSI-RS | |  | k0 = 3 for CSI-RS resource 1,2,3,4 |
| OFDM symbols in the PRB used for CSI-RS | |  | l0 = 6 for CSI-RS resource 1 and 3  l0 = 10 for CSI-RS resource 2 and 4 |
| Number of CSI-RS ports (X) | |  | 1 for CSI-RS resource 1,2,3,4 |
| CDM Type | |  | 'No CDM' for CSI-RS resource 1,2,3,4 |
| Density (ρ) | |  | 3 for CSI-RS resource 1,2,3,4 |
| CSI-RS periodicity | | Slots | 60 kHz SCS: 80 for CSI-RS resource 1,2,3,4  120 kHz SCS: 160 for CSI-RS resource 1,2,3,4 |
| CSI-RS offset | | Slots | 60 kHz SCS:  40 for CSI-RS resource 1 and 2  41 for CSI-RS resource 3 and 4  120 kHz SCS:  80 for CSI-RS resource 1 and 2  81 for CSI-RS resource 3 and 4 |
| Frequency Occupation | |  | Start PRB 0  Number of PRB = ceil(BWP size/4)\*4 |
| QCL info | |  | TCI state #0 |
| NZP CSI-RS for CSI acquisition | Subcarrier indexes in the PRB used for CSI-RS | |  | k0 = 4 |
| OFDM symbols in the PRB used for CSI-RS | |  | l0 = 13 |
| Number of CSI-RS ports (X) | |  | Same as number of transmit antenna |
| CDM Type | |  | 'FD-CDM2' |
| Density (ρ) | |  | 1 |
| CSI-RS periodicity | | Slots | 60 kHz SCS: 80  120 kHz SCS: 160 |
| CSI-RS offset | |  | 0 |
| Frequency Occupation | |  | Start PRB 0  Number of PRB = ceil(BWP size/4)\*4 |
| QCL info | |  | TCI state #1 |
| ZP CSI-RS for CSI acquisition | Subcarrier indexes in the PRB used for CSI-RS | |  | k0 = 0 |
| OFDM symbols in the PRB used for CSI-RS | |  | l0 = 12 |
| Number of CSI-RS ports (X) | |  | 4 |
| CDM Type | |  | 'FD-CDM2' |
| Density (ρ) | |  | 1 |
| CSI-RS periodicity | | Slots | 60 kHz SCS: 80  120 kHz SCS: 160 |
| CSI-RS offset | |  | 0 |
| Frequency Occupation | |  | Start PRB 0  Number of PRB = ceil(BWP size/4)\*4 |
| CSI-RS for beam refinement | First subcarrier index in the PRB used for CSI-RS | |  | k0=0 for CSI-RS resource 1,2 |
| First OFDM symbol in the PRB used for CSI-RS | |  | l0 = 8 for CSI-RS resource 1  l0 = 9 for CSI-RS resource 2 |
| Number of CSI-RS ports (X) | |  | 1 for CSI-RS resource 1,2 |
| CDM Type | |  | 'No CDM' for CSI-RS resource 1,2 |
| Density (ρ) | |  | 3 for CSI-RS resource 1,2 |
| CSI-RS periodicity | | Slots | 60 kHz SCS: 80 for CSI-RS resource 1,2  120 kHz SCS: 160 for CSI-RS resource 1,2 |
| CSI-RS offset | | Slots | 0 for CSI-RS resource 1,2 |
| Frequency Occupation | |  | Start PRB 0  Number of PRB = ceil(BWP size/4)\*4 |
| Repetition | |  | ON |
| QCL info | |  | TCI state #1 |
| TCI state #0 | Type 1 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type D |
| TCI state #1 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking' configuration |
| QCL Type |  | Type D |
| Maximum number of code block groups for ACK/NACK feedback | | |  | 1 |
| Number of HARQ Processes | | |  | 10 for FR2.60-1 and 8 for FR2.120-1 |
| K1 value | | |  | Specific to each UL-DL pattern |
| Maximum number of HARQ transmission | | |  | 4 |
| HARQ ACK/NACK bundling | | |  | Multiplexed |
| Redundancy version coding sequence | | |  | {0,2,3,1} |
| TDD UL-DL pattern | | |  | 60 kHz SCS: FR2.60-1  120 kHz SCS: FR2.120-1 |
| PDSCH & PDSCH DMRS Precoding configuration | | |  | Single Panel Type I, Precoder index 0 per slot with Wideband granularity for Rank 2 |
| Symbols for all unused REs | | |  | OP.1 FDD as defined in Annex A.5.1.1  OP.1 TDD as defined in Annex A.5.2.1 |
| Propagation condition | | |  | Static propagation condition  No external noise sources are applied |
| Antenna configuration | 1 layer CCs | |  | 1x2 or 1x4 |
| 2 layers CCs | |  | 2x2 or 2x4 |
| Antenna configuration for RedCap | 1 layer | |  | 1x2 |
| 2 layers | |  | 2x2 |
| Physical signals, channels mapping and precoding | | |  | As specified in Annex B.4.1 |
| Note 1: PDSCH is scheduled only on full DL slots not containing SSB or TRS.  Note 2: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH transmission.  Note 3: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-2 [7] for tested channel bandwidth and subcarrier spacing. | | | | |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

### 8.1.1 Applicability of requirements

#### 8.1.1.1 General

The minimum performance requirements are applicable to the FR2 operating bands defined in TS 38.101-2 [7] with FDL\_high not exceeding 48200 MHz.

The minimum performance requirements in Clause 8 are mandatory for UE supporting NR operation, except test cases listed in Clause 8.1.1.3, 8.1.1.4, 8.1.1.5, 8.1.1.6.

If same test is listed for different UE features/capabilities in Clauses 8.1.1.3 and 8.1.1.4, then this test shall apply for UEs which support all corresponding UE features/capabilities.

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

#### 8.1.1.6 Applicability of requirements for RedCap

The performance requirements in Table 8.1.1.6-1 shall apply for UEs which support optional feature *supportOfRedCap*.

Table 8.1.1.6-1: Requirements applicability for RedCap

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| UE capability | Test type | | Test list | Applicability notes |
| RedCap with 2RX | FR2 TDD | CQI | Clause 8.2.2.2.1.1 (Tests 1 and 2)  Clause 8.2.2.2.2.1 (Test 1) |  |
|  |  | PMI | Clause 8.3.2.2.1 (Tests 2) |  |
|  |  | RI | Clause 8.4.2.2 (Test 2) |  |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

Table A.3.2.1.1-3: PDSCH Reference Channel for FDD (64QAM)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **Value** | | | | |
| Reference channel |  | R.PDSCH.1-3.1 FDD | R.PDSCH.1-3.2 FDD | R.PDSCH.1-3.3 FDD | R.PDSCH.1-3.4 FDD | R.PDSCH.1-3.5 FDD |
| Channel bandwidth | MHz | 10 | 10 | 10 | 10 | 10 |
| Subcarrier spacing | kHz | 15 | 15 | 15 | 15 | 15 |
| Number of allocated resource blocks | PRBs | 52 | 52 | 26 (Note 3) | 26 (Note 4) | 52 |
| Number of consecutive PDSCH symbols |  | 12 | 12 | 12 | 12 | 12 |
| Allocated slots per 2 frames | Slots | 19 | 19 | 19 | 19 | 19 |
| MCS table |  | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| MCS index |  | 19 | 19 | 19 | 19 | 19 |
| Modulation |  | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Target Coding Rate |  | 0.51 | 0.51 | 0.51 | 0.51 | 0.51 |
| Number of MIMO layers |  | 2 | 2 | 2 | 2 | 1 |
| Number of DMRS REs |  | 12 | 24 | 24 | 24 | 12 |
| Overhead for TBS determination |  | 0 | 0 | 0 | 0 | 0 |
| Information Bit Payload per Slot |  |  |  |  |  |  |
| For Slot i = 0 | Bits | N/A | N/A | N/A | N/A | N/A |
| For Slots i = 1,…, 19 | Bits | 42016 | 37896 | 18960 | 18960 | 21000 |
| Transport block CRC per Slot |  |  |  |  |  |  |
| For Slot i = 0 | Bits | N/A | N/A | N/A | N/A | N/A |
| For Slots i = 1,…, 19 | Bits | 24 | 24 | 24 | 24 | 24 |
| Number of Code Blocks per Slot |  |  |  |  |  |  |
| For Slot i = 0 | CBs | N/A | N/A | N/A | N/A | N/A |
| For Slots i = 1,…, 19 | CBs | 5 | 5 | 3 | 3 | 3 |
| Binary Channel Bits Per Slot |  |  |  |  |  |  |
| For Slot i = 0 | Bits | N/A | N/A | N/A | N/A | N/A |
| For Slots i = 10, 11 | Bits | 78624 | 67392 | 33696 | 33696 | 39312 |
| For Slots i = 1,…, 9, 12, …, 19 | Bits | 82368 | 74880 | 37440 | 37440 | 41184 |
| Max. Throughput averaged over 2 frames | Mbps | 39.915 | 36.001 | 18.012 | 18.012 | 19.950 |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms  Note 2: Slot i is slot index per 2 frames  Note 3: PDSCH is scheduled in PRB numbers from 0 to 25.  Note 4: PDSCH is scheduled in PRB numbers from 26 to 51. | | | | | | |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

 Table A.3.2.1.1-4: PDSCH Reference Channel for FDD (256QAM)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **Value** | | | | |
| Reference channel |  | R.PDSCH.1-4.1 FDD | R.PDSCH.1-4.2 FDD |  |  |  |
| Channel bandwidth | MHz | 10 | 10 |  |  |  |
| Subcarrier spacing | kHz | 15 | 15 |  |  |  |
| Number of allocated resource blocks | PRBs | 52 | 52 |  |  |  |
| Number of consecutive PDSCH symbols |  | 12 | 12 |  |  |  |
| Allocated slots per 2 frames | Slots | 19 | 19 |  |  |  |
| MCS table |  | 256QAM | 256QAM |  |  |  |
| MCS index |  | 24 | 20 |  |  |  |
| Modulation |  | 256QAM | 256QAM |  |  |  |
| Target Coding Rate |  | 0.82 | 0.67 |  |  |  |
| Number of MIMO layers |  | 1 | 1 |  |  |  |
| Number of DMRS REs |  | 12 | 12 |  |  |  |
| Overhead for TBS determination |  | 0 | 0 |  |  |  |
| Information Bit Payload per Slot |  |  |  |  |  |  |
| For Slot i = 0 | Bits | N/A | N/A |  |  |  |
| For Slots i = 1,…, 19 | Bits | 45096 | 36896 |  |  |  |
| Transport block CRC per Slot |  |  |  |  |  |  |
| For Slot i = 0 | Bits | N/A | N/A |  |  |  |
| For Slots i = 1,…, 19 | Bits | 24 | 24 |  |  |  |
| Number of Code Blocks per Slot |  |  |  |  |  |  |
| For Slot i = 0 | CBs | N/A | N/A |  |  |  |
| For Slots i = 1,…, 19 | CBs | 6 | 5 |  |  |  |
| Binary Channel Bits Per Slot |  |  |  |  |  |  |
| For Slot i = 0 | Bits | N/A | N/A |  |  |  |
| For Slots i = 10, 11 | Bits | 52416 | 52416 |  |  |  |
| For Slots i = 1,…, 9, 12, …, 19 | Bits | 54912 | 54912 |  |  |  |
| Max. Throughput averaged over 2 frames | Mbps | 42.841 | 35.051 |  |  |  |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms  Note 2: Slot i is slot index per 2 frames | | | | | | |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

Table A.3.2.2.2-1: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-1 and FR1.30-1A (QPSK)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **Value** | | | | |
| Reference channel |  | R.PDSCH.2-1.1 TDD | R.PDSCH.2-1.2 TDD | R.PDSCH.2-1.3 TDD | R.PDSCH.2-1.4 TDD | R.PDSCH.2-1.5 TDD |
| Channel bandwidth | MHz | 40 | 40 | 40 | 40 | 20 |
| Subcarrier spacing | kHz | 30 | 30 | 30 | 30 | 30 |
| Allocated resource blocks | PRBs | 106 | 6 | 106 | 106 | 51 |
| Number of consecutive PDSCH symbols |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} |  | N/A | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} |  | 4 | 4 | N/A | N/A | 4 |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} |  | 12 | 12 | 7 | 12 | 12 |
| Allocated slots per 2 frames |  | 31 | 31 | 27 | 27 | 31 |
| MCS table |  | 64QAM | 64QAM | 64QAM | 64QAMLowSE | 64QAM |
| MCS index |  | 4 | 4 | 4 | 14 | 4 |
| Modulation |  | QPSK | QPSK | QPSK | QPSK | QPSK |
| Target Coding Rate |  | 0.30 | 0.30 | 0.30 | 0.59 | 0.30 |
| Number of MIMO layers |  | 1 | 1 | 1 | 1 | 1 |
| Number of DMRS REs |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} |  | N/A | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} |  | 6 | 6 | N/A | N/A | 6 |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} |  | 18 | 12 | 12 | 12 | 18 |
| Overhead for TBS determination |  | 0 | 0 | 0 | 0 | 0 |
| Information Bit Payload per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | Bits | N/A | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | Bits | 2664 | 144 | N/A | N/A | 1288 |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} | Bits | 8064 | 480 | 4608 | 16392 | 3840 |
| Transport block CRC per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | Bits | N/A | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | Bits | 16 | 16 | N/A | N/A | 16 |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} | Bits | 24 | 16 | 24 | 24 | 24 |
| Number of Code Blocks per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | CBs | N/A | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | CBs | 1 | 1 | N/A | N/A | 1 |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} | CBs | 1 | 1 | 1 | 2 | 1 |
| Binary Channel Bits Per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | Bits | N/A | N/A | N/A | N/A | N/A |
| For Slots i = 20, 21 | Bits | 25440 | 1512 | 13992 | 26712 | 12240 |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | Bits | 8904 | 504 | N/A | N/A | 4284 |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,19,22,…,39} | Bits | 26712 | 1584 | 15264 | 27984 | 12852 |
| Max. Throughput averaged over 2 frames | Mbps | 11.419 | 0.677 | 6.221 | 22.129 | 5442 |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms  Note 2: Slot i is slot index per 2 frames | | | | | | |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

 Table A.3.2.2.2-3: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-1 (64QAM)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **Value** | | | | |
| Reference channel |  | R.PDSCH.2-3.1 TDD | R.PDSCH.2-3.2 TDD | R.PDSCH.2-3.3 TDD | R.PDSCH.2-3.4 TDD | R.PDSCH.2-3.5 TDD |
| Channel bandwidth | MHz | 40 | 40 | 40 | 40 | 20 |
| Subcarrier spacing | kHz | 30 | 30 | 30 | 30 | 30 |
| Allocated resource blocks | PRBs | 106 | 106 | 53 (Note 3) | 53 (Note 4) | 51 |
| Number of consecutive PDSCH symbols |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} |  | N/A | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} |  | 4 | 4 | 4 | 4 | 4 |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} |  | 12 | 12 | 12 | 12 | 12 |
| Allocated slots per 2 frames |  | 31 | 31 | 31 | 31 | 31 |
| MCS table |  | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| MCS index |  | 19 | 19 | 19 | 19 | 19 |
| Modulation |  | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Target Coding Rate |  | 0.51 | 0.51 | 0.51 | 0.51 | 0.51 |
| Number of MIMO layers |  | 2 | 2 | 2 | 2 | 1 |
| Number of DMRS REs |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} |  | N/A | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} |  | 6 | 12 | 12 | 12 | 6 |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} |  | 12 | 24 | 24 | 24 | 12 |
| Overhead for TBS determination |  | 0 | 0 | 0 | 0 | 0 |
| Information Bit Payload per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | Bits | N/A | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | Bits | 27144 | 23040 | 11528 | 11528 | 6528 |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} | Bits | 83976 | 77896 | 38936 | 38936 | 20496 |
| Transport block CRC per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | Bits | N/A | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | Bits | 24 | 24 | 24 | 24 | 24 |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6}for i from {1,…,39} | Bits | 24 | 24 | 24 | 24 | 24 |
| Number of Code Blocks per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | CBs | N/A | N/A | N/A | N/A | N/A |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | CBs | 4 | 3 | 2 | 2 | 1 |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} | CBs | 10 | 10 | 5 | 5 | 3 |
| Binary Channel Bits Per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | Bits | N/A | N/A | N/A | N/A | N/A |
| For Slots i = 20, 21 | Bits | 160272 | 137376 | 68688 | 68688 | 38556 |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | Bits | 53424 | 45792 | 22896 | 22896 | 12852 |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,19,22,…,39} | Bits | 167904 | 152640 | 76320 | 76320 | 40392 |
| Max. Throughput averaged over 2 frames | Mbps | 118.796 | 109.768 | 54.869 | 54.869 | 28.975 |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms  Note 2: Slot i is slot index per 2 frames  Note 3: PDSCH is scheduled in PRB numbers from 0 to 52.  Note 4: PDSCH is scheduled in PRB numbers from 53 to 105. | | | | | | |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

 Table A.3.2.2.2-4: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-1 (256QAM)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **Value** | | | | |
| Reference channel |  | R.PDSCH.2-4.1 TDD | R.PDSCH.2-4.2 TDD | R.PDSCH.2-4.3 TDD |  |  |
| Channel bandwidth | MHz | 40 | 20 | 20 |  |  |
| Subcarrier spacing | kHz | 30 | 30 | 30 |  |  |
| Allocated resource blocks | PRBs | 106 | 51 | 51 |  |  |
| Number of consecutive PDSCH symbols |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} |  | N/A | N/A | N/A |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} |  | 4 | 4 | 4 |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} |  | 12 | 12 | 12 |  |  |
| Allocated slots per 2 frames |  | 31 | 31 | 31 |  |  |
| MCS table |  | 256QAM | 256QAM | 256QAM |  |  |
| MCS index |  | 24 | 24 | 20 |  |  |
| Modulation |  | 256QAM | 256QAM | 256QAM |  |  |
| Target Coding Rate |  | 0.82 | 0.82 | 0.67 |  |  |
| Number of MIMO layers |  | 1 | 1 | 1 |  |  |
| Number of DMRS REs |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} |  | N/A | N/A | N/A |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} |  | 6 | 6 | 6 |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} |  | 12 | 12 | 12 |  |  |
| Overhead for TBS determination |  | 0 | 0 | 0 |  |  |
| Information Bit Payload per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | Bits | N/A | N/A | N/A |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | Bits | 29192 | 14088 | 11528 |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} | Bits | 92200 | 44040 | 35856 |  |  |
| Transport block CRC per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | Bits | N/A | N/A | N/A |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | Bits | 24 | 24 | 24 |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} | Bits | 24 | 24 | 24 |  |  |
| Number of Code Blocks per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | CBs | N/A | N/A | N/A |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | CBs | 4 | 2 | 2 |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} | CBs | 11 | 6 | 5 |  |  |
| Binary Channel Bits Per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | Bits | N/A | N/A | N/A |  |  |
| For Slots i = 20, 21 | Bits | 106848 | 51408 | 51408 |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | Bits | 35616 | 17136 | 17136 |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,19,22,…,39} | Bits | 111936 | 53856 | 53856 |  |  |
| Max. Throughput averaged over 2 frames | Mbps | 130.308 | 62.272 | 50.711 |  |  |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms  Note 2: Slot i is slot index per 2 frames | | | | | | |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

Table A.3.2.2.2-8: PDSCH Reference Channel for TDD PMI reporting requirements with UL-DL pattern FR1.30-1

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **Value** | | | | |
| Reference channel |  | R.PDSCH.2-8.1 TDD | R.PDSCH.2-8.2 TDD | R.PDSCH.2-8.3 TDD | R.PDSCH.2-8.4 TDD |  |
| Channel bandwidth | MHz | 40 | 40 | 40 | 20 |  |
| Subcarrier spacing | kHz | 30 | 30 | 30 | 30 |  |
| Allocated resource blocks | PRBs | 106 | 106 | 106 | 51 |  |
| Number of consecutive PDSCH symbols |  | 12 | 12 | 12 | 12 |  |
| Allocated slots per 2 frames |  | 23 | 23 | 23 | 23 |  |
| MCS table |  | 64QAM | 64QAM | 64QAM | 64QAM |  |
| MCS index |  | 13 | 13 | 20 | 13 |  |
| Modulation |  | 16QAM | 16QAM | 64QAM | 16QAM |  |
| Target Coding Rate |  | 0.48 | 0.48 | 0.55 | 0.48 |  |
| Number of MIMO layers |  | 1 | 2 | 2 | 1 |  |
| Number of DMRS REs (Note 3) |  | 24 | 24 | 24 | 24 |  |
| Overhead for TBS determination |  | 0 | 0 | 0 | 0 |  |
| Information Bit Payload per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,…,39} | Bits | N/A | N/A | N/A | N/A |  |
| For CSI-RS Slot i, if mod(i,10) =1 for i from {0,…,39} | Bits | N/A | N/A | N/A | N/A |  |
| For Slot i = 20 | Bits | 24576 | 49176 | 83976 | 11784 |  |
| For Slot i, if mod(i, 10) = {0,2,3,4,5,6} for i from {1,…,19,22,…,39} | Bits | 24576 | 49176 | 83976 | 11784 |  |
| Transport block CRC per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,…,39} | Bits | N/A | N/A | N/A | N/A |  |
| For CSI-RS Slot i, if mod(i,10) =1 for i from {0,…,39} | Bits | N/A | N/A | N/A | N/A |  |
| For Slot i = 20 | Bits | 24 | 24 | 24 | 24 |  |
| For Slot i, if mod(i, 10) = {0,2,3,4,5,6} for i from {1,…,19,22,…,39} | Bits | 24 | 24 | 24 | 24 |  |
| Number of Code Blocks per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,…,39} | CBs | N/A | N/A | N/A | N/A |  |
| For CSI-RS Slot i, if mod(i,10) =1 for i from {0,…,39} | CBs | N/A | N/A | N/A | N/A |  |
| For Slot i = 20 | CBs | 3 | 6 | 10 | 2 |  |
| For Slot i, if mod(i, 10) = {0,2,3,4,5,6} for i from {1,…,19,22,…,39} | CBs | 3 | 6 | 10 | 2 |  |
| Binary Channel Bits Per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,…,39} | Bits | N/A | N/A | N/A | N/A |  |
| For CSI-RS Slot i, if mod(i,10) =1 for i from {0,…,39} | Bits | N/A | N/A | N/A | N/A |  |
| For Slot i = 20 | Bits | 48336 | 96672 | 145008 | 23256 |  |
| For Slot i, if mod(i, 10) = {0,2,3,4,5,6} for i from {1,…,19,22,…,39} | Bits | 50880 | 101760 | 152640 | 24480 |  |
| Max. Throughput averaged over 2 frames | Mbps | 28.2624 | 56.5524 | 96.5724 | 13.5516 |  |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms  Note 2: Slot i is slot index per 2 frames  Note 3: Number of DMRS REs includes the overhead of the DM-RS CDM groups without data | | | | | | |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

Table A.3.2.2.2-26: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-1 (16QAM)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **Value** | | | | | |
| Reference channel |  | R.PDSCH.2-26.1 TDD |  |  |  |  |  |
| Channel bandwidth | MHz | 20 |  |  |  |  |  |
| Subcarrier spacing | kHz | 30 |  |  |  |  |  |
| Allocated resource blocks | PRBs | 51 |  |  |  |  |  |
| Number of consecutive PDSCH symbols |  |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} |  | N/A |  |  |  |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} |  | 4 |  |  |  |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} |  | 12 |  |  |  |  |  |
| Allocated slots per 2 frames |  | 31 |  |  |  |  |  |
| MCS table |  | 64QAM |  |  |  |  |  |
| MCS index |  | 13 |  |  |  |  |  |
| Modulation |  | 16QAM |  |  |  |  |  |
| Target Coding Rate |  | 0.48 |  |  |  |  |  |
| Number of MIMO layers |  | 1 |  |  |  |  |  |
| Number of DMRS Res |  |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} |  | N/A |  |  |  |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} |  | 6 |  |  |  |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} |  | 12 |  |  |  |  |  |
| Overhead for TBS determination |  | 0 |  |  |  |  |  |
| Information Bit Payload per Slot |  |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | Bits | N/A |  |  |  |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | Bits | 4096 |  |  |  |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} | Bits | 12808 |  |  |  |  |  |
| Transport block CRC per Slot |  |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | Bits | N/A |  |  |  |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | Bits | 24 |  |  |  |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6}for i from {1,…,39} | Bits | 24 |  |  |  |  |  |
| Number of Code Blocks per Slot |  |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | CBs | N/A |  |  |  |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | CBs | 1 |  |  |  |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} | CBs | 2 |  |  |  |  |  |
| Binary Channel Bits Per Slot |  |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | Bits | N/A |  |  |  |  |  |
| For Slots i = 20, 21 | Bits | 25704 |  |  |  |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | Bits | 8568 |  |  |  |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,19,22,…,39} | Bits | 26928 |  |  |  |  |  |
| Max. Throughput averaged over 2 frames | Mbps | 18.110 |  |  |  |  |  |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms  Note 2: Slot i is slot index per 2 frames | | | | | | |  |

 Table A.3.2.2.2-27: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-1 (64QAM)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **Value** | | | | |
| Reference channel |  | R.PDSCH.2-27.1 TDD |  |  |  |  |
| Channel bandwidth | MHz | 20 |  |  |  |  |
| Subcarrier spacing | kHz | 30 |  |  |  |  |
| Allocated resource blocks | PRBs | 51 |  |  |  |  |
| Number of consecutive PDSCH symbols |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} |  | N/A |  |  |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} |  | 4 |  |  |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} |  | 12 |  |  |  |  |
| Allocated slots per 2 frames |  | 31 |  |  |  |  |
| MCS table |  | 64QAM |  |  |  |  |
| MCS index |  | 19 |  |  |  |  |
| Modulation |  | 64QAM |  |  |  |  |
| Target Coding Rate |  | 0.51 |  |  |  |  |
| Number of MIMO layers |  | 2 |  |  |  |  |
| Number of DMRS REs |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} |  | N/A |  |  |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} |  | 6 |  |  |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} |  | 12 |  |  |  |  |
| Overhead for TBS determination |  | 0 |  |  |  |  |
| Information Bit Payload per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | Bits | N/A |  |  |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | Bits | 13064 |  |  |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} | Bits | 40976 |  |  |  |  |
| Transport block CRC per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | Bits | N/A |  |  |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | Bits | 24 |  |  |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6}for i from {1,…,39} | Bits | 24 |  |  |  |  |
| Number of Code Blocks per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | CBs | N/A |  |  |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | CBs | 2 |  |  |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} | CBs | 5 |  |  |  |  |
| Binary Channel Bits Per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | Bits | N/A |  |  |  |  |
| For Slots i = 20, 21 | Bits | 77112 |  |  |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | Bits | 25704 |  |  |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,19,22,…,39} | Bits | 80784 |  |  |  |  |
| Max. Throughput averaged over 2 frames | Mbps | 57.930 |  |  |  |  |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms  Note 2: Slot i is slot index per 2 frames  Note 3: PDSCH is scheduled in PRB numbers from 0 to 52.  Note 4: PDSCH is scheduled in PRB numbers from 53 to 105. | | | | | | |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

A.3.3.2.2 Reference measurement channels for SCS 30 kHz FR1

**Table A.3.3.2.2-1: PDCCH Reference Channels (Time domain allocation 1 symbol)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **Value** | | | | | |
| Reference channel |  | R.PDCCH.2-1.1 TDD | R.PDCCH.2-1.2 TDD | R.PDCCH.2-1.3 TDD | R.PDCCH.2-1.4 TDD | R.PDCCH.2-1.5 TDD | R.PDCCH.2-1.6 TDD |
| Subcarrier spacing | kHz | 30 | 30 | 30 | 30 | 30 | 30 |
| CORESET frequency domain allocation |  | 102 | 102 | 90 | 102 | 48 | 48 |
| CORESET time domain allocation |  | 1 | 1 | 1 | 1 | 1 | 1 |
| Aggregation level |  | 2 | 4 | 8 | 8 | 4 | 8 |
| DCI Format |  | 1\_0 | 1\_1 | 1\_1 | 2\_6 | 1\_1 | 1\_1 |
| Payload (without CRC) | Bits | 41 | 53 | 53 | 12 | 53 | 53 |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

# A.4 CSI reference measurement channels

This clause defines the DL signal applicable to the reporting of channel state information (Clauses 6 and 8).

Tables in this clause specifies the mapping of CQI index to Information Bit payload, which complies with the CQI definition specified in clause 5.2.2.1 of TS 38.214 [12] and with MCS definition specified in clause 5.1.3 of TS 38.214 [12].

Table A.4-1: Mapping of CQI Index to Information Bit payload (CQI table 1)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TBS Scheme | | | | TBS.1-1 | TBS.1-2 | TBS.1-3 | TBS.1-4 | TBS.1-5 | TBS.1-6 |
| MCS table | | | | 64QAM | | | | | |
| Number of allocated PDSCH resource blocks | | | | 66 | 66 | [52] | [52] | [51] | [51] |
| Number of consecutive PDSCH symbols | | | | 12 | 12 | [12] | [12] | [12] | [12] |
| Number of PDSCH MIMO layers | | | | 1 | 2 | [1] | [2] | [1] | [2] |
| Number of DMRS REs (Note 1) | | | | 24 | 24 | [24] | [24] | [24] | [24] |
| Overhead for TBS determination | | | | 6 | 6 | [0] | [0] | [0] | [0] |
| Available RE-s | | | | 7590 | 7590 | [6240] | [6240] | [6120] | [6120] |
| CQI index | Spectral efficiency | MCS index | Modulation | Information Bit Payload per Slot | | | | | |
| 0 | OOR | OOR | OOR | N/A | N/A | N/A | N/A | N/A | N/A |
| 1 | 0.2344 | 0 | QPSK | 1800 | 3624 | [1480] | [2976] | [1480] | [2856] |
| 2 | 0.2344 | 0 | 1800 | 3624 | [1480] | [2976] | [1480] | [2856] |
| 3 | 0.3770 | 2 | 2856 | 5640 | [2408] | [4744] | [2408] | [4616] |
| 4 | 0.6016 | 4 | 4480 | 8968 | [3752] | [7424] | [3752] | [7296] |
| 5 | 0.8770 | 6 | 6528 | 13064 | [5504] | [11016] | [5376] | [10760] |
| 6 | 1.1758 | 8 | 8712 | 17928 | [7296] | [14600] | [7168] | [14344] |
| 7 | 1.4766 | 11 | 16QAM | 11016 | 22032 | [9224] | [18432] | [8968] | [17928] |
| 8 | 1.9141 | 13 | 14344 | 28680 | [12040] | [24072] | [11784] | [23568] |
| 9 | 2.4063 | 15 | 17928 | 35856 | [15112] | [30216] | [14600] | [29192] |
| 10 | 2.7305 | 18 | 64QAM | 20496 | 40976 | [16896] | [33816] | [16896] | [33816] |
| 11 | 3.3223 | 20 | 25104 | 50184 | [20496] | [40976] | [20496] | [40976] |
| 12 | 3.9023 | 22 | 29192 | 58384 | [24576] | [49176] | [24072] | [48168] |
| 13 | 4.5234 | 24 | 33816 | 67584 | [28168] | [56368] | [27656] | [55304] |
| 14 | 5.1152 | 26 | 38936 | 77896 | [31752] | [63528] | [31240] | [62504] |
| 15 | 5.5547 | 28 | 42016 | 83976 | [34816] | [69672] | [33816] | [67584] |
| Note 1: Number of DMRS REs includes the overhead of the DM-RS CDM groups without data  Note 2: PDSCH is not scheduled on slots containing CSI-RS for tracking, CSI-RS for CSI acquisition and CSI-RS for beam refinement or slots which are not full DL  Note 3: PDSCH is not scheduled on slots containing PBCH, i.e. slot#0 per 20ms periodicity  Note 4: Spectral efficiency is based on MCS Table defined in Table 5.1.3.1-1 of TS 38.214 [12] | | | | | | | | | |

Table A.4-2: Mapping of CQI Index to Information Bit payload (CQI table 2, Rank 1 and Rank 2)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TBS Scheme | | | | TBS.2-1 | TBS.2-2 | TBS.2-3 | TBS.2-4 | TBS.2-5 | TBS.2-6 | TBS.2-7 | TBS.2-8 |
| MCS table | | | | 256QAM | | | | | | | |
| Number of allocated PDSCH resource blocks | | | | 52 | 52 | 106 | 106 | 8 | 16 | 32 | 51 |
| Number of consecutive PDSCH symbols | | | | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Number of PDSCH MIMO layers | | | | 1 | 2 | 1 | 2 | 1 | 1 | 1 | 2 |
| Number of DMRS REs (Note 1) | | | | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Overhead for TBS determination | | | | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 |
| Available RE-s for PDSCH | | | | 6240 | 6240 | 12720 | 12720 | 960 | 1920 | 3680 | 6120 |
| CQI index | Spectral efficiency | MCS index | Modulation | Information Bit Payload per Slot | | | | | | | |
| 0 | OOR | OOR | OOR | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| 1 | 0.2344 | 0 | QPSK | 1480 | 2976 | 2976 | 5896 | 224 | 456 | 848 | 1864 |
| 2 | 0.3770 | 1 | 2408 | 4744 | 4744 | 9480 | 368 | 736 | 1416 | 4616 |
| 3 | 0.8770 | 3 | 5504 | 11016 | 11016 | 22536 | 848 | 1736 | 3240 | 10760 |
| 4 | 1.4766 | 5 | 16QAM | 9224 | 18432 | 18960 | 37896 | 1416 | 2856 | 5376 | 17928 |
| 5 | 1.9141 | 7 | 12040 | 24072 | 24576 | 49176 | 1864 | 3752 | 6912 | 23568 |
| 6 | 2.4063 | 9 | 15112 | 30216 | 30728 | 61480 | 2408 | 4608 | 8712 | 29192 |
| 7 | 2.7305 | 11 | 64QAM | 16896 | 33816 | 34816 | 69672 | 2600 | 5248 | 9992 | 33816 |
| 8 | 3.3223 | 13 | 20496 | 40976 | 42016 | 83976 | 3240 | 6400 | 12040 | 40976 |
| 9 | 3.9023 | 15 | 24576 | 49176 | 49176 | 98376 | 3752 | 7424 | 14344 | 48168 |
| 10 | 4.5234 | 17 | 28168 | 56368 | 57376 | 114776 | 4352 | 8712 | 16392 | 55304 |
| 11 | 5.1152 | 19 | 31752 | 63528 | 65576 | 131176 | 4864 | 9736 | 18432 | 62504 |
| 12 | 5.5547 | 21 | 256QAM | 34816 | 69672 | 69672 | 139376 | 5248 | 10760 | 20496 | 67584 |
| 13 | 6.2266 | 23 | 38936 | 77896 | 79896 | 159880 | 6016 | 12040 | 22536 | 75792 |
| 14 | 6.9141 | 25 | 43032 | 86040 | 88064 | 176208 | 6656 | 13320 | 25104 | 83976 |
| 15 | 7.4063 | 27 | 46104 | 92200 | 94248 | 188576 | 7040 | 14088 | 27144 | 90176 |
| Note 1: Number of DMRS REs includes the overhead of the DM-RS CDM groups without data  Note 2: PDSCH is not scheduled on slots containing CSI-RS for tracking, CSI-RS for CSI acquisition and CSI-RS for beam refinement or slots which are not full DL  Note 3: PDSCH is not scheduled on slots containing PBCH, i.e. slot#0 per 20ms periodicity  Note 4: Spectral efficiency is based on MCS Table defined in Table 5.1.3.1-2 of TS 38.214 [12] | | | | | | | | | | |  |

**Table A.4-3: Mapping of CQI Index to Information Bit payload (CQI table 2, Rank 3 and Rank 4)**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TBS Scheme | | | | TBS.3-1 | TBS.3-2 | TBS.3-3 | TBS.3-4 |  |  |
| MCS table | | | | 256QAM | | | | | |
| Number of allocated PDSCH resource blocks | | | | 52 | 52 | 106 | 106 |  |  |
| Number of consecutive PDSCH symbols | | | | 12 | 12 | 12 | 12 |  |  |
| Number of PDSCH MIMO layers | | | | 3 | 4 | 3 | 4 |  |  |
| Number of DMRS REs (Note 1) | | | | 24 | 24 | 24 | 24 |  |  |
| Overhead for TBS determination | | | | 0 | 0 | 0 | 0 |  |  |
| Available RE-s for PDSCH | | | | 6240 | 6240 | 12720 | 12720 |  |  |
| CQI index | Spectral efficiency | MCS index | Modulation | Information Bit Payload per Slot | | | | | |
| 0 | OOR | OOR | OOR | N/A | N/A | N/A | N/A |  |  |
| 1 | 0.2344 | 0 | QPSK | 4360 | 5896 | 8976 | 11784 |  |  |
| 2 | 0.3770 | 1 | 7048 | 9480 | 14344 | 18976 |  |  |
| 3 | 0.8770 | 3 | 16392 | 22032 | 33816 | 45096 |  |  |
| 4 | 1.4766 | 5 | 16QAM | 27656 | 36896 | 56368 | 75792 |  |  |
| 5 | 1.9141 | 7 | 35856 | 48168 | 73776 | 98376 |  |  |
| 6 | 2.4063 | 9 | 45096 | 60456 | 92200 | 122976 |  |  |
| 7 | 2.7305 | 11 | 64QAM | 51216 | 67584 | 104496 | 139376 |  |  |
| 8 | 3.3223 | 13 | 62504 | 81976 | 127080 | 167976 |  |  |
| 9 | 3.9023 | 15 | 73776 | 98376 | 147576 | 196776 |  |  |
| 10 | 4.5234 | 17 | 83976 | 112648 | 172176 | 229576 |  |  |
| 11 | 5.1152 | 19 | 96264 | 127080 | 196776 | 262376 |  |  |
| 12 | 5.5547 | 21 | 256QAM | 104496 | 139376 | 213176 | 278776 |  |  |
| 13 | 6.2266 | 23 | 116792 | 155776 | 237776 | 319784 |  |  |
| 14 | 6.9141 | 25 | 129128 | 172176 | 262376 | 352440 |  |  |
| 15 | 7.4063 | 27 | 139376 | 184424 | 278776 | 376896 |  |  |
| Note 1: Number of DMRS REs includes the overhead of the DM-RS CDM groups without data  Note 2: PDSCH is not scheduled on slots containing CSI-RS for tracking, CSI-RS for CSI acquisition and CSI-RS for beam refinement or slots which are not full DL  Note 3: PDSCH is not scheduled on slots containing PBCH, i.e. slot#0 per 20ms periodicity  Note 4: Spectral efficiency is based on MCS Table defined in Table 5.1.3.1-2 of TS 38.214 [12] | | | | | | | | | |

Table A.4-4: Mapping of CQI Index to Information Bit payload (CQI table 3)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TBS Scheme | | | | TBS.4-1 | TBS.4-2 |  |  |  |  |
| MCS table | | | | 64QAMLowSE | | | | | |
| Number of allocated PDSCH resource blocks | | | | 52 | 106 |  |  |  |  |
| Number of consecutive PDSCH symbols | | | | 12 | 12 |  |  |  |  |
| Number of PDSCH MIMO layers | | | | 1 | 1 |  |  |  |  |
| Number of DMRS REs (Note 1) | | | | 24 | 24 |  |  |  |  |
| Overhead for TBS determination | | | | 0 | 0 |  |  |  |  |
| Available RE-s for PDSCH | | | | 6240 | 12720 |  |  |  |  |
| CQI index | Spectral efficiency | MCS index | Modulation | Information Bit Payload per Slot | | | | | |
| 0 | OOR | OOR | OOR | N/A | N/A |  |  |  |  |
| 1 | 0.0586 | 0 | QPSK | 368 | 768 |  |  |  |  |
| 2 | 0.0977 | 2 | 608 | 1256 |  |  |  |  |
| 3 | 0.1523 | 4 | 984 | 2024 |  |  |  |  |
| 4 | 0.2344 | 6 | 1480 | 2976 |  |  |  |  |
| 5 | 0.3770 | 8 | 2408 | 4744 |  |  |  |  |
| 6 | 0.6016 | 10 | 3752 | 7680 |  |  |  |  |
| 7 | 0.8770 | 12 | 5504 | 11016 |  |  |  |  |
| 8 | 1.1758 | 14 | 7296 | 14856 |  |  |  |  |
| 9 | 1.4766 | 16 | 16QAM | 9224 | 18960 |  |  |  |  |
| 10 | 1.9141 | 18 | 12040 | 24576 |  |  |  |  |
| 11 | 2.4063 | 20 | 15112 | 30728 |  |  |  |  |
| 12 | 2.7305 | 22 | 64QAM | 16896 | 34816 |  |  |  |  |
| 13 | 3.3223 | 24 | 20496 | 42016 |  |  |  |  |
| 14 | 3.9023 | 26 | 24576 | 49176 |  |  |  |  |
| 15 | 4.5234 | 28 | 28168 | 57376 |  |  |  |  |
| Note 1: Number of DMRS REs includes the overhead of the DM-RS CDM groups without data  Note 2: PDSCH is not scheduled on slots containing CSI-RS for tracking and CSI-RS for CSI acquisition or slots which are not full DL  Note 3: PDSCH is not scheduled on slots containing PBCH, i.e. slot#0 per 20ms periodicity | | | | | | | | | |

Table A.4-5: Mapping of CQI Index to Information Bit payload (CQI table 4)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TBS Scheme | | | | TBS.5-1 | TBS.5-2 |  |  |  |  |
| MCS table | | | | 1024QAM | | | | | |
| Number of allocated PDSCH resource blocks | | | | 52 | 106 |  |  |  |  |
| Number of consecutive PDSCH symbols | | | | 12 | 12 |  |  |  |  |
| Number of PDSCH MIMO layers | | | | 1 | 1 |  |  |  |  |
| Number of DMRS REs (Note 1) | | | | 24 | 24 |  |  |  |  |
| Overhead for TBS determination | | | | 0 | 0 |  |  |  |  |
| Available RE-s | | | | 6240 | 12720 |  |  |  |  |
| CQI index | Spectral efficiency | MCS index | Modulation | Information Bit Payload per Slot | | | | | |
| 0 | OOR | OOR | OOR | N/A | N/A |  |  |  |  |
| 1 | 0.2344 | 0 | QPSK | 1480 | 2976 |  |  |  |  |
| 2 | 0.377 | 1 | 2408 | 4744 |  |  |  |  |
| 3 | 0.877 | 2 | 5504 | 11016 |  |  |  |  |
| 4 | 1.4766 | 3 | 16QAM | 9224 | 18960 |  |  |  |  |
| 5 | 2.4063 | 5 | 15112 | 30728 |  |  |  |  |
| 6 | 3.3223 | 8 | 64QAM | 20496 | 42016 |  |  |  |  |
| 7 | 3.9023 | 10 | 24576 | 49176 |  |  |  |  |
| 8 | 4.5234 | 12 | 28168 | 57376 |  |  |  |  |
| 9 | 5.1152 | 14 | 31752 | 65576 |  |  |  |  |
| 10 | 5.5547 | 16 | 256QAM | 34816 | 69672 |  |  |  |  |
| 11 | 6.2266 | 18 | 38936 | 79896 |  |  |  |  |
| 12 | 6.9141 | 20 | 43032 | 88064 |  |  |  |  |
| 13 | 7.4063 | 22 | 46104 | 94248 |  |  |  |  |
| 14 | 8.3301 | 24 | 1024QAM | 52224 | 106576 |  |  |  |  |
| 15 | 9.2578 | 26 | 57376 | 116792 |  |  |  |  |
| Note 1: Number of DMRS REs includes the overhead of the DM-RS CDM groups without data  Note 2: PDSCH is not scheduled on slots containing CSI-RS for tracking, CSI-RS for CSI acquisition and CSI-RS for beam refinement or slots which are not full DL  Note 3: PDSCH is not scheduled on slots containing PBCH, i.e. slot#0 per 20ms periodicity  Note 4: Spectral efficiency is based on MCS Table defined in Table 5.1.3.1-4 of TS 38.214 [12] | | | | | | | | | |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

# B.1 Static propagation condition

## B.1.0 UE Receiver with 1Rx

For 2 port transmission the channel matrix is defined in the frequency domain by

..

For 4 port transmission the channel matrix is defined in the frequency domain by

**H** = [1 1 j j]

For 8 port transmission the channel matrix is defined in the frequency domain by

**H** = [1 1 1 1 j j j j]

## B.1.1 UE Receiver with 2Rx

For 1 port transmission the channel matrix is defined in the frequency domain by

.

For 2 port transmission the channel matrix is defined in the frequency domain by

.

For 4 port transmission the channel matrix is defined in the frequency domain by



For 8 port transmission the channel matrix is defined in the frequency domain by



## B.1.2 UE Receiver with 4Rx

For 1 port transmission the channel matrix is defined in the frequency domain by

.

For 2 port transmission the channel matrix is defined in the frequency domain by

.

For 4 port transmission the channel matrix is defined in the frequency domain by

.

For 8 port transmission the channel matrix is defined in the frequency domain by



------------------------------------------------------------- End of change ------------------------------------------------------------