# Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

In the present document, modal verbs have the following meanings:

**shall** indicates a mandatory requirement to do something

**shall not** indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

**should** indicates a recommendation to do something

**should not** indicates a recommendation not to do something

**may** indicates permission to do something

**need not** indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

**can** indicates that something is possible

**cannot** indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

**will** indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**will not** indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**might** indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

**might not** indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

**is** (or any other verb in the indicative mood) indicates a statement of fact

**is not** (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

# 1 Scope

The present document establishes the minimum performance requirements for NR User Equipment (UE).

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 38.521-4: "NR; User Equipment (UE) conformance specification; Radio transmission and reception; Part 4: Performance requirements".

[3] Recommendation ITU-R M.1545: "Measurement uncertainty as it applies to test limits for the terrestrial component of International Mobile Telecommunications-2000".

[4] 3GPP TS 36.101: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception".

[5] 3GPP TR 38.901: "Study on channel model for frequencies from 0.5 to 100 GHz".

[6] 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone".

[7] 3GPP TS 38.101-2: "NR; User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone".

[8] 3GPP TS 38.101-3: "NR; User Equipment (UE) radio transmission and reception; Part 3: Range 1 and Range 2 Interworking operation with other radios".

[9] 3GPP TS 38.211: "NR; Physical channels and modulation".

[10] 3GPP TS 38.212: "NR; Multiplexing and channel coding".

[11] 3GPP TS 38.213: "NR; Physical layer procedures for control ".

[12] 3GPP TS 38.214: "NR; Physical layer procedures for data".

[13] 3GPP TS 37.340: "Evolved Universal Terrestrial Radio Access (E-UTRA) and NR; Multi-connectivity", Stage 2.

[14] 3GPP TS 38.306: "NR; User Equipment (UE) radio access capabilities".

[15] 3GPP TS 36.211: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation".

[16] Void.

[17] 3GPP TS 38.331: “Radio Resource Control (RRC) protocol specification”.

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

CRS Cell-specific Reference Signal

CRS-IM CRS-Interference Mitigation

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

# 4 General

## 4.1 Relationship between minimum requirements and test requirements

The present document is a Single-RAT and interwork specification for NR UE, covering minimum performance requirements of both conducted and radiated requirements. Conformance to the present specification is demonstrated by fulfilling the test requirements specified in the conformance specification TS 38.521-4 [2].

The Minimum Requirements given in this specification make no allowance for measurement uncertainty. The test specification TS 38.521-4 [2] defines test tolerances. These test tolerances are individually calculated for each test. The test tolerances are used to relax the minimum requirements in this specification to create test requirements.

The measurement results returned by the test system are compared – without any modification – against the test requirements as defined by the shared risk principle.

The shared risk principle is defined in Recommendation ITU‑R M.1545 [3].

The applicability of each requirement is described under each sub-clause in 5.1, 6.1, 7.1, 8.1, 9.1 and 10.1.

## 4.2 Applicability of minimum requirements

The conducted minimum requirements specified in this specification shall be met in all applicable scenarios for FR1. The radiated minimum requirements specified in this specification shall be met in all applicable scenarios for FR2. The minimum requirements for interworking specified in this specification shall be met in all applicable scenarios for NR interworking operation.

All minimum performance requirements defined in Clauses 5-8 are applicable to both SA and NSA unless otherwise explicitly stated in Clause 9 and 10.

All minimum performance requirements defined in Clauses 5-10 are applicable to all UE power classes unless otherwise stated.

For radiated minimum requirements specified in the specification, if maximum achievable SNR in the test system for certain test conditions is less than the defined SNR requirement for those tests, those requirements shall not be tested.

## 4.3 Specification suffix information

Unless stated otherwise the following suffixes are used for indicating at 2nd level clause, shown in Table 4.3-1.

Table 4.3-1: Definition of suffixes

|  |  |
| --- | --- |
| **Clause suffix** | **Variant** |
| None | Single Carrier |
| A | Carrier Aggregation (CA) |
| B | Dual-Connectivity (DC) |
| C | Supplement Uplink (SUL) |

A terminal which supports the above features needs to meet the requirement defined in the additional clause (suffix A, B, C) in clauses 5, 6, 7, 8, 9, 10.

## 4.4 Conducted requirements

### 4.4.0 Introduction

The requirements are defined for the following modes:

- Mode 1: Conditions with external noise source

- Wanted signal with power level Es is transmitted.

- External white noise source with power spectral density Noc is used.

- *Es* and *Noc* levels are selected to achieve target SNR as described in Clause 4.4.2.

- Mode 2: Noise free conditions

- Wanted signal with power level Es is transmitted.

- No external noise transmitted.

### 4.4.1 Reference point

The reference point for SNR, Es and Noc of DL signal is the UE antenna connector or connectors.

### 4.4.2 SNR definition

For Mode 1 conditions conducted UE demodulation and CSI requirements the SNR is defined as:

Where

- NRX denotes the number of receiver antenna connectors and the superscript receiver antenna connector *j*.

- The above SNR definition assumes that the REs are not precoded, and does not account for any gain which can be associated to the precoding operation.

- Unless otherwise stated, the SNR refers to the SSS wanted signal.

- The downlink SSS transmit power is defined as the linear average over the power contributions in [W] of all resource elements that carry the SSS within the operating system bandwidth.

- The power ratio of other wanted signals to the SSS is defined in clause C.3.1.

### 4.4.3 Noc

#### 4.4.3.1 Introduction

This clause describes the Noc power level for Mode 1 conditions conducted testing of demodulation and CSI requirements.

Unless otherwise stated for CA and EN-DC testing, the same Noc level shall be provided on different component carriers.

#### 4.4.3.2 Noc for NR operating bands in FR1

The Noc power spectrum density shall be larger or equal to the minimum Noc power level for each operating band supported by the UE as defined in clause 4.4.3.2.1.

Unless otherwise stated, a fixed Noc power level of -134 dBm/Hz shall be used for all operating bands.

##### 4.4.3.2.1 Derivation of Noc values for NR operating bands in FR1

The minimum Noc power level for an operating band, subcarrier spacing and channel bandwidth is derived based on the following equation:

NocBand\_X, SCS\_Y, CBW\_Z = REFSENSBand\_X, SCS\_Y, CBW\_Z – 10\*log10(12\*SCS\_Y\*nPRB) + D – SNRREFSENS + ∆thermal

where

- REFSENSBand\_X, SCS\_Y, CBW\_Z is the REFSENS value in dBm for Band X, SCS Y and CBW Z specified in Table 7.3.2-1 of TS 38.101-1 [6]

- 12 is the number of subcarriers in a PRB

- SCS Y is the subcarrier spacing associated with the REFSENS value

- nPRB is the maximum number of PRB for SCS Y and CBW Z associated with the REFSENS value, and is specified in Table 5.3.2-1 of TS 38.101-1 [6]

- D is diversity gain equal to 3 dB

- 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 defined rise in total noise. ∆thermal = 16dB, giving a rise in total noise of 0.1dB, regarded as insignificant**.**

The calculated Noc value for the baseline of Band n12, 15 kHz SCS, 15 MHz CBW is -135.5 dBm/Hz.

An allowance of 1.5dB is made for CA and for future bands, giving an Noc power level of -134 dBm/Hz.

### 4.4.4 Es

#### 4.4.4.1 Introduction

This clause describes the Es power level for Mode 2 conditions conducted testing of demodulation and CSI requirements.

Unless otherwise stated for CA and EN-DC testing, the same Es level shall be provided on different component carriers.

#### 4.4.4.2 Es for NR operating bands in FR1

The Es power spectrum density shall be larger or equal to the minimum Es power level for each operating band supported by the UE as defined in Clause 4.4.4.2.1.

Unless otherwise stated, a fixed Es power level of -112 dBm/Hz shall be used for all operating bands.

#### 4.4.4.2.1 Derivation of Es values for NR operating bands in FR1

The minimum Es power level for an operating band, subcarrier spacing and channel bandwidth is derived based on the following equation:

EsBand\_X, SCS\_Y, CBW\_Z = REFSENSBand\_X, SCS\_Y, CBW\_Z – 10\*log10(12\*SCS\_Y\*nPRB) + D – SNRREFSENS + dBEVM +∆thermal

where:

- REFSENSBand\_X, SCS\_Y, CBW\_Z is the REFSENS value in dBm for Band X, SCS Y and CBW Z specified in Table 7.3.2-1 of TS 38.101-1 [6]

- 12 is the number of subcarriers in a PRB

- SCS Y is the subcarrier spacing associated with the REFSENS value

- nPRB is the maximum number of PRB for SCS Y and CBW Z associated with the REFSENS value, and is specified in Table 5.3.2-1 of TS 38.101-1 [6]

- D is diversity gain equal to 3 dB

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

- dBEVM is the SNR of the applied signal due to EVM impairment on the wanted Es. An allowed EVM of 3% gives a dBEVM of 30.5dB, derived as 20\*log10(1/0.03)**.**

- ∆thermal is the amount of dB that the impairment due to EVM on the wanted Es is set above UE thermal noise, giving a defined rise in total impairment. ∆thermal = 7.6dB, giving a rise in total impairment of 0.7dB, regarded as acceptable**.**

The calculated Es value for the baseline of Band n12, 15kHz SCS, 15MHz CBW is -113.5 dBm/Hz.

An allowance of 1.5dB is made for CA and for future bands, giving an Es power level of -112 dBm/Hz.

### 4.4.5 SINR definition

Where is 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 j-th UE receiver antenna connector; average power is computed within a set of REs used for the transmission of physical, divided transmission bandwidth within the set.

And is the power spectral density (average power per RE normalised to the subcarrier spacing) of the summation of the received power spectral densities of the strongest interfering cells explicitly defined in a test procedure plus , as measured at the j-th UE receiver antenna connector. The respective power spectral density of each interfering cell relative to is defined by its associated Es/Noc value.

## 4.5 Radiated requirements

### 4.5.0 Introduction

The requirements are defined for the following modes:

- Mode 1: conditions with external noise source

- Wanted signal with power level Es is transmitted.

- External white noise source with power spectral density Noc is used.

- Es and Noc levels are selected to achieve target SNR as described in Clause 4.5.2.

- Mode 2: Noise free conditions

- Wanted signal with power level Es is transmitted.

- No external noise transmitted.

### 4.5.1 Reference point

The reference point for SNR, Es and Noc of DL signal from the UE perspective is the input of UE antenna array.



Figure 4.5.1-1: Reference point for radiated Demodulation and CSI requirements

### 4.5.2 SNR definition

For Mode 1 conditions UE demodulation and CSI requirements, the Minimum performance requirement in clause 7, 8, 9 and 10 are defined relative to the baseband SNR level SNRBB*.* The SNR at the reference point is defined as

*SNR = SNRBB +* ***∆BB***

where **∆BB**is specified in clause 4.5.3.

The reference point SNR is defined as:

- NRX denotes the number of receiver reference points, and the super script receiver reference point *j*.

- The above SNR definition assumes that the REs are not precoded, and does not account for any gain which can be associated to the precoding operation.

- Unless otherwise stated, the SNR refers to the SSS wanted signal.

- The downlink SSS transmit power is defined as the linear average over the power contributions in [W] of all resource elements that carry the SSS within the operating system bandwidth.

- The power ratio of other wanted signals to the SSS is defined in Clause C.3.1.

### 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 [2] and rank number in TS 38.521-4 [2] 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 [2] and rank number in TS 38.521-4 [2] 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

# 5 Demodulation performance requirements (Conducted requirements)

## 5.1 General

### 5.1.1 Applicability of requirements

#### 5.1.1.1 General

The minimum performance requirements are applicable to all FR1 operating bands defined in TS 38.101-1[6].

The minimum performance requirements in Clause 5 are mandatory for UE supporting NR operation, except test cases listed in Clauses 5.1.1.3, 5.1.1.4, 5.1.1.5, 5.1.1.6, 5.1.1.7, 5.1.1.8.

If same test is listed for different UE features/capabilities in Clauses 5.1.1.3 and 5.1.1.4, then this test shall apply for UEs which support all corresponding UE features/capabilities.

#### 5.1.1.2 Applicability of requirements for different number of RX antenna ports

The number of RX antenna ports for different RF operating bands is up to UE declaration.

The UE shall support 2 or 4 RX antenna ports for different RF operating bands. The operating bands, where 4 RX antenna ports shall be the baseline, are defined in Clause 7.2 of TS 38.101-1 [6]. The UE requirements applicability for UEs with different number of RX antenna ports is defined in Table 5.1.1.2-1.

Table 5.1.1.2-1: Requirements applicability

|  |  |  |
| --- | --- | --- |
| Supported RX antenna ports | Test type | Test list |
| UE supports only 2RX | PDSCH | All tests in Clause 5.2.2 |
|  | PDCCH | All tests in Clause 5.3.2 |
|  | PBCH | All tests in Clause 5.4.2 |
| UE supports only 4RX or both 2RX and 4RX | PDSCH | All tests in Clause 5.2.3 (Note 2) |
|  | PDCCH | All tests in Clause 5.3.3 (Note 2) |
|  | PBCH | All tests in Clause 5.4.2 or 5.4.3 (Note) |
| Note 1: Requirements for PBCH with 4Rx is up to UE declaration  Note 2: ‘*maxMIMO-Layers-r16*’ is not configured during the performance requirements testing for UE supporting Release 16 per-BWP MIMO layer adaptation. | | |

#### 5.1.1.3 Applicability of requirements for optional UE features

The performance requirements in Table 5.1.1.3-1 shall apply for UEs which support optional UE features only.

Table 5.1.1.3-1: Requirements applicability for optional UE features

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| UE feature/capability [14] | Test type | | Test list | Applicability notes | |
| SU-MIMO Interference Mitigation advanced receiver | FR1 FDD | PDSCH | Clause 5.2.2.1.1 (Test 3-1)  Clause 5.2.3.1.1 (Test 5-1) |  | |
|  | FR1 TDD | PDSCH | Clause 5.2.2.2.1 (Test 3-1)  Clause 5.2.3.2.1 (Test 5-1) |  | |
| Alternative additional DMRS position for co-existence with LTE CRS *(additionalDMRS-DL-Alt)* | FR1 FDD | PDSCH | Clause 5.2.2.1.4 (Test 1-2)  Clause 5.2.3.1.4 (Test 1-2) |  | |
|  | FR1 TDD | PDSCH | Clause 5.2.2.2.4 (Test 1-2)  Clause 5.2.3.2.4 (Test 1-2) |  | |
| Basic DL NR-NR CA operation (*supportedBandCombinationList*) | NR CA | SDR | Clause 5.5A.1 | 1)Up to 16 DL carriers  2)Same numerology across carrier for data/control channel at a given time | |
| Enhanced demodulation processing for HST-SFN joint transmission scheme with velocity up to 500km/h | FR1 FDD | PDSCH | Clause 5.2.2.1.9 (Test 1-1)  Clause 5.2.3.1.9 (Test 1-1) |  | |
|  | FR1 TDD | PDSCH | Clause 5.2.2.2.9 (Test 1-1)  Clause 5.2.3.2.9 (Test 1-1) |  | |
| Alternative 64QAM MCS table for PDSCHNew 64QAM MCS table for PDSCH (*dl-64QAM-MCS-TableAlt*) | FR1 FDD | PDSCH | Clause 5.2.2.1.5  Clause 5.2.3.1.5  Clause 5.2.2.1.6  Clause 5.2.3.1.6 |  | |
|  | FR1 TDD | PDSCH | Clause 5.2.2.2.5  Clause 5.2.3.2.5  Clause 5.2.2.2.6  Clause 5.2.3.2.6 |  | |
| CQI table with target BLER of 10^-5New CQI table (cqi-TableAlt) | FR1 FDD | PDSCH | Clause 5.2.2.1.5  Clause 5.2.3.1.5 |  | |
|  | FR1 TDD | PDSCH | Clause 5.2.2.2.5  Clause 5.2.3.2.5 |  | |
| PDSCH repetitions over multiple slots *(pdsch-RepetitionMultiSlots)* | FR1 FDD | PDSCH | Clause 5.2.2.1.6  Clause 5.2.3.1.6 |  | |
|  | FR1 TDD | PDSCH | Clause 5.2.2.2.6  Clause 5.2.3.2.6 |  | |
| UE PDSCH processing capability #2 *(pdsch-ProcessingType2)* | FR1 FDD | PDSCH | Clause 5.2.2.1.7  Clause 5.2.3.1.7 |  | |
|  | FR1 TDD | PDSCH | Clause 5.2.2.2.7  Clause 5.2.3.2.7 |  | |
| Pre-emption indication for DL *(pre-EmptIndication-DL)* | FR1 FDD | PDSCH | Clause 5.2.2.1.8  Clause 5.2.3.1.8 |  | |
|  | FR1 TDD | PDSCH | Clause 5.2.2.2.8  Clause 5.2.3.2.8 |  | |
| Single DCI based SDM transmission for multi-TRxP (singleDCI-SDM-scheme-r16) | FR1 FDD | PDSCH | Clause 5.2.2.1.11  Clause 5.2.3.1.11 |  | |
| FR1 TDD | PDSCH | Clause 5.2.2.2.11  Clause 5.2.3.2.11 |  | |
| Multi DCI based multi-TRxP support (multiDCI-MultiTRP-r16) | FR1 FDD | PDSCH | Clause 5.2.2.1.12  Clause 5.2.3.1.12 |  | |
| FR1 TDD | PDSCH | Clause 5.2.2.2.12  Clause 5.2.3.2.12 |  | |
| Single DCI based FDM Scheme-A for multi-TRxP(supportFDM-SchemeA-r16) | FR1 FDD | PDSCH | Clause 5.2.2.1.13  Clause 5.2.3.1.13 |  | |
| FR1 TDD | PDSCH | Clause 5.2.2.2.13  Clause 5.2.3.2.13 |  | |
| Single DCI based inter-slot TDM for multi-TRxP (supportInter-slotTDM-r16) | FR1 FDD | PDSCH | Clause 5.2.2.1.14  Clause 5.2.3.1.14 |  | |
| FR1 TDD | PDSCH | Clause 5.2.2.2.14  Clause 5.2.3.2.14 |  | |
| Maximum number of TCI states in Single-DCI based inter-slot TDM (maxNumberTCI-states-r16) | FR1 FDD | PDSCH | Clause 5.2.2.1.14  Clause 5.2.3.1.14 | | The requirements apply only when maxNumberTCI-states-r16 = 2. | |
| FR1 TDD | PDSCH | Clause 5.2.2.2.14  Clause 5.2.3.2.14 | |
| DRX Adaptation (*drx-Adaptation-r16*) | FR1 FDD | PDCCH | Clause 5.3.2.1.3 | If the Test 1 in Clause 5.3.2.1.3 is passed, the test coverage can be considered fulfilled without executing Test 3 in clause 5.3.2.1.1. | |
| FR1 TDD | PDCCH | Clause 5.3.2.2.3 | If the Test 1 in Clause 5.3.2.2.3 is passed, the test coverage can be considered fulfilled without executing Test 2 in clause 5.3.2.2.1. | |
| FR1 FDD | PDCCH | Clause 5.3.3.1.3 | If the Test 1 in Clause 5.3.3.1.3 is passed, the test coverage can be considered fulfilled without executing Test 3 in clause 5.3.3.1.1. | |
| FR1 TDD | PDCCH | Clause 5.3.3.2.3 | If the Test 1 in Clause 5.3.3.2.3 is passed, the test coverage can be considered fulfilled without executing Test 2 in clause 5.3.3.2.1. | |
| Validating P/SP-CSI-RS reception (*periodicAndSemi-PersistentCSI-RS-r16*) | FR1 TDD | PDSCH | Clause 5.2.2.2.15  Clause 5.2.3.2.15  Clause 5.2A.2.3  Clause 5.2A.3.3 | The requirements apply only in case tested UE supporting operations in shared spectrum access and validation of P/SP-CSI-RS reception based on DCI | |
| Supported UL channels for dynamic channel access mode (*ul-DynamicChAccess-r16*) or UL channel access for semi-static channel access mode (ul-Semi-StaticChAccess-r16) or both | FR1 TDD | PDSCH | Clause 5.2.2.2.15  Clause 5.2.3.2.15 | The requirements apply only in case tested UE supports one of UL channels for dynamic channel access mode and UL channel access for semi-static channel access mode | |
| 1024QAM modulation for PDSCH for FR1 (*pdsch-1024QAM-FR1-r17* or *pdsch-1024QAM-2MIMO-FR1-r17*) | FR1 FDD | PDSCH | Clause 5.2.2.1.1 (Test 1-8)  Clause 5.2.3.1.1 (Test 1-8) |  | |
|  | FR1 TDD | PDSCH | Clause 5.2.2.2.1 (Test 1-12)  Clause 5.2.3.2.1 (Test 1-12) |  | |
|  |  | SDR | Clause 5.5.1  Clause 5.5A.1 | 1024QAM MCS indexes are used only if UE supports 1024QAM for FR1 DL. | |
| Support of neighboring LTE cell CRS-IM in DSS scenario with NR 15 kHz SCS ( *CRS-IM-DSS-15kHzSCS-r17*) | FR1 FDD | PDSCH | Clause 5.2.2.1.18  Clause 5.2.3.1.17 | UE can support the feature on the CC(s) in a band only if the UE indicates support of rateMatchingLTE-CRS on that band. | |
| FR1 TDD | PDSCH | Clause 5.2.2.2.19  Clause 5.2.3.2.18 |
| Support of neighboring LTE cell CRS-IM in non-DSS and 15 kHz NR SCS scenario, without the assistance of network signaling on LTE channel bandwidth (*CRS-IM-nonDSS-15kHzSCS-r17*) | FR1 FDD | PDSCH | Clause 5.2.2.1.19 (Test 2-1)  Clause 5.2.3.1.18 (Test 2-1) | The UE can perform CRS-IM when MeasObjectEUTRA IE is configured, and the configured measurement gaps overlap with neighbour LTE cell PBCH position. | |
| FR1 TDD | PDSCH | Clause 5.2.2.2.20 (Test 2-1)  Clause 5.2.3.2.19 (Test 2-1) |
| Support of neighboring LTE cell CRS-IM in non-DSS and 15 kHz NR SCS scenario, with the assistance of network signaling on LTE channel bandwidth (*CRS-IM-nonDSS-NWA-15kHzSCS-r17*) | FR1 FDD | PDSCH | Clause 5.2.2.1.19 (Test 1-1)  Clause 5.2.3.1.18 (Test 1-1) | If the Test 2-1 in Clause 5.2.2.1.19 is passed, the test coverage can be considered fulfilled without executing Test 1-1 in clause 5.2.2.1.19.  If the Test 2-1 in Clause 5.2.3.1.18 is passed, the test coverage can be considered fulfilled without executing Test 1-1 in clause 5.2.3.1.18. | |
| FR1 TDD | PDSCH | Clause 5.2.2.2.20 (Test 1-1)  Clause 5.2.3.2.19 (Test 1-1) | If the Test 2-1 in Clause 5.2.2.2.20 is passed, the test coverage can be considered fulfilled without executing Test 1-1 in clause 5.2.2.2.20.  If the Test 2-1 in Clause 5.2.3.2.19 is passed, the test coverage can be considered fulfilled without executing Test 1-1 in clause 5.2.3.2.19. | |
| CRS-IM in non-DSS and 30 kHz NR SCS scenario, without the assistance of network signaling on LTE channel bandwidth (*crs-IM-nonDSS-30kHzSCS-r17*) | FR1 TDD | PDSCH | Clause 5.2.2.2.20 (Test 2-2)  Clause 5.2.3.2.19 (Test 2-2) | The UE can perform CRS-IM when MeasObjectEUTRA IE is configured, and the configured measurement gaps overlap with neighbour LTE cell PBCH position. | |
| CRS-IM in non-DSS and 30 kHz NR SCS scenario, with the assistance of network signaling on LTE channel bandwidth (crs*-IM-nonDSS-NWA-30kHzSCS-r17*) | FR1 TDD | PDSCH | Clause 5.2.2.2.20 (Test 1-2)  Clause 5.2.3.2.19 (Test 1-2) | If the Test 2-2 in Clause 5.2.2.2.20 is passed, the test coverage can be considered fulfilled without executing Test 1-2 in clause 5.2.2.2.20.  If the Test 2-2 in Clause 5.2.3.2.19 is passed, the test coverage can be considered fulfilled without executing Test 1-2 in clause 5.2.3.2.19. | |
| Support for SFN scheme A for PDCCH scheduling SFN Scheme A PDSCH *(sfn-SchemeA-r17)* | FR1 FDD | PDSCH | Clause 5.2.2.1.20  Clause 5.2.3.1.19 |  | |
|  | FR1 TDD | PDSCH | Clause 5.2.2.2.21  Clause 5.2.3.2.20 |  | |
| Support for SFN scheme B for PDCCH scheduling SFN Scheme B PDSCH *(sfn-SchemeB-r17)* | FR1 FDD | PDSCH | Clause 5.2.2.1.21  Clause 5.2.3.1.20 |  | |
|  | FR1 TDD | PDSCH | Clause 5.2.2.2.22  Clause 5.2.3.2.21 |  | |
| Support for PDCCH with intra-slot repetition *(mTRP-PDCCH-Repetition-r17)* | FR1 FDD | PDCCH | Clause 5.3.2.1.5  Clause 5.3.3.1.4 |  | |
|  | FR1 TDD | PDCCH | Clause 5.3.2.2.5  Clause 5.3.3.2.4 |  | |

#### 5.1.1.4 Applicability of requirements for mandatory UE features with capability signalling

The performance requirements in Table 5.1.1.4-1 shall apply for UEs which support mandatory UE features with capability signalling only.

Table 5.1.1.4-1: Requirements applicability for mandatory features with UE capability signalling

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| UE feature/capability [14] | Test type | | Test list | Applicability notes |
| 256QAM modulation scheme for PDSCH for FR1 (*pdsch-256QAM-FR1*) | FR1 FDD | PDSCH | Clause 5.2.2.1.1 (Test 1-3)  Clause 5.2.3.1.1 (Test 1-3) |  |
|  | FR1 TDD | PDSCH | Clause 5.2.2.2.1 (Test 1-3)  Clause 5.2.3.2.1 (Test 1-3) |  |
| PDSCH mapping type B (*pdsch-MappingTypeB*) | FR1 FDD | PDSCH | Clause 5.2.2.1.3  Clause 5.2.3.1.3  Clause 5.2.2.1.7  Clause 5.2.3.1.7 |  |
|  | FR1 TDD | PDSCH | Clause 5.2.2.2.3  Clause 5.2.3.2.3  Clause 5.2.2.2.7  Clause 5.2.3.2.7 |  |
| Rate-matching around LTE CRS (*rateMatchingLTE-CRS*) | FR1 FDD | PDSCH | Clause 5.2.2.1.4  Clause 5.2.3.1.4 | For UEs supporting “Alternative additional DMRS position for co-existence with LTE CRS”, if Test 1-2 is tested, the test coverage can be considered fulfilled without executing Test 1-1. Otherwise, only Test 1-1 is tested. |
| FR1 TDD | PDSCH | Clause 5.2.2.2.4  Clause 5.2.3.2.4 |
| Supported maximum number of ports across all configured NZP-CSI-RS resources per CC (*maxConfigNumberPortsAcrossNZP-CSI-RS-PerCC*) | FR1 FDD | PDSCH | Clause 5.2.2.1.4 (Tests 1-1, 1-2)  Clause 5.2.3.1.1 (Tests 3-1, 4-1, 5-1)  Clause 5.2.3.1.4 (Tests 1-1, 1-2) | The requirements apply only in case the number of NZP-CSI-RS ports in the test case satisfies UE capability on maximum number of NZP-CSI-RS ports |
|  | FR1 TDD | PDSCH | Clause 5.2.3.2.1 (Test 3-1, 4-1, 5-1) |  |
| Supported maximum number of PDSCH MIMO layers (*maxNumberMIMO-LayersPDSCH*) | FR1 FDD | PDSCH | Clause 5.2.2.1.1 (Tests 2-1, 2-2, 3-1)  Clause 5.2.2.1.2  Clause 5.2.3.1.1 (Tests 2-1, 2-2, 3-1, 4-1, 5-1)  Clause 5.2.3.1.2 | The requirements apply only in case the PDSCH MIMO rank in the test case does not exceed UE PDSCH MIMO layers capability |
|  | FR1 TDD | PDSCH | Clause 5.2.2.2.1 (Tests 2-1, 2-2, 3-1)  Clause 5.2.2.2.2  Clause 5.2.3.2.1 (Tests 2-1, 2-2, 3-1, 4-1, 5-1)  Clause 5.2.3.2.2 |  |
| Support number of active TCI states per BWP per CC, including control and data *(maxNumberActiveTCI-PerBWP)* | FR1 FDD | PDSCH | Clause 5.2.2.1.10 (Test 1-2)  Clause 5.2.3.1.10 (Test 1-2) | The requirements apply only when *maxNumberActiveTCI-PerBWP* is other than n1. |
|  | FR1 TDD | PDSCH | Clause 5.2.2.2.10 (Test 1-2)  Clause 5.2.3.2.10 (Test 1-2) |  |
| Support for maximum number of TRS resource sets per CC which the UE can track simultaneously (*maxSimultaneousResourceSetsPerCC*) | FR1 FDD | PDSCH | Clause 5.2.2.1.10 (Test 1-2)  Clause 5.2.3.1.10 (Test 1-2)  Clause 5.2.2.1.11  Clause 5.2.2.1.12  Clause 5.2.2.1.13  Clause 5.2.2.1.14  Clause 5.2.3.1.11  Clause 5.2.3.1.12  Clause 5.2.3.1.13  Clause 5.2.3.1.14 | The requirements apply only when *maxSimultaneousResourceSetsPerCC* ≥ 2 |
| FR1 TDD | PDSCH | Clause 5.2.2.2.10 (Test 1-2)  Clause 5.2.3.2.10 (Test 1-2)  Clause 5.2.2.2.11  Clause 5.2.2.2.12  Clause 5.2.2.2.13  Clause 5.2.2.2.14  Clause 5.2.3.2.11  Clause 5.2.3.2.12  Clause 5.2.3.2.13  Clause 5.2.3.2.14 |

#### 5.1.1.5 Applicability of different requirements for HST

The applicability rules for different HST requirements in section 5 are specified in Table 5.1.1.5-1, Table 5.1.1.5-2.

Table 5.1.1.5-1: Applicability of requirements for HST

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| If UE has passed | | | UE can skip | | | Applicability notes |
| Test type | | Test list | Test type | | Test list |  |
| FR1 FDD | PDSCH | Clause 5.2.2.1.1 (Test 1-6) | FR1 FDD | PDSCH | Clause 5.2.2.1.1 (Test 1-5) |  |
| FR1 TDD | PDSCH | Clause 5.2.2.2.1 (Test 1-11) | FR1 TDD | PDSCH | Clause 5.2.2.2.1 (Test 1-7) |  |
| FR1 FDD | PDSCH | Clause 5.2.3.1.1 (Test 1-6) | FR1 FDD | PDSCH | Clause 5.2.3.1.1 (Test 1-5) |  |
| FR1 TDD | PDSCH | Clause 5.2.3.2.1 (Test 1-11) | FR1 TDD | PDSCH | Clause 5.2.3.2.1 (Test 1-7) |  |
| FR1 FDD | PDSCH | Clause 5.2.2.1.9 (Test 1-1) | FR1 FDD | PDSCH | Clause 5.2.2.1.1 (Test 1-5 ) |  |
| FR1 TDD | PDSCH | Clause 5.2.2.2.9 (Test 1-1) | FR1 TDD | PDSCH | Clause 5.2.2.2.1 (Test 1-7 and 1-11) |  |
| FR1 FDD | PDSCH | Clause 5.2.3.1.9 (Test 1-1) | FR1 FDD | PDSCH | Clause 5.2.3.1.1 (Test 1-5) |  |
| FR1 TDD | PDSCH | Clause 5.2.3.2.9 (Test 1-1) | FR1 TDD | PDSCH | Clause 5.2.3.2.1 (Test 1-7 and 1-11) |  |
| FR1 FDD | PDSCH | Clause 5.2.2.1.1 (Test 1-7) | FR1 FDD | PDSCH | Clause 5.2.2.1.1 (Test 1-1) |  |
| FR1 FDD | PDSCH | Clause 5.2.3.1.1 (Test 1-7) | FR1 FDD | PDSCH | Clause 5.2.3.1.1 (Test 1-1) |  |
| FR1 FDD | PDSCH | Clause 5.2.2.1.10 (Test 1-1 or 1-2) | FR1 FDD | PDSCH | Clause 5.2.2.1.1 (Test 1-5 ) |  |
| FR1 TDD | PDSCH | Clause 5.2.2.2.10 (Test 1-1 or 1-2) | FR1 TDD | PDSCH | Clause 5.2.2.2.1 (Test 1-7 and 1-11) |  |
| FR1 FDD | PDSCH | Clause 5.2.3.1.10 (Test 1-1 or 1-2) | FR1 FDD | PDSCH | Clause 5.2.3.1.1 (Test 1-5) |  |
| FR1 TDD | PDSCH | Clause 5.2.3.2.10 (Test 1-1 or 1-2) | FR1 TDD | PDSCH | Clause 5.2.3.2.1 (Test 1-7 and 1-11) |  |
| FR1 FDD | PDSCH | Clause 5.2.2.1.10 (Test 1-2) | FR1 FDD | PDSCH | Clause 5.2.2.1.10 (Test 1-1) |  |
| FR1 TDD | PDSCH | Clause 5.2.2.2.10 (Test 1-2) | FR1 TDD | PDSCH | Clause 5.2.2.2.10 (Test 1-1) |  |
| FR1 FDD | PDSCH | Clause 5.2.3.1.10 (Test 1-2) | FR1 FDD | PDSCH | Clause 5.2.3.1.10 (Test 1-1) |  |
| FR1 TDD | PDSCH | Clause 5.2.3.2.10 (Test 1-2) | FR1 TDD | PDSCH | Clause 5.2.3.2.10 (Test 1-1) |  |

Table 5.1.1.5-2: Applicability of requirements for HST Enhanced SFN Transmission schemes

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| If UE has passed | | | UE can skip | | | Applicability notes |
| Test type | | Test list | Test type | | Test list |  |
| FR1 FDD | PDSCH | Clause 5.2.2.1.20 | FR1 FDD | PDSCH | Clause 5.2.2.1.21 |  |
| FR1 TDD | PDSCH | Clause 5.2.2.2.21 | FR1 TDD | PDSCH | Clause 5.2.2.2.22 |  |
| FR1 FDD | PDSCH | Clause 5.2.3.1.19 | FR1 FDD | PDSCH | Clause 5.2.3.1.20 |  |
| FR1 TDD | PDSCH | Clause 5.2.3.2.20 | FR1 TDD | PDSCH | Clause 5.2.3.2.21 |  |

#### 5.1.1.6 Applicability and test rules for PDSCH performance requirements with power imbalance for intra-band contiguous CA

For UE passing the FDD and TDD CA power imbalance performance requirements with 2 DL CCs as defined in sections 5.2A.2.2 and 5.2A.3.2, the test coverage can be considered fulfilled with FDD or TDD intra-band contiguous CA with 3 or more DL CCs supported by the UE. During the test, UE is required to test the supported intra-band contiguous CA configurations with 2 DL CCs covering the lowest and highest operating bands.

The channel bandwidth combination for testing is determined by following procedure:

- First select the bandwidth combinations with the same bandwidth in each carrier.

- If there is no such bandwidth combination, select the bandwidth combinations with smallest bandwidth difference between the two carriers, and the carrier with smaller bandwidth will be used for test.

- Among the bandwidth combinations selected, select the CA combination with largest aggregated bandwidth combination.

#### 5.1.1.7 Applicability of CA requirements

##### 5.1.1.7.1 Definition of CA capability

The definition with respect to CA capabilities is given as in Table 5.1.1.7.1-1.

Table 5.1.1.7.1-1: Definition of CA capability

|  |  |
| --- | --- |
| CA Capability | CA Capability Description |
| CA\_C | Intra-band contiguous CA |
| CA\_N | Intra-band non-contiguous CA |
| CA\_AX | Inter-band CA (X bands) |
| NOTE 1: CA\_C corresponds to NR CA configurations and bandwidth combination sets defined in Clause 5.5A.1 of TS 38.101-1 [6]. CA\_N corresponds to NR CA configurations and bandwidth combination sets defined in Clause 5.5A.2 of TS 38.101-1 [6]. CA\_AX corresponds to NR CA configurations and bandwidth combination sets defined in Clause 5.5A.3 of TS 38.101-1 [6]. | |

##### 5.1.1.7.2 Applicability and test rules for different CA configurations and bandwidth combination sets

The performance requirement for CA UE demodulation tests in Clause 5.2A are defined independent of CA configurations and bandwidth combination sets specified in Clause 5.5A of TS 38.101-1. For UEs supporting different CA configurations and bandwidth combination sets, the applicability and test rules are defined in Table 5.1.1.7.2-1 and Table 5.1.1.7.2-2. For simplicity, CA configuration below refers to combination of CA configuration and bandwidth combination set.

Table 5.1.1.7.2-1: Applicability and test rules for CA UE demodulation tests

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Tests | CA capability where the tests apply | CA configuration from the selected CA capability where the tests apply | CA Bandwidth combination to be tested in priority order | PCell CC configuration |
| Test 1 in Clause 5.2A.2.1 and 5.2A.3.1 | CA\_C, CA\_N, CA\_AX | Table 5.1.1.7.2-2 | Largest aggregated CA bandwidth combination | Any of CCs |
| Test 2 in Clause 5.2A.2.1 and 5.2A.3.1 | CA\_C, CA\_N, CA\_AX | Table 5.1.1.7.2-2 | Largest aggregated CA bandwidth combination | Any of CCs |
| Test 3 in Clause 5.2A.2.1 and 5.2A.3.1 | CA\_AX | Table 5.1.1.7.2-2 | Largest aggregated CA bandwidth combination | TDD CC if supported, otherwise FDD CC |
| Test 4 in Clause 5.2A.2.1 and 5.2A.3.1 (NOTE 2) | CA\_AX | Table 5.1.1.7.2-2 | Largest aggregated CA bandwidth combination | Any of CCs |
| Test 5 in Clause 5.2A.2.1 and 5.2A.3.1 (NOTE 3) | CA\_AX | Table 5.1.1.7.2-2 | Largest aggregated CA bandwidth combination | 15 kHz CC if supported, otherwise 30 kHz CC |
| NOTE 1: In case CA\_AX with different number of X is supported then one or two CA configurations are selected based on procedure from Table 5.1.1.7.2-2.  NOTE 2: These scenarios are only tested for UEs which are not verified with Test 3 in Clause 5.2A.2.1 and 5.2A.3.1.  NOTE 3: These scenarios are only tested for UEs which are not verified with Test 2 in Clause 5.2A.2.1 and 5.2A.3.1. | | | | |

Table 5.1.1.7.2-2: Selection of CA configurations

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CA capability | Step 1 | Step 2 | Step 3 | Step 4 |
| CA\_C or CA\_N | Select the CA configurations with the maximum number of CCs, for which the supported maximum number of MIMO layers is not lower than 2. | Select any one of CA configurations, which contain CA bandwidth combination with the largest aggregated channel bandwidth and supported maximum data rate is not lower than the tested date rate, among all the selected CA configurations from Step 1. | N/A | N/A |
| CA\_AX | Select the CA configurations with the maximum number of CCs, for which the supported maximum number of MIMO layers is not lower than 2. | Select any one of CA configurations, which contain CA bandwidth combination with the largest aggregated channel bandwidth and supported maximum data rate is not lower than the tested date rate, among all the selected CA configurations from Step 1. | Select the CA configurations with the largest number of bands and with the maximum number of CCs, for which the supported maximum number of MIMO layers is not lower than 2. | Select any one of CA configurations, which contain CA bandwidth combination with the largest aggregated channel bandwidth and supported maximum data rate is not lower than the tested date rate, among all the selected CA configurations from Step 3. |
| NOTE 1: For CA\_AX capability, if CA configuration from step 2 is CA configuration with the largest number of bands then Step 3 and Step 4 are skipped. Otherwise, the two CA configurations selected from Step 2 and Step 4 are used for testing.  NOTE 2: Maximum supported data rate for Step 2 and Step 4 is calculated based clause 4.1.2 of TS 38.306 [14].  NOTE 3: Tested data rate for Step 2 and Step 4 is calculated based on the equation and FRCs used in the test. | | | | |

##### 5.1.1.7.3 Applicability rule and antenna connection for CA tests with 4 RX

Within the CA configuration if any of the PCell and/or the SCells is a 2Rx supported RF band, 2 out of the 4Rx should be connected with data source from system simulator, depending on UE’s declaration and AP configuration. Requirements from Clause 5.2A.2.1 are applied.

Within the CA configuration if any of the PCell and/or the SCells is a 4Rx supported RF band, all 4Rx should be connected with data source from system simulator. Requirements from Clause5.2A.3.1 are applied.

For 4Rx capable UEs, the 2Rx supported RF bands and 4Rx supported RF bands are up to UE’s declaration.

##### 5.1.1.7.4 Applicability of different requirements for HST

The applicability rules for different HST requirements in section 5 are specified in Table 5.1.1.7.4-1.

Table 5.1.1.7.4-1: Applicability of requirements for HST

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| If UE has passed | | | UE can skip | | | Applicability notes |
| Test type | | Test list | Test type | | Test list |  |
| FR1 2Rx | PDSCH | Clause 5.2A.2.4 (Test 3), and Clause 5.2A.2.5 (Test 1-2) | FR1 2Rx | PDSCH | Clause 5.2A.2.4 (Test 2), and Clause 5.2A.2.5 (Test 1-3) |  |
| FR1 2Rx | PDSCH | Clause 5.2A.2.4 (Test 1), and Clause 5.2A.2.5 (Test 1-2) | FR1 2Rx | PDSCH | Clause 5.2A.2.4 (Test 2), and Clause 5.2A.2.5 (Test 1-1) |  |
| FR1 4Rx | PDSCH | Clause 5.2A.3.4 (Test 3), and Clause 5.2A.3.5 (Test 1-2) | FR1 4Rx | PDSCH | Clause 5.2A.3.4 (Test 2), and Clause 5.2A.3.5 (Test 1-3), |  |
| FR1 4Rx | PDSCH | Clause 5.2A.3.4 (Test 1), and Clause 5.2A.3.5 (Test 1-2) | FR1 4Rx | PDSCH | Clause 5.2A.3.4 (Test 2), and Clause 5.2A.3.5 (Test 1-1), |  |
| FR1 2Rx | PDSCH | Clause 5.2A.2.5 (Test 1-3) | FR1 2Rx | PDSCH | Clause 5.2A.2.5 (Test 1-1) |  |
| FR1 2Rx | PDSCH | Clause 5.2A.2.4 (Test 3) | FR1 2Rx | PDSCH | Clause 5.2A.2.4 (Test 1) |  |
| FR1 4Rx | PDSCH | Clause 5.2A.3.5 (Test 1-3) | FR1 4Rx | PDSCH | Clause 5.2A.3.5 (Test 1-1) |  |
| FR1 4Rx | PDSCH | Clause 5.2A.3.4 (Test 3) | FR1 4Rx | PDSCH | Clause 5.2A.3.4 (Test 1) |  |
| FR1 2Rx | PDSCH | Clause 5.2A.2.4 (Test 3) | FR1 2Rx | PDSCH | Clause 5.2.2.1.9 (Test 1-1), Clause 5.2.2.2.1 (Test 1-11),  Clause 5.2.2.2.9 (Test 1-1) |  |
| FR1 2Rx | PDSCH | Clause 5.2A.2.5 (Test 1-3) | FR1 2Rx | PDSCH | Clause 5.2.2.1.10 (Test 1-1), Clause 5.2.2.2.1 (Test 1-11),  Clause 5.2.2.2.10 (Test 1-1) |  |
| FR1 2Rx | PDSCH | Clause 5.2A.2.4 (Test 1) | FR1 2Rx | PDSCH | Clause 5.2.2.1.9 (Test 1-1) |  |
| FR1 2Rx | PDSCH | Clause 5.2A.2.5 (Test 1-1) | FR1 2Rx | PDSCH | Clause 5.2.2.1.10 (Test 1-1) |  |
| FR1 2Rx | PDSCH | Clause 5.2A.2.4 (Test 2) | FR1 2Rx | PDSCH | Clause 5.2.2.2.1 (Test 1-11),  Clause 5.2.2.2.9 (Test 1-1) |  |
| FR1 2Rx | PDSCH | Clause 5.2A.2.5 (Test 1-2) | FR1 2Rx | PDSCH | Clause 5.2.2.2.1 (Test 1-11),  Clause 5.2.2.2.10 (Test 1-1) |  |
| FR1 4Rx | PDSCH | Clause 5.2A.3.4 (Test 3) | FR1 4Rx | PDSCH | Clause 5.2.3.1.9 (Test 1-1), Clause 5.2.3.2.1 (Test 1-11),  Clause 5.2.3.2.9 (Test 1-1) |  |
| FR1 4Rx | PDSCH | Clause 5.2A.3.5 (Test 1-3) | FR1 4Rx | PDSCH | Clause 5.2.3.1.10 (Test 1-1), Clause 5.2.3.2.1 (Test 1-11),  Clause 5.2.3.2.10 (Test 1-1) |  |
| FR1 4Rx | PDSCH | Clause 5.2A.3.4 (Test 1) | FR1 4Rx | PDSCH | Clause 5.2.3.1.9 (Test 1-1) |  |
| FR1 4Rx | PDSCH | Clause 5.2A.3.5 (Test 1-1) | FR1 4Rx | PDSCH | Clause 5.2.3.1.10 (Test 1-1) |  |
| FR1 4Rx | PDSCH | Clause 5.2A.3.4 (Test 2) | FR1 4Rx | PDSCH | Clause 5.2.3.2.1 (Test 1-11),  Clause 5.2.3.2.9 (Test 1-1) |  |
| FR1 4Rx | PDSCH | Clause 5.2A.3.5 (Test 1-2) | FR1 4Rx | PDSCH | Clause 5.2.3.2.1 (Test 1-11),  Clause 5.2.3.2.10 (Test 1-1) |  |
| FR1 2Rx | PDSCH | Clause 5.2A.2.5 (Test 2-1) | FR1 2Rx | PDSCH | Clause 5.2A.2.5 (Test 1-1) |  |
| FR1 2Rx | PDSCH | Clause 5.2A.2.5 (Test 2-2) | FR1 2Rx | PDSCH | Clause 5.2A.2.5 (Test 1-2) |  |
| FR1 2Rx | PDSCH | Clause 5.2A.2.5 (Test 2-3) | FR1 2Rx | PDSCH | Clause 5.2A.2.5 (Test 1-3) |  |
| FR1 4Rx | PDSCH | Clause 5.2A.3.5 (Test 2-1) | FR1 4Rx | PDSCH | Clause 5.2A.3.5 (Test 1-1) |  |
| FR1 4Rx | PDSCH | Clause 5.2A.3.5 (Test 2-2) | FR1 4Rx | PDSCH | Clause 5.2A.3.5 (Test 1-2) |  |
| FR1 4Rx | PDSCH | Clause 5.2A.3.5 (Test 2-3) | FR1 4Rx | PDSCH | Clause 5.2A.3.5 (Test 1-3) |  |
| FR1 2Rx | PDSCH | Clause 5.2A.2.4 (Test 3), and Clause 5.2A.2.5 (Test 2-2) | FR1 2Rx | PDSCH | Clause 5.2A.2.4 (Test 2), and Clause 5.2A.2.5 (Test 2-3) |  |
| FR1 2Rx | PDSCH | Clause 5.2A.2.4 (Test 1), and Clause 5.2A.2.5 (Test 2-2) | FR1 2Rx | PDSCH | Clause 5.2A.2.4 (Test 2), and Clause 5.2A.2.5 (Test 2-1) |  |
| FR1 4Rx | PDSCH | Clause 5.2A.3.4 (Test 3), and Clause 5.2A.3.5 (Test 2-2) | FR1 4Rx | PDSCH | Clause 5.2A.3.4 (Test 2), and Clause 5.2A.3.5 (Test 2-3), |  |
| FR1 4Rx | PDSCH | Clause 5.2A.3.4 (Test 1), and Clause 5.2A.3.5 (Test 2-2) | FR1 4Rx | PDSCH | Clause 5.2A.3.4 (Test 2), and Clause 5.2A.3.5 (Test 2-1), |  |
| FR1 2Rx | PDSCH | Clause 5.2A.2.5 (Test 2-3) | FR1 2Rx | PDSCH | Clause 5.2A.2.5 (Test 2-1) |  |
| FR1 4Rx | PDSCH | Clause 5.2A.3.5 (Test 2-3) | FR1 4Rx | PDSCH | Clause 5.2A.3.5 (Test 2-1) |  |
| FR1 2Rx | PDSCH | Clause 5.2A.2.5 (Test 2-3) | FR1 2Rx | PDSCH | Clause 5.2.2.1.10 (Test 1-1), Clause 5.2.2.2.1 (Test 1-11),  Clause 5.2.2.2.10 (Test 1-1),  Clause 5.2.2.1.10 (Test 1-2),  Clause 5.2.2.2.10 (Test 1-2) |  |
| FR1 2Rx | PDSCH | Clause 5.2A.2.5 (Test 2-1) | FR1 2Rx | PDSCH | Clause 5.2.2.1.10 (Test 1-1),  Clause 5.2.2.1.10 (Test 1-2) |  |
| FR1 2Rx | PDSCH | Clause 5.2A.2.5 (Test 2-2) | FR1 2Rx | PDSCH | Clause 5.2.2.2.1 (Test 1-11),  Clause 5.2.2.2.10 (Test 1-1),  Clause 5.2.2.2.10 (Test 1-2) |  |
| FR1 4Rx | PDSCH | Clause 5.2A.3.5 (Test 2-3) | FR1 4Rx | PDSCH | Clause 5.2.3.1.10 (Test 1-1), Clause 5.2.3.2.1 (Test 1-11),  Clause 5.2.3.2.10 (Test 1-1),  Clause 5.2.3.1.10 (Test 1-2),  Clause 5.2.3.2.10 (Test 1-2) |  |
| FR1 4Rx | PDSCH | Clause 5.2A.3.5 (Test 2-1) | FR1 4Rx | PDSCH | Clause 5.2.3.1.10 (Test 1-1),  Clause 5.2.3.1.10 (Test 1-2) |  |
| FR1 4Rx | PDSCH | Clause 5.2A.3.5 (Test 2-2) | FR1 4Rx | PDSCH | Clause 5.2.3.2.1 (Test 1-11),  Clause 5.2.3.2.10 (Test 1-1),  Clause 5.2.3.2.10 (Test 1-2) |  |

#### 5.1.1.8 Applicability of different requirements with Multi-TRxP

The applicability rules for requirements with multi-TRxP transmission schemes in section 5 are specified in Table 5.1.1.8-1.

Table 5.1.1.8-1: Applicability of requirements with Multi-TRxP Transmission

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| If UE has passed | | | UE can skip | | | Applicability notes |
| Test type | | Test list | Test type | | Test list |
| FR1 FDD | PDSCH | Clause 5.2.2.1.12 (Test 1-1) | FR1 FDD | PDSCH | Clause 5.2.2.1.11 (Test 1-1) |  |
| FR1 FDD | PDSCH | Clause 5.2.2.1.12 (Test 1-1) | FR1 FDD | PDSCH | Clause 5.2.2.1.13 (Test 1-1) |  |
| FR1 FDD | PDSCH | Clause 5.2.2.1.6 (Test 1-1) | FR1 FDD | PDSCH | Clause 5.2.2.1.14 (Test 1-1) |  |
| FR1 TDD | PDSCH | Clause 5.2.2.2.12 (Test 1-1) | FR1 TDD | PDSCH | Clause 5.2.2.2.11 (Test 1-1) |  |
| FR1 TDD | PDSCH | Clause 5.2.2.2.12 (Test 1-1) | FR1 TDD | PDSCH | Clause 5.2.2.2.13 (Test 1-1) |  |
| FR1 TDD | PDSCH | Clause 5.2.2.2.6 (Test 1-1) | FR1 TDD | PDSCH | Clause 5.2.2.2.14 (Test 1-1) |  |
| FR1 FDD | PDSCH | Clause 5.2.3.1.12 (Test 1-1) | FR1 FDD | PDSCH | Clause 5.2.3.1.11 (Test 1-1) |  |
| FR1 FDD | PDSCH | Clause 5.2.3.1.12 (Test 1-1) | FR1 FDD | PDSCH | Clause 5.2.3.1.13 (Test 1-1) |  |
| FR1 FDD | PDSCH | Clause 5.2.3.1.6 (Test 1-1) | FR1 FDD | PDSCH | Clause 5.2.3.1.14 (Test 1-1) |  |
| FR1 TDD | PDSCH | Clause 5.2.3.2.12 (Test 1-1) | FR1 TDD | PDSCH | Clause 5.2.3.2.11 (Test 1-1) |  |
| FR1 TDD | PDSCH | Clause 5.2.3.2.12 (Test 1-1) | FR1 TDD | PDSCH | Clause 5.2.3.2.13 (Test 1-1) |  |
| FR1 TDD | PDSCH | Clause 5.2.3.2.6 (Test 1-1) | FR1 TDD | PDSCH | Clause 5.2.3.2.14 (Test 1-1) |  |

#### 5.1.1.9 Applicability of requirements for PDSCH on bands with shared spectrum access

|  |  |
| --- | --- |
| Tests | Applicability notes |
| All tests in Clause 5.2.2.2.15 and 5.2.3.2.15 | Only test the supported largest channel bandwidth. |
| All tests in Clause 5.2A.2.3 and 5.2A.3.3 | Only test the supported largest channel bandwidth on SCell. |

#### 5.1.1.10 Applicability of requirements for PDSCH with inter cell interference

|  |  |
| --- | --- |
| Tests | Applicability notes |
| All tests in Clause 5.2.2.1.15, 5.2.3.1.15, 5.2.2.2.16 and 5.2.3.2.16 | If UE supporting both duplex mode TDD and FDD with 2RX, only test 1-1 in clause 5.2.2.1.15 and test 1-2 in clause 5.2.2.2.16 will be applied.  If UE supporting both duplex mode TDD and FDD with 4RX, only test 1-1 in clause 5.2.3.1.15 and test 1-2 in clause 5.2.3.2.16 will be applied. |

#### 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*.

Other performance requirements mandatory for UE supporting NR operation defined in Section 5 but not included in table 5.1.1.11-1 should not be considered applicable to RedCap UEs.

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 |  |
|  |  | SDR | Clause 5.5.1 |  |
|  | 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 5.2.2.1.17 |  |
|  |  | 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) |  |
|  |  | SDR | Clause 5.5.1 |  |
|  | FR1 TDD | PDSCH | All tests in Clause 5.2.2.2.18 |  |
|  |  | 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 | | | | |

## 5.2 PDSCH demodulation requirements

The parameters specified in Table 5.2-1 are valid for all PDSCH tests unless otherwise stated.

Table 5.2-1: Common test parameters

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | | Unit | Value |
| PDSCH transmission scheme | | |  | Transmission scheme 1 |
| Carrier configuration | Offset between Point A and the lowest usable subcarrier on this carrier (Note 2) | | RBs | 0 |
| Subcarrier spacing | | kHz | 15 or 30 |
| DL BWP configuration #1 | Cyclic prefix | |  | Normal |
| RB offset | | RBs | 0 |
| Number of contiguous PRB | | PRBs | Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-1 [6] for tested channel bandwidth and subcarrier spacing |
| Common serving cell parameters | Physical Cell ID | |  | 0 |
| SSB position in burst | |  | First SSB in Slot #0 |
| SSB periodicity | | ms | 20 |
| PDCCH configuration | Slots for PDCCH monitoring | |  | Each slot |
| Symbols with PDCCH | | Symbols | 0, 1 |
| Number of PRBs in CORESET | |  | Table 5.2-2 for tested channel bandwidth and subcarrier spacing |
| Number of PDCCH candidates and aggregation levels | |  | 1/AL8 |
| CCE-to-REG mapping type | |  | Non-interleaved |
| DCI format | |  | 1\_1 |
| TCI state | |  | TCI state #1 |
| PDCCH & PDCCH DMRS Precoding configuration | |  | For number of TX = 1: No precoding;  For number of TX > 1: Single Panel Type I; Randomized precoder selection for every REG bundle and updated per slot with equal probability of each applicable i1/i2 combination or codebook  index, chosen from section 5.2.2.2.1 of TS 38.214 [12]  For number of Tx>2, set “codebookMode” to 1 as defined in section 5.2.2.2.1 of TS 38.214 [12] |
| Cross carrier scheduling | | |  | Not configured |
| CSI-RS for tracking | First subcarrier index in the PRB used for CSI-RS | |  | k0=0 for CSI-RS resource 1,2,3,4 |
| First OFDM symbol 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 | 15 kHz SCS: 20 for CSI-RS resource 1,2,3,4  30 kHz SCS: 40 for CSI-RS resource 1,2,3,4 |
| CSI-RS offset | | Slots | 15 kHz SCS:  10 for CSI-RS resource 1 and 2  11 for CSI-RS resource 3 and 4  30 kHz SCS:  20 for CSI-RS resource 1 and 2  21 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 | Row index (Note 3) | |  | 3 for 2 CSI-RS ports and 5 for 4 CSI-RS ports |
| First subcarrier index in the PRB used for CSI-RS | |  | k0 = 0 |
| First OFDM symbol in the PRB used for CSI-RS | |  | l0 = 12 |
| Number of CSI-RS ports (X) | |  | Same as number of transmit antenna |
| CDM Type | |  | 'No CDM' for 1 transmit antenna  'FD-CDM2' for 2 and 4 transmit antenna |
| Density (ρ) | |  | 1 |
| CSI-RS periodicity | | Slots | 15 kHz SCS: 20  30 kHz SCS: 40 |
| CSI-RS offset | | Slots | 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 | Row index (Note 3) | |  | 5 |
| First subcarrier index in the PRB used for CSI-RS | |  | k0 = 4 |
| First OFDM symbol 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 | 15 kHz SCS: 20  30 kHz SCS: 40 |
| CSI-RS offset | | Slots | 0 |
| Frequency Occupation | |  | Start PRB 0  Number of PRB = ceil(BWP size/4)\*4 |
| PDSCH DMRS configuration | Antenna ports indexes | |  | {1000} for Rank 1 tests {1000, 1001} for Rank 2 tests  {1000-1002} for Rank 3 tests  {1000-1003} for Rank 4 tests |
| Position of the first DMRS for PDSCH mapping type A | |  | 2 |
| Number of PDSCH DMRS CDM group(s) without data | |  | 1 for Rank 1 and Rank 2 tests  2 for Rank 3 and Rank 4 tests |
| TCI state #0 | Type 1 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| 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 |  | N/A |
| QCL Type |  | N/A |
| PT-RS configuration | | |  | PT-RS is not configured |
| Maximum number of code block groups for ACK/NACK feedback | | |  | 1 |
| Maximum number of HARQ transmission | | |  | 4 |
| HARQ ACK/NACK bundling | | |  | Multiplexed |
| Redundancy version coding sequence | | |  | {0,2,3,1} |
| PDSCH & PDSCH DMRS Precoding configuration | | |  | For number of TX = 1: No precoding;  For number of TX > 1:Single Panel Type I; Randomized precoder selection for every PRB bundle and updated per slot, with equal probability of each applicable i1/i2 combination or codebook  index, chosen from section 5.2.2.2.1 of TS 38.214 [12].  For number of Tx>2 and Rank=1 or 2, Set “codebookMode” to 1 as defined in section 5.2.2.2.1 of TS 38.214 [12] |
| 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 |
| Physical signals, channels mapping and precoding | | |  | As specified in Annex B.4.1 |
| Note 1: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH transmission.  Note 2: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-1 [6] for tested channel bandwidth and subcarrier spacing.  Note 3: Refer to Table 7.4.1.5.3-1 in [9] | | | | |

Table 5.2-2: Number of PRBs in CORESET

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **SCS (kHz)** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** | **25 MHz** | **30 MHz** | **35 MHz** | **40 MHz** | **45 MHz** | **50 MHz** | **60 MHz** | **80 MHz** | **100 MHz** |
| 15 | 24 | 48 | 78 | 102 | 132 | 156 | 186 | 216 | 240 | 270 | N/A | N/A | N/A |
| 30 | 6 | 24 | 36 | 48 | 60 | 78 | 90 | 102 | 114 | 132 | 162 | 216 | 270 |

### 5.2.1 1RX requirements

#### 5.2.1.1 FDD

##### 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. 1-1.1 HD-FDD | 10 / 15 | QPSK, 0.30 | TDLB100-400 | 2x1 Low | 70 | 3.7 |
| 1-2 | R.PDSCH.1-2.1 FDD  R.PDSCH. 1-1.2 HD-FDD | 10 / 15 | 16QAM, 0.48 | TDLC300-100 | 2x1 Low | 70 | 12.2 |
| 1-3 | R.PDSCH.1-3.5 FDD  R.PDSCH. 1-1.3 HD-FDD | 10 / 15 | 64QAM, 0.50 | TDLA30-10 | 2x1 Low | 70 | 16.5 |
| 1-4 | R.PDSCH.1-4.2 FDD  R.PDSCH. 1-1.4 HD-FDD | 10 / 15 | 256QAM, 0.67 | TDLA30-10 | 2x1 Low | 70 | 25.3 |
| Note 1: Applied reference channel depends on the supported operation mode: FDD or HD-FDD. | | | | | | | |

#### 5.2.1.2 TDD

##### 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 | 25.5 |

### 5.2.2 2RX requirements

#### 5.2.2.1 FDD

##### 5.2.2.1.1 Minimum requirements for PDSCH Mapping Type A

The performance requirements are specified in Table 5.2.2.1.1-3 and Table 5.2.2.1.1-4, with the addition of test parameters in Table 5.2.2.1.1-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.1.1-1.

Table 5.2.2.1.1-1: Tests purpose

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify the PDSCH mapping Type A normal performance under 2 receive antenna conditions and with different channel models, MCSs and number of MIMO layers | 1-1, 1-2, 1-3, 1-5, 1-6, 1-7, 1-8, 2-1, 2-2 |
| Verify the PDSCH mapping Type A HARQ soft combining performance under 2 receive antenna conditions. | 1-4 |
| Verify the PDSCH mapping Type A performance requirements for Enhanced Receiver Type 1 under 2 receive antenna conditions. | 3-1 |

Table 5.2.2.1.1-2: 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 |  | Test 1-2: Type 1 with start RB = 23, LRBs = 6  Other tests: Type 0 |
|  | RBG size |  | Test 1-2: N/A  Other tests: 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 Tests 1-1, 1-5, 1-6, 1-7 1 for other tests |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| CSI-RS for tracking | CSI-RS periodicity | Slots | Test 1-5, 1-6, 1-7: 10 for CSI-RS resource 1,2,3,4.  Other tests: Table 5.2-1. |
|  | CSI-RS offset | Slots | Test 1-5, 1-6, 1-7: 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4.  Other tests: Table 5.2-1. |
| Number of HARQ Processes | |  | 8 for Test 1-4  4 for other tests |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 2 |

Table 5.2.2.1.1-3: Minimum performance for Rank 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | 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 | 10 / 15 | QPSK, 0.30 | TDLB100-400 | 2x2, ULA Low | 70 | -0.8 |
| 1-2 | R.PDSCH.1-1.2 FDD | 10 / 15 | QPSK, 0.30 | TDLC300-100 | 2x2, ULA Low | 70 | 0.2 |
| 1-3 | R.PDSCH.1-4.1 FDD | 10 / 15 | 256QAM, 0.82 | TDLA30-10 | 2x2, ULA Low | 70 | 24.6 |
| 1-4 | R.PDSCH.1-2.1 FDD | 10 / 15 | 16QAM, 0.48 | TDLC300-100 | 2x2, ULA Low | 30 | 1.1 |
| 1-5 | R.PDSCH.1-8.1 FDD | 10 / 15 | 16QAM, 0.48 | HST-750 | 1x2 | 70 | 6.2 |
| 1-6 | R.PDSCH.1-8.2 FDD | 10 / 15 | 64QAM, 0.43 | HST-972 | 1x2 | 70 | 9.9 |
| 1-7 | R.PDSCH.1-8.1 FDD | 10 / 15 | 16QAM, 0.48 | TDLC300-600 | 2x2 | 70 | 8.6 |
| 1-8 | R.PDSCH.1-17.1 FDD | 10 / 15 | 1024QAM,  0.79 | TDLD30-5 | 2x2, ULA Low | 70 | 29.5 |

Table 5.2.2.1.1-4: Minimum performance for Rank 2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | 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 | 10 / 15 | 64QAM, 0.50 | TDLA30-10 | 2x2, ULA Low | 70 | 19.4 |
| 2-2 | R.PDSCH.2-1.1 FDD | 20 / 30 | 64QAM, 0.50 | TDLA30-10 | 2x2, ULA Low | 70 | 19.7 |

Table 5.2.2.1.1-5: Minimum performance for Rank 2 and Enhanced Receiver Type 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | 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) |
| 3-1 | R.PDSCH.1-2.2 FDD | 10 / 15 | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Medium | 70 | 17.6 |

##### 5.2.2.1.2 Minimum requirements for PDSCH Mapping Type A and CSI-RS overlapped with PDSCH

The performance requirements are specified in Table 5.2.2.1.2-3, with the addition of test parameters in Table 5.2.2.1.2-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.1.2-1.

Table 5.2.2.1.2-1: Tests purpose

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify the PDSCH mapping Type A normal performance under 2 receive antenna conditions and CSI-RS overlapped with PDSCH | 1-1 |

Table 5.2.2.1.2-2: 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 |  | 2 |
|  | 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 |  | 1 |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| NZP CSI-RS for CSI acquisition | OFDM symbols in the PRB used for CSI-RS |  | l0 = 13 |
|  | CSI-RS periodicity | Slots | 5 |
| ZP CSI-RS for CSI acquisition | Subcarrier index in the PRB used for CSI-RS |  | (k0, k1, k2, k3)=(2, 4, 6, 8) |
|  | Number of CSI-RS ports (X) |  | 8 |
|  | CSI-RS periodicity | Slots | 5 |
| Number of HARQ Processes | |  | 4 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 2 |

Table 5.2.2.1.2-3: Minimum performance for Rank 2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Test num.** | **Reference channel** | **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.1-5.1 FDD | 10 / 15 | 16QAM, 0.48 | TDLC300-100 | 2x2, ULA Low | 70 | 14.8 |

##### 5.2.2.1.3 Minimum requirements for PDSCH Mapping Type B

The performance requirements are specified in Table 5.2.2.1.3-3, with the addition of test parameters in Table 5.2.2.1.3-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.1.3-1.

Table 5.2.2.1.3-1: Tests purpose

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify PDSCH mapping Type B performance under 2 receive antenna conditions | 1-1 |

Table 5.2.2.1.3-2: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Value** |
| Duplex mode | |  | FDD |
| Active DL BWP index | |  | 1 |
| PDSCH configuration | Mapping type |  | Type B |
|  | k0 |  | 0 |
|  | Starting symbol (S) |  | 5 |
|  | Length (L) |  | 7 |
|  | PDSCH aggregation factor |  | 1 |
|  | PRB bundling type |  | Static |
|  | PRB bundling size |  | 2 |
|  | 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 |  | 1 |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| Number of HARQ Processes | |  | 4 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 2 |

Table 5.2.2.1.3-3: Minimum performance for Rank 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | 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.1-1.3 FDD | 10 / 15 | QPSK, 0.30 | TDLA30-10 | 2x2, ULA Low | 70 | -0.9 |

##### 5.2.2.1.4 Minimum requirements for PDSCH Mapping Type A and LTE-NR coexistence

The performance requirements are specified in Table 5.2.2.1.4-3, with the addition of test parameters in Table 5.2.2.1.4-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.1.4-1.

Table 5.2.2.1.4-1: Tests purpose

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify the PDSCH mapping Type A normal performance under 2 receive antenna conditions with CRS rate matching configured | 1-1, 1-2 |

Table 5.2.2.1.4-2: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Value** |
| Duplex mode | |  | FDD |
| Active DL BWP index | |  | 1 |
| NR UL transmission with a 7.5 kHz shift to the LTE raster | |  | true |
| PDCCH configuration | Symbols with PDCCH |  | Symbol# 2 | |
| PDSCH configuration | Mapping type |  | Type A |
|  | k0 |  | 0 |
|  | Starting symbol (S) |  | 3 |
|  | Length (L) |  | 9 for Test 1-1 11 for Test 1-2 |
|  | PDSCH aggregation factor |  | 1 |
|  | PRB bundling type |  | Static |
|  | PRB bundling size |  | 2 |
|  | 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 |
|  | Position of the first DM-RS for downlink |  | 3 |
|  | Number of additional DMRS |  | 1 |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| CRS for rate matching (Note 1) | LTE carrier centre subcarrier location |  | Same as NR carrier centre subcarrier location |
|  | LTE carrier BW | MHz | 10 |
|  | Number of antenna ports |  | 4 |
|  | v-shift |  | 0 |
| Number of HARQ Processes | |  | 4 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 2 |
| Note 1: No MBSFN is configured on LTE carrier | | | |

Table 5.2.2.1.4-3: Minimum performance for Rank 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | 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.1-7.1 FDD | 10 / 15 | QPSK, 0.30 | TDLA30-10 | 4x2, ULA Low | 70 | -1.0 |
| 1-2 | R.PDSCH.1-7.2 FDD | 10 / 15 | QPSK, 0.30 | TDLA30-10 | 4x2, ULA Low | 70 | -1.0 |

##### 5.2.2.1.5 Minimum requirements for PDSCH 0.001% BLER

The performance requirements are specified in Table 5.2.2.1.5-3, with the addition of test parameters in Table 5.2.2.1.5-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.1.5-1.

Table 5.2.2.1.5-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH 0.001% BLER performance under 2 receive antenna conditions | 1-1 |

Table 5.2.2.1.5-2: 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 |  | 2 |
|  | 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 |  | 1 |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| Maximum number of HARQ transmission | |  | 1 |
| Number of HARQ Processes | |  | 4 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 2 |

Table 5.2.2.1.5-3: Minimum performance for Rank 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
| Target BLER | SNR (dB) |
| 1-1 | R.PDSCH.1-1.4 FDD | 10 / 15 | QPSK, 0.59 | AWGN | 1x2, ULA Low | 0.001% | 3.2 |

##### 5.2.2.1.6 Minimum requirements for PDSCH repetitions over multiple slots

The performance requirements are specified in Table 5.2.2.1.6-3, with the addition of test parameters in Table 5.2.2.1.6-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.1.6-1.

Table 5.2.2.1.6-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH repetitions over multiple slots performance under 2 receive antenna conditions | 1-1 |

Table 5.2.2.1.6-2: 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 |  | 2 |
|  | PRB bundling type |  | Static |
|  | PRB bundling size |  | 2 |
|  | 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 |  | 1 |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| Number of HARQ Processes | |  | 4 |
| The number of slots between final repetition of PDSCH and corresponding HARQ-ACK information | |  | 2 |

Table 5.2.2.1.6-3: Minimum performance for Rank 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
| Target BLER | SNR (dB) |
| 1-1 | R.PDSCH.1-11.1 FDD | 10 / 15 | 16QAM, 0.54 | TDLA30-10 | 2x2, ULA Low | 1% (Note 1) | 1.6 |
| Note 1: BLER is defined as residual BLER; i.e. ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block. | | | | | | | |

##### 5.2.2.1.7 Minimum requirements for PDSCH Mapping Type B and UE processing capability 2

The performance requirements are specified in Table 5.2.2.1.7-3, with the addition of test parameters in Table 5.2.2.1.7-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.1.7-1.

Table 5.2.2.1.7-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify PDSCH mapping Type B performance and UE processing capability 2 under two receive antenna conditions | 1-1 |

Table 5.2.2.1.7-2: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | Value |
| Duplex mode | |  | FDD |
| Active DL BWP index | |  | 1 |
| PDSCH configuration | Mapping type |  | Type B |
|  | k0 |  | 0 |
|  | Starting symbol (S) |  | 2 |
|  | Length (L) |  | 2 |
|  | PDSCH aggregation factor |  | 1 |
|  | PRB bundling type |  | Static |
|  | PRB bundling size |  | 2 |
|  | 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 |  | 0 |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| Maximum number of HARQ transmission | |  | 1 |
| Number of HARQ Processes | |  | 2 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 0 |

Table 5.2.2.1.7-3: Minimum performance for Rank 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | 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.1-12.1 FDD | 10 / 15 | QPSK, 0.30 | TDLA30-10 | 2x2, ULA Low | 70 | 0.8 |

##### 5.2.2.1.8 Minimum requirements for PDSCH pre-emption

The performance requirements are specified in Table 5.2.2.1.8-3, with the addition of test parameters in Table 5.2.2.1.8-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.1.8-1.

Table 5.2.2.1.8-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH pre-emption performance under 2 receive antenna conditions | 1-1 |

Table 5.2.2.1.8-2: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | Value |
| Duplex mode | |  | FDD |
| Active DL BWP index | |  | 1 |
| PDCCH configuration (Note 4) | Symbols with PDCCH |  | 0, 1 |
|  | DCI format |  | 2\_1 |
|  | timeFrequencySet |  | 14x1 |
| 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 |  | 2 |
|  | 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 |  | 1 |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| Pre-emption configuration (Note 2) | Starting symbol (S) |  | 3 |
|  | Length (L) |  | 2 |
|  | Pre-emption periodicity and offset (Note 3) | Slots | 10/1 |
| Number of HARQ Processes | |  | 4 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 2 |
| Note 1: Void  Note 2: Interference modelled as random data on pre-empted REs.  Note 3: Pre-emption is scheduled with a fixed scheduling with 10% probability within 10ms periodicity.  Note 4: In addition to PDCCH configuration in Table 5.2-1. | | | |

Table 5.2.2.1.8-3: Minimum performance for Rank 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | 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.1-2.6 FDD | 10 / 15 | 16QAM  0.64 | TDLA30-10 | 2x2, ULA Low | 70 | 10.5 |

##### 5.2.2.1.9 Minimum requirements for PDSCH HST-SFN

The performance requirements are specified in Table 5.2.2.1.9-3, with the addition of test parameters in Table 5.2.2.1.9-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.1.9-1.

Table 5.2.2.1.9-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify PDSCH performance under 2 receive antenna conditions in the HST-SFN scenario defined in B.3.2 when highSpeedDemodFlag-r16 IE [17] is configured | 1-1 |

Table 5.2.2.1.9-2: 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 |  | 2 |
|  | 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 |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| CSI-RS for tracking | CSI-RS periodicity | Slots | 10 for CSI-RS resource 1,2,3,4. |
|  | CSI-RS offset | Slots | 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4. |
| Number of HARQ Processes | |  | 4 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 2 |

Table 5.2.2.1.9-3: Minimum performance for Rank 2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | 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.1-8.3 FDD | 10 / 15 | 16QAM, 0.48 | HST-SFN | 2x2 | 70 | 13.0 |

##### 5.2.2.1.10 Minimum requirements for HST-DPS

The performance requirements are specified in Table 5.2.2.1.10-3, with the addition of test parameters in Table 5.2.2.1.10-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.1.10-1.

Table 5.2.2.1.10-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify UE performance in the HST-DPS scenario defined in B.3.3 | 1-1, 1-2 |

Table 5.2.2.1.10-2: Test parameters

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | | Unit | Value |
| Duplex mode | | |  | FDD |
| Active DL BWP index | | |  | 1 |
| PDCCH configuration | TCI state | |  | Note 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 | |  | 2 |
|  | Resource allocation type | |  | Type 0 |
|  | RBG size | |  | Config2 |
|  | VRB-to-PRB mapping type | |  | Non-interleaved |
|  | VRB-to-PRB mapping interleaver bundle size | |  | N/A |
|  | TCI state | |  | Note 1 |
| PDSCH DMRS configuration | DMRS Type | |  | Type 1 |
|  | Number of additional DMRS | |  | 2 |
|  | Maximum number of OFDM symbols for DL front loaded DMRS | |  | 1 |
| CSI-RS for tracking | Resource set #1 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 5 for CSI-RS resource 1 and 3  l0 = 9 for CSI-RS resource 2 and 4 |
|  |  | CSI-RS periodicity | Slots | 10 for CSI-RS resource 1,2,3,4. |
|  |  | CSI-RS offset | Slots | 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4 |
|  |  | QCL info |  | TCI state #2 |
|  | Resource set #2 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 6 for CSI-RS resource 5 and 7  l0 = 10 for CSI-RS resource 6 and 8 |
|  |  | CSI-RS periodicity | Slots | 10 for CSI-RS resource 5,6,7,8. |
|  |  | CSI-RS offset | Slots | 1 for CSI-RS resource 5 and 6 2 for CSI-RS resource 7 and 8 |
|  |  | QCL info |  | TCI state #3 |
| NZP CSI-RS for CSI acquisition | Resource set #3 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 12 |
|  |  | CSI-RS periodicity | Slots | 20 |
|  |  | CSI-RS offset | Slots | 0 |
|  |  | QCL info |  | TCI state #0 |
|  | Resource set #4 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 13 |
|  |  | CSI-RS periodicity | Slots | 20 |
|  |  | CSI-RS offset | Slots | 0 |
|  |  | QCL info |  | TCI state #1 |
| TCI state #0 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking Resource set #1' configuration |
|  |  | QCL Type |  | Type A |
|  | Type 2 QCL information | CSI-RS resource |  | N/A |
|  |  | QCL Type |  | N/A |
| TCI state #1 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration |
|  |  | QCL Type |  | Type A |
|  | Type 2 QCL information | CSI-RS resource |  | N/A |
|  |  | QCL Type |  | N/A |
| TCI state #2 | Type 1 QCL information | SSB index |  | SSB #0 |
|  |  | QCL Type |  | Type C |
|  | Type 2 QCL information | SSB index |  | N/A |
|  |  | QCL Type |  | N/A |
| TCI state #3 | Type 1 QCL information | SSB index |  | SSB #1 |
|  |  | QCL Type |  | Type C |
|  | Type 2 QCL information | SSB index |  | N/A |
|  |  | QCL Type |  | N/A |
| Number of HARQ Processes | | |  | 4 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | | |  | 2 |
| Note 1: SSB # (k mod 2) , CSI-RS (for tracking) resource set # ((k mod 2) + 1) and CSI-RS (for CSI acquisition) resource set # ((k mod 2) + 3) are transmitted by kth RRH.  For Test 1-1, TCI state switching command scheduled by MAC CE with MCS 4 is transmitted in slot #i that satisfy. PDCCH and PDSCH associated with TCI # (k mod 2) is transmitted by kth RRH from slot#  to slot#  ,  PDCCH and PDSCH are DTXed in other slots in which throughput statistics are not considered.  For Test 1-2, TCI state switching command scheduled by MAC CE with MCS 4 is transmitted in slot #i that satisfy. PDCCH and PDSCH associated with TCI # (k mod 2) is transmitted by kth RRH from slot#  to slot#  Where k=0, 1, 2… is the RRH number, n = 2520 is half of the number of slots between two RRH, = 2 is the number of slots between PDSCH and corresponding HARQ-ACK information, = 3 is the number of slots for MAC CE processing, = 6 is the number of slots to first TRS transmission occasion after MAC CE command is decoded by the UE, = 2 is the number of slots for TRS processing. | | | | |

Table 5.2.2.1.10-3: Minimum performance for HST-DPS

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | Number of active PDSCH TCI states | Correlation matrix and antenna configuration | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.1-8.4 FDD | 10 / 15 | 64QAM, 0.43 | HST-DPS | 1 | 2x2 | 70 | 13.4 |
| 1-2 | R.PDSCH.1-8.4 FDD | 10 / 15 | 64QAM, 0.43 | HST-DPS | 2 | 2x2 | 70 | 13.4 |

##### 5.2.2.1.11 Minimum requirements for PDSCH Single-DCI based SDM scheme

The performance requirements are specified in Table 5.2.2.1.11-3, with the addition of test parameters in Table 5.2.2.1.11-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.1.11-1.

Table 5.2.2.1.11-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH performance with Single-DCI based SDM scheme under 2 receive antenna conditions | 1-1,1-2 |

Table 5.2.2.1.11-2: Test parameters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | | | | Unit | Value | |
| TRxP #1(Note 1) | TRxP #2(Note 1) |
| Transmit TRxP of SSB | | | |  | TRxP #1 | |
| PDCCH configuration | | TCI state | |  | TCI State #1 | |
| CORESETPoolIndex | |  | 0 | |
| CSI-RS for tracking | | First subcarrier index in the PRB used for CSI-RS | |  | k0=0 for CSI-RS resources 1,2,3,4 | k0=1 for CSI-RS resources 5,6,7,8 |
| First OFDM symbol in the PRB used for CSI-RS | |  | l0 = 6 for CSI-RS resources 1 and 3  l0 = 10 for CSI-RS resources 2 and 4 | l0 = 6 for CSI-RS resources 5 and 7  l0 = 10 for CSI-RS resources 6 and 8 |
| Number of CSI-RS ports (X) | |  | 1 for CSI-RS resource 1,2,3,4 | 1 for CSI-RS resource 5,6,7,8 |
| CDM Type | |  | ‘No CDM’ for CSI-RS resource 1,2,3,4,5,6,7,8 | |
| Density | |  | 3 | |
| CSI-RS periodicity | | Slots | 20 | |
| CSI-RS offset | | Slots | 10 for CSI-RS resources 1 and 2  11 for CSI-RS resources 3 and 4 | 10 for CSI-RS resources 5 and 6  11 for CSI-RS resources 7 and 8 |
| QCL info | |  | TCI state #0 | |
| Duplex mode | | | |  | FDD | |
| Active DL BWP index | | | |  | 1 | |
| PDSCH configuration | Mapping type | | |  | Type A | |
| k0 | | |  | 0 | |
| Starting symbol (S) | | |  | 2 | |
| Length (L) | | |  | 12 | |
| PRB bundling type | | |  | Static | |
| PRB bundling size | | |  | 2 | |
| Resource allocation type | | |  | Type 1 | |
| RBG size | | |  | Config2 | |
| VRB-to-PRB mapping type | | |  | Non-interleaved | |
| VRB-to-PRB mapping interleaver bundle size | | |  | N/A | |
| PDSCH DMRS configuration | Antenna port indexes | | |  | 1000 | 1002 |
| TCI state | | |  | TCI State #1 | TCI State #2 |
| DMRS Type | | |  | Type 1 | |
| Number of additional DMRS | | |  | 1 | |
| Maximum number of OFDM symbols for DL front loaded DMRS | | |  | 1 | |
| TCI State #1 | Type 1 QCL information | | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking’ configuration | N/A |
| QCL Type |  | Type A | N/A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| TCI State #2 | Type 1 QCL information | | CSI-RS resource |  | N/A | CSI-RS resource 5 from 'CSI-RS for tracking’ configuration |
| QCL Type |  | N/A | Type A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| Resource allocation | | | |  | Full-overlapping | |
| Timing offset of the second TRxP from the first TRxP | | | | us | -0.5 for test 1-1  2 for test 1-2 | |
| Frequency offset of the second TRxP from the first TRxP | | | | Hz | 200 for test 1-1  0 for test 1-2 | |
| Number of HARQ Processes | | | |  | 4 | |
| The number of slots between PDSCH and corresponding HARQ-ACK information | | | |  | 2 | |
| Precoding configuration | | | |  | SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity | |
| Note 1: PDSCH transmission is done from both TRxPs (PDSCH Layer 0 is transmitted from TRxP #1 and PDSCH layer 1 is transmitted from TRxP #2) | | | | | | |

Table 5.2.2.1.11-3: Minimum performance

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition(Note 1) | Correlation matrix and antenna configuration(Note 2) | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB)(Note 3) |
| 1-1 | R.PDSCH.1-3.2 FDD | 10 / 15 | 64QAM, 0.50 | TDLA30-10 | 2x2, ULA Low | 70 | 20.7 |
| 1-2 | R.PDSCH.1-3.2 FDD | 10 / 15 | 64QAM, 0.50 | TDLA30-10 | 2x2, ULA Low | 70 | 20.1 |
| Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent  Note 2: Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2  Note 3: SNR corresponds to SNR of TRxP #1 and TRxP #2 as defined in 4.4.2 with scaling factor as 1/sqrt(2) for transmitted signal from each TRxP | | | | | | | |

##### 5.2.2.1.12 Minimum requirements for PDSCH Multi-DCI based transmission scheme

The performance requirements are specified in Table 5.2.2.1.12-3, with the addition of test parameters in Table 5.2.2.1.12-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.1.12-1.

Table 5.2.2.1.12-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH performance when UE is configured two different values of CORESETPoolIndex in ControlResourceSet and when UE receives multiple PDCCHs scheduling PDSCHs | 1-1 |

Table 5.2.2.1.12-2: Test parameters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | | | | Unit | Value | |
| TRxP #1(Note 1) | TRxP #2(Note 1) |
| Transmit TRxP of SSB | | | |  | TRxP #1 | |
| PDCCH configuration | | TCI state | |  | TCI State #1 | TCI State #2 |
| CORESETPoolIndex | |  | 0,1 | |
| CSI-RS for tracking | | First subcarrier index in the PRB used for CSI-RS | |  | k0=0 for CSI-RS resources 1,2,3,4 | k0=1 for CSI-RS resources 5,6,7,8 |
| First OFDM symbol in the PRB used for CSI-RS | |  | l0 = 6 for CSI-RS resources 1 and 3  l0 = 10 for CSI-RS resources 2 and 4 | l0 = 6 for CSI-RS resources 5 and 7  l0 = 10 for CSI-RS resources 6 and 8 |
| Number of CSI-RS ports (X) | |  | 1 for CSI-RS resource 1,2,3,4 | 1 for CSI-RS resource 5,6,7,8 |
| CDM Type | |  | ‘No CDM’ for CSI-RS resource 1,2,3,4,5,6,7,8 | |
| Density | |  | 3 | |
| CSI-RS periodicity | | Slots | 20 | |
| CSI-RS offset | | Slots | 10 for CSI-RS resources 1 and 2  11 for CSI-RS resources 3 and 4 | 10 for CSI-RS resources 5 and 6  11 for CSI-RS resources 7 and 8 |
| QCL info | |  | TCI state #0 | |
| Duplex mode | | | |  | FDD | |
| Active DL BWP index | | | |  | 1 | |
| PDSCH configuration | Mapping type | | |  | Type A | |
| k0 | | |  | 0 | |
| Starting symbol (S) | | |  | 2 | |
| Length (L) | | |  | 12 | |
| PRB bundling type | | |  | Static | |
| PRB bundling size | | |  | 2 | |
| Resource allocation type | | |  | Type 1 | |
| RBG size | | |  | Config2 | |
| VRB-to-PRB mapping type | | |  | Non-interleaved | |
| VRB-to-PRB mapping interleaver bundle size | | |  | N/A | |
| PDSCH DMRS configuration | Antenna port indexes | | |  | {1000,1001} | {1002,1003} |
| TCI state | | |  | TCI State #1 | TCI State #2 |
| DMRS Type | | |  | Type 1 | |
| Number of additional DMRS | | |  | 1 | |
| Maximum number of OFDM symbols for DL front loaded DMRS | | |  | 1 | |
| TCI State #1 | Type 1 QCL information | | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking’ configuration | N/A |
| QCL Type |  | Type A | N/A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| TCI State #2 | Type 1 QCL information | | CSI-RS resource |  | N/A | CSI-RS resource 5 from 'CSI-RS for tracking’ configuration |
| QCL Type |  | N/A | Type A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| Resource allocation | | | |  | Non-overlapping | |
| Timing offset of the second TRxP from the first TRxP | | | | us | -0.5 | |
| Frequency offset of the second TRxP from the first TRxP | | | | Hz | 200 | |
| Number of HARQ Processes | | | |  | 4 | |
| The number of slots between PDSCH and corresponding HARQ-ACK information | | | |  | 2 | |
| Precoding configuration | | | |  | SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity | |
| Note 1: PDSCH transmission is done from both TRxPs. Transmission from TRxP #1 uses CORESETPoolIndex 0 and transmission from TRxP #2 uses CORESETPoolIndex 1 | | | | | | |

Table 5.2.2.1.12-3: Minimum performance

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition(Note 1) | Correlation matrix and antenna configuration(Note 2) | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB)(Note 3) |
|  | TRxP #1 | TRxP #2 |  |  |  |  |  |  |
| 1-1 | R.PDSCH.1-3.3 FDD | R.PDSCH.1-3.4 FDD | 10 / 15 | 64QAM, 0.50 | TDLA30-10 | 2x2, ULA Low | 70 | 20.6 |
| Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent  Note 2: Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2  Note 3: SNR corresponds to SNR of TRxP #1 and TRxP #2 as defined in 4.4.2 | | | | | | | | |

##### 5.2.2.1.13 Minimum requirements for PDSCH with single-DCI based FDM Scheme A

The performance requirements are specified in Table 5.2.2.1.13-3, with the addition of test parameters in Table 5.2.2.1.13-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.1.13-1.

Table 5.2.2.1.13-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify PDSCH performance under 2 receive antenna conditions when UE is configured with “FDMSchemeA” in “RepetitionScheme-r16” defined in clause 5.1 of TS 38.214 [12] | 1-1 |

Table 5.2.2.1.13-2: Test parameters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | | | | Unit | Value | |
| TRxP #1 (Note 1) | TRxP #2 (Note 1) |
| Transmit TRxP of SSB | | | |  | TRxP #1 | |
| PDCCH configuration | | TCI state | |  | TCI State #1 | |
| CORESETPoolIndex | |  | Not configured | |
| CSI-RS for tracking | | First subcarrier index in the PRB used for CSI-RS | |  | k0=0 for CSI-RS resources 1,2,3,4 | k0=1 for CSI-RS resources 5,6,7,8 |
| First OFDM symbol in the PRB used for CSI-RS | |  | l0 = 6 for CSI-RS resources 1 and 3  l0 = 10 for CSI-RS resources 2 and 4 | l0 = 6 for CSI-RS resources 5 and 7  l0 = 10 for CSI-RS resources 6 and 8 |
| Number of CSI-RS ports (X) | |  | 1 for CSI-RS resource 1,2,3,4 | 1 for CSI-RS resource 5,6,7,8 |
| CDM Type | |  | 'No CDM’ for CSI-RS resource 1,2,3,4,5,6,7,8 | |
| Density | |  | 3 | |
| CSI-RS periodicity | | Slots | 20 | |
| CSI-RS offset | | Slots | 10 for CSI-RS resources 1 and 2  11 for CSI-RS resources 3 and 4 | 10 for CSI-RS resources 5 and 6  11 for CSI-RS resources 7 and 8 |
| QCL info | |  | TCI state #0 | |
| Duplex mode | | | |  | FDD | |
| Active DL BWP index | | | |  | 1 | |
| PDSCH configuration | Mapping type | | |  | Type A | |
| k0 | | |  | 0 | |
| Starting symbol (S) | | |  | 2 | |
| Length (L) | | |  | 12 | |
| 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 | |
| PDSCH DMRS configuration | Antenna port indexes | | |  | 1000, 1001 | 1000, 1001 |
| TCI state | | |  | TCI State #1 | TCI State #2 |
| DMRS Type | | |  | Type 1 | |
| Number of additional DMRS | | |  | 1 | |
| Maximum number of OFDM symbols for DL front loaded DMRS | | |  | 1 | |
| TCI State #1 | Type 1 QCL information | | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking’ configuration | N/A |
| QCL Type |  | Type A | N/A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| TCI State #2 | Type 1 QCL information | | CSI-RS resource |  | N/A | CSI-RS resource 5 from 'CSI-RS for tracking’ configuration |
| QCL Type |  | N/A | Type A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| Timing offset of the second TRxP from the first TRxP | | | | us | -0.5 | |
| Frequency offset of the second TRxP from the first TRxP | | | | Hz | 200 | |
| Number of HARQ Processes | | | |  | 4 | |
| The number of slots between PDSCH and corresponding HARQ-ACK information | | | |  | 2 | |
| Precoding configuration | | | |  | SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity. | |
| Note 1: PDSCH transmission is done from both TRxPs | | | | | | |

Table 5.2.2.1.13-3: Minimum performance for Rank 2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition (Note 1) | Correlation matrix and antenna configuration (Note 2) | Reference value | |
| Fraction of  maximum  throughput  (%) | SNR (dB) (Note 3) |
| 1-1 | R.PDSCH.1-2.5 FDD | 10 / 15 | 16QAM, 0.54 | TDLA30-10 | 2x2, ULA Low | 70 | 17. 3 |
| Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent.  Note 2: Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2.  Note 3: SNR corresponds to SNR of TRxP #1 and TRxP #2 as defined in 4.4.2 | | | | | | | |

##### 5.2.2.1.14 Minimum requirements for PDSCH with single-DCI based Inter-slot TDM scheme

The performance requirements are specified in Table 5.2.2.1.14-3, with the addition of test parameters in Table 5.2.2.1.14-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.1.14-1.

Table 5.2.2.1.14-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify PDSCH performance under 2 receive antenna conditions when UE is configured with repetitionNumber-r16 with multiple slot level PDSCH transmission occasions of the same TB with two TCI states defined in clause 5.1 of TS 38.214 [12] | 1-1 |

Table 5.2.2.1.14-2: Test parameters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | | | | Unit | Value | |
| TRxP #1 (Note 1) | TRxP #2 (Note 1) |
| Transmit TRxP of SSB | | | |  | TRxP #1 | |
| PDCCH configuration | | TCI state | |  | TCI State #1 | |
| CORESETPoolIndex | |  | Not configured | |
| CSI-RS for tracking | | First subcarrier index in the PRB used for CSI-RS | |  | k0=0 for CSI-RS resources 1,2,3,4 | k0=1 for CSI-RS resources 5,6,7,8 |
| First OFDM symbol in the PRB used for CSI-RS | |  | l0 = 6 for CSI-RS resources 1 and 3  l0 = 10 for CSI-RS resources 2 and 4 | l0 = 6 for CSI-RS resources 5 and 7  l0 = 10 for CSI-RS resources 6 and 8 |
| Number of CSI-RS ports (X) | |  | 1 for CSI-RS resource 1,2,3,4 | 1 for CSI-RS resource 5,6,7,8 |
| CDM Type | |  | 'No CDM’ for CSI-RS resource 1,2,3,4,5,6,7,8 | |
| Density | |  | 3 | |
| CSI-RS periodicity | | Slots | 20 | |
| CSI-RS offset | | Slots | 10 for CSI-RS resources 1 and 2  11 for CSI-RS resources 3 and 4 | 10 for CSI-RS resources 5 and 6  11 for CSI-RS resources 7 and 8 |
| QCL info | |  | TCI state #0 | |
| Duplex mode | | | |  | FDD | |
| Active DL BWP index | | | |  | 1 | |
| PDSCH configuration | Mapping type | | |  | Type A | |
| k0 | | |  | 0 | |
| Starting symbol (S) | | |  | 2 | |
| Length (L) | | |  | 12 | |
| Repetition number | | |  | 2 | |
| PRB bundling type | | |  | Static | |
| PRB bundling size | | |  | 2 | |
| 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 | Antenna port indexes | | |  | 1000 | 1000 |
| TCI state | | |  | TCI State #1 | TCI State #2 |
| DMRS Type | | |  | Type 1 | |
| Number of additional DMRS | | |  | 1 | |
| Maximum number of OFDM symbols for DL front loaded DMRS | | |  | 1 | |
| TCI State #1 | Type 1 QCL information | | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking’ configuration | N/A |
| QCL Type |  | Type A | N/A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| TCI State #2 | Type 1 QCL information | | CSI-RS resource |  | N/A | CSI-RS resource 5 from 'CSI-RS for tracking’ configuration |
| QCL Type |  | N/A | Type A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| Timing offset of the second TRxP from the first TRxP | | | | us | 2 | |
| Frequency offset of the second TRxP from the first TRxP | | | | Hz | 200 | |
| Number of HARQ Processes | | | |  | 4 | |
| The number of slots between PDSCH and corresponding HARQ-ACK information | | | |  | 2 | |
| Precoding configuration | | | |  | SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity. | |
| Note 1: PDSCH transmission is done from both TRxPs | | | | | | |

Table 5.2.2.1.14-3: Minimum performance for Rank 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition (Note 1) | Correlation matrix and antenna configuration Note 2) | Reference value | |
| BLER (%) | SNR (dB) (Note 4) |
| 1-1 | R.PDSCH.1-11.2 FDD | 10 / 15 | 16QAM, 0.54 | TDLA30-10 | 2x2, ULA Low | 1 (Note 3) | 2. 9 |
| Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent.  Note 2: Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2.  Note 3: BLER is defined as residual BLER; i.e. ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block.  Note 4: SNR corresponds to SNR of TRxP #1 and TRxP #2 as defined in 4.4.2 | | | | | | | |

##### 5.2.2.1.15 Minimum requirements for PDSCH with inter-cell interference

The performance requirements are specified in Table 5.2.2.1.15-3, with the addition of test parameters in Table 5.2.2.1.15-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.1.15-1.

Table 5.2.2.1.15-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH performance under 2 receive antenna conditions, when transmission from the serving cell is interfered by 1 or 2 interfering cells. | 1-1, 1-2 |

Table 5.2.2.1.15-2: Test parameters

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | | Unit | Value | | |
|  | |  | Cell 1 | Cell 2 | Cell 3 |
|  | |  | Enabled | Enabled | Enabled for Test 1-1 Disabled for Test 1-2 |
| Duplex mode | |  | FDD | | |
| Active DL BWP index | |  | 1 | | |
| Physical cell ID | |  | 0 | 1 | 2 |
| Transmission rank | |  | 1 | Random rank with 70% and 30% probability for rank 1 and rank 2 | Random rank with 70% and 30% probability for rank 1 and rank 2 for Test 1-1  N/A for Test 1-2 |
| Time offset to Cell1 | | us | N/A | 3 | -1 |
| Frequency offset to Cell 1 | | Hz | N/A | 300 | -100 |
| Interference Model | |  | N/A | As specified in B.6.2 | |
| INR (Note 2) | | dB | N/A | 7.77 for Test 1-1  7.58 for Test 1-2 | 2.29 for Test 1-1  N/A for Test 1-2 |
| SSB configuration | SSB position in burst |  | First SSB in Slot #0 | 1st SSB in Slot#0 for Test 1-1 2nd SSB in Slot #0 for Test 1-2 | 1st SSB in Slot#0 for Test 1-1 N/A for Test 1-2 |
| SSB periodicity | ms | 20 | 20 | 20 |
| 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 |  | 2 | | |
|  | 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 |  | 1 | | |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 | | |
| Number of HARQ Processes | |  | 4 | | |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 2 | | |
| Note1: Cell 1 is the serving cell; Cells 2, 3 are interfering cells  Note 2: INR is defined in Annex B.6.1 | | | | | |

Table 5.2.2.1.15-3: Minimum performance for PDSCH with rank 1 and with inter-cell interference

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num | Reference channel | 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.1-2.1 FDD | 10 / 15 | 16QAM, 0.48 | TDLC300-100 | 2x2, ULA Low | 70 | 15.4 |
| 1-2 | R.PDSCH.1-2.1 FDD | 10 / 15 | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 12.5 |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.  Note 2: Bandwidth/ Sub carrier spacing, Propagation Condition, Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3. | | | | | | | |

##### 5.2.2.1.16 Minimum requirements for PDSCH with intra cell inter user interference

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 performance under 2 receive antenna conditions when the PDSCH transmission of target UE is interfered by co-scheduled UE | 1-1 |

Table 5.2.2.1.16-2: Test parameters

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | Unit | Target UE | Co-scheduled UE |
| 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 |  | 2 | |
| 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 |  | 1 | |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 | |
| Antenna ports indexes |  | 1000 | 1001 |
| Number of PDSCH DMRS CDM group(s) without data |  | 1 | 1 |
| PDSCH & PDSCH DMRS Precoding configuration | |  | Single Panel Type I, Randomized precoder selection for every PRB bundle and updated per slot, with equal probability of each applicable i1/i2 combination or codebook  Index, chosen from section 5.2.2.2.1 of TS 38.214 [12]. | Single Panel Type I, Randomized precoder selection for every PRB bundle and updated per slot, with equal probability of each applicable i1/i2 combination or codebook  Index, chosen from section 5.2.2.2.1 of TS 38.214 [12].Any column of precoder matrix is not equal to any column of precoder matrix of Target UE |
| MU-MIMO Beamforming Model | |  | As specified in B.4.2 | |
| Number of HARQ Processes | |  | 4 | N/A |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 2 | N/A |
| Note 1: The DMRS scrambling ID is same for both target UE and Co-scheduled UE. | | | | |

Table 5.2.2.1.16-3: Minimum performance for PDSCH of target UE with intra-cell inter user interference

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test num | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
| Target UE | Co-scheduled UE | Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.1-2.1 FDD | 10 / 15 | 16QAM, 0.48 | Random 16QAM symbols | TDLC300-100 | 2x2, ULA Low | 70 | 18.0 |

##### 5.2.2.1.17 Minimum requirements for RedCap

The performance requirements are specified in Table 5.2.2.1.17-3 and Table 5.2.2.1.17-4, with the addition of test parameters in Table 5.2.2.1.17-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.1.17-1.

Table 5.2.2.1.17-1: Tests purpose

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

Table 5.2.2.1.17-2: 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 5.2.2.1.17-3: 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. 1-1.1 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. 1-1.2 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. 1-1.5 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 5.2.2.1.17-4: 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. 1-2.1 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. | | | | | | | |

##### 5.2.2.1.18 Minimum requirements for PDSCH CRS interference mitigation under NR-LTE coexistence scenario

The performance requirements are specified in Table 5.2.2.1.18-4, with the addition of test parameters in Table 5.2.2.1.18-2 for the serving cell and Table 5.2.2.1.18-3 for the LTE interference cells and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.1.18-1.

Table 5.2.2.1.18-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify PDSCH CRS interference mitigation performance under 2 receive antenna conditions with CRS rate matching configured for the serving cell. | 1-1 |

Table 5.2.2.1.18-2: Test parameters for the serving cell

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | Value |
| Duplex mode | |  | FDD |
| Active DL BWP index | |  | 1 |
| NR UL transmission with a 7.5 kHz shift to the LTE raster | |  | true |
| PDCCH configuration | Symbols with PDCCH |  | Symbol# 2 | |
| PDSCH configuration | Mapping type |  | Type A |
|  | k0 |  | 0 |
|  | Starting symbol (S) |  | 3 |
|  | Length (L) |  | 9 |
|  | PDSCH aggregation factor |  | 1 |
|  | PRB bundling type |  | Static |
|  | PRB bundling size |  | 2 |
|  | 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 |
|  | Position of the first DM-RS for downlink |  | 3 |
|  | Number of additional DMRS |  | 1 |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| CRS for rate matching (Note 1) | LTE carrier centre subcarrier location |  | Same as NR carrier centre subcarrier location |
|  | LTE carrier BW | MHz | 10 |
|  | Number of antenna ports |  | 2 |
|  | v-shift |  | 0 |
| Number of HARQ Processes | |  | 4 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 2 |
| Note 1: No MBSFN is configured on LTE carrier.  Note 2: Network-based CRS interference mitigation is disabled on LTE carrier. | | | |

Table 5.2.2.1.18-3: Test parameters for the LTE interference cells

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Cell 1** | **Cell 2** |
| Propagation conditions and MIMO configuration (Note 1) | |  | TDLA30-10 ULA Low | TDLA30-10 ULA Low |
| INR (Note 2) | | dB | 10.45 | 4.6 |
| Cell-specific reference signals | |  | Antenna ports 0,1 | Antenna ports 0,1 |
| Carrier centre subcarrier location | |  | Same as the serving carrier centre subcarrier location | Same as the serving carrier centre subcarrier location |
| BWChannel | | MHz | 10 | 10 |
| Cyclic Prefix | |  | Normal | Normal |
| Physical cell ID | |  | 1 | 2 |
| Number of control OFDM symbols | |  | 2 | 2 |
| PDSCH transmission mode | |  | 4 | 4 |
| Interference model | |  | As specified in clause B.7 | As specified in clause B.7 |
| Probability of occurrence of PDSCH data | | % | 20 | 20 |
| Probability of occurrence of transmission rank | Rank 1 | % | 80 | 80 |
| Rank 2 | % | 20 | 20 |
| Downlink power allocation |  | dB | -3 | -3 |
|  | dB | -3 | -3 |
| σ | dB | 0 | 0 |
| Precoding granularity | | PRB | 6 | 6 |
| Time offset to the serving cell | | us | 3 | -1 |
| Frequency offset to the serving cell | | Hz | 300 | -100 |
| MBSFN | |  | Not configured | Not configured |
| Network-based CRS interference mitigation | |  | Disabled | Disabled |
| Note 1: The channel for the LTE interference cells and the serving cell are independent.  Note 2: Defined in B.6.1. | | | | |

Table 5.2.2.1.18-4: Minimum performance for Rank 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | 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.1-7.3 FDD | 10 / 15 | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 11.9 |

##### 5.2.2.1.19 Minimum requirements for PDSCH with inter cell CRS interference

The performance requirements are specified in Table 5.2.2.1.19-4 and Table 5.2.2.1.19-6, with the addition of test parameters in Table 5.2.2.1.19-2 and 5.2.2.1.19-3 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.1.19-1.

Table 5.2.2.1.19-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify PDSCH performance under 2 receive antenna conditions when PDSCH is interfered by inter cell CRS signal | 1-1 and 2-1 |

Table 5.2.2.1.19-2: Tests parameter for serving cell PDSCH

|  |  |  |  |
| --- | --- | --- | --- |
| 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 |  | 2 |
|  | 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 |  | 1 |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| Number of HARQ Processes | |  | 4 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 2 |

Table 5.2.2.1.19-3: Tests parameter for interference cells

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | Unit | Cell 1 | Cell 2 |
| Duplex mode | |  | FDD | FDD |
| INR | | dB | 10.45 | 4.6 |
| LTE Bandwidth (Note 5) | | MHz | 20 | 20 |
| Carrier centre subcarrier location (Note 6) | |  | Same as the NR serving carrier centre subcarrier location | Same as the NR serving carrier centre subcarrier location |
| Cyclic Prefix | |  | Normal | Normal |
| Physical cell ID | |  | 1 | 2 |
| CRS pattern | Number of antenna ports |  | 4 | 4 |
| v-shift |  | 1 | 2 |
| Downlink power allocation |  | dB | -6 | -6 |
|  | dB | -6 | -6 |
| σ | dB | 0 | 0 |
| PDSCH transmission mode | |  | TM4 | TM4 |
| PDSCH loading level | | % | 20% probability of occurrence of LTE data transmission in time domain, and full bandwidth allocation in frequency domain for test 1-1. | 20% probability of occurrence of LTE data transmission in time domain, and full bandwidth allocation in frequency domain for test 1-1. |
| Transmission rank | | % | 80% and 20% probability for rank 1 and rank 2 respectively | 80% and 20% probability for rank 1 and rank 2 respectively |
| Interference model | |  | As specified in clause B.7 | As specified in clause B.7 |
| Time offset to the serving cell | | us | 3 | -1 |
| Frequency offset to the serving cell | | Hz | 300 | -100 |
| Propagation conditions and MIMO configuration (Note 1) | |  | TDLA30-10 ULA Low | TDLA30-10 ULA Low |
| Precoding granularity | | PRB | 8 | 8 |
| Note 1: The channel for the LTE interference cells and the serving cell are independent.  Note 2: No MBSFN is configured on LTE carrier.  Note 3: Network-based CRS interference mitigation is disabled on LTE carrier.  Note 4: The start of transmission of LTE frame is delayed by 2 LTE subframes with respect to the start of transmission of NR frame  Note 5: This parameter is informed to UE via network assistance signalling for Test 1-1 in Table 5.2.2.1.19-4.  Note 6: Single entry is included in IE *LTE-NeighCellsCRS-AssistInfoList-r17* that applies for both cells for cases | | | | |

The requirements for UE capable of performing CRS-IM with the assistance of network signaling on LTE channel bandwidth are specified in Table 5.2.2.1.19-4.

Table 5.2.2.1.19-4: Minimum performance for Rank 1 with the assistance of network signaling on LTE channel bandwidth

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | 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.1-18.1 FDD | 10 / 15 | 16QAM, 0.48 | TDLA30-10 | 4x2, ULA Low | 70 | 11.9 |

The requirements for UE capable of performing CRS-IM without the assistance of network signaling on LTE channel bandwidth are specified in Table 5.2.2.1.19-6 with following test procedure:

The network configures an inter-RAT LTE measurement object of the interfering cells to the tested UE. Inter-RAT measurement is configured at the beginning of the test and applied throughout the test with gap pattern configurations in Table 5.2.2.1.19-5. PDSCH is not scheduled and throughput is not counted during 4.64s after the beginning of test. PDSCH is not scheduled in the measurement gaps.

Table 5.2.2.1.19-5: Measurement Gap configurations

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| Measurement Gap Length | ms | 6 |
| Measurement Gap Repetition Period | ms | 40 |
| Gap offset | ms | 7 |
| Measurement gap timeing advance | ms | 0 |

Table 5.2.2.1.19-6: Minimum performance for Rank 1 without the assistance of network signaling on LTE channel bandwidth

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | 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.1-17.2 FDD | 10 / 15 | 16QAM, 0.48 | TDLA30-10 | 4x2, ULA Low | 70 | 11.9 |

##### 5.2.2.1.20 Minimum requirements for HST-SFN Scheme A

The performance requirements are specified in Table 5.2.2.1.20-3, with the addition of test parameters in Table 5.2.2.1.20-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.1.20-1.

**Table 5.2.2.1.20-1: Tests purpose**

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify UE performance in the HST-SFN Scheme A scenario defined in B.3. 5 | 1-1 |

**Table 5.2.2.1.20-2: Test parameters**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Value** |
| Duplex mode | | |  | FDD |
| Active DL BWP index | | |  | 1 |
| PDCCH configuration | TCI state | |  | Note 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 | |  | 2 |
| Resource allocation type | |  | Type 0 |
| RBG size | |  | Config2 |
| VRB-to-PRB mapping type | |  | Non-interleaved |
| VRB-to-PRB mapping interleaver bundle size | |  | N/A |
| TCI state | |  | Note 1 |
| PDSCH DMRS configuration | DMRS Type | |  | Type 1 |
| Number of additional DMRS | |  | 2 |
| Maximum number of OFDM symbols for DL front loaded DMRS | |  | 1 |
| CSI-RS for tracking | Resource set #1 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 5 for CSI-RS resource 1 and 3  l0 = 9 for CSI-RS resource 2 and 4 |
| CSI-RS periodicity | Slots | 10 for CSI-RS resource 1,2,3,4. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4 |
| QCL info |  | TCI state #3 |
| Resource set #2 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 6 for CSI-RS resource 5 and 7  l0 = 10 for CSI-RS resource 6 and 8 |
| CSI-RS periodicity | Slots | 10 for CSI-RS resource 5,6,7,8. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 5 and 6 2 for CSI-RS resource 7 and 8 |
| QCL info |  | TCI state #4 |
| Resource set #3 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 4 for CSI-RS resource 9 and 11  l0 = 8 for CSI-RS resource 10 and 12 |
| CSI-RS periodicity | Slots | 10 for CSI-RS resource 9,10,11,12. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 9 and 10 2 for CSI-RS resource 11 and 12 |
| QCL info |  | TCI state #5 |
| NZP CSI-RS for CSI acquisition | Resource set #4 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 12 |
| CSI-RS periodicity | Slots | 20 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #0 |
| Resource set #5 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 13 |
| CSI-RS periodicity | Slots | 20 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #1 |
| Resource set #6 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 7 |
| CSI-RS periodicity | Slots | 20 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #2 |
| TCI state #0 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking Resource set #1' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #1 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #2 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 9 from 'CSI-RS for tracking Resource set #3' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #3 | Type 1 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| TCI state #4 | Type 1 QCL information | SSB index |  | SSB #1 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| TCI state #5 | Type 1 QCL information | SSB index |  | SSB #2 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| Number of HARQ Processes | | |  | 4 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | | |  | 2 |
| Note 1: SSB # (k mod 3) , CSI-RS (for tracking) resource set # ((k mod 3) + 1) and CSI-RS (for CSI acquisition) resource set # ((k mod 3) + 4) are transmitted by kth RRH.  Codepoint #0 is activated when UE receives PDCCH/PDSCH from RRH#3k and RRH#3k+1 with TCI States TCI state #0, TCI State #1.  Codepoint #1 is activated when UE receives PDCCH/PDSCH from RRH#3k+1 and RRH#3k+2 with TCI States TCI state #1, TCI State #2.  Codepoint #2 is activated when UE receives PDCCH/PDSCH from RRH#3k+2 and RRH#3k+3 with TCI States TCI state #2, TCI State #0. | | | | |

**Table 5.2.2.1.20-3: Minimum performance for HST-SFN Scheme A**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test num.** | **Reference channel** | **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.1-8.5 FDD | 10 / 15 | 16QAM, 0.48 | HST-SFN Scheme A | 2x2 | 70 | 11.8 |

##### 5.2.2.1.21 Minimum requirements for HST-SFN Scheme B

The performance requirements are specified in Table 5.2.2.1.21-3, with the addition of test parameters in Table 5.2.2.1.21-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.1.21-1.

**Table 5.2.2.1.21-1: Tests purpose**

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify UE performance in the HST-SFN Scheme B scenario defined in B.3.6 | 1-1 |

**Table 5.2.2.1.21-2: Test parameters**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Value** |
| Duplex mode | | |  | FDD |
| Active DL BWP index | | |  | 1 |
| PDCCH configuration | TCI state | |  | Note 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 | |  | 2 |
| Resource allocation type | |  | Type 0 |
| RBG size | |  | Config2 |
| VRB-to-PRB mapping type | |  | Non-interleaved |
| VRB-to-PRB mapping interleaver bundle size | |  | N/A |
| TCI state | |  | Note 1 |
| PDSCH DMRS configuration | DMRS Type | |  | Type 1 |
| Number of additional DMRS | |  | 2 |
| Maximum number of OFDM symbols for DL front loaded DMRS | |  | 1 |
| CSI-RS for tracking | Resource set #1 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 5 for CSI-RS resource 1 and 3  l0 = 9 for CSI-RS resource 2 and 4 |
| CSI-RS periodicity | Slots | 10 for CSI-RS resource 1,2,3,4. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4 |
| QCL info |  | TCI state #3 |
| Resource set #2 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 6 for CSI-RS resource 5 and 7  l0 = 10 for CSI-RS resource 6 and 8 |
| CSI-RS periodicity | Slots | 10 for CSI-RS resource 5,6,7,8. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 5 and 6 2 for CSI-RS resource 7 and 8 |
| QCL info |  | TCI state #4 |
| Resource set #3 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 4 for CSI-RS resource 9 and 11  l0 = 8 for CSI-RS resource 10 and 12 |
| CSI-RS periodicity | Slots | 10 for CSI-RS resource 9,10,11,12. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 9 and 10 2 for CSI-RS resource 11 and 12 |
| QCL info |  | TCI state #5 |
| NZP CSI-RS for CSI acquisition | Resource set #4 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 12 |
| CSI-RS periodicity | Slots | 20 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #0 |
| Resource set #5 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 13 |
| CSI-RS periodicity | Slots | 20 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #1 |
| Resource set #6 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 7 |
| CSI-RS periodicity | Slots | 20 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #2 |
| TCI state #0 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking Resource set #1' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #1 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #2 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 9 from 'CSI-RS for tracking Resource set #3' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #3 | Type 1 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| TCI state #4 | Type 1 QCL information | SSB index |  | SSB #1 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| TCI state #5 | Type 1 QCL information | SSB index |  | SSB #2 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| Number of HARQ Processes | |  | 4 | |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 2 | |
| Note 1: SSB # (k mod 3), CSI-RS (for tracking) resource set # ((k mod 3) + 1) and CSI-RS (for CSI acquisition) resource set # ((k mod 3) + 4) are transmitted by kth RRH.  Codepoint#0 {TCI state #0, TCI State #1} is activated when UE receives PDCCH/PDSCH from RRH#3k and RRH#3k+1.  Codepoint#1 {TCI state #1, TCI State #2} is activated when UE receives PDCCH/PDSCH from RRH#3k+1 and RRH#3k+2.  Codepoint#2 {TCI state #2, TCI State #0} is activated when UE receives PDCCH/PDSCH from RRH#3k+2 and RRH#3k+3.  The second indicated TCI state in each codepoint is not used for quasi co-location parameters {Doppler shift, Doppler spread}. | | | | |

**Table 5.2.2.1.21-3: Minimum performance for HST-SFN Scheme B**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Test num.** | **Reference channel** | **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.1-8.5 FDD | 10/15 | 16QAM, 0.48 | HST-SFN-Scheme B | 2x2 | 70 | 11.3 |

#### 5.2.2.2 TDD

##### 5.2.2.2.1 Minimum requirements for PDSCH Mapping Type A

The performance requirements are specified in Table 5.2.2.2.1-3 and Table 5.2.2.2.1-4, with the addition of test parameters in Table 5.2.2.2.1-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.2.1-1.

Table 5.2.2.2.1-1: Tests purpose

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify the PDSCH mapping Type A normal performance under 2 receive antenna conditions and with different channel models, MCSs and number of MIMO layers | 1-1, 1-2, 1-3, 1-5, 1-6, 1-7, 1-8, 1-9, 1-10, 1-11, 1-12, 2-1, 2-2 |
| Verify the PDSCH mapping Type A HARQ soft combining performance under 2 receive antenna conditions. | 1-4 |
| Verify the PDSCH mapping Type A performance requirements for Enhanced Receiver Type 1 under 2 receive antenna conditions. | 3-1 |

Table 5.2.2.2.1-2: 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 Tests 1-1, 1-8, 1-9  2 for other tests |
|  | Resource allocation type |  | Test 1-2: Type 1 with start RB = 50, LRBs = 6  Other tests: Type 0 |
|  | RBG size |  | Test 1-2: N/A  Other tests: 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 Tests 1-1, 1-7, 1-8, 1-9, 1-10, 1-11  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 |  | Tests 1-8, 1-9:  l0 = 4 for CSI-RS resource 1 and 3  l0 = 8 for CSI-RS resource 2 and 4  Other tests; Table 5.2-1. |
|  | CSI-RS periodicity | Slots | Test 1-7, 1-10, 1-11: 20 for CSI-RS resource 1,2,3,4.  Other tests: Table 5.2-1. |
|  | CSI-RS offset | Slots | Test 1-7, 1-10, 1-11: 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4.  Other tests: Table 5.2-1. |
|  | Frequency Occupation |  | Test 1-7, 1-10, 1-11: Start PRB 0 Number of PRB = 52  Other tests: Table 5.2-1. |
| Number of HARQ Processes | |  | 16 for Test 1-4  10 for Test 1-9  8 for other tests |
| 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 5.2.2.2.1-3: 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.2-1.1 TDD | 40 / 30 | QPSK, 0.30 | FR1.30-1A | TDLB100-400 | 2x2, ULA Low | 70 | -1.1 |
| 1-2 | R.PDSCH.2-1.2 TDD | 40 / 30 | QPSK, 0.30 | FR1.30-1 | TDLC300-100 | 2x2, ULA Low | 70 | 0.2 |
| 1-3 | R.PDSCH.2-4.1 TDD | 40 / 30 | 256QAM, 0.82 | FR1.30-1 | TDLA30-10 | 2x2, ULA Low | 70 | 25.3 |
| 1-4 | R.PDSCH.2-2.1 TDD | 40 / 30 | 16QAM, 0.48 | FR1.30-1 | TDLC300-100 | 2x2, ULA Low | 30 | 1.6 |
| 1-5 | R.PDSCH.2-5.1 TDD | 40 / 30 | QPSK, 0.30 | FR1.30-2 | TDLA30-10 | 2x2, ULA Low | 70 | -0.9 |
| 1-6 | R.PDSCH.2-6.1 TDD | 40 / 30 | QPSK, 0.30 | FR1.30-3 | TDLA30-10 | 2x2, ULA Low | 70 | -0.8 |
| 1-7 | R.PDSCH.2-10.1 TDD | 40 / 30 | 16QAM, 0.48 | FR1.30-1 | HST-1000 | 1x2 | 70 | 6.4 |
| 1-8 | R.PDSCH.2-11.1 TDD | 40 / 30 | QPSK, 0.30 | FR1.30-5 | TDLB100-400 | 2x2, ULA Low | 70 | -1.0 |
| 1-9 | R.PDSCH.2-12.1 TDD | 40 / 30 | QPSK, 0.30 | FR1.30-6 | TDLB100-400 | 2x2, ULA Low | 70 | -1.1 |
| 1-10 | R.PDSCH.2-10.2 TDD | 40 / 30 | 16QAM, 0.48 | FR1.30-1 | TDLC300-1200 | 2x2 | 70 | 9.5 |
| 1-11 | R.PDSCH.2-10.3 TDD | 40 / 30 | 64QAM, 0.43 | FR1.30-1 | HST-1667 | 1x2 | 70 | 9.6 |
| 1-12 | R.PDSCH.2-25.1 TDD | 40 / 30 | 1024QAM, 0.79 | FR1.30-1 | TDLD30-5 | 2x2, ULA Low | 70 | 29.4 |

Table 5.2.2.2.1-4: 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.2-3.1 TDD | 40 / 30 | 64QAM, 0.50 | FR1.30-1 | TDLA30-10 | 2x2, ULA Low | 70 | 19.8 |
| 2-2 | R.PDSCH.2-9.1 TDD | 20 / 30 | 64QAM, 0.50 | FR1.30-4 | TDLA30-10 | 2x2, ULA Low | 70 | 19.8 |

Table 5.2.2.2.1-5: Minimum performance for Rank 2 and Enhanced Receiver Type 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) |
| 3-1 | R.PDSCH.2-2.2 TDD | 40 / 30 | 16QAM, 0.48 | FR1.30-1 | TDLA30-10 | 2x2, ULA Medium | 70 | 18.0 |

##### 5.2.2.2.2 Minimum requirements for PDSCH Mapping Type A and CSI-RS overlapped with PDSCH

The performance requirements are specified in Table 5.2.2.2.2-3, with the addition of test parameters in Table 5.2.2.2.2-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.2.2-1.

Table 5.2.2.2.2-1: Tests purpose

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify the PDSCH mapping Type A normal performance under 2 receive antenna conditions and CSI-RS overlapped with PDSCH | 1-1 |

Table 5.2.2.2.2-2: 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 |  | 2 |
|  | 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 |  | 1 |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| NZP CSI-RS for CSI acquisition | OFDM symbols in the PRB used for CSI-RS |  | l0 = 13 |
|  | CSI-RS periodicity | Slots | 5 |
| ZP CSI-RS for CSI acquisition | Subcarrier index in the PRB used for CSI-RS |  | (k0, k1, k2, k3)=(2, 4, 6, 8) |
|  | Number of CSI-RS ports (X) |  | 8 |
|  | CSI-RS periodicity | Slots | 5 |
| 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 5.2.2.2.2-3: 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)** |
| 1-1 | R.PDSCH.2-7.1 TDD | 40 / 30 | 16QAM, 0.48 | FR1.30-1 | TDLC300-100 | 2x2, ULA Low | 70 | 14.8 |

##### 5.2.2.2.3 Minimum requirements for PDSCH Mapping Type B

The performance requirements are specified in Table 5.2.2.2.3-3, with the addition of test parameters in Table 5.2.2.2.3-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.2.3-1.

Table 5.2.2.2.3-1: Tests purpose

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify PDSCH mapping Type B performance under 2 receive antenna conditions | 1-1 |

Table 5.2.2.2.3-2: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Value** |
| Duplex mode | |  | TDD |
| Active DL BWP index | |  | 1 |
| PDSCH configuration | Mapping type |  | Type B |
|  | k0 |  | 0 |
|  | Starting symbol (S) |  | 5 |
|  | Length (L) |  | 7 |
|  | PDSCH aggregation factor |  | 1 |
|  | PRB bundling type |  | Static |
|  | PRB bundling size |  | 2 |
|  | 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 |  | 1 |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 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 5.2.2.2.3-3: 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.2-1.3 TDD | 40 / 30 | QPSK, 0.30 | FR1.30-1 | TDLA30-10 | 2x2, ULA Low | 70 | -0.9 |

##### 5.2.2.2.4 Minimum requirements for PDSCH Mapping Type A and LTE-NR coexistence

The performance requirements are specified in Table 5.2.2.2.4-3, with the addition of test parameters in Table 5.2.2.2.4-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.2.4-1.

Table 5.2.2.2.4-1: Tests purpose

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify the PDSCH mapping Type A normal performance under 2 receive antenna conditions with CRS rate matching configured | 1-1, 1-2 |

Table 5.2.2.2.4-2: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Value** |
| Duplex mode | |  | TDD |
| Active DL BWP index | |  | 1 |
| NR UL transmission with a 7.5 kHz shift to the LTE raster | |  | true |
| PDCCH configuration | Symbols with PDCCH |  | Symbol# 2 |
| PDSCH configuration | Mapping type |  | Type A |
|  | k0 |  | 0 |
|  | Starting symbol (S) |  | 3 |
|  | Length (L) |  | 9 for Test 1-1 11 for Test 1-2 |
|  | PDSCH aggregation factor |  | 1 |
|  | PRB bundling type |  | Static |
|  | PRB bundling size |  | 2 |
|  | 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 |
|  | Position of the first DM-RS for downlink |  | 3 |
|  | Number of additional DMRS |  | 1 |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| CRS for rate matching (Note 1) | LTE carrier centre subcarrier location |  | Same as NR carrier centre subcarrier location |
|  | LTE carrier BW | MHz | 10 |
|  | Number of antenna ports |  | 4 |
|  | v-shift |  | 0 |
| 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 |
| Note 1: No MBSFN is configured on LTE carrier.  Note 2: LTE carrier is configured with Uplink-downlink configuration 2 [Table 4.2-2, TS 36.211] and Special subframe configuration 7 [Table 4.2-1, TS 36.211]. The start of transmission of LTE frame is delayed by 2 LTE subframes with respect to the start of transmission of NR frame. | | | |

Table 5.2.2.2.4-3: 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.1-1.1 TDD | 10 / 15 | QPSK, 0.30 | FR1.15-1 | TDLA30-10 | 4x2, ULA Low | 70 | -0.8 |
| 1-2 | R.PDSCH.1-1.2 TDD | 10 / 15 | QPSK, 0.30 | FR1.15-1 | TDLA30-10 | 4x2, ULA Low | 70 | -0.8 |

##### 5.2.2.2.5 Minimum requirements for PDSCH 0.001% BLER

The performance requirements are specified in Table 5.2.2.2.5-3, with the addition of test parameters in Table 5.2.2.2.5-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.2.5-1.

Table 5.2.2.2.5-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH 0.001% BLER performance under 2 receive antenna conditions | 1-1 |

Table 5.2.2.2.5-2: 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) |  | 12 |
|  | PDSCH aggregation factor |  | 1 |
|  | PRB bundling type |  | Static |
|  | PRB bundling size |  | 2 |
|  | 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 |  | 1 |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| Maximum number of HARQ transmission | |  | 1 |
| Number of HARQ Processes | |  | 8 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | Defined in Annex A.1.2 for TDD pattern FR1.30-1 |

Table 5.2.2.2.5-3: 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 | |
| Target BLER | SNR (dB) |
| 1-1 | R.PDSCH.2-1.4 TDD | 40 / 30 | QPSK, 0.59 | FR1.30-1 | AWGN | 1x2, ULA Low | 0.001% | 3.3 |

##### 5.2.2.2.6 Minimum requirements for PDSCH repetitions over multiple slots

The performance requirements are specified in Table 5.2.2.2.6-3, with the addition of test parameters in Table 5.2.2.2.6-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.2.6-1.

Table 5.2.2.2.6-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH repetitions over multiple slots performance under 2 receive antenna conditions | 1-1 |

Table 5.2.2.2.6-2: 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) |  | 12 |
|  | PDSCH aggregation factor |  | 2 |
|  | PRB bundling type |  | Static |
|  | PRB bundling size |  | 2 |
|  | 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 |  | 1 |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| Number of HARQ Processes | |  | 4 |
| The number of slots between final repetition of PDSCH and corresponding HARQ-ACK information | |  | Specific to each TDD UL-DL pattern and as defined in Annex A.1.2 (Note 1) |
| Note 1: ACK/NACK feedback is generated for PDSCH on slot i, where mod(i,10) = {2, 4, 6}. | | | |

Table 5.2.2.2.6-3: 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 | |
| Target BLER | SNR (dB) |
| 1-1 | R.PDSCH.2-16.1 TDD | 40 / 30 | 16QAM, 0.54 | FR1.30-1 | TDLA30-10 | 2x2, ULA Low | 1%(Note 1) | 1.4 |
| Note 1: BLER is defined as residual BLER; i.e. ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block. | | | | | | | | |

##### 5.2.2.2.7 Minimum requirements for PDSCH Mapping Type B and UE processing capability 2

The performance requirements are specified in Table 5.2.2.2.7-3, with the addition of test parameters in Table 5.2.2.2.7-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.2.7-1.

Table 5.2.2.2.7-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify PDSCH mapping Type B performance and UE processing capability 2 under two receive antenna conditions | 1-1 |

Table 5.2.2.2.7-2: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | Value |
| Duplex mode | |  | TDD |
| Active DL BWP index | |  | 1 |
| PDSCH configuration | Mapping type |  | Type B |
|  | k0 |  | 0 |
|  | Starting symbol (S) |  | 2 |
|  | Length (L) |  | 2 |
|  | PDSCH aggregation factor |  | 1 |
|  | PRB bundling type |  | Static |
|  | PRB bundling size |  | 2 |
|  | 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 |  | 0 |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| Maximum number of HARQ transmission | |  | 1 |
| Number of HARQ Processes | |  | 2 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 0 |

Table 5.2.2.2.7-3: 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.2-17.1 TDD | 40 / 30 | QPSK, 0.30 | FR1.30-2 | TDLA30-10 | 2x2, ULA Low | 70 | 0.6 |

##### 5.2.2.2.8 Minimum requirements for PDSCH pre-emption

The performance requirements are specified in Table 5.2.2.2.8-3, with the addition of test parameters in Table 5.2.2.2.8-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.2.8-1.

Table 5.2.2.2.8-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH pre-emption performance under 2 receive antenna conditions | 1-1 |

Table 5.2.2.2.8-2: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | Value |
| Duplex mode | |  | TDD |
| Active DL BWP index | |  | 1 |
| PDCCH configuration (Note 4) | Symbols with PDCCH |  | 0, 1 |
| DCI format |  | 2\_1 |
| timeFrequencySet |  | 14x1 |
| 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 |  | 2 |
| 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 |  | 1 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| Pre-emption configuration (Note 2) | Starting symbol (S) |  | 3 |
| Length (L) |  | 2 |
| Pre-emption periodicity and offset | Slots | 40/(1,12,23,34) (Note 3) |
| Number of HARQ Processes | |  | 8 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | FR1.30-1 |
| Note 1: Void  Note 2: Interference modelled as random data on pre-empted REs.  Note 3: Pre-emption is scheduled with 10% probability within 20ms periodicity.  Note 4: In addition to PDCCH configuration in Table 5.2-1. | | | |

Table 5.2.2.2.8-3: 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.2-2.6 TDD | 40 / 30 | 16QAM  0.64 | FR1.30-1 | TDLA30-10 | 2x2, ULA Low | 70 | 12.5 |

##### 5.2.2.2.9 Minimum requirements for HST-SFN

The performance requirements are specified in Table 5.2.2.2.9-3, with the addition of test parameters in Table 5.2.2.2.9-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.2.9-1.

Table 5.2.2.2.9-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify PDSCH performance under 2 receive antenna conditions in the HST-SFN scenario defined in B.3.2 when *highSpeedDemodFlag-r16* [17] is configured | 1-1 |

Table 5.2.2.2.9-2: 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) |  | 12 |
| PDSCH aggregation factor |  | 1 |
| PRB bundling type |  | Static |
| PRB bundling size |  | 2 |
| 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 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| CSI-RS for tracking | CSI-RS periodicity | Slots | 20 for CSI-RS resource 1,2,3,4. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4. |
| Frequency Occupation |  | Start PRB 0 Number of PRB = 52 |
| 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 5.2.2.2.9-3: 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) |
| 1-1 | R.PDSCH.2-10.4 TDD | 40 / 30 | 16QAM, 0.48 | FR1.30-1 | HST-SFN | 2x2 | 70 | 14.2 |

##### 5.2.2.2.10 Minimum requirements for HST-DPS

The performance requirements are specified in Table 5.2.2.2.10-3, with the addition of test parameters in Table 5.2.2.2.10-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.2.10-1.

Table 5.2.2.2.10-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify UE performance in the HST-DPS scenario defined in B.3.3 | 1-1, 1-2 |

Table 5.2.2.2.10-2: Test parameters

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | | Unit | Value |
| Duplex mode | | |  | TDD |
| Active DL BWP index | | |  | 1 |
| PDCCH configuration | TCI state | |  | Note 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 | |  | 2 |
| Resource allocation type | |  | Type 0 |
| RBG size | |  | Config2 |
| VRB-to-PRB mapping type | |  | Non-interleaved |
| VRB-to-PRB mapping interleaver bundle size | |  | N/A |
| TCI state | |  | Note 1 |
| PDSCH DMRS configuration | DMRS Type | |  | Type 1 |
| Number of additional DMRS | |  | 2 |
| Maximum number of OFDM symbols for DL front loaded DMRS | |  | 1 |
| CSI-RS for tracking | Resource set #1 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 5 for CSI-RS resource 1 and 3 |
| l0 = 9 for CSI-RS resource 2 and 4 |
| CSI-RS periodicity | Slots | 20 for CSI-RS resource 1,2,3,4 |
| CSI-RS offset | Slots | 1 for CSI-RS resource 1 and 2 |
| 2 for CSI-RS resource 3 and 4 |
| QCL info |  | TCI state #2 |
| Frequency Occupation |  | Start PRB 0 |
| Number of PRB = 52 |
| Resource set #2 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 6 for CSI-RS resource 5 and 7 |
| l0 = 10 for CSI-RS resource 6 and 8 |
| CSI-RS periodicity | Slots | 20 for CSI-RS resource 5,6,7,8. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 5 and 6 |
| 2 for CSI-RS resource 7 and 8 |
| QCL info |  | TCI state #3 |
| Frequency Occupation |  | Start PRB 0 |
| Number of PRB = 52 |
| NZP CSI-RS for CSI acquisition | Resource set #3 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 12 |
| CSI-RS periodicity | Slots | 40 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #0 |
| Resource set #4 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 13 |
| CSI-RS periodicity | Slots | 40 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #1 |
| TCI state #0 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking Resource set #1' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #1 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #2 | Type 1 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| TCI state #3 | Type 1 QCL information | SSB index |  | SSB #1 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| 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 |
| Note 1: SSB # (k mod 2) , CSI-RS (for tracking) resource set # ((k mod 2) + 1) and CSI-RS (for CSI acquisition) resource set # ((k mod 2) + 3) are transmitted by kth RRH.  For Test 1-1, TCI state switching command scheduled by MAC CE with MCS 4 is transmitted in slot #i that satisfy. PDCCH and PDSCH associated with TCI # (k mod 2) is transmitted by kth RRH from slot#  to slot#  ,  PDCCH and PDSCH are DTXed in other slots in which throughput statistics are not considered.  For Test 1-2, TCI state switching command scheduled by MAC CE with MCS 4 is transmitted in slot #i that satisfy. PDCCH and PDSCH associated with TCI # (k mod 2) is transmitted by kth RRH from slot#  to slot#  Where k=0, 1, 2… is the RRH number, n = 5040 is half of the number of slots between two RRH, = 8 is the number of slots between PDSCH and corresponding HARQ-ACK information, = 6 is the number of slots for MAC CE processing, = 7 is the number of slots to first TRS transmission occasion after MAC CE command is decoded by the UE, = 4 is the number of slots for TRS processing. | | | | |

Table 5.2.2.2.10-3: Minimum performance for HST-DPS

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL-DL pattern | Propagation condition | Number of active PDSCH TCI states | Correlation matrix and antenna configuration | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.2-10.5 TDD | 40 / 30 | 64QAM, 0.43 | FR1.30-1 | HST-DPS | 1 | 2x2 | 70 | 13.0 |
| 1-2 | R.PDSCH.2-10.5 TDD | 40 / 30 | 64QAM, 0.43 | FR1.30-1 | HST-DPS | 2 | 2x2 | 70 | 13.0 |

##### 5.2.2.2.11 Minimum requirements for PDSCH Single-DCI based SDM scheme

The performance requirements are specified in Table 5.2.2.2.11-3, with the addition of test parameters in Table 5.2.2.2.11-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.2.11-1.

Table 5.2.2.2.11-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH performance with Single-DCI based SDM scheme under 2 receive antenna conditions. | 1-1,1-2 |

Table 5.2.2.2.11-2: Test parameters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | | | | Unit | Value | |
| TRxP #1(Note 1) | TRxP #2(Note 1) |
| Transmit TRxP of SSB | | | |  | TRxP #1 | |
| PDCCH configuration | | TCI state | |  | TCI State #1 | |
| CORESETPoolIndex | |  | 0 | |
| CSI-RS for tracking | | First subcarrier index in the PRB used for CSI-RS | |  | k0=0 for CSI-RS resources 1,2,3,4 | k0=1 for CSI-RS resources 5,6,7,8 |
| First OFDM symbol in the PRB used for CSI-RS | |  | l0 = 6 for CSI-RS resources 1 and 3  l0 = 10 for CSI-RS resources 2 and 4 | l0 = 6 for CSI-RS resources 5 and 7  l0 = 10 for CSI-RS resources 6 and 8 |
| Number of CSI-RS ports (X) | |  | 1 for CSI-RS resource 1,2,3,4 | 1 for CSI-RS resource 5,6,7,8 |
| CDM Type | |  | ‘No CDM’ for CSI-RS resource 1,2,3,4,5,6,7,8 | |
| Density | |  | 3 | |
| CSI-RS periodicity | | Slots | 40 | |
| CSI-RS offset | | Slots | 20 for CSI-RS resources 1 and 2  21 for CSI-RS resources 3 and 4 | 20 for CSI-RS resources 5 and 6  21 for CSI-RS resources 7 and 8 |
| QCL info | |  | TCI state #0 | |
| Duplex mode | | | |  | TDD | |
| Active DL BWP index | | | |  | 1 | |
| PDSCH configuration | Mapping type | | |  | Type A | |
| k0 | | |  | 0 | |
| Starting symbol (S) | | |  | 2 | |
| Length (L) | | |  | 12 | |
| PRB bundling type | | |  | Static | |
| PRB bundling size | | |  | 2 | |
| Resource allocation type | | |  | Type 1 | |
| RBG size | | |  | Config2 | |
| VRB-to-PRB mapping type | | |  | Non-interleaved | |
| VRB-to-PRB mapping interleaver bundle size | | |  | N/A | |
| PDSCH DMRS configuration | Antenna port indexes | | |  | 1000 | 1002 |
| TCI state | | |  | TCI State #1 | TCI State #2 |
| DMRS Type | | |  | Type 1 | |
| Number of additional DMRS | | |  | 1 | |
| Maximum number of OFDM symbols for DL front loaded DMRS | | |  | 1 | |
| TCI State #1 | Type 1 QCL information | | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking’ configuration | N/A |
| QCL Type |  | Type A | N/A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| TCI State #2 | Type 1 QCL information | | CSI-RS resource |  | N/A | CSI-RS resource 5 from 'CSI-RS for tracking’ configuration |
| QCL Type |  | N/A | Type A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| Resource allocation | | | |  | Full-overlapping | |
| Timing offset of the second TRxP from the first TRxP | | | | us | -0.25 for test 1-1  1 for test 1-2 | |
| Frequency offset of the second TRxP from the first TRxP | | | | Hz | 300 for test 1-1  0 for test 1-2 | |
| 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 | |
| Precoding configuration | | | |  | SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity. | |
| Note 1: PDSCH transmission is done from both TRxPs (PDSCH Layer 0 is transmitted from TRxP #1 and PDSCH layer 1 is transmitted from TRxP #2) | | | | | | |

Table 5.2.2.2.11-3: Minimum performance

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL-DL pattern | Propagation condition(Note 1) | Correlation matrix and antenna configuration(Note 2) | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB)(Note 3) |
| 1-1 | R.PDSCH.2-3.2 TDD | 40 / 30 | 64QAM, 0.50 | FR1.30-1 | TDLA30-10 | 2x2, ULA Low | 70 | 20.2 |
| 1-2 | R.PDSCH.2-3.2 TDD | 40 / 30 | 64QAM, 0.50 | FR1.30-1 | TDLA30-10 | 2x2, ULA Low | 70 | 20.0 |
| Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent  Note 2: Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2  Note 3: SNR corresponds to SNR of TRxP #1 and TRxP #2 as defined in 4.4.2 with scaling factor as 1/sqrt(2) for transmitted signal from each TRxP | | | | | | | | |

##### 5.2.2.2.12 Minimum requirements for PDSCH Multi-DCI based transmission scheme

The performance requirements are specified in Table 5.2.2.2.12-3, with the addition of test parameters in Table 5.2.2.2.12-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.2.12-1.

Table 5.2.2.2.12-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH performance when UE is configured two different values of CORESETPoolIndex in ControlResourceSet and when UE receives multiple PDCCHs scheduling PDSCHs | 1-1 |

Table 5.2.2.2.12-2: Test parameters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | | | | Unit | Value | |
| TRxP #1(Note 1) | TRxP #2(Note 1) |
| Transmit TRxP of SSB | | | |  | TRxP #1 | |
| PDCCH configuration | | TCI state | |  | TCI State #1 | TCI State #2 |
| CORESETPoolIndex | |  | 0,1 | |
| CSI-RS for tracking | | First subcarrier index in the PRB used for CSI-RS | |  | k0=0 for CSI-RS resources 1,2,3,4 | k0=1 for CSI-RS resources 5,6,7,8 |
| First OFDM symbol in the PRB used for CSI-RS | |  | l0 = 6 for CSI-RS resources 1 and 3  l0 = 10 for CSI-RS resources 2 and 4 | l0 = 6 for CSI-RS resources 5 and 7  l0 = 10 for CSI-RS resources 6 and 8 |
| Number of CSI-RS ports (X) | |  | 1 for CSI-RS resource 1,2,3,4 | 1 for CSI-RS resource 5,6,7,8 |
| CDM Type | |  | ‘No CDM’ for CSI-RS resource 1,2,3,4,5,6,7,8 | |
| Density | |  | 3 | |
| CSI-RS periodicity | | Slots | 40 | |
| CSI-RS offset | | Slots | 20 for CSI-RS resources 1 and 2  21 for CSI-RS resources 3 and 4 | 20 for CSI-RS resources 5 and 6  21 for CSI-RS resources 7 and 8 |
| QCL info | |  | TCI state #0 | |
| Duplex mode | | | |  | TDD | |
| Active DL BWP index | | | |  | 1 | |
| PDSCH configuration | Mapping type | | |  | Type A | |
| k0 | | |  | 0 | |
| Starting symbol (S) | | |  | 2 | |
| Length (L) | | |  | 12 | |
| PRB bundling type | | |  | Static | |
| PRB bundling size | | |  | 2 | |
| Resource allocation type | | |  | Type 1 | |
| RBG size | | |  | Config2 | |
| VRB-to-PRB mapping type | | |  | Non-interleaved | |
| VRB-to-PRB mapping interleaver bundle size | | |  | N/A | |
| PDSCH DMRS configuration | Antenna port indexes | | |  | {1000,1001} | {1002,1003} |
| TCI state | | |  | TCI State #1 | TCI State #2 |
| DMRS Type | | |  | Type 1 | |
| Number of additional DMRS | | |  | 1 | |
| Maximum number of OFDM symbols for DL front loaded DMRS | | |  | 1 | |
| TCI State #1 | Type 1 QCL information | | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking’ configuration | N/A |
| QCL Type |  | Type A | N/A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| TCI State #2 | Type 1 QCL information | | CSI-RS resource |  | N/A | CSI-RS resource 5 from 'CSI-RS for tracking’ configuration |
| QCL Type |  | N/A | Type A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| Resource allocation | | | |  | Non-overlapping | |
| Timing offset of the second TRxP from the first TRxP | | | | us | -0.25 | |
| Frequency offset of the second TRxP from the first TRxP | | | | Hz | 300 | |
| 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 | |
| Precoding configuration | | | |  | SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity | |
| Note 1: PDSCH transmission is done from both TRxPs. Transmission from TRxP #1 uses CORESETPoolIndex 0 and transmission from TRxP #2 uses CORESETPoolIndex 1 | | | | | | |

Table 5.2.2.2.12-3: Minimum performance

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL-DL pattern | Propagation condition(Note 1) | Correlation matrix and antenna configuration(Note 2) | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB)(Note 3) |
|  | TRxP #1 | TRxP #2 |  |  |  |  |  |  |  |
| 1-1 | R.PDSCH.2-3.3 TDD | R.PDSCH.2-3.4 TDD | 40 / 30 | 64QAM, 0.50 | FR1.30-1 | TDLA30-10 | 2x2, ULA Low | 70 | 20.4 |
| Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent  Note 2: Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2  Note 3: SNR corresponds to SNR of TRxP #1 and TRxP #2 as defined in 4.4.2 | | | | | | | | | |

##### 5.2.2.2.13 Minimum requirements for PDSCH with single-DCI based FDM Scheme A

The performance requirements are specified in Table 5.2.2.2.13-3, with the addition of test parameters in Table 5.2.2.2.13-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.2.13-1.

Table 5.2.2.2.13-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify PDSCH performance under 2 receive antenna conditions when UE is configured with “FDMSchemeA” in “RepetitionScheme-r16” defined in clause 5.1 of TS 38.214 [12]] | 1-1 |

Table 5.2.2.1.13-2: Test parameters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | | | | Unit | Value | |
| TRxP #1 (Note 1) | TRxP #2 (Note 1) |
| Transmit TRxP of SSB | | | |  | TRxP #1 | |
| PDCCH configuration | | TCI state | |  | TCI State #1 | |
| CORESETPoolIndex | |  | Not configured | |
| CSI-RS for tracking | | First subcarrier index in the PRB used for CSI-RS | |  | k0=0 for CSI-RS resources 1,2,3,4 | k0=1 for CSI-RS resources 5,6,7,8 |
| First OFDM symbol in the PRB used for CSI-RS | |  | l0 = 6 for CSI-RS resources 1 and 3  l0 = 10 for CSI-RS resources 2 and 4 | l0 = 6 for CSI-RS resources 5 and 7  l0 = 10 for CSI-RS resources 6 and 8 |
| Number of CSI-RS ports (X) | |  | 1 for CSI-RS resource 1,2,3,4 | 1 for CSI-RS resource 5,6,7,8 |
| CDM Type | |  | 'No CDM’ for CSI-RS resource 1,2,3,4,5,6,7,8 | |
| Density | |  | 3 | |
| CSI-RS periodicity | | Slots | 40 | |
| CSI-RS offset | | Slots | 20 for CSI-RS resources 1 and 2  21 for CSI-RS resources 3 and 4 | 20 for CSI-RS resources 5 and 6  21 for CSI-RS resources 7 and 8 |
| QCL info | |  | TCI state #0 | |
| Duplex mode | | | |  | TDD | |
| Active DL BWP index | | | |  | 1 | |
| PDSCH configuration | Mapping type | | |  | Type A | |
| k0 | | |  | 0 | |
| Starting symbol (S) | | |  | 2 | |
| Length (L) | | |  | 12 | |
| 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 | |
| PDSCH DMRS configuration | Antenna port indexes | | |  | 1000, 1001 | 1000, 1001 |
| TCI state | | |  | TCI State #1 | TCI State #2 |
| DMRS Type | | |  | Type 1 | |
| Number of additional DMRS | | |  | 1 | |
| Maximum number of OFDM symbols for DL front loaded DMRS | | |  | 1 | |
| TCI State #1 | Type 1 QCL information | | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking’ configuration | N/A |
| QCL Type |  | Type A | N/A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| TCI State #2 | Type 1 QCL information | | CSI-RS resource |  | N/A | CSI-RS resource 5 from 'CSI-RS for tracking’ configuration |
| QCL Type |  | N/A | Type A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| Timing offset of the second TRxP from the first TRxP | | | | us | -0.25 | |
| Frequency offset the second TRxP from the first TRxP | | | | Hz | 300 | |
| 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 | |
| Precoding configuration | | | |  | SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity. | |
| Note 1: PDSCH transmission is done from both TRxPs | | | | | | |

Table 5.2.2.2.13-3: 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 (Note 1) | Correlation matrix and antenna configuration (Note 2) | Reference value | |
| Fraction of  maximum  throughput  (%) | SNR (dB) (Note 3) |
| 1-1 | R.PDSCH.2-2.5 TDD | 40 / 30 | 16QAM, 0.54 | FR1.30-1 | TDLA30-10 | 2x2, ULA Low | 70 | 17.6 |
| Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent.  Note 2: Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2.  Note 3: SNR corresponds to SNR of TRxP #1 and TRxP #2 as defined in 4.4.2 | | | | | | | | |

##### 5.2.2.2.14 Minimum requirements for PDSCH with single-DCI based Inter-slot TDM scheme

The performance requirements are specified in Table 5.2.2.2.14-3, with the addition of test parameters in Table 5.2.2.2.14-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.2.14-1.

Table 5.2.2.2.14-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify PDSCH performance under 2 receive antenna conditions when UE is configured with repetitionNumber-r16 with multiple slot level PDSCH transmission occasions of the same TB with two TCI states defined in clause 5.1 of TS 38.214 [12] | 1-1 |

Table 5.2.2.2.14-2: Test parameters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | | | | Unit | Value | |
| TRxP #1 (Note 1) | TRxP #2 (Note 1) |
| Transmit TRxP of SSB | | | |  | TRxP #1 | |
| PDCCH configuration | | TCI state | |  | TCI State #1 | |
| CORESETPoolIndex | |  | Not configured | |
| CSI-RS for tracking | | First subcarrier index in the PRB used for CSI-RS | |  | k0=0 for CSI-RS resources 1,2,3,4 | k0=1 for CSI-RS resources 5,6,7,8 |
| First OFDM symbol in the PRB used for CSI-RS | |  | l0 = 6 for CSI-RS resources 1 and 3  l0 = 10 for CSI-RS resources 2 and 4 | l0 = 6 for CSI-RS resources 5 and 7  l0 = 10 for CSI-RS resources 6 and 8 |
| Number of CSI-RS ports (X) | |  | 1 for CSI-RS resource 1,2,3,4 | 1 for CSI-RS resource 5,6,7,8 |
| CDM Type | |  | 'No CDM’ for CSI-RS resource 1,2,3,4,5,6,7,8 | |
| Density | |  | 3 | |
| CSI-RS periodicity | | Slots | 40 | |
| CSI-RS offset | | Slots | 20 for CSI-RS resources 1 and 2  21 for CSI-RS resources 3 and 4 | 20 for CSI-RS resources 5 and 6  21 for CSI-RS resources 7 and 8 |
| QCL info | |  | TCI state #0 | |
| Duplex mode | | | |  | TDD | |
| Active DL BWP index | | | |  | 1 | |
| PDSCH configuration | Mapping type | | |  | Type A | |
| k0 | | |  | 0 | |
| Starting symbol (S) | | |  | 2 | |
| Length (L) | | |  | 12 | |
| Repetition number | | |  | 2 | |
| PRB bundling type | | |  | Static | |
| PRB bundling size | | |  | 2 | |
| 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 | Antenna port indexes | | |  | 1000 | 1000 |
| TCI state | | |  | TCI State #1 | TCI State #2 |
| DMRS Type | | |  | Type 1 | |
| Number of additional DMRS | | |  | 1 | |
| Maximum number of OFDM symbols for DL front loaded DMRS | | |  | 1 | |
| TCI State #1 | Type 1 QCL information | | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking’ configuration | N/A |
| QCL Type |  | Type A | N/A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| TCI State #2 | Type 1 QCL information | | CSI-RS resource |  | N/A | CSI-RS resource 5 from 'CSI-RS for tracking’ configuration |
| QCL Type |  | N/A | Type A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| Timing offset of the second TRxP from the first TRxP | | | | us | 1 | |
| Frequency offset of the second TRxP from the first TRxP | | | | Hz | 300 | |
| Number of HARQ Processes | | | |  | 4 | |
| 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 (Note 2) | |
| Precoding configuration | | | |  | SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity. | |
| Note 1: PDSCH transmission is done from both TRxPs  Note 2: ACK/NACK feedback is generated for PDSCH on slot i, where mod(i,10) = {2, 4, 6}. | | | | | | |

Table 5.2.2.2.14-3: 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 (Note 1) | Correlation matrix and antenna configuration (Note 2) | Reference value | |
| BLER (%) | SNR (dB) (Note 4) |
| 1-1 | R.PDSCH.2-16.2 TDD | 40 / 30 | 16QAM, 0.54 | FR1.30-1 | TDLA30-10 | 2x2, ULA Low | 1 (Note 3) | 2. 8 |
| Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent.  Note 2: Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2.  Note 3: BLER is defined as residual BLER; i.e. ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block.  Note 4: SNR corresponds to SNR of TRxP #1 and TRxP #2 as defined in 4.4.2 | | | | | | | | |

##### 5.2.2.2.15 Minimum requirements for PDSCH of PCell on band with shared spectrum access

The performance requirements are specified in Table 5.2.2.2.15-3, with the addition of test parameters in Table 5.2.2.2.15-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.2.15-1.

Table 5.2.2.2.15-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify PDSCH performance for UE supporting operations in shared spectrum access | 1-1, 1-2, 1-3, 1-4 |

Table 5.2.2.2.15-2: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | Value |
| Duplex mode | |  | TDD |
| Active DL BWP index | |  | 1 |
| DL transmission model | |  | As specified in B.5 |
| Downlink Model Parameters | SSB Q factor |  | 8 |
| Downlink transmission duration values | Slots | {2,4,6,7} |
| Occupied OFDM symbols in slot other than the last slot of the downlink duration | Symbols | 14 |
| Occupied OFDM symbols in the last slot of the downlink duration | Symbols | {6,9,12,14} (Note 1) |
| Downlink period | ms | 5 |
| LBT failure probability (*pLBT*) |  | 0.25 |
| PDSCH configuration | Mapping type |  | Type A |
| k0 |  | 0 |
| Starting symbol (S) |  | 2 |
| PDSCH aggregation factor |  | 1 |
| PRB bundling type |  | Static |
| PRB bundling size |  | 2 |
| 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 |
| dmrs-AdditionalPosition |  | pos1 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 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 |
| Note 1: If DL Transmission duration is 2 Slot, the occupied OFDM symbols in the last slot of the downlink duration is 14. | | | |

Table 5.2.2.2.15-3: 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) |
| 1-1 | R.PDSCH.2-18.1 TDD | 20 / 30 | 16QAM, 0.48 | FR1.30-7 | TDLA30-10 | 2x2, ULA Low | 70 | 13.8 |
| 1-2 | R.PDSCH.2-18.2 TDD | 40 / 30 | 16QAM, 0.48 | FR1.30-7 | TDLA30-10 | 2x2, ULA Low | 70 | 14.1 |
| 1-3 | R.PDSCH.2-18.3 TDD | 60 / 30 | 16QAM, 0.48 | FR1.30-7 | TDLA30-10 | 2x2, ULA Low | 70 | 14.2 |
| 1-4 | R.PDSCH.2-18.4 TDD | 80 / 30 | 16QAM, 0.48 | FR1.30-7 | TDLA30-10 | 2x2, ULA Low | 70 | 14.5 |

##### 5.2.2.2.16 Minimum requirements for PDSCH with inter-cell interference

The performance requirements are specified in Table 5.2.2.2.16-3, with the addition of test parameters in Table 5.2.2.2.16-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.2.16-1.

Table 5.2.2.2.16-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH performance under 2 receive antenna conditions, when transmission from the serving cell is interfered by 1 or 2 interfering cells. | 1-1, 1-2 |

Table 5.2.2.2.16-2: Test parameters

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | | Unit | Value | | |
|  | |  | Cell 1 | Cell 2 | Cell 3 |
|  | |  | Enabled | Enabled | Enabled for test 1-1  Disabled for test 1-2 |
| Duplex mode | |  | TDD | | |
| TDD UL-DL pattern | |  | FR1.30-1 | | |
| Active DL BWP index | |  | 1 | | |
| Physical cell ID | |  | 0 | 1 | 2 |
| Transmission rank | |  | 1 | Random rank with 70% and 30% probability for rank 1 and rank 2 | Random rank with 70% and 30% probability for rank 1 and rank 2 for Test 1-1  N/A for Test 1-2 |
| Time offset to Cell 1 | | us | N/A | 1.5 | -0.5 |
| Frequency shift to Cell 1 | | Hz | N/A | 300 | -100 |
| Interference Model | |  | N/A | As specified in B.6.2 | |
| INR (Note 2) | | dB | N/A | 7.77 for Test 1-1  7.58 for Test 1-2 | 2.29 for Test 1-1  N/A for Test 1-2 |
| SSB configuration | SSB position in burst |  | First SSB in Slot #0 | First SSB in Slot #0 for Test 1-1  Second SSB in Slot #0 for Test 1-2 | First SSB in Slot #0 for Test 1-1  N/A for Test 1-2 |
|  | SSB periodicity | ms | 20 | 20 | 20 |
| 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 |  | 2 | | |
|  | 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 |  | 1 | | |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 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 | | |
| Note 1: Cell 1 is the serving cell, Cell 2, 3 are interference cells.  Note 2: INR is defined in Annex B.6.1 | | | | | |

Table 5.2.2.2.16-3: Minimum performance for PDSCH with rank 1 and with inter-cell interference

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
| Cell1 | Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.2-2.1 TDD | 40 / 30 | 16QAM, 0.48 | TDLC300-100 | 2x2, ULA Low | 70 | 15.7 |
| 1-2 | R.PDSCH.2-2.1 TDD | 40 / 30 | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 12.6 |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.  Note 2: Bandwidth/ Subcarrier spacing, Propagation Condition, Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3. | | | | | | | |

##### 5.2.2.2.17 Minimum requirements for PDSCH with intra cell inter user interference

The performance requirements are specified in Table 5.2.2.2.17-3, 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 performance under 2 receive antenna conditions when the PDSCH transmission of target UE is interfered by co-scheduled UE | 1-1 |

Table 5.2.2.2.17-2: Test parameters

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | Unit | Target UE | Co-scheduled UE |
| Duplex mode | |  | TDD | |
| 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 |  | 2 | |
| 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 |  | 1 | |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 | |
| Antenna ports indexes |  | 1000 | 1001 |
| Number of PDSCH DMRS CDM group(s) without data |  | 1 | 1 |
| PDSCH & PDSCH DMRS Precoding configuration | |  | Single Panel Type I, Randomized precoder selection for every PRB bundle and updated per slot, with equal probability of each applicable i1/i2 combination or codebook  Index, chosen from section 5.2.2.2.1 of TS 38.214 [12]. | Single Panel Type I, Randomized precoder selection for every PRB bundle and updated per slot, with equal probability of each applicable i1/i2 combination or codebook  Index, chosen from section 5.2.2.2.1 of TS 38.214 [12].Any column of precoder matrix is not equal to any column of precoder matrix of Target UE |
| MU-MIMO Beamforming Model | |  | As specified in B.4.2 | |
| Number of HARQ Processes | |  | 8 | N/A |
| 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 | N/A |
| Note 1: The DMRS scrambling ID is same for both target UE and Co-scheduled UE. | | | | |

Table 5.2.2.2.17-3: Minimum performance for PDSCH of target UE with intra-cell inter user interference

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | |
| Target UE | Co-scheduled UE | Fraction of  maximum  throughput  (%) | SNR (dB) |
| 1-1 | R.PDSCH.2-2.1 TDD | 40 / 30 | 16QAM, 0.48 | Random 16QAM symbols | FR1.30-1 | TDLC300-100 | 2x2, ULA Low | 70 | 18.9 |

##### 5.2.2.2.18 Minimum requirements for RedCap

The performance requirements are specified in Table 5.2.2.2.18-3 and Table 5.2.2.2.18-4, with the addition of test parameters in Table 5.2.2.2.18-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.2.18-1.

Table 5.2.2.2.18-1: 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 5.2.2.2.18-2: 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 5.2.2.2.18-3: 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 5.2.2.2.18-4: 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 |

##### 5.2.2.2.19 Minimum requirements for PDSCH CRS interference mitigation under NR-LTE coexistence scenario

The performance requirements are specified in Table 5.2.2.2.19-4, with the addition of test parameters in Table 5.2.2.2.19-2 for the serving cell and Table 5.2.2.2.19-3 for the LTE interference cells and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.2.19-1.

Table 5.2.2.2.19-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify PDSCH CRS interference mitigation performance under 2 receive antenna conditions with CRS rate matching configured for the serving cell. | 1-1 |

Table 5.2.2.2.19-2: Tests parameters for serving cell PDSCH

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | Value |
| Duplex mode | |  | TDD |
| Active DL BWP index | |  | 1 |
| PDSCH configuration | Mapping type |  | Type A |
|  | k0 |  | 0 |
|  | Starting symbol (S) |  | 3 |
|  | Length (L) |  | 9 |
|  | PDSCH aggregation factor |  | 1 |
|  | PRB bundling type |  | Static |
|  | PRB bundling size |  | 2 |
|  | 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 |  | 1 |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| CRS for rate  Matchin (Note 1) | LTE carrier centre subcarrier location |  | Same as NR carrier centre subcarrier location |
| LTE carrier BW | Hz | 20 |
| Number of antenna ports |  | 4 |
| v-shift |  | 0 |
| 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 |
| Note 1: No MBSFN is configured on LTE carrier.  Note 2: Network-based CRS interference mitigation is disabled on LTE carrier | | | |

Table 5.2.2.2.19-3: Tests parameter for interference cells

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | Unit | Cell 1 | Cell 2 |
| Duplex mode | |  | TDD | TDD |
| TDD UL-DL pattern | |  | DSUDDDSUDD  S = 10D + 2G + 2U | DSUDDDSUDD  S = 10D + 2G + 2U |
| INR (Note 1) | | dB | 10.45 | 4.6 |
| LTE Bandwidth | | MHz | 20 | 20 |
| Carrier centre subcarrier location | |  | Same as the NR serving carrier centre subcarrier location | Same as the NR serving carrier centre subcarrier location |
| Cyclic Prefix | |  | Normal | Normal |
| Physical cell ID | |  | 1 | 2 |
| CRS pattern | Number of antenna ports |  | 4 | 4 |
| v-shift |  | 1 | 2 |
| Downlink power allocation |  | dB | -6 | -6 |
|  | dB | -6 | -6 |
| σ | dB | 0 | 0 |
| PDSCH transmission mode | |  | TM4 | TM4 |
| PDSCH loading level | | % | 20% probability of occurrence of LTE data transmission in time domain, and full bandwidth allocation in frequency domain. | 20% probability of occurrence of LTE data transmission in time domain, and full bandwidth allocation in frequency domain. |
| Transmission rank | | % | 80% and 20% probability for rank 1 and rank 2 respectively | 80% and 20% probability for rank 1 and rank 2 respectively |
| Interference model | |  | As specified in clause B.7 | As specified in clause B.7 |
| Time offset to the serving cell | | us | 3 | -1 |
| Frequency offset to the serving cell | | Hz | 300 | -100 |
| Propagation conditions and MIMO configuration (Note 2) | |  | TDLA30-10 ULA Low | TDLA30-10 ULA Low |
| Precoding granularity | | PRB | 8 | 8 |
| Note 1: Defined in B.6.1  Note 2: The channel for the LTE interference cells and the serving cell are independent. | | | | |

Table 5.2.2.2.19-4: 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.1-1.3 TDD | 20 / 15 | 16QAM, 0.48 | FR1.15-1 | TDLA30-10 | 4x2, ULA Low | 70 | 12.5 |

##### 5.2.2.2.20 Minimum requirements for PDSCH with inter cell CRS interference

The performance requirements are specified in Table 5.2.2.2.20-4 and Table 5.2.2.2.20-6, with the addition of test parameters in Table 5.2.2.2.20-2 for the serving cell and Table 5.2.2.2.20-3 for the LTE interference cells and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.2.20-1.

**Table 5.2.2.2.20-1: Tests purpose**

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify PDSCH performance under 2 receive antenna conditions when PDSCH is interfered by inter cell CRS signal | 1-1, 1-2, 2-1 and 2-2 |

Table 5.2.2.2.20-2: Tests parameters for serving cell PDSCH

|  |  |  |  |
| --- | --- | --- | --- |
| 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) |  | 12 |
|  | PDSCH aggregation factor |  | 1 |
|  | PRB bundling type |  | Static |
|  | PRB bundling size |  | 2 |
|  | 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 |  | 1 |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 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 5.2.2.2.20-3: Tests parameter for interference cells

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | Unit | Cell 1 | Cell 2 |
| Duplex mode | |  | TDD | TDD |
| TDD UL-DL pattern | |  | DSUDDDSUDD  S = 10D + 2G + 2U | DSUDDDSUDD  S = 10D + 2G + 2U |
| INR (Note 5) | | dB | 10.45 | 4.6 |
| LTE Bandwidth (Note 6) | | MHz | 20 | 20 |
| Carrier centre subcarrier location (Note 7) | |  | Same as the NR serving carrier centre subcarrier location | Same as the NR serving carrier centre subcarrier location |
| Cyclic Prefix | |  | Normal | Normal |
| Physical cell ID | |  | 1 | 2 |
| CRS pattern | Number of antenna ports |  | 4 | 4 |
| v-shift |  | 1 | 2 |
| Downlink power allocation |  | dB | -6 | -6 |
|  | dB | -6 | -6 |
| σ | dB | 0 | 0 |
| PDSCH transmission mode | |  | TM4 | TM4 |
| PDSCH loading level | | % | 20% probability of occurrence of LTE data transmission in time domain, and full bandwidth allocation in frequency domain for test 1-1.  10% probability of occurrence of LTE data transmission in time domain, and full bandwidth allocation in frequency domain for test 1-2. | 20% probability of occurrence of LTE data transmission in time domain, and full bandwidth allocation in frequency domain for test 1-1.  10% probability of occurrence of LTE data transmission in time domain, and full bandwidth allocation in frequency domain for test 1-2. |
| Transmission rank | | % | 80% and 20% probability for rank 1 and rank 2 respectively | 80% and 20% probability for rank 1 and rank 2 respectively |
| Interference model | |  | As specified in clause B.7 | As specified in clause B.7 |
| Time offset to the serving cell | | us | 3 for test 1-1  1.5 for test 1-2 | -1 for test 1-1  -0.5 for test 1-2 |
| Frequency offset to the serving cell | | Hz | 300 | -100 |
| Propagation conditions and MIMO configuration (Note 1) | |  | TDLA30-10 ULA Low | TDLA30-10 ULA Low |
| Precoding granularity | | PRB | 8 | 8 |
| Note 1: The channel for the LTE interference cells and the serving cell are independent.  Note 2: No MBSFN is configured on LTE carrier.  Note 3: Network-based CRS interference mitigation is disabled on LTE carrier.  Note 4: The start of transmission of LTE frame is delayed by 2 LTE subframes with respect to the start of transmission of NR frame  Note 5: Defined in B.6.1  Note 6: This parameter is informed to UE via network assistance signalling for Test 1-1 and 1-2 in Table 5.2.2.2.20-4.  Note 7 Single entry is included in IE *LTE-NeighCellsCRS-AssistInfoList-r17* that applies for both cells for cases with network signalling assistance | | | | |

The requirements for UE capable of performing CRS-IM with the assistance of network signaling on LTE channel bandwidth are specified in Table 5.2.2.2.20-4:

Table 5.2.2.2.20-4: Minimum performance for Rank 1 with the assistance of network signaling on LTE channel bandwidth

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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.1-4.1 TDD | 20 / 15 | 16QAM, 0.48 | FR1.15-1 | TDLA30-10 | 4x2, ULA Low | 70 | 12.3 |
| 1-2 | R.PDSCH.2-25.1 TDD | 20 / 30 | 16QAM, 0.48 | FR1.30-1 | TDLA30-10 | 4x2, ULA Low | 70 | 11.7 |

The requirements for UE capable of performing CRS-IM without the assistance of network signaling on LTE channel bandwidth are specified in Table 5.2.2.2.20-6 with following test procedure:

The network configures an inter-RAT LTE measurement object of the interfering cells to the tested UE. Inter-RAT measurement is configured at the beginning of the test and applied throughout the test with gap pattern configurations according to Table 5.2.2.2.20-5. PDSCH is not scheduled and throughput is not counted during 4.64s after the beginning of test. PDSCH is not scheduled in the measurement gaps.

Table 5.2.2.2.20-5: Measurement Gap configurations

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| Measurement Gap Length (mgl) | ms | 6 |
| Measurement Gap Repetition Period (mgrp) | ms | 40 |
| Gap offset (gapoffset) | ms | 1 |
| Measurement gap timeing advance (mgta) | ms | 0 |

Table 5.2.2.2.20-6: Minimum performance for Rank 1 without the assistance of network signaling on LTE channel bandwidth

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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.1-4.2 TDD | 20 / 15 | 16QAM, 0.48 | FR1.15-1 | TDLA30-10 | 4x2, ULA Low | 70 | 12.3 |
| 2-2 | R.PDSCH.2-26.1 TDD | 20 / 30 | 16QAM, 0.48 | FR1.30-1 | TDLA30-10 | 4x2, ULA Low | 70 | 11.7 |

##### 5.2.2.2.21 Minimum requirements for HST-SFN Scheme A

The performance requirements are specified in Table 5.2.2.2.21-3, with the addition of test parameters in Table 5.2.2.2.21-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.2.21-1.

**Table 5.2.2.2.21-1: Tests purpose**

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify UE performance in the HST-SFN Scheme A scenario defined in B.3.5 | 1-1 |

**Table 5.2.2.2.21-2: Test parameters**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Value** |
| Duplex mode | | |  | TDD |
| Active DL BWP index | | |  | 1 |
| PDCCH configuration | TCI state | |  | Note 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 | |  | 2 |
| Resource allocation type | |  | Type 0 |
| RBG size | |  | Config2 |
| VRB-to-PRB mapping type | |  | Non-interleaved |
| VRB-to-PRB mapping interleaver bundle size | |  | N/A |
| TCI state | |  | Note 1 |
| PDSCH DMRS configuration | DMRS Type | |  | Type 1 |
| Number of additional DMRS | |  | 2 |
| Maximum number of OFDM symbols for DL front loaded DMRS | |  | 1 |
| CSI-RS for tracking | Resource set #1 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 5 for CSI-RS resource 1 and 3  l0 = 9 for CSI-RS resource 2 and 4 |
| CSI-RS periodicity | Slots | 20 for CSI-RS resource 1,2,3,4. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4 |
| QCL info |  | TCI state #3 |
| Resource set #2 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 6 for CSI-RS resource 5 and 7  l0 = 10 for CSI-RS resource 6 and 8 |
| CSI-RS periodicity | Slots | 20 for CSI-RS resource 5,6,7,8. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 5 and 6 2 for CSI-RS resource 7 and 8 |
| QCL info |  | TCI state #4 |
| Resource set #3 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 4 for CSI-RS resource 9 and 11  l0 = 8 for CSI-RS resource 10 and 12 |
| CSI-RS periodicity | Slots | 20 for CSI-RS resource 9,10,11,12. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 9 and 10 2 for CSI-RS resource 11 and 12 |
| QCL info |  | TCI state #5 |
| NZP CSI-RS for CSI acquisition | Resource set #4 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 12 |
| CSI-RS periodicity | Slots | 40 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #0 |
| Resource set #5 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 13 |
| CSI-RS periodicity | Slots | 40 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #1 |
| Resource set #6 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 7 |
| CSI-RS periodicity | Slots | 40 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #2 |
| TCI state #0 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking Resource set #1' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #1 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #2 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 9 from 'CSI-RS for tracking Resource set #3' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #3 | Type 1 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| TCI state #4 | Type 1 QCL information | SSB index |  | SSB #1 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| TCI state #5 | Type 1 QCL information | SSB index |  | SSB #2 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| 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 |
| Note 1: SSB # (k mod 3) , CSI-RS (for tracking) resource set # ((k mod 3) + 1) and CSI-RS (for CSI acquisition) resource set # ((k mod 3) + 4) are transmitted by kth RRH.  Codepoint #0 is activated when UE receives PDCCH/PDSCH from RRH#3k and RRH#3k+1 with TCI States TCI state #0, TCI State #1.  Codepoint #1 is activated when UE receives PDCCH/PDSCH from RRH#3k+1 and RRH#3k+2 with TCI States TCI state #1, TCI State #2.  Codepoint #2 is activated when UE receives PDCCH/PDSCH from RRH#3k+2 and RRH#3k+3 with TCI States TCI state #2, TCI State #0. | | | | |

**Table 5.2.2.2.21-3: Minimum performance for HST-SFN Scheme A**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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.2-30.1 TDD | 40 / 30 | 16QAM, 0.48 | FR1.30-1 | HST-SFN Scheme A | 2x2 | 70 | 12.9 |

##### 5.2.2.2.22 Minimum requirements for HST-SFN Scheme B

The performance requirements are specified in Table 5.2.2.2.22-3, with the addition of test parameters in Table 5.2.2.2.22-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.2.22-1.

**Table 5.2.2.2.22-1: Tests purpose**

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify UE performance in the HST-SFN Scheme B scenario defined in B.3.6 | 1-1 |

**Table 5.2.2.2.22-2: Test parameters**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Value** |
| Duplex mode | | |  | TDD |
| Active DL BWP index | | |  | 1 |
| PDCCH configuration | TCI state | |  | Note 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 | |  | 2 |
| Resource allocation type | |  | Type 0 |
| RBG size | |  | Config2 |
| VRB-to-PRB mapping type | |  | Non-interleaved |
| VRB-to-PRB mapping interleaver bundle size | |  | N/A |
| TCI state | |  | Note 1 |
| PDSCH DMRS configuration | DMRS Type | |  | Type 1 |
| Number of additional DMRS | |  | 2 |
| Maximum number of OFDM symbols for DL front loaded DMRS | |  | 1 |
| CSI-RS for tracking | Resource set #1 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 5 for CSI-RS resource 1 and 3  l0 = 9 for CSI-RS resource 2 and 4 |
| CSI-RS periodicity | Slots | 20 for CSI-RS resource 1,2,3,4. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4 |
| QCL info |  | TCI state #3 |
| Frequency Occupation |  | Start PRB 0 |
| Number of PRB = 52 |
| Resource set #2 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 6 for CSI-RS resource 5 and 7  l0 = 10 for CSI-RS resource 6 and 8 |
| CSI-RS periodicity | Slots | 20 for CSI-RS resource 5,6,7,8. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 5 and 6 2 for CSI-RS resource 7 and 8 |
| QCL info |  | TCI state #4 |
| Frequency Occupation |  | Start PRB 0 |
| Number of PRB = 52 |
| Resource set #3 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 4 for CSI-RS resource 9 and 11  l0 = 8 for CSI-RS resource 10 and 12 |
| CSI-RS periodicity | Slots | 20 for CSI-RS resource 9,10,11,12. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 9 and 10 2 for CSI-RS resource 11 and 12 |
| QCL info |  | TCI state #5 |
| Frequency Occupation |  | Start PRB 0 |
| Number of PRB = 52 |
| NZP CSI-RS for CSI acquisition | Resource set #4 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 12 |
| CSI-RS periodicity | Slots | 40 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #0 |
| Resource set #5 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 13 |
| CSI-RS periodicity | Slots | 40 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #1 |
| Resource set #6 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 7 |
| CSI-RS periodicity | Slots | 40 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #2 |
| TCI state #0 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking Resource set #1' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #1 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #2 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 9 from 'CSI-RS for tracking Resource set #3' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #3 | Type 1 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| TCI state #4 | Type 1 QCL information | SSB index |  | SSB #1 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| TCI state #5 | Type 1 QCL information | SSB index |  | SSB #2 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| 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 | |
| Note 1: SSB # (k mod 3), CSI-RS (for tracking) resource set # ((k mod 3) + 1) and CSI-RS (for CSI acquisition) resource set # ((k mod 3) + 4) are transmitted by kth RRH.  Codepoint#0 {TCI state #0, TCI State #1} is activated when UE receives PDCCH/PDSCH from RRH#3k and RRH#3k+1.  Codepoint#1 {TCI state #1, TCI State #2} is activated when UE receives PDCCH/PDSCH from RRH#3k+1 and RRH#3k+2.  Codepoint#2 {TCI state #2, TCI State #0} is activated when UE receives PDCCH/PDSCH from RRH#3k+2 and RRH#3k+3.  The second indicated TCI state in each codepoint is not used for quasi co-location parameters {Doppler shift, Doppler spread}. | | | | |

**Table 5.2.2.2.22-3: Minimum performance for HST-SFN Scheme B**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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.2-30.1 TDD | 40/30 | 16QAM, 0.48 | FR1.30-1 | HST-SFN-Scheme B | 2x2 | 70 | 11.8 |

### 5.2.3 4RX requirements

#### 5.2.3.1 FDD

##### 5.2.3.1.1 Minimum requirements for PDSCH Mapping Type A

The performance requirements are specified in Table 5.2.3.1.1-3, Table 5.2.3.1.1-4, Table 5.2.3.1.1-5 and Table 5.2.3.1.1-6, with the addition of test parameters in Table 5.2.3.1.1-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.1.1-1.

Table 5.2.3.1.1-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH mapping Type A normal performance under 4 receive antenna conditions and with different channel models, MCSs and number of MIMO layers | 1-1, 1-2, 1-3, 1-5, 1-6, 1-7, 1-8, 2-1, 2-2, 3-1, 4-1 |
| Verify the PDSCH mapping Type A HARQ soft combining performance under 4 receive antenna conditions. | 1-4 |
| Verify the PDSCH mapping Type A performance requirements for Enhanced Receiver Type 1 under 4 receive antenna conditions. | 5-1 |

Table 5.2.3.1.1-2: 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 wideband for Test 3-1  2 for other tests |
| Resource allocation type |  | Test 1-2: Type 1 with start RB = 23, LRBs = 6  Other test: Type 0 |
| RBG size |  | Test 1-2: N/A  Other tests: 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, 1-5, 1-6, 1-7  1 for other tests |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| CSI-RS for tracking | CSI-RS periodicity | Slots | Test 1-5, 1-6, 1-7: 10 for CSI-RS resource 1,2,3,4.  Other tests: Table 5.2-1. |
| CSI-RS offset | Slots | Test 1-5, 1-6, 1-7: 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4.  Other tests: Table 5.2-1. |
| Number of HARQ Processes | |  | 8 for Test 1-4, 2-1  4 for other tests |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 2 |

Table 5.2.3.1.1-3: Minimum performance for Rank 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | 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 | 10 / 15 | QPSK, 0.30 | TDLB100-400 | 2x4, ULA Low | 70 | -3.5 |
| 1-2 | R.PDSCH.1-1.2 FDD | 10 / 15 | QPSK, 0.30 | TDLC300-100 | 2x4, ULA Low | 70 | -2.9 |
| 1-3 | R.PDSCH.1-4.1 FDD | 10 / 15 | 256QAM, 0.82 | TDLA30-10 | 2x4, ULA Low | 70 | 21.0 |
| 1-4 | R.PDSCH.1-2.1 FDD | 10 / 15 | 16QAM, 0.48 | TDLC300-100 | 2x4, ULA Low | 30 | -1.5 |
| 1-5 | R.PDSCH.1-8.1 FDD | 10 / 15 | 16QAM, 0.48 | HST-750 | 1x4 | 70 | 3.3 |
| 1-6 | R.PDSCH.1-8.2 FDD | 10 / 15 | 64QAM, 0.43 | HST-972 | 1x4 | 70 | 7.0 |
| 1-7 | R.PDSCH.1-8.1 FDD | 10 / 15 | 16QAM, 0.48 | TDLC300-600 | 2x4 | 70 | 5.0 |
| 1-8 | R.PDSCH.1-17.1 FDD | 10 / 15 | 1024QAM,  0.79 | TDLD30-5 | 2x4, ULA Low | 70 | 26.3 |

Table 5.2.3.1.1-4: Minimum performance for Rank 2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Test num.** | **Reference channel** | **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 | 10 / 15 | 64QAM, 0.50 | TDLA30-10 | 2x4, ULA Low | 70 | 13.5 |
| 2-2 | R.PDSCH.2-1.1 FDD | 20 / 30 | 64QAM, 0.50 | TDLA30-10 | 2x4, ULA Low | 70 | 13.7 |

Table 5.2.3.1.1-5: Minimum performance for Rank 3

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Test num.** | **Reference channel** | **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)** |
| 3-1 | R.PDSCH.1-2.3 FDD | 10 / 15 | 16QAM, 0.48 | TDLA30-10 | 4x4, ULA Low | 70 | 11.0 |

Table 5.2.3.1.1-6: Minimum performance for Rank 4

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Test num.** | **Reference channel** | 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)** |
| 4-1 | R.PDSCH.1-2.4 FDD | 10 / 15 | 16QAM, 0.48 | TDLA30-10 | 4x4, ULA Low | 70 | 15.6 |

Table 5.2.3.1.1-7: Minimum performance for Rank 3 and Enhanced Receiver Type 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | 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) |
| 5-1 | R.PDSCH.1-2.3 FDD | 10 / 15 | 16QAM, 0.48 | TDLA30-10 | 4x4, ULA Medium A | 70 | 22.3 |

##### 5.2.3.1.2 Minimum requirements for PDSCH Mapping Type A and CSI-RS overlapped with PDSCH

The performance requirements are specified in Table 5.2.3.1.2-3, with the addition of test parameters in Table 5.2.3.1.2-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.1.2-1.

Table 5.2.3.1.2-1: Tests purpose

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify the PDSCH mapping Type A normal performance under 4 receive antenna conditions and CSI-RS overlapped with PDSCH | 1-1 |

Table 5.2.3.1.2-2: 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 |  | 2 |
| 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 |  | 1 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| NZP CSI-RS for CSI acquisition | OFDM symbols in the PRB used for CSI-RS |  | l0 = 13 |
| CSI-RS periodicity | Slots | 5 |
| ZP CSI-RS for CSI acquisition | Subcarrier index in the PRB used for CSI-RS |  | (k0, k1, k2, k3)=(2, 4, 6, 8) |
| Number of CSI-RS ports (X) |  | 8 |
| CSI-RS periodicity | Slots | 5 |
| Number of HARQ Processes | |  | 4 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 2 |

Table 5.2.3.1.2-3: Minimum performance for Rank 2

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test num.** | **Reference channel** | **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.1-5.1 FDD | 10 / 15 | 16QAM, 0.48 | TDLC300-100 | 2x4, ULA Low | 70 | | 9.1 |

##### 5.2.3.1.3 Minimum requirements for PDSCH Mapping Type B

The performance requirements are specified in Table 5.2.3.1.3-3, with the addition of test parameters in Table 5.2.3.1.3-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.1.3-1.

Table 5.2.3.1.3-1: Tests purpose

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| PDSCH mapping Type B performance under 4 receive antenna conditions | 1-1 |

Table 5.2.3.1.3-2: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Value** |
| Duplex mode | |  | FDD |
| Active DL BWP index | |  | 1 |
| PDSCH configuration | Mapping type |  | Type B |
| k0 |  | 0 |
| Starting symbol (S) |  | 5 |
| Length (L) |  | 7 |
| PDSCH aggregation factor |  | 1 |
| PRB bundling type |  | Static |
| PRB bundling size |  | 2 |
| 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 |  | 1 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| Number of HARQ Processes | |  | 4 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 2 |

Table 5.2.3.1.3-3: Minimum performance for Rank 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Test num.** | **Reference channel** | **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.1-1.3 FDD | 10 / 15 | QPSK, 0.30 | TDLA30-10 | 2x4, ULA Low | 70 | -3.8 |

##### 5.2.3.1.4 Minimum requirements for PDSCH Mapping Type A and LTE-NR coexistence

The performance requirements are specified in Table 5.2.3.1.4-3, with the addition of test parameters in Table 5.2.3.1.4-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.1.4-1.

Table 5.2.3.1.4-1: Tests purpose

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify the PDSCH mapping Type A normal performance under 4 receive antenna conditions with CRS rate matching configured | 1-1, 1-2 |

Table 5.2.3.1.4-2: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Value** |
| Duplex mode | |  | FDD |
| Active DL BWP index | |  | 1 |
| NR UL transmission with a 7.5 kHz shift to the LTE raster | |  | true |
| PDCCH configuration | Symbols with PDCCH |  | Symbol# 2 | |
| PDSCH configuration | Mapping type |  | Type A |
| k0 |  | 0 |
| Starting symbol (S) |  | 3 |
| Length (L) |  | 9 for Test 1-1 11 for Test 1-2 |
| PDSCH aggregation factor |  | 1 |
| PRB bundling type |  | Static |
| PRB bundling size |  | 2 |
| 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 |
| Position of the first DM-RS for downlink |  | 3 |
| Number of additional DMRS |  | 1 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| CRS for rate matching (Note 1) | LTE carrier centre subcarrier location |  | Same as NR carrier centre subcarrier location |
| LTE carrier BW | MHz | 10 |
| Number of antenna ports |  | 4 |
| v-shift |  | 0 |
| Number of HARQ Processes | |  | 4 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 2 |
| Note 1: No MBSFN is configured on LTE carrier | | | |

Table 5.2.3.1.4-3: Minimum performance for Rank 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Test num.** | **Reference channel** | **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.1-7.1 FDD | 10 / 15 | QPSK, 0.30 | TDLA30-10 | 4x4, ULA Low | 70 | -4.0 |
| 1-2 | R.PDSCH.1-7.2 FDD | 10 / 15 | QPSK, 0.30 | TDLA30-10 | 4x4, ULA Low | 70 | -4.0 |

##### 5.2.3.1.5 Minimum requirements for PDSCH 0.001% BLER

The performance requirements are specified in Table 5.2.3.1.5-3, with the addition of test parameters in Table 5.2.3.1.5-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.1.5-1.

Table 5.2.3.1.5-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH 0.001% BLER performance under 4 receive antenna conditions | 1-1 |

Table 5.2.3.1.5-2: 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 |  | 2 |
| 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 |  | 1 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| Maximum number of HARQ transmission | |  | 1 |
| Number of HARQ Processes | |  | 4 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 2 |

Table 5.2.3.1.5-3: Minimum performance for Rank 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
| Target BLER | SNR (dB) |
| 1-1 | R.PDSCH.1-1.4 FDD | 10 / 15 | QPSK, 0.59 | AWGN | 1x4, ULA Low | 0.001% | 0.7 |

##### 5.2.3.1.6 Minimum requirements for PDSCH repetitions over multiple slots

The performance requirements are specified in Table 5.2.3.1.6-3, with the addition of test parameters in Table 5.2.3.1.6-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.1.6-1.

Table 5.2.3.1.6-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH repetitions over multiple slots performance under 4 receive antenna conditions | 1-1 |

Table 5.2.3.1.6-2: 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 |  | 2 |
| PRB bundling type |  | Static |
| PRB bundling size |  | 2 |
| 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 |  | 1 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| Number of HARQ Processes | |  | 4 |
| The number of slots between final repetition of PDSCH and corresponding HARQ-ACK information | |  | 2 |

Table 5.2.3.1.6-3: Minimum performance for Rank 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
| Target BLER | SNR (dB) |
| 1-1 | R.PDSCH.1-11.1 FDD | 10 / 15 | 16QAM, 0.54 | TDLA30-10 | 2x4, ULA Low | 1%(Note 1) | -2.3 |
| Note 1: BLER is defined as residual BLER; i.e. ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block. | | | | | | | |

##### 5.2.3.1.7 Minimum requirements for PDSCH Mapping Type B and UE processing capability 2

The performance requirements are specified in Table 5.2.3.1.7-3, with the addition of test parameters in Table 5.2.3.1.7-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.1.7-1.

Table 5.2.3.1.7-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| PDSCH mapping Type B performance and UE processing capability 2 under four receive antenna conditions | 1-1 |

Table 5.2.3.1.7-2: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | Value |
| Duplex mode | |  | FDD |
| Active DL BWP index | |  | 1 |
| PDSCH configuration | Mapping type |  | Type B |
| k0 |  | 0 |
| Starting symbol (S) |  | 2 |
| Length (L) |  | 2 |
| PDSCH aggregation factor |  | 1 |
| PRB bundling type |  | Static |
| PRB bundling size |  | 2 |
| 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 |  | 0 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| Maximum number of HARQ transmission | |  | 1 |
| Number of HARQ Processes | |  | 2 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 0 |

Table 5.2.3.1.7-3: Minimum performance for Rank 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | 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.1-12.1 FDD | 10 / 15 | QPSK, 0.30 | TDLA30-10 | 2x4, ULA Low | 70 | -2.3 |

##### 5.2.3.1.8 Minimum requirements for PDSCH pre-emption

The performance requirements are specified in Table 5.2.3.1.8-3, with the addition of test parameters in Table 5.2.3.1.8-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.1.8-1.

Table 5.2.3.1.8-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH pre-emption performance under 4 receive antenna conditions | 1-1 |

Table 5.2.3.1.8-2: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | Value |
| Duplex mode | |  | FDD |
| Active DL BWP index | |  | 1 |
| PDCCH configuration (Note 4) | Symbols with PDCCH |  | 0, 1 |
| DCI format |  | 2\_1 |
| timeFrequencySet |  | 14x1 |
| 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 |  | 2 |
| 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 |  | 1 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| Pre-emption configuration (Note 2) | Starting symbol (S) |  | 3 |
| Length (L) |  | 2 |
| Pre-emption periodicity and offset (Note 3) | Slots | 10/1 |
| Number of HARQ Processes | |  | 4 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 2 |
| Note 1: Void  Note 2: Interference modelled as random data on pre-empted REs.  Note 3: Pre-emption is scheduled with a fixed scheduling with 10% probability within 10ms periodicity.  Note 4: In addition to PDCCH configuration in Table 5.2-1. | | | |

Table 5.2.3.1.8-3: Minimum performance for Rank 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | 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.1-2.6 FDD | 10 / 15 | 16QAM  0.64 | TDLA30-10 | 2x4, ULA Low | 70 | 6.6 |

##### 5.2.3.1.9 Minimum requirements for PDSCH HST-SFN

The performance requirements are specified in Table 5.2.3.1.9-3, with the addition of test parameters in Table 5.2.3.1.9-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.1.9-1.

Table 5.2.3.1.9-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify PDSCH performance under 4 receive antenna conditions in the HST-SFN scenario defined in B.3.2 when highSpeedDemodFlag-r16 IE [17] is configured | 1-1 |

Table 5.2.3.1.9-2: 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 |  | 2 |
| 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 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| CSI-RS for tracking | CSI-RS periodicity | Slots | 10 for CSI-RS resource 1,2,3,4. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4. |
| Number of HARQ Processes | |  | 4 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 2 |

Table 5.2.3.1.9-3: Minimum performance for Rank 2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | 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.1-8.3 FDD | 10 / 15 | 16QAM, 0.48 | HST-SFN | 2x4 | 70 | 10.4 |

##### 5.2.3.1.10 Minimum requirements for HST-DPS

The performance requirements are specified in Table 5.2.3.1.10-3, with the addition of test parameters in Table 5.2.3.1.10-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.1.10-1.

Table 5.2.3.1.10-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify UE performance in the HST-DPS scenario defined in B.3.3 | 1-1, 1-2 |

Table 5.2.3.1.10-2: Test parameters

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | | Unit | Value |
| Duplex mode | | |  | FDD |
| Active DL BWP index | | |  | 1 |
| PDCCH configuration | TCI state | |  | Note 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 | |  | 2 |
| Resource allocation type | |  | Type 0 |
| RBG size | |  | Config2 |
| VRB-to-PRB mapping type | |  | Non-interleaved |
| VRB-to-PRB mapping interleaver bundle size | |  | N/A |
| TCI state | |  | Note 1 |
| PDSCH DMRS configuration | DMRS Type | |  | Type 1 |
| Number of additional DMRS | |  | 2 |
| Maximum number of OFDM symbols for DL front loaded DMRS | |  | 1 |
| CSI-RS for tracking | Resource set #1 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 5 for CSI-RS resource 1 and 3  l0 = 9 for CSI-RS resource 2 and 4 |
| CSI-RS periodicity | Slots | 10 for CSI-RS resource 1,2,3,4. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4 |
| QCL info |  | TCI state #2 |
| Resource set #2 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 6 for CSI-RS resource 5 and 7  l0 = 10 for CSI-RS resource 6 and 8 |
| CSI-RS periodicity | Slots | 10 for CSI-RS resource 5,6,7,8. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 5 and 6 2 for CSI-RS resource 7 and 8 |
| QCL info |  | TCI state #3 |
| NZP CSI-RS for CSI acquisition | Resource set #3 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 12 |
| CSI-RS periodicity | Slots | 20 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #0 |
| Resource set #4 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 13 |
| CSI-RS periodicity | Slots | 20 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #1 |
| TCI state #0 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking Resource set #1' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #1 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #2 | Type 1 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| TCI state #3 | Type 1 QCL information | SSB index |  | SSB #1 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| Number of HARQ Processes | | |  | 4 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | | |  | 2 |
| Note 1: SSB # (k mod 2), CSI-RS (for tracking) resource set # ((k mod 2) + 1) and CSI-RS (for CSI acquisition) resource set # ((k mod 2) + 3) are transmitted by kth RRH.  For Test 1-1, TCI state switching command scheduled by MAC CE with MCS 4 is transmitted in slot #i that satisfy. PDCCH and PDSCH associated with TCI # (k mod 2) is transmitted by kth RRH from slot#  to slot#  ,  PDCCH and PDSCH are DTXed in other slots in which throughput statistics are not considered.  For Test 1-2, TCI state switching command scheduled by MAC CE with MCS 4 is transmitted in slot #i that satisfy. PDCCH and PDSCH associated with TCI # (k mod 2) is transmitted by kth RRH from slot#  to slot#  Where k=0, 1, 2… is the RRH number, n = 2520 is half of the number of slots between two RRH, = 2 is the number of slots between PDSCH and corresponding HARQ-ACK information, = 3 is the number of slots for MAC CE processing, = 6 is the number of slots to first TRS transmission occasion after MAC CE command is decoded by the UE, = 2 is the number of slots for TRS processing. | | | | |

Table 5.2.3.1.10-3: Minimum performance for HST-DPS

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | Number of active PDSCH TCI states | Correlation matrix and antenna configuration | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.1-8.4 FDD | 10 / 15 | 64QAM, 0.43 | HST-DPS | 1 | 2x4 | 70 | 10.6 |
| 1-2 | R.PDSCH.1-8.4 FDD | 10 / 15 | 64QAM, 0.43 | HST-DPS | 2 | 2x4 | 70 | 10.6 |

##### 5.2.3.1.11 Minimum requirements for PDSCH Single-DCI based SDM scheme

The performance requirements are specified in Table 5.2.3.1.11-3, with the addition of test parameters in Table 5.2.3.1.11-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.1.11-1.

Table 5.2.3.1.11-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH performance with Single-DCI based SDM scheme under 4 receive antenna conditions | 1-1,1-2 |

Table 5.2.3.1.11-2: Test parameters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | | | | Unit | Value | |
| TRxP #1(Note 1) | TRxP #2(Note 1) |
| Transmit TRxP of SSB | | | |  | TRxP #1 | |
| PDCCH configuration | | TCI state | |  | TCI State #1 | |
| CORESETPoolIndex | |  | 0 | |
| CSI-RS for tracking | | First subcarrier index in the PRB used for CSI-RS | |  | k0=0 for CSI-RS resources 1,2,3,4 | k0=1 for CSI-RS resources 5,6,7,8 |
| First OFDM symbol in the PRB used for CSI-RS | |  | l0 = 6 for CSI-RS resources 1 and 3  l0 = 10 for CSI-RS resources 2 and 4 | l0 = 6 for CSI-RS resources 5 and 7  l0 = 10 for CSI-RS resources 6 and 8 |
| Number of CSI-RS ports (X) | |  | 1 for CSI-RS resource 1,2,3,4 | 1 for CSI-RS resource 5,6,7,8 |
| CDM Type | |  | ‘No CDM’ for CSI-RS resource 1,2,3,4,5,6,7,8 | |
| Density | |  | 3 | |
| CSI-RS periodicity | | Slots | 20 | |
| CSI-RS offset | | Slots | 10 for CSI-RS resources 1 and 2  11 for CSI-RS resources 3 and 4 | 10 for CSI-RS resources 5 and 6  11 for CSI-RS resources 7 and 8 |
| QCL info | |  | TCI state #0 | |
| Duplex mode | | | |  | FDD | |
| Active DL BWP index | | | |  | 1 | |
| PDSCH configuration | Mapping type | | |  | Type A | |
| k0 | | |  | 0 | |
| Starting symbol (S) | | |  | 2 | |
| Length (L) | | |  | 12 | |
| PRB bundling type | | |  | Static | |
| PRB bundling size | | |  | 2 | |
| Resource allocation type | | |  | Type 1 | |
| RBG size | | |  | Config2 | |
| VRB-to-PRB mapping type | | |  | Non-interleaved | |
| VRB-to-PRB mapping interleaver bundle size | | |  | N/A | |
| PDSCH DMRS configuration | Antenna port indexes | | |  | 1000 | 1002 |
| TCI state | | |  | TCI State #1 | TCI State #2 |
| DMRS Type | | |  | Type 1 | |
| Number of additional DMRS | | |  | 1 | |
| Maximum number of OFDM symbols for DL front loaded DMRS | | |  | 1 | |
| TCI State #1 | Type 1 QCL information | | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking’ configuration | N/A |
| QCL Type |  | Type A | N/A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| TCI State #2 | Type 1 QCL information | | CSI-RS resource |  | N/A | CSI-RS resource 5 from 'CSI-RS for tracking’ configuration |
| QCL Type |  | N/A | Type A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| Resource allocation | | | |  | Full-overlapping | |
| Timing offset of the second TRxP from the first TRxP | | | | us | -0.5 for test 1-1  2 for test 1-2 | |
| Frequency offset of the second TRxP from the first TRxP | | | | Hz | 200 for test 1-1  0 for test 1-2 | |
| Number of HARQ Processes | | | |  | 4 | |
| The number of slots between PDSCH and corresponding HARQ-ACK information | | | |  | 2 | |
| Precoding configuration | | | |  | SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity. | |
| Note 1: PDSCH transmission is done from both TRxPs (PDSCH Layer 0 is transmitted from TRxP #1 and PDSCH layer 1 is transmitted from TRxP #2) | | | | | | |

Table 5.2.3.1.11-3: Minimum performance

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition(Note 1) | Correlation matrix and antenna configuration(Note 2) | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB)(Note 3) |
| 1-1 | R.PDSCH.1-3.2 FDD | 10 / 15 | 64QAM, 0.50 | TDLA30-10 | 2x4, ULA Low | 70 | 14.6 |
| 1-2 | R.PDSCH.1-3.2 FDD | 10 / 15 | 64QAM, 0.50 | TDLA30-10 | 2x4, ULA Low | 70 | 13.9 |
| Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent  Note 2: Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2  Note 3: SNR corresponds to SNR of TRxP #1 and TRxP #2 as defined in 4.4.2 with scaling factor as 1/sqrt(2) for transmitted signal from each TRxP | | | | | | | |

##### 5.2.3.1.12 Minimum requirements for PDSCH Multi-DCI based transmission scheme

The performance requirements are specified in Table 5.2.3.1.12-3, with the addition of test parameters in Table 5.2.3.1.12-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.1.12-1.

Table 5.2.3.1.12-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH performance when UE is configured two different values of CORESETPoolIndex in ControlResourceSet and when UE receives multiple PDCCHs scheduling PDSCHs | 1-1 |

Table 5.2.3.1.12-2: Test parameters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | | | | Unit | Value | |
| TRxP #1(Note 1) | TRxP #2(Note 1) |
| Transmit TRxP of SSB | | | |  | TRxP #1 | |
| PDCCH configuration | | TCI state | |  | TCI State #1 | TCI State #2 |
| CORESETPoolIndex | |  | 0,1 | |
| CSI-RS for tracking | | First subcarrier index in the PRB used for CSI-RS | |  | k0=0 for CSI-RS resources 1,2,3,4 | k0=1 for CSI-RS resources 5,6,7,8 |
| First OFDM symbol in the PRB used for CSI-RS | |  | l0 = 6 for CSI-RS resources 1 and 3  l0 = 10 for CSI-RS resources 2 and 4 | l0 = 6 for CSI-RS resources 5 and 7  l0 = 10 for CSI-RS resources 6 and 8 |
| Number of CSI-RS ports (X) | |  | 1 for CSI-RS resource 1,2,3,4 | 1 for CSI-RS resource 5,6,7,8 |
| CDM Type | |  | ‘No CDM’ for CSI-RS resource 1,2,3,4,5,6,7,8 | |
| Density | |  | 3 | |
| CSI-RS periodicity | | Slots | 20 | |
| CSI-RS offset | | Slots | 10 for CSI-RS resources 1 and 2  11 for CSI-RS resources 3 and 4 | 10 for CSI-RS resources 5 and 6  11 for CSI-RS resources 7 and 8 |
| QCL info | |  | TCI state #0 | |
| Duplex mode | | | |  | FDD | |
| Active DL BWP index | | | |  | 1 | |
| PDSCH configuration | Mapping type | | |  | Type A | |
| k0 | | |  | 0 | |
| Starting symbol (S) | | |  | 2 | |
| Length (L) | | |  | 12 | |
| PRB bundling type | | |  | Static | |
| PRB bundling size | | |  | 2 | |
| Resource allocation type | | |  | Type 1 | |
| RBG size | | |  | Config2 | |
| VRB-to-PRB mapping type | | |  | Non-interleaved | |
| VRB-to-PRB mapping interleaver bundle size | | |  | N/A | |
| PDSCH DMRS configuration | Antenna port indexes | | |  | {1000,1001} | {1002,1003} |
| TCI state | | |  | TCI State #1 | TCI State #2 |
| DMRS Type | | |  | Type 1 | |
| Number of additional DMRS | | |  | 1 | |
| Maximum number of OFDM symbols for DL front loaded DMRS | | |  | 1 | |
| TCI State #1 | Type 1 QCL information | | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking’ configuration | N/A |
| QCL Type |  | Type A | N/A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| TCI State #2 | Type 1 QCL information | | CSI-RS resource |  | N/A | CSI-RS resource 5 from 'CSI-RS for tracking’ configuration |
| QCL Type |  | N/A | Type A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| Resource allocation | | | |  | Non-overlapping | |
| Timing offset of the second TRxP from the first TRxP | | | | us | -0.5 | |
| Frequency offset of the second TRxP from the first TRxP | | | | Hz | 200 | |
| Number of HARQ Processes | | | |  | 4 | |
| The number of slots between PDSCH and corresponding HARQ-ACK information | | | |  | 2 | |
| Precoding configuration | | | |  | SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity | |
| Note 1: PDSCH transmission is done from both TRxPs. Transmission from TRxP #1 uses CORESETPoolIndex 0 and transmission from TRxP #2 uses CORESETPoolIndex 1 | | | | | | |

Table 5.2.3.1.12-3: Minimum performance

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition(Note 1) | Correlation matrix and antenna configuration(Note 2) | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB)(Note 3) |
| 1-1 | R.PDSCH.1-3.3 FDD | R.PDSCH.1-3.4 FDD | 10 / 15 | 64QAM, 0.50 | TDLA30-10 | 2x4, ULA Low | 70 | 14.6 |
| Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent  Note 2: Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2  Note 3: SNR corresponds to SNR of TRxP #1 and TRxP #2 as defined in 4.4.2 | | | | | | | | |

##### 5.2.3.1.13 Minimum requirements for PDSCH with single-DCI based FDM Scheme A

The performance requirements are specified in Table 5.2.3.1.13-3, with the addition of test parameters in Table 5.2.3.1.13-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.1.13-1.

Table 5.2.3.1.13-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify PDSCH performance under 4 receive antenna conditions when UE is configured with “FDMSchemeA” in “RepetitionScheme-r16” defined in clause 5.1 of TS 38.214 [12] | 1-1 |

Table 5.2.3.1.13-2: Test parameters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | | | | Unit | Value | |
| TRxP #1 (Note 1) | TRxP #2 (Note 1) |
| Transmit TRxP of SSB | | | |  | TRxP #1 | |
| PDCCH configuration | | TCI state | |  | TCI State #1 | |
| CORESETPoolIndex | |  | Not configured | |
| CSI-RS for tracking | | First subcarrier index in the PRB used for CSI-RS | |  | k0=0 for CSI-RS resources 1,2,3,4 | k0=1 for CSI-RS resources 5,6,7,8 |
| First OFDM symbol in the PRB used for CSI-RS | |  | l0 = 6 for CSI-RS resources 1 and 3  l0 = 10 for CSI-RS resources 2 and 4 | l0 = 6 for CSI-RS resources 5 and 7  l0 = 10 for CSI-RS resources 6 and 8 |
| Number of CSI-RS ports (X) | |  | 1 for CSI-RS resource 1,2,3,4 | 1 for CSI-RS resource 5,6,7,8 |
| CDM Type | |  | 'No CDM’ for CSI-RS resource 1,2,3,4,5,6,7,8 | |
| Density | |  | 3 | |
| CSI-RS periodicity | | Slots | 20 | |
| CSI-RS offset | | Slots | 10 for CSI-RS resources 1 and 2  11 for CSI-RS resources 3 and 4 | 10 for CSI-RS resources 5 and 6  11 for CSI-RS resources 7 and 8 |
| QCL info | |  | TCI state #0 | |
| Duplex mode | | | |  | FDD | |
| Active DL BWP index | | | |  | 1 | |
| PDSCH configuration | Mapping type | | |  | Type A | |
| k0 | | |  | 0 | |
| Starting symbol (S) | | |  | 2 | |
| Length (L) | | |  | 12 | |
| 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 | |
| PDSCH DMRS configuration | Antenna port indexes | | |  | 1000, 1001 | 1000, 1001 |
| TCI state | | |  | TCI State #1 | TCI State #2 |
| DMRS Type | | |  | Type 1 | |
| Number of additional DMRS | | |  | 1 | |
| Maximum number of OFDM symbols for DL front loaded DMRS | | |  | 1 | |
| TCI State #1 | Type 1 QCL information | | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking’ configuration | N/A |
| QCL Type |  | Type A | N/A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| TCI State #2 | Type 1 QCL information | | CSI-RS resource |  | N/A | CSI-RS resource 5 from 'CSI-RS for tracking’ configuration |
| QCL Type |  | N/A | Type A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| Timing offset of the second TRxP from the first TRxP | | | | us | -0.5 | |
| Frequency offset of the second TRxP from the first TRxP | | | | Hz | 200 | |
| Number of HARQ Processes | | | |  | 4 | |
| The number of slots between PDSCH and corresponding HARQ-ACK information | | | |  | 2 | |
| Precoding configuration | | | |  | SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity. | |
| Note 1: PDSCH transmission is done from both TRxPs | | | | | | |

Table 5.2.3.1.13-3: Minimum performance for Rank 2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition (Note 1) | Correlation matrix and antenna configuration (Note 2) | Reference value | |
| Fraction of  maximum  throughput  (%) | SNR (dB) (Note 3) |
| 1-1 | R.PDSCH.1-2.5 FDD | 10 / 15 | 16QAM, 0.54 | TDLA30-10 | 2x4, ULA Low | 70 | 10. 9 |
| Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent.  Note 2: Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2.  Note 3: SNR corresponds to SNR of TRxP #1 and TRxP #2 as defined in 4.4.2 | | | | | | | |

##### 5.2.3.1.14 Minimum requirements for PDSCH with single-DCI based Inter-slot TDM scheme

The performance requirements are specified in Table 5.2.3.1.14-3, with the addition of test parameters in Table 5.2.3.1.14-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.1.14-1.

Table 5.2.3.1.14-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify PDSCH performance under 4 receive antenna conditions when UE is configured with repetitionNumber-r16 with multiple slot level PDSCH transmission occasions of the same TB with two TCI states defined in clause 5.1 of TS 38.214 [12] | 1-1 |

Table 5.2.3.1.14-2: Test parameters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | | | | Unit | Value | |
| TRxP #1 (Note 1) | TRxP #2 (Note 1) |
| Transmit TRxP of SSB | | | |  | TRxP #1 | |
| PDCCH configuration | | TCI state | |  | TCI State #1 | |
| CORESETPoolIndex | |  | Not configured | |
| CSI-RS for tracking | | First subcarrier index in the PRB used for CSI-RS | |  | k0=0 for CSI-RS resources 1,2,3,4 | k0=1 for CSI-RS resources 5,6,7,8 |
| First OFDM symbol in the PRB used for CSI-RS | |  | l0 = 6 for CSI-RS resources 1 and 3  l0 = 10 for CSI-RS resources 2 and 4 | l0 = 6 for CSI-RS resources 5 and 7  l0 = 10 for CSI-RS resources 6 and 8 |
| Number of CSI-RS ports (X) | |  | 1 for CSI-RS resource 1,2,3,4 | 1 for CSI-RS resource 5,6,7,8 |
| CDM Type | |  | 'No CDM’ for CSI-RS resource 1,2,3,4,5,6,7,8 | |
| Density | |  | 3 | |
| CSI-RS periodicity | | Slots | 20 | |
| CSI-RS offset | | Slots | 10 for CSI-RS resources 1 and 2  11 for CSI-RS resources 3 and 4 | 10 for CSI-RS resources 5 and 6  11 for CSI-RS resources 7 and 8 |
| QCL info | |  | TCI state #0 | |
| Duplex mode | | | |  | FDD | |
| Active DL BWP index | | | |  | 1 | |
| PDSCH configuration | Mapping type | | |  | Type A | |
| k0 | | |  | 0 | |
| Starting symbol (S) | | |  | 2 | |
| Length (L) | | |  | 12 | |
| Repetition number | | |  | 2 | |
| PRB bundling type | | |  | Static | |
| PRB bundling size | | |  | 2 | |
| 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 | Antenna port indexes | | |  | 1000 | 1000 |
| TCI state | | |  | TCI State #1 | TCI State #2 |
| DMRS Type | | |  | Type 1 | |
| Number of additional DMRS | | |  | 1 | |
| Maximum number of OFDM symbols for DL front loaded DMRS | | |  | 1 | |
| TCI State #1 | Type 1 QCL information | | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking’ configuration | N/A |
| QCL Type |  | Type A | N/A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| TCI State #2 | Type 1 QCL information | | CSI-RS resource |  | N/A | CSI-RS resource 5 from 'CSI-RS for tracking’ configuration |
| QCL Type |  | N/A | Type A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| Timing offset of the second TRxP from the first TRxP | | | | us | 2 | |
| Frequency offset of the second TRxP from the first TRxP | | | | Hz | 200 | |
| Number of HARQ Processes | | | |  | 4 | |
| The number of slots between PDSCH and corresponding HARQ-ACK information | | | |  | 2 | |
| Precoding configuration | | | |  | SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity. | |
| Note 1: PDSCH transmission is done from both TRxPs | | | | | | |

Table 5.2.3.1.14-3: Minimum performance for Rank 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition (Note 1) | Correlation matrix and antenna configuration (Note 2) | Reference value | |
| BLER (%) | SNR (dB) (Note 4) |
| 1-1 | R.PDSCH.1-11.2 FDD | 10 / 15 | 16QAM, 0.54 | TDLA30-10 | 2x4, ULA Low | 1 (Note 3) | -0. 4 |
| Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent.  Note 2: Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2.  Note 3: BLER is defined as residual BLER; i.e. ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block.  Note 4: SNR corresponds to SNR of TRxP #1 and TRxP #2 as defined in 4.4.2 | | | | | | | |

##### 5.2.3.1.15 Minimum requirements for PDSCH with inter-cell interference

The performance requirements are specified in Table 5.2.3.1.15-3, with the addition of test parameters in Table 5.2.3.1.15-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.1.15-1.

Table 5.2.3.1.15-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH performance in 4 receive antenna conditions, when the transmission from the serving cell is interfered by 1 or 2 interfering cells. | 1-1, 1-2 |

Table 5.2.3.1.15-2: Test parameters

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | | Unit | Value | | |
|  | |  | Cell 1 | Cell 2 | Cell 3 |
|  | |  | Enabled | Enabled | Enabled for Test 1-1 Disabled for Test 1-2 |
| Duplex mode | |  | FDD | | |
| Active DL BWP index | |  | 1 | | |
| Physical cell ID | |  | 0 | 1 | 2 |
| Transmission rank | |  | 1 | Random rank with 70% and 30% probability for rank 1 and rank 2 | Random rank with 70% and 30% probability for rank 1 and rank 2 for Test 1-1  N/A for Test 1-2 |
| Time offset to Cell 1 | | us | N/A | 3 | -1 |
| Frequency offset to Cell 1 | | Hz | N/A | 300 | -100 |
| Interference Model | |  | N/A | As specified in B.6.2 | |
| INR (Note 2) | | dB | N/A | 7.77 for Test 1-1  7.58 for Test 1-2 | 2.29 for Test 1-1  N/A for Test 1-2 |
| SSB configuration | SSB position in burst |  | First SSB in Slot #0 | 1st SSB in Slot#0 for Test 1-1 2nd SSB in Slot #0 for Test 1-2 | 1st SSB in Slot#0 for Test 1-1 N/A for Test 1-2 |
| SSB periodicity | ms | 20 | 20 | 20 |
| 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 |  | 2 | | |
|  | 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 |  | 1 | | |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 | | |
| Number of HARQ Processes | |  | 4 | | |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 2 | | |
| Note1: Cell 1 is the serving cell; Cells 2, 3 are interfering cells  Note 2: INR is defined in Annex B.6.1 | | | | | |

**Table 5.2.3.1.15-3: Minimum performance for PDSCH with rank 1 and with inter-cell interference**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num | Reference channel | 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.1-2.1 FDD | 10 / 15 | 16QAM, 0.48 | TDLC300-100 | 2x4, ULA Low | 70 | 10.1 |
| 1-2 | R.PDSCH.1-2.1 FDD | 10 / 15 | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 7.4 |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.  Note 2: Bandwidth/ Sub carrier spacing, Propagation Condition, Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3. | | | | | | | |

##### 5.2.3.1.16 Minimum requirements for PDSCH with intra-cell inter-user interference

The performance requirements are specified in Table 5.2.3.1.16-3 and Table 5.2.3.1.16-4, with the addition of test parameters in Table 5.2.3.1.16-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.1.16-1.

Table 5.2.3.1.16-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify PDSCH performance under 4 receive antenna conditions, when the PDSCH transmission of target UE is interfered by co-scheduled UE. | 1-1, 2-1 |

Table 5.2.3.1.16-2: Test parameters

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | Unit | Target UE | Co-scheduled UE |
| 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 |  | 2 | |
| 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 (Note 1) | DMRS Type |  | Type 1 | |
| Number of additional DMRS |  | 1 | |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 | |
| Antenna ports indexes |  | {1000} for test 1-1  {1000, 1001} for test 2-1 | {1001} for test 1-1  {1002, 1003} for test 2-1 |
| Number of PDSCH DMRS CDM group(s) without data |  | 1 for test 1-1  2 for test 2-1 | 1 for test 1-1  2 for test 2-1 |
| PDSCH & PDSCH DMRS Precoding configuration | |  | Single Panel Type I, Randomized precoder selection for every PRB bundle and updated per slot, with equal probability of each applicable i1/i2 combination or codebook  Index, chosen from section 5.2.2.2.1 of TS 38.214 [12]. | Single Panel Type I, Randomized precoder selection for every PRB bundle and updated per slot, with equal probability of each applicable i1/i2 combination or codebook  Index, chosen from section 5.2.2.2.1 of TS 38.214 [12].  Any column of precoder matrix is not equal to any column of precoder matrix of Target UE for test 1-1  Select the precoder to ensure any column of precoder is orthogonal to any column of precoder for the target PDSCH for test 2-1 |
| MU-MIMO Beamforming Model | |  | As specified in B.4.2 | |
| Number of HARQ Processes | |  | 4 | N/A |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 2 | N/A |
| Note 1: DMRS scrambling ID is the same for both target and co-scheduled UEs. | | | | |

Table5.2.3.1.16-3: Minimum performance for target UE with Rank 1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
| Target UE | Co-scheduled UE | Fraction of  maximum  throughput  (%) | SNR (dB) |
| 1-1 | R.PDSCH.5-1.1 FDD | 10 / 15 | 16QAM, 0.48 | Random 16QAM symbols | TDLC300-100 | 2x4, ULA Low | 70 | 11.5 |

Table5.2.3.1.16-4: Minimum performance for target UE with Rank 2

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
| Target UE | Co-scheduled UE | Fraction of  maximum  throughput  (%) | SNR (dB) |
| 2-1 | R.PDSCH.5-1.2 FDD | 10 / 15 | 16QAM, 0.48 | Random 16QAM symbols | TDLA30-10 | 4x4, ULA Low | 70 | 15.3 |

##### 5.2.3.1.17 Minimum requirements for PDSCH CRS interference mitigation under NR-LTE coexistence scenario

The performance requirements are specified in Table 5.2.3.1.17-4, with the addition of test parameters in Table 5.2.3.1.17-2 for the serving cell and Table 5.2.3.1.17-3 for the LTE interference cells and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.1.17-1.

Table 5.2.3.1.17-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify PDSCH CRS interference mitigation performance under 4 receive antenna conditions with CRS rate matching configured for the serving cell. | 1-1 |

Table 5.2.3.1.17-2: Test parameters for the serving cell

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Value** |
| Duplex mode | |  | FDD |
| Active DL BWP index | |  | 1 |
| NR UL transmission with a 7.5 kHz shift to the LTE raster | |  | true |
| PDCCH configuration | Symbols with PDCCH |  | Symbol# 2 | |
| PDSCH configuration | Mapping type |  | Type A |
|  | k0 |  | 0 |
|  | Starting symbol (S) |  | 3 |
|  | Length (L) |  | 9 |
|  | PDSCH aggregation factor |  | 1 |
|  | PRB bundling type |  | Static |
|  | PRB bundling size |  | 2 |
|  | 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 |
|  | Position of the first DM-RS for downlink |  | 3 |
|  | Number of additional DMRS |  | 1 |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| CRS for rate matching (Note 1) | LTE carrier centre subcarrier location |  | Same as NR carrier centre subcarrier location |
|  | LTE carrier BW | MHz | 10 |
|  | Number of antenna ports |  | 2 |
|  | v-shift |  | 0 |
| Number of HARQ Processes | |  | 4 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 2 |
| Note 1: No MBSFN is configured on LTE carrier.  Note 2: Network-based CRS interference mitigation is disabled on LTE carrier. | | | |

Table 5.2.3.1.17-3: Test parameters for the LTE interference cells

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | Unit | Cell 1 | Cell 2 |
| Propagation conditions and MIMO configuration (Note 1) | |  | TDLA30-10 ULA Low | TDLA30-10 ULA Low |
| INR (Note 2) | | dB | 10.45 | 4.6 |
| Cell-specific reference signals | |  | Antenna ports 0,1 | Antenna ports 0,1 |
| Carrier centre subcarrier location | |  | Same as the serving carrier centre subcarrier location | Same as the serving carrier centre subcarrier location |
| BWChannel | | MHz | 10 | 10 |
| Cyclic Prefix | |  | Normal | Normal |
| Physical cell ID | |  | 1 | 2 |
| Number of control OFDM symbols | |  | 2 | 2 |
| PDSCH transmission mode | |  | 4 | 4 |
| Interference model | |  | As specified in clause B.7 | As specified in clause B.7 |
| Probability of occurrence of PDSCH data | | % | 20 | 20 |
| Probability of occurrence of transmission rank | Rank 1 | % | 80 | 80 |
| Rank 2 | % | 20 | 20 |
| Downlink power allocation |  | dB | -3 | -3 |
|  | dB | -3 | -3 |
| σ | dB | 0 | 0 |
| Precoding granularity | | PRB | 6 | 6 |
| Time offset to the serving cell | | us | 3 | -1 |
| Frequency offset to the serving cell | | Hz | 300 | -100 |
| MBSFN | |  | Not configured | Not configured |
| Network-based CRS interference mitigation | |  | Disabled | Disabled |
| Note 1: The channel for the LTE interference cells and the serving cell are independent.  Note 2: Defined in B.6.1. | | | | |

Table 5.2.3.1.17-4: Minimum performance for Rank 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | 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.1-7.3 FDD | 10 / 15 | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 8.0 |

##### 5.2.3.1.18 Minimum requirements for PDSCH with inter cell CRS interference

The performance requirements are specified in Table 5.2.3.1.18-4 and Table 5.2.3.1.18-6, with the addition of test parameters in Table 5.2.3.1.18-2 and 5.2.3.1.18-3 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.1.18-1.

Table 5.2.3.1.18-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify PDSCH performance under 4 receive antenna conditions when PDSCH is interfered by inter cell CRS signal | 1-1 and 2-1 |

Table 5.2.3.1.18-2: Tests parameter for serving cell PDSCH

|  |  |  |  |
| --- | --- | --- | --- |
| 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 |  | 2 |
|  | 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 |  | 1 |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| Number of HARQ Processes | |  | 4 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 2 |

Table 5.2.3.1.18-3: Tests parameter for interference cells

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | Unit | Cell 1 | Cell 2 |
| Duplex mode | |  | FDD | FDD |
| INR | | dB | 10.45 | 4.6 |
| LTE Bandwidth (Note 5) | | MHz | 20 | 20 |
| Carrier centre subcarrier location (Note 6) | |  | Same as the NR serving carrier centre subcarrier location | Same as the NR serving carrier centre subcarrier location |
| Cyclic Prefix | |  | Normal | Normal |
| Physical cell ID | |  | 1 | 2 |
| CRS pattern | Number of antenna ports |  | 4 | 4 |
| v-shift |  | 1 | 2 |
| Downlink power allocation |  | dB | -6 | -6 |
|  | dB | -6 | -6 |
| σ | dB | 0 | 0 |
| PDSCH transmission mode | |  | TM4 | TM4 |
| PDSCH loading level | | % | 20% probability of occurrence of LTE data transmission in time domain, and full bandwidth allocation in frequency domain for test 1-1. | 20% probability of occurrence of LTE data transmission in time domain, and full bandwidth allocation in frequency domain for test 1-1. |
| Transmission rank | | % | 80% and 20% probability for rank 1 and rank 2 respectively | 80% and 20% probability for rank 1 and rank 2 respectively |
| Interference model | |  | As specified in clause B.7 | As specified in clause B.7 |
| Time offset to the serving cell | | us | 3 | -1 |
| Frequency offset to the serving cell | | Hz | 300 | -100 |
| Propagation conditions and MIMO configuration (Note 1) | |  | TDLA30-10 ULA Low | TDLA30-10 ULA Low |
| Precoding granularity | | PRB | 8 | 8 |
| Note 1: The channel for the LTE interference cells and the serving cell are independent.  Note 2: No MBSFN is configured on LTE carrier.  Note 3: Network-based CRS interference mitigation is disabled on LTE carrier.  Note 4: The start of transmission of LTE frame is delayed by 2 LTE subframes with respect to the start of transmission of NR frame  Note 5: This parameter is informed to UE via network assistance signalling for Test 1-1 in Table 5.2.3.1.18-4.  Note 6: Single entry is included in IE *LTE-NeighCellsCRS-AssistInfoList-r17* that applies for both cells for cases with network signalling assistance | | | | |

The requirements for UE capable of performing CRS-IM with the assistance of network signalling on LTE channel bandwidth are specified in Table 5.2.3.1.18-4:

Table 5.2.3.1.18-4: Minimum performance for Rank 1 with the assistance of network signaling on LTE channel bandwidth

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | 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.1-18.1 FDD | 10 / 15 | 16QAM, 0.48 | TDLA30-10 | 4x4, ULA Low | 70 | 8.0 |

The requirements for UE capable of performing CRS-IM without the assistance of network signalling on LTE channel bandwidth are specified in Table 5.2.3.1.18-6 with following test procedure:

The network configures an inter-RAT LTE measurement object of the interfering cells to the tested UE. Inter-RAT measurement is configured at the beginning of the test and applied throughout the test with gap pattern configurations in Table 5.2.3.1.18-5. PDSCH is not scheduled and throughput is not counted during 4.64s after the beginning of test. PDSCH is not scheduled in the measurement gaps.

Table 5.2.3.1.18-5: Measurement Gap configurations

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| Measurement Gap Length | ms | 6 |
| Measurement Gap Repetition Period | ms | 40 |
| Gap offset | ms | 7 |
| Measurement gap timeing advance | ms | 0 |

Table 5.2.3.1.18-6: Minimum performance for Rank 1 without the assistance of network signaling on LTE channel bandwidth

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | 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.1-17.2 FDD | 10 / 15 | 16QAM, 0.48 | TDLA30-10 | 4x4, ULA Low | 70 | 8.0 |

##### 5.2.3.1.19 Minimum requirements for HST-SFN Scheme A

The performance requirements are specified in Table 5.2.3.1.19-3, with the addition of test parameters in Table 5.2.3.1.19-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.1.19-1.

Table 5.2.3.1.19-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify UE performance in the HST-SFN Scheme A scenario defined in B.3.5 | 1-1 |

Table 5.2.3.1.19-2: Test parameters

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | | Unit | Value |
| Duplex mode | | |  | FDD |
| Active DL BWP index | | |  | 1 |
| PDCCH configuration | TCI state | |  | Note 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 | |  | 2 |
| Resource allocation type | |  | Type 0 |
| RBG size | |  | Config2 |
| VRB-to-PRB mapping type | |  | Non-interleaved |
| VRB-to-PRB mapping interleaver bundle size | |  | N/A |
| TCI state | |  | Note 1 |
| PDSCH DMRS configuration | DMRS Type | |  | Type 1 |
| Number of additional DMRS | |  | 2 |
| Maximum number of OFDM symbols for DL front loaded DMRS | |  | 1 |
| CSI-RS for tracking | Resource set #1 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 5 for CSI-RS resource 1 and 3  l0 = 9 for CSI-RS resource 2 and 4 |
| CSI-RS periodicity | Slots | 10 for CSI-RS resource 1,2,3,4. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4 |
| QCL info |  | TCI state #3 |
| Resource set #2 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 6 for CSI-RS resource 5 and 7  l0 = 10 for CSI-RS resource 6 and 8 |
| CSI-RS periodicity | Slots | 10 for CSI-RS resource 5,6,7,8. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 5 and 6 2 for CSI-RS resource 7 and 8 |
| QCL info |  | TCI state #4 |
| Resource set #3 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 4 for CSI-RS resource 9 and 11  l0 = 8 for CSI-RS resource 10 and 12 |
| CSI-RS periodicity | Slots | 10 for CSI-RS resource 9,10,11,12. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 9 and 10 2 for CSI-RS resource 11 and 12 |
| QCL info |  | TCI state #5 |
| NZP CSI-RS for CSI acquisition | Resource set #4 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 12 |
| CSI-RS periodicity | Slots | 20 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #0 |
| Resource set #5 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 13 |
| CSI-RS periodicity | Slots | 20 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #1 |
| Resource set #6 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 7 |
| CSI-RS periodicity | Slots | 20 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #2 |
| TCI state #0 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking Resource set #1' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #1 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #2 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 9 from 'CSI-RS for tracking Resource set #3' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #3 | Type 1 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| TCI state #4 | Type 1 QCL information | SSB index |  | SSB #1 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| TCI state #5 | Type 1 QCL information | SSB index |  | SSB #2 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| Number of HARQ Processes | | |  | 4 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | | |  | 2 |
| Note 1: SSB # (k mod 3) , CSI-RS (for tracking) resource set # ((k mod 3) + 1) and CSI-RS (for CSI acquisition) resource set # ((k mod 3) + 4) are transmitted by kth RRH.  Codepoint #0 is activated when UE receives PDCCH/PDSCH from RRH#3k and RRH#3k+1 with TCI States TCI state #0, TCI State #1.  Codepoint #1 is activated when UE receives PDCCH/PDSCH from RRH#3k+1 and RRH#3k+2 with TCI States TCI state #1, TCI State #2.  Codepoint #2 is activated when UE receives PDCCH/PDSCH from RRH#3k+2 and RRH#3k+3 with TCI States TCI state #2, TCI State #0. | | | | |

Table 5.2.3.1.19-3: Minimum performance for HST-SFN Scheme A

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | 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.1-8.5 FDD | 10 / 15 | 16QAM, 0.48 | HST-SFN Scheme A | 2x4 | 70 | 9.1 |

##### 5.2.3.1.20 Minimum requirements for HST-SFN Scheme B

The performance requirements are specified in Table 5.2.3.1.20-3, with the addition of test parameters in Table 5.2.3.1.20-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.1.20-1.

Table 5.2.3.1.20-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify UE performance in the HST-SFN Scheme B scenario defined in B.3.6 | 1-1 |

Table 5.2.3.1.20-2: Test parameters

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | | Unit | Value |
| Duplex mode | | |  | FDD |
| Active DL BWP index | | |  | 1 |
| PDCCH configuration | TCI state | |  | Note 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 | |  | 2 |
| Resource allocation type | |  | Type 0 |
| RBG size | |  | Config2 |
| VRB-to-PRB mapping type | |  | Non-interleaved |
| VRB-to-PRB mapping interleaver bundle size | |  | N/A |
| TCI state | |  | Note 1 |
| PDSCH DMRS configuration | DMRS Type | |  | Type 1 |
| Number of additional DMRS | |  | 2 |
| Maximum number of OFDM symbols for DL front loaded DMRS | |  | 1 |
| CSI-RS for tracking | Resource set #1 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 5 for CSI-RS resource 1 and 3  l0 = 9 for CSI-RS resource 2 and 4 |
| CSI-RS periodicity | Slots | 10 for CSI-RS resource 1,2,3,4. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4 |
| QCL info |  | TCI state #3 |
| Resource set #2 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 6 for CSI-RS resource 5 and 7  l0 = 10 for CSI-RS resource 6 and 8 |
| CSI-RS periodicity | Slots | 10 for CSI-RS resource 5,6,7,8. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 5 and 6 2 for CSI-RS resource 7 and 8 |
| QCL info |  | TCI state #4 |
| Resource set #3 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 4 for CSI-RS resource 9 and 11  l0 = 8 for CSI-RS resource 10 and 12 |
| CSI-RS periodicity | Slots | 10 for CSI-RS resource 9,10,11,12. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 9 and 10 2 for CSI-RS resource 11 and 12 |
| QCL info |  | TCI state #5 |
| NZP CSI-RS for CSI acquisition | Resource set #4 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 12 |
| CSI-RS periodicity | Slots | 20 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #0 |
| Resource set #5 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 13 |
| CSI-RS periodicity | Slots | 20 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #1 |
| Resource set #6 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 7 |
| CSI-RS periodicity | Slots | 20 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #2 |
| TCI state #0 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking Resource set #1' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #1 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #2 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 9 from 'CSI-RS for tracking Resource set #3' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #3 | Type 1 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| TCI state #4 | Type 1 QCL information | SSB index |  | SSB #1 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| TCI state #5 | Type 1 QCL information | SSB index |  | SSB #2 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| Number of HARQ Processes | |  | 4 | |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 2 | |
| Note 1: SSB # (k mod 3), CSI-RS (for tracking) resource set # ((k mod 3) + 1) and CSI-RS (for CSI acquisition) resource set # ((k mod 3) + 4) are transmitted by kth RRH.  Codepoint#0 {TCI state #0, TCI State #1} is activated when UE receives PDCCH/PDSCH from RRH#3k and RRH#3k+1.  Codepoint#1 {TCI state #1, TCI State #2} is activated when UE receives PDCCH/PDSCH from RRH#3k+1 and RRH#3k+2.  Codepoint#2 {TCI state #2, TCI State #0} is activated when UE receives PDCCH/PDSCH from RRH#3k+2 and RRH#3k+3.  The second indicated TCI state in each codepoint is not used for quasi co-location parameters {Doppler shift, Doppler spread}. | | | | |

Table 5.2.3.1.20-3: Minimum performance for HST-SFN Scheme B

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | 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.1-8.5 FDD | 10/15 | 16QAM, 0.48 | HST-SFN-Scheme B | 2x4 | 70 | 8.4 |

#### 5.2.3.2 TDD

##### 5.2.3.2.1 Minimum requirements for PDSCH Mapping Type A

The performance requirements are specified in Table 5.2.3.2.1-3, Table 5.2.3.2.1-4, Table 5.2.3.2.1-5 and Table 5.2.3.2.1-6, with the addition of test parameters in Table 5.2.3.2.1-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.2.1-1.

Table 5.2.3.2.1-1: Tests purpose

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify the PDSCH mapping Type A normal performance under4 receive antenna conditions and with different channel models, MCSs and number of MIMO layers | 1-1, 1-2, 1-3, 1-5, 1-6, 1-7, 1-8, 1-9, 1-10, 1-11, 1-12, 2-1, 2-2, 3-1, 4-1 |
| Verify the PDSCH mapping Type A HARQ soft combining performance under 4 receive antenna conditions. | 1-4 |
| Verify the PDSCH mapping Type A performance requirements for Enhanced Receiver Type 1 under 4 receive antenna conditions. | 5-1 |

Table 5.2.3.2.1-2: 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 Tests 1-1, 1-8, 1-9  wideband for Test 3-1  2 for other tests |
| Resource allocation type |  | Test 1-2: Type 1 with start RB = 50, LRBs = 6  Other tests: Type 0 |
| RBG size |  | Test 1-2: N/A  Other tests: 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 Tests 1-1, 1-7, 1-8, 1-9, 1-10, 1-11 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 |  | Tests 1-8, 1-9:  l0 = 4 for CSI-RS resource 1 and 3  l0 = 8 for CSI-RS resource 2 and 4  Other tests; Table 5.2-1. |
| CSI-RS periodicity | Slots | Test 1-7, 1-10, 1-11: 20 for CSI-RS resource 1,2,3,4.  Other tests: Table 5.2-1. |
| CSI-RS offset | Slots | Test 1-7, 1-10, 1-11: 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4.  Other tests: Table 5.2-1. |
| Frequency Occupation |  | Test 1-7, 1-10, 1-11: Start PRB 0 Number of PRB = 52  Other tests: Table 5.2-1. |
| Number of HARQ Processes | |  | 16 for Test 1-4  10 for Test 1-9  8 for other tests |
| 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 5.2.3.2.1-3: 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.2-1.1 TDD | 40 / 30 | QPSK, 0.30 | FR1.30-1A | TDLB100-400 | 2x4, ULA Low | 70 | -4.1 |
| 1-2 | R.PDSCH.2-1.2 TDD | 40 / 30 | QPSK, 0.30 | FR1.30-1 | TDLC300-100 | 2x4, ULA Low | 70 | -2.7 |
| 1-3 | R.PDSCH.2-4.1 TDD | 40 / 30 | 256QAM, 0.82 | FR1.30-1 | TDLA30-10 | 2x4, ULA Low | 70 | 21.6 |
| 1-4 | R.PDSCH.2-2.1 TDD | 40 / 30 | 16QAM, 0.48 | FR1.30-1 | TDLC300-100 | 2x4, ULA Low | 30 | -1.2 |
| 1-5 | R.PDSCH.2-5.1 TDD | 40 / 30 | QPSK, 0.30 | FR1.30-2 | TDLA30-10 | 2x4, ULA Low | 70 | -3.8 |
| 1-6 | R.PDSCH.2-6.1 TDD | 40 / 30 | QPSK, 0.30 | FR1.30-3 | TDLA30-10 | 2x4, ULA Low | 70 | -3.6 |
| 1-7 | R.PDSCH.2-10.1 TDD | 40 / 30 | 16QAM, 0.48 | FR1.30-1 | HST-1000 | 1x4 | 70 | 3.4 |
| 1-8 | R.PDSCH.2-11.1 TDD | 40 / 30 | QPSK, 0.30 | FR1.30-5 | TDLB100-400 | 2x4, ULA Low | 70 | -4.0 |
| 1-9 | R.PDSCH.2-12.1 TDD | 40 / 30 | QPSK, 0.30 | FR1.30-6 | TDLB100-400 | 2x4, ULA Low | 70 | -4.0 |
| 1-10 | R.PDSCH.2-10.2 TDD | 40 / 30 | 16QAM, 0.48 | FR1.30-1 | TDLC300-1200 | 2x4 | 70 | 5.8 |
| 1-11 | R.PDSCH.2-10.3 TDD | 40 / 30 | 64QAM, 0.43 | FR1.30-1 | HST-1667 | 1x4 | 70 | 6.8 |
| 1-12 | R.PDSCH.2-25.1 TDD | 40 / 30 | 1024QAM, 0.79 | FR1.30-1 | TDLD30-5 | 2x4, ULA Low | 70 | 26.3 |

Table 5.2.3.2.1-4: 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.2-3.1 TDD | 40 / 30 | 64QAM, 0.50 | FR1.30-1 | TDLA30-10 | 2x4, ULA Low | 70 | 13.6 |
| 2-2 | R.PDSCH.2-9.1 TDD | 20 / 30 | 64QAM, 0.50 | FR1.30-4 | TDLA30-10 | 2x4, ULA Low | 70 | 13.7 |

Table 5.2.3.2.1-5: Minimum performance for Rank 3

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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)** |
| 3-1 | R.PDSCH.2-2.3 TDD | 40 / 30 | 16QAM, 0.48 | FR1.30-1 | TDLA30-10 | 4x4, ULA Low | 70 | 11.1 |

Table 5.2.3.2.1-6: Minimum performance for Rank 4

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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)** |
| 4-1 | R.PDSCH.2-2.4 TDD | 40 / 30 | 16QAM, 0.48 | FR1.30-1 | TDLA30-10 | 4x4, ULA Low | 70 | 15.4 |

Table 5.2.3.2.1-7: Minimum performance for Rank 3 and Enhanced Receiver Type 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)** |
| 5-1 | R.PDSCH.2-2.3 TDD | 40 / 30 | 16QAM, 0.48 | FR1.30-1 | TDLA30-10 | 4x4, ULA Medium A | 70 | 22.9 |

##### 5.2.3.2.2 Minimum requirements for PDSCH Mapping Type A and CSI-RS overlapped with PDSCH

The performance requirements are specified in Table 5.2.3.2.2-3, with the addition of test parameters in Table 5.2.3.2.2-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.2.2-1.

Table 5.2.3.2.2-1: Tests purpose

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify the PDSCH mapping Type A normal performance under 4 receive antenna conditions and CSI-RS overlapped with PDSCH | 1-1 |

Table 5.2.3.2.2-2: 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) |  | 12 |
| PDSCH aggregation factor |  | 1 |
| PRB bundling type |  | Static |
| PRB bundling size |  | 2 |
| 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 |  | 1 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| NZP CSI-RS for CSI acquisition | OFDM symbols in the PRB used for CSI-RS |  | l0 = 13 |
| CSI-RS periodicity | Slots | 5 |
| ZP CSI-RS for CSI acquisition | Subcarrier index in the PRB used for CSI-RS |  | (k0, k1, k2, k3)=(2, 4, 6, 8) |
| Number of CSI-RS ports (X) |  | 8 |
| CSI-RS periodicity | Slots | 5 |
| 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 5.2.3.2.2-3: 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)** |
| 1-1 | R.PDSCH.2-7.1 TDD | 40 / 30 | 16QAM, 0.48 | FR1.30-1 | TDLC300-100 | 2x4, ULA Low | 70 | 9.0 |

##### 5.2.3.2.3 Minimum requirements for PDSCH Mapping Type B

The performance requirements are specified in Table 5.2.3.2.3-3, with the addition of test parameters in Table 5.2.3.2.3-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.2.3-1.

Table 5.2.3.2.3-1: Tests purpose

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| PDSCH mapping Type B performance under 4 receive antenna conditions | 1-1 |

Table 5.2.3.2.3-2: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Value** |
| Duplex mode | |  | TDD |
| Active DL BWP index | |  | 1 |
| PDSCH configuration | Mapping type |  | Type B |
| k0 |  | 0 |
| Starting symbol (S) |  | 5 |
| Length (L) |  | 7 |
| PDSCH aggregation factor |  | 1 |
| PRB bundling type |  | Static |
| PRB bundling size |  | 2 |
| 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 |  | 1 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 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 5.2.3.2.3-3: 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.2-1.3 TDD | 40 / 30 | QPSK, 0.30 | FR1.30-1 | TDLA30-10 | 2x4, ULA Low | 70 | -3.9 |

##### 5.2.3.2.4 Minimum requirements for PDSCH Mapping Type A and LTE-NR coexistence

The performance requirements are specified in Table 5.2.3.2.4-3, with the addition of test parameters in Table 5.2.3.2.4-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.2.4-1.

Table 5.2.3.2.4-1: Tests purpose

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify the PDSCH mapping Type A normal performance under 4 receive antenna conditions with CRS rate matching configured | 1-1, 1-2 |

Table 5.2.3.2.4-2: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Value** |
| Duplex mode | |  | TDD |
| Active DL BWP index | |  | 1 |
| NR UL transmission with a 7.5 kHz shift to the LTE raster | |  | true |
| PDSCH configuration | Mapping type |  | Type A |
| k0 |  | 0 |
| Starting symbol (S) |  | 3 |
| Length (L) |  | 9 for Test 1-1 11 for Test 1-2 |
| PDSCH aggregation factor |  | 1 |
| PRB bundling type |  | Static |
| PRB bundling size |  | 2 |
| 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 |
| Position of the first DM-RS for downlink |  | 3 |
| Number of additional DMRS |  | 1 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| CRS for rate matching (Note 1) | LTE carrier centre subcarrier location |  | Same as NR carrier centre subcarrier location |
| LTE carrier BW | MHz | 10 |
| Number of antenna ports |  | 4 |
| v-shift |  | 0 |
| 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 |
| Note 1: No MBSFN is configured on LTE carrier.  Note 2: LTE carrier is configured with Uplink-downlink configuration 2 [Table 4.2-2, TS 36.211] and Special subframe configuration 7 [Table 4.2-1, TS 36.211]. The start of transmission of LTE frame is delayed by 2 LTE subframes with respect to the start of transmission of NR frame. | | | |

Table 5.2.3.2.4-3: 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.1-1.1 TDD | 10 / 15 | QPSK, 0.30 | FR1.15-1 | TDLA30-10 | 4x4, ULA Low | 70 | -3.6 |
| 1-2 | R.PDSCH.1-1.2 TDD | 10 / 15 | QPSK, 0.30 | FR1.15-1 | TDLA30-10 | 4x4, ULA Low | 70 | -3.5 |

##### 5.2.3.2.5 Minimum requirements for PDSCH 0.001% BLER

The performance requirements are specified in Table 5.2.3.2.5-3, with the addition of test parameters in Table 5.2.3.2.5-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.2.5-1.

Table 5.2.3.2.5-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH 0.001% BLER performance under 4 receive antenna conditions | 1-1 |

Table 5.2.3.2.5-2: 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) |  | 12 |
| PDSCH aggregation factor |  | 1 |
| PRB bundling type |  | Static |
| PRB bundling size |  | 2 |
| 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 |  | 1 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| Maximum number of HARQ transmission | |  | 1 |
| Number of HARQ Processes | |  | 8 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | Defined in Annex A.1.2 for TDD pattern FR1.30-1 |

Table 5.2.3.2.5-3: 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 | |
| Target BLER | SNR (dB) |
| 1-1 | R.PDSCH.2-1.4 TDD | 40 / 30 | QPSK, 0.59 | FR1.30-1 | AWGN | 1x4, ULA Low | 0.001% | 0.7 |

##### 5.2.3.2.6 Minimum requirements for PDSCH repetitions over multiple slots

The performance requirements are specified in Table 5.2.3.2.6-3, with the addition of test parameters in Table 5.2.3.2.6-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.2.6-1.

Table 5.2.3.2.6-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH repetitions over multiple slots performance under 4 receive antenna conditions | 1-1 |

Table 5.2.3.2.6-2: 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) |  | 12 |
| PDSCH aggregation factor |  | 2 |
| PRB bundling type |  | Static |
| PRB bundling size |  | 2 |
| 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 |  | 1 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| Number of HARQ Processes | |  | 4 |
| The number of slots between final repetition of PDSCH and corresponding HARQ-ACK information | |  | Specific to each TDD UL-DL pattern and as defined in Annex A.1.2 (Note 1) |
| Note 1: ACK/NACK feedback is generated for PDSCH on slot i, where mod(i,10) = {2, 4, 6}. | | | |

Table 5.2.3.2.6-3: 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 | |
| Target BLER | SNR (dB) |
| 1-1 | R.PDSCH.2-16.1 TDD | 40 / 30 | 16QAM, 0.54 | FR1.30-1 | TDLA30-10 | 2x4, ULA Low | 1%(Note 1) | -2.6 |
| Note 1: BLER is defined as residual BLER; i.e. ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block. | | | | | | | | |

##### 5.2.3.2.7 Minimum requirements for PDSCH Mapping Type B and UE processing capability 2

The performance requirements are specified in Table 5.2.3.2.7-3, with the addition of test parameters in Table 5.2.3.2.7-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.2.7-1.

Table 5.2.3.2.7-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| PDSCH mapping Type B performance and UE processing capability 2 under four receive antenna conditions | 1-1 |

Table 5.2.3.2.7-2: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | Value |
| Duplex mode | |  | TDD |
| Active DL BWP index | |  | 1 |
| PDSCH configuration | Mapping type |  | Type B |
| k0 |  | 0 |
| Starting symbol (S) |  | 2 |
| Length (L) |  | 2 |
| PDSCH aggregation factor |  | 1 |
| PRB bundling type |  | Static |
| PRB bundling size |  | 2 |
| 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 |  | 0 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| Maximum number of HARQ transmission | |  | 1 |
| Number of HARQ Processes | |  | 2 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | 0 |

Table 5.2.3.2.7-3: 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.2-17.1 TDD | 40 / 30 | QPSK, 0.30 | FR1.30-2 | TDLA30-10 | 2x4, ULA Low | 70 | -2.5 |

##### 5.2.3.2.8 Minimum requirements for PDSCH pre-emption

The performance requirements are specified in Table 5.2.3.2.8-3, with the addition of test parameters in Table 5.2.3.2.8-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.2.8-1.

Table 5.2.3.2.8-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH pre-emption performance under 4 receive antenna conditions | 1-1 |

Table 5.2.3.2.8-2: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | Value |
| Duplex mode | |  | TDD |
| Active DL BWP index | |  | 1 |
| PDCCH configuration (Note 4) | Symbols with PDCCH |  | 0, 1 |
| DCI format |  | 2\_1 |
| timeFrequencySet |  | 14x1 |
| 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 |  | 2 |
| 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 |  | 1 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| Pre-emption configuration (Note 2) | Starting symbol (S) |  | 3 |
| Length (L) |  | 2 |
| Pre-emption periodicity and offset | Slots | 40/(1,12,23,34) (Note 3) |
| Number of HARQ Processes | |  | 8 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | FR1.30-1 |
| Note 1: Void  Note 2: Interference modelled as random data on pre-empted REs.  Note 3: Pre-emption is scheduled with with 10% probability with 20ms periodicity.  Note 4: In addition to PDCCH configuration in Table 5.2-1. | | | |

Table 5.2.3.2.8-3: 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.2-2.6 TDD | 40 / 30 | 16QAM  0.64 | FR1.30-1 | TDLA30-10 | 2x4, ULA Low | 70 | 8.7 |

##### 5.2.3.2.9 Minimum requirements for HST-SFN

The performance requirements are specified in Table 5.2.3.2.9-3, with the addition of test parameters in Table 5.2.3.2.9-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.2.9-1.

Table 5.2.3.2.9-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify PDSCH performance under 4 receive antenna conditions in the HST-SFN scenario defined in B.3.2 when *highSpeedDemodFlag-r16* [17] is configured. | 1-1 |

Table 5.2.3.2.9-2: 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) |  | 12 |
| PDSCH aggregation factor |  | 1 |
| PRB bundling type |  | Static |
| PRB bundling size |  | 2 |
| 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 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| CSI-RS for tracking | CSI-RS periodicity | Slots | 20 for CSI-RS resource 1,2,3,4 |
| CSI-RS offset | Slots | 1 for CSI-RS resource 1 and 22 for CSI-RS resource 3 and 4. |
| Frequency Occupation |  | Start PRB 0Number of PRB = 52 |
| 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 5.2.3.2.9-3: 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) |
| 1-1 | R.PDSCH.2-10.4 TDD | 40 / 30 | 16QAM, 0.48 | FR1.30-1 | HST-SFN | 2x4 | 70 | 11.7 |

##### 5.2.3.2.10 Minimum requirements for HST-DPS

The performance requirements are specified in Table 5.2.3.2.10-3, with the addition of test parameters in Table 5.2.3.2.10-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.2.10-1.

Table 5.2.3.2.10-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify UE performance in the HST-DPS scenario defined in B.3.3 | 1-1, 1-2 |

Table 5.2.3.2.10-2: Test parameters

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | | Unit | Value |
| Duplex mode | | |  | TDD |
| Active DL BWP index | | |  | 1 |
| PDCCH configuration | TCI state | |  | Note 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 | |  | 2 |
| Resource allocation type | |  | Type 0 |
| RBG size | |  | Config2 |
| VRB-to-PRB mapping type | |  | Non-interleaved |
| VRB-to-PRB mapping interleaver bundle size | |  | N/A |
| TCI state | |  | Note 1 |
| PDSCH DMRS configuration | DMRS Type | |  | Type 1 |
| Number of additional DMRS | |  | 2 |
| Maximum number of OFDM symbols for DL front loaded DMRS | |  | 1 |
| CSI-RS for tracking | Resource set #1 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 5 for CSI-RS resource 1 and 3 |
| l0 = 9 for CSI-RS resource 2 and 4 |
| CSI-RS periodicity | Slots | 20 for CSI-RS resource 1,2,3,4 |
| CSI-RS offset | Slots | 1 for CSI-RS resource 1 and 2 |
| 2 for CSI-RS resource 3 and 4 |
| QCL info |  | TCI state #2 |
| Frequency Occupation |  | Start PRB 0 |
| Number of PRB = 52 |
| Resource set #2 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 6 for CSI-RS resource 5 and 7 |
| l0 = 10 for CSI-RS resource 6 and 8 |
| CSI-RS periodicity | Slots | 20 for CSI-RS resource 5,6,7,8. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 5 and 6 |
| 2 for CSI-RS resource 7 and 8 |
| QCL info |  | TCI state #3 |
| Frequency Occupation |  | Start PRB 0 |
| Number of PRB = 52 |
| NZP CSI-RS for CSI acquisition | Resource set #3 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 12 |
| CSI-RS periodicity | Slots | 40 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #0 |
| Resource set #4 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 13 |
| CSI-RS periodicity | Slots | 40 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #1 |
| TCI state #0 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking Resource set #1' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #1 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #2 | Type 1 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| TCI state #3 | Type 1 QCL information | SSB index |  | SSB #1 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| 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 |
| Note 1: SSB # (k mod 2) , CSI-RS (for tracking) resource set # ((k mod 2) + 1) and CSI-RS (for CSI acquisition) resource set # ((k mod 2) + 3) are transmitted by kth RRH.  For Test 1-1, TCI state switching command scheduled by MAC CE with MCS 4 is transmitted in slot #i that satisfy. PDCCH and PDSCH associated with TCI # (k mod 2) is transmitted by kth RRH from slot#  to slot#  ,  PDCCH and PDSCH are DTXed in other slots in which throughput statistics are not considered.  For Test 1-2, TCI state switching command scheduled by MAC CE with MCS 4 is transmitted in slot #i that satisfy. PDCCH and PDSCH associated with TCI # (k mod 2) is transmitted by kth RRH from slot#  to slot#  Where k=0, 1, 2… is the RRH number, n = 5040 is half of the number of slots between two RRH, = 8 is the number of slots between PDSCH and corresponding HARQ-ACK information, = 6 is the number of slots for MAC CE processing, = 7 is the number of slots to first TRS transmission occasion after MAC CE command is decoded by the UE, = 4 is the number of slots for TRS processing. | | | | |

Table 5.2.3.2.10-3: Minimum performance for HST-DPS

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL-DL pattern | Propagation condition | Number of active PDSCH TCI states | Correlation matrix and antenna configuration | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.2-10.5 TDD | 40 / 30 | 64QAM, 0.43 | FR1.30-1 | HST-DPS | 1 | 2x4 | 70 | 10.2 |
| 1-2 | R.PDSCH.2-10.5 TDD | 40 / 30 | 64QAM, 0.43 | FR1.30-1 | HST-DPS | 2 | 2x4 | 70 | 10.2 |

##### 5.2.3.2.11 Minimum requirements for PDSCH Single-DCI based SDM scheme

The performance requirements are specified in Table 5.2.3.2.11-3, with the addition of test parameters in Table 5.2.3.2.11-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.2.11-1.

Table 5.2.3.2.11-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH performance with Single-DCI based SDM scheme under 4 receive antenna conditions. | 1-1,1-2 |

Table 5.2.3.2.11-2: Test parameters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | | | | Unit | Value | |
| TRxP #1(Note 1) | TRxP #2(Note 1) |
| Transmit TRxP of SSB | | | |  | TRxP #1 | |
| PDCCH configuration | | TCI state | |  | TCI State #1 | |
| CORESETPoolIndex | |  | 0 | |
| CSI-RS for tracking | | First subcarrier index in the PRB used for CSI-RS | |  | k0=0 for CSI-RS resources 1,2,3,4 | k0=1 for CSI-RS resources 5,6,7,8 |
| First OFDM symbol in the PRB used for CSI-RS | |  | l0 = 6 for CSI-RS resources 1 and 3  l0 = 10 for CSI-RS resources 2 and 4 | l0 = 6 for CSI-RS resources 5 and 7  l0 = 10 for CSI-RS resources 6 and 8 |
| Number of CSI-RS ports (X) | |  | 1 for CSI-RS resource 1,2,3,4 | 1 for CSI-RS resource 5,6,7,8 |
| CDM Type | |  | ‘No CDM’ for CSI-RS resource 1,2,3,4,5,6,7,8 | |
| Density | |  | 3 | |
| CSI-RS periodicity | | Slots | 40 | |
| CSI-RS offset | | Slots | 20 for CSI-RS resources 1 and 2  21 for CSI-RS resources 3 and 4 | 20 for CSI-RS resources 5 and 6  21 for CSI-RS resources 7 and 8 |
| QCL info | |  | TCI state #0 | |
| Duplex mode | | | |  | TDD | |
| Active DL BWP index | | | |  | 1 | |
| PDSCH configuration | Mapping type | | |  | Type A | |
| k0 | | |  | 0 | |
| Starting symbol (S) | | |  | 2 | |
| Length (L) | | |  | 12 | |
| PRB bundling type | | |  | Static | |
| PRB bundling size | | |  | 2 | |
| Resource allocation type | | |  | Type 1 | |
| RBG size | | |  | Config2 | |
| VRB-to-PRB mapping type | | |  | Non-interleaved | |
| VRB-to-PRB mapping interleaver bundle size | | |  | N/A | |
| PDSCH DMRS configuration | Antenna port indexes | | |  | 1000 | 1002 |
| TCI state | | |  | TCI State #1 | TCI State #2 |
| DMRS Type | | |  | Type 1 | |
| Number of additional DMRS | | |  | 1 | |
| Maximum number of OFDM symbols for DL front loaded DMRS | | |  | 1 | |
| TCI State #1 | Type 1 QCL information | | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking’ configuration | N/A |
| QCL Type |  | Type A | N/A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| TCI State #2 | Type 1 QCL information | | CSI-RS resource |  | N/A | CSI-RS resource 5 from 'CSI-RS for tracking’ configuration |
| QCL Type |  | N/A | Type A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| Resource allocation | | | |  | Full-overlappling | |
| Timing offset of the second TRxP from the first TRxP | | | | us | -0.25 for test 1-1  1 for test 1-2 | |
| Frequency offset of the second TRxP from the first TRxP | | | | Hz | 300 for test 1-1  0 for test 1-2 | |
| 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 | |
| Precoding configuration | | | |  | SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity. | |
| Note 1: PDSCH transmission is done from both TRxPs (PDSCH Layer 0 is transmitted from TRxP #1 and PDSCH layer 1 is transmitted from TRxP #2) | | | | | | |

Table 5.2.3.2.11-3: Minimum performance

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL-DL pattern | Propagation condition(Note 1) | Correlation matrix and antenna configuration(Note 2) | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB)(Note 3) |
| 1-1 | R.PDSCH.2-3.2 TDD | 40 / 30 | 64QAM, 0.50 | FR1.30-1 | TDLA30-10 | 2x4, ULA Low | 70 | 14.5 |
| 1-2 | R.PDSCH.2-3.2 TDD | 40 / 30 | 64QAM, 0.50 | FR1.30-1 | TDLA30-10 | 2x4, ULA Low | 70 | 13.9 |
| Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent  Note 2: Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2  Note 3: SNR corresponds to SNR of TRxP #1 and TRxP #2 as defined in 4.4.2 with scaling factor as 1/sqrt(2) for transmitted signal from each TRxP | | | | | | | | |

##### 5.2.3.2.12 Minimum requirements for PDSCH Multi-DCI based transmission scheme

The performance requirements are specified in Table 5.2.3.2.12-3, with the addition of test parameters in Table 5.2.3.2.12-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.2.12-1.

Table 5.2.3.2.12-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH performance when UE is configured two different values of CORESETPoolIndex in ControlResourceSet and when UE receives multiple PDCCHs scheduling PDSCHs | 1-1 |

Table 5.2.3.2.12-2: Test parameters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | | | | Unit | Value | |
| TRxP #1(Note 1) | TRxP #2(Note 1) |
| Transmit TRxP of SSB | | | |  | TRxP #1 | |
| PDCCH configuration | | TCI state | |  | TCI State #1 | TCI State #2 |
| CORESETPoolIndex | |  | 0,1 | |
| CSI-RS for tracking | | First subcarrier index in the PRB used for CSI-RS | |  | k0=0 for CSI-RS resources 1,2,3,4 | k0=1 for CSI-RS resources 5,6,7,8 |
| First OFDM symbol in the PRB used for CSI-RS | |  | l0 = 6 for CSI-RS resources 1 and 3  l0 = 10 for CSI-RS resources 2 and 4 | l0 = 6 for CSI-RS resources 5 and 7  l0 = 10 for CSI-RS resources 6 and 8 |
| Number of CSI-RS ports (X) | |  | 1 for CSI-RS resource 1,2,3,4 | 1 for CSI-RS resource 5,6,7,8 |
| CDM Type | |  | ‘No CDM’ for CSI-RS resource 1,2,3,4,5,6,7,8 | |
| Density | |  | 3 | |
| CSI-RS periodicity | | Slots | 40 | |
| CSI-RS offset | | Slots | 20 for CSI-RS resources 1 and 2  21 for CSI-RS resources 3 and 4 | 20 for CSI-RS resources 5 and 6  21 for CSI-RS resources 7 and 8 |
| QCL info | |  | TCI state #0 | |
| Duplex mode | | | |  | TDD | |
| Active DL BWP index | | | |  | 1 | |
| PDSCH configuration | Mapping type | | |  | Type A | |
| k0 | | |  | 0 | |
| Starting symbol (S) | | |  | 2 | |
| Length (L) | | |  | 12 | |
| PRB bundling type | | |  | Static | |
| PRB bundling size | | |  | 2 | |
| Resource allocation type | | |  | Type 1 | |
| RBG size | | |  | Config2 | |
| VRB-to-PRB mapping type | | |  | Non-interleaved | |
| VRB-to-PRB mapping interleaver bundle size | | |  | N/A | |
| PDSCH DMRS configuration | Antenna port indexes | | |  | {1000,1001} | {1002,1003} |
| TCI state | | |  | TCI State #1 | TCI State #2 |
| DMRS Type | | |  | Type 1 | |
| Number of additional DMRS | | |  | 1 | |
| Maximum number of OFDM symbols for DL front loaded DMRS | | |  | 1 | |
| TCI State #1 | Type 1 QCL information | | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking’ configuration | N/A |
| QCL Type |  | Type A | N/A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| TCI State #2 | Type 1 QCL information | | CSI-RS resource |  | N/A | CSI-RS resource 5 from 'CSI-RS for tracking’ configuration |
| QCL Type |  | N/A | Type A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| Resource allocation | | | |  | Non-overlapping | |
| Timing offset of the second TRxP from the first TRxP | | | | us | -0.25 | |
| Frequency offset of the second TRxP from the first TRxP | | | | Hz | 300 | |
| 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 | |
| Precoding configuration | | | |  | SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity | |
| Note 1: PDSCH transmission is done from both TRxPs. Transmission from TRxP #1 uses CORESETPoolIndex 0 and transmission from TRxP #2 uses CORESETPoolIndex 1 | | | | | | |

Table 5.2.3.2.12-3: Minimum performance

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL-DL pattern | Propagation condition(Note 1) | Correlation matrix and antenna configuration(Note 2) | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB)(Note 3) |
|  | TRxP #1 | TRxP #2 |  |  |  |  |  |  |  |
| 1-1 | R.PDSCH.2-3.3 TDD | R.PDSCH.2-3.4 TDD | 40 / 30 | 64QAM, 0.50 | FR1.30-1 | TDLA30-10 | 2x4, ULA Low | 70 | 14. 6 |
| Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent  Note 2: Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2  Note 3: SNR corresponds to SNR of TRxP #1 and TRxP #2 as defined in 4.4.2 | | | | | | | | | |

##### 5.2.3.2.13 Minimum requirements for PDSCH with single-DCI based FDM Scheme A

The performance requirements are specified in Table 5.2.3.2.13-3, with the addition of test parameters in Table 5.2.3.2.13-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.2.13-1.

Table 5.2.3.2.13-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify PDSCH performance under 4 receive antenna conditions when UE is configured with “FDMSchemeA” in “RepetitionScheme-r16” defined in clause 5.1 of TS 38.214 [12] | 1-1 |

Table 5.2.3.1.13-2: Test parameters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | | | | Unit | Value | |
| TRxP #1 (Note 1) | TRxP #2 (Note 1) |
| Transmit TRxP of SSB | | | |  | TRxP #1 | |
| PDCCH configuration | | TCI state | |  | TCI State #1 | |
| CORESETPoolIndex | |  | Not configured | |
| CSI-RS for tracking | | First subcarrier index in the PRB used for CSI-RS | |  | k0=0 for CSI-RS resources 1,2,3,4 | k0=1 for CSI-RS resources 5,6,7,8 |
| First OFDM symbol in the PRB used for CSI-RS | |  | l0 = 6 for CSI-RS resources 1 and 3  l0 = 10 for CSI-RS resources 2 and 4 | l0 = 6 for CSI-RS resources 5 and 7  l0 = 10 for CSI-RS resources 6 and 8 |
| Number of CSI-RS ports (X) | |  | 1 for CSI-RS resource 1,2,3,4 | 1 for CSI-RS resource 5,6,7,8 |
| CDM Type | |  | 'No CDM’ for CSI-RS resource 1,2,3,4,5,6,7,8 | |
| Density | |  | 3 | |
| CSI-RS periodicity | | Slots | 40 | |
| CSI-RS offset | | Slots | 20 for CSI-RS resources 1 and 2  21 for CSI-RS resources 3 and 4 | 20 for CSI-RS resources 5 and 6  21 for CSI-RS resources 7 and 8 |
| QCL info | |  | TCI state #0 | |
| Duplex mode | | | |  | TDD | |
| Active DL BWP index | | | |  | 1 | |
| PDSCH configuration | Mapping type | | |  | Type A | |
| k0 | | |  | 0 | |
| Starting symbol (S) | | |  | 2 | |
| Length (L) | | |  | 12 | |
| 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 | |
| PDSCH DMRS configuration | Antenna port indexes | | |  | 1000, 1001 | 1000, 1001 |
| TCI state | | |  | TCI State #1 | TCI State #2 |
| DMRS Type | | |  | Type 1 | |
| Number of additional DMRS | | |  | 1 | |
| Maximum number of OFDM symbols for DL front loaded DMRS | | |  | 1 | |
| TCI State #1 | Type 1 QCL information | | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking’ configuration | N/A |
| QCL Type |  | Type A | N/A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| TCI State #2 | Type 1 QCL information | | CSI-RS resource |  | N/A | CSI-RS resource 5 from 'CSI-RS for tracking’ configuration |
| QCL Type |  | N/A | Type A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| Timing offset of the second TRxP from the first TRxP | | | | us | -0.25 | |
| Frequency offset of the second TRxP from the first TRxP | | | | Hz | 300 | |
| 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 | |
| Precoding configuration | | | |  | SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity. | |
| Note 1: PDSCH transmission is done from both TRxPs | | | | | | |

Table 5.2.3.2.13-3: 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 (Note 1) | Correlation matrix and antenna configuration (Note 2) | Reference value | |
| Fraction of  maximum  throughput  (%) | SNR (dB) (Note 3) |
| 1-1 | R.PDSCH.2-2.5 TDD | 40 / 30 | 16QAM, 0.54 | FR1.30-1 | TDLA30-10 | 2x4, ULA Low | 70 | 10.5 |
| Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent.  Note 2: Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2.  Note 3: SNR corresponds to SNR of TRxP #1 and TRxP #2 as defined in 4.4.2 | | | | | | | | |

##### 5.2.3.2.14 Minimum requirements for PDSCH with single-DCI based Inter-slot TDM scheme

The performance requirements are specified in Table 5.2.3.2.14-3, with the addition of test parameters in Table 5.2.3.2.14-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.2.14-1.

Table 5.2.3.2.14-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify PDSCH performance under 4 receive antenna conditions when UE is configured with repetitionNumber-r16 with multiple slot level PDSCH transmission occasions of the same TB with two TCI states defined in clause 5.1 of TS 38.214 [12] | 1-1 |

Table 5.2.3.2.14-2: Test parameters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | | | | Unit | Value | |
| TRxP #1 (Note 1) | TRxP #2 (Note 1) |
| Transmit TRxP of SSB | | | |  | TRxP #1 | |
| PDCCH configuration | | TCI state | |  | TCI State #1 | |
| CORESETPoolIndex | |  | Not configured | |
| CSI-RS for tracking | | First subcarrier index in the PRB used for CSI-RS | |  | k0=0 for CSI-RS resources 1,2,3,4 | k0=1 for CSI-RS resources 5,6,7,8 |
| First OFDM symbol in the PRB used for CSI-RS | |  | l0 = 6 for CSI-RS resources 1 and 3  l0 = 10 for CSI-RS resources 2 and 4 | l0 = 6 for CSI-RS resources 5 and 7  l0 = 10 for CSI-RS resources 6 and 8 |
| Number of CSI-RS ports (X) | |  | 1 for CSI-RS resource 1,2,3,4 | 1 for CSI-RS resource 5,6,7,8 |
| CDM Type | |  | 'No CDM’ for CSI-RS resource 1,2,3,4,5,6,7,8 | |
| Density | |  | 3 | |
| CSI-RS periodicity | | Slots | 40 | |
| CSI-RS offset | | Slots | 20 for CSI-RS resources 1 and 2  21 for CSI-RS resources 3 and 4 | 20 for CSI-RS resources 5 and 6  21 for CSI-RS resources 7 and 8 |
| QCL info | |  | TCI state #0 | |
| Duplex mode | | | |  | TDD | |
| Active DL BWP index | | | |  | 1 | |
| PDSCH configuration | Mapping type | | |  | Type A | |
| k0 | | |  | 0 | |
| Starting symbol (S) | | |  | 2 | |
| Length (L) | | |  | 12 | |
| Repetition number | | |  | 2 | |
| PRB bundling type | | |  | Static | |
| PRB bundling size | | |  | 2 | |
| 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 | Antenna port indexes | | |  | 1000 | 1000 |
| TCI state | | |  | TCI State #1 | TCI State #2 |
| DMRS Type | | |  | Type 1 | |
| Number of additional DMRS | | |  | 1 | |
| Maximum number of OFDM symbols for DL front loaded DMRS | | |  | 1 | |
| TCI State #1 | Type 1 QCL information | | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking’ configuration | N/A |
| QCL Type |  | Type A | N/A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| TCI State #2 | Type 1 QCL information | | CSI-RS resource |  | N/A | CSI-RS resource 5 from 'CSI-RS for tracking’ configuration |
| QCL Type |  | N/A | Type A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| Timing offset of the second TRxP from the first TRxP | | | | us | 1 | |
| Frequency offset of the second TRxP from the first TRxP | | | | Hz | 300 | |
| Number of HARQ Processes | | | |  | 4 | |
| 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 (Note 2) | |
| Precoding configuration | | | |  | SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity. | |
| Note 1: PDSCH transmission is done from both TRxPs  Note 2: ACK/NACK feedback is generated for PDSCH on slot i, where mod(i,10) = {2, 4, 6}. | | | | | | |

Table 5.2.3.2.14-3: 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 (Note 1) | Correlation matrix and antenna configuration (Note 2) | Reference value | |
| BLER (%) | SNR (dB) (Note 4) |
| 1-1 | R.PDSCH.2-16.2 TDD | 40 / 30 | 16QAM, 0.54 | FR1.30-1 | TDLA30-10 | 2x4, ULA Low | 1 (Note 3) | -0.5 |
| Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent.  Note 2: Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2.  Note 3: BLER is defined as residual BLER; i.e. ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block.  Note 4: SNR corresponds to SNR of TRxP #1 and TRxP #2 as defined in 4.4.2 | | | | | | | | |

5.2.3.2.15 Minimum requirements for PDSCH of PCell on band with shared spectrum access

The performance requirements are specified in Table 5.2.3.2.15-3, with the addition of test parameters in Table 5.2.3.2.15-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.2.15-1.

**Table 5.2.3.2.15-1: Tests purpose**

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify PDSCH performance for UE supporting operations in shared spectrum access | 1-1, 1-2, 1-3, 1-4 |

**Table 5.2.3.2.15-2: Test parameters**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Value** |
| Duplex mode | |  | TDD |
| Active DL BWP index | |  | 1 |
| DL transmission model | |  | As specified in B.5 |
| Downlink Model Parameters | SSB Q factor |  | 8 |
| Downlink transmission duration values | Slots | {2,4,6,7} |
| Occupied OFDM symbols in slot other than the last slot of the downlink duration | Symbols | 14 |
| Occupied OFDM symbols in the last slot of the downlink duration | Symbols | {6,9,12,14} (Note 1) |
| Downlink period | ms | 5 |
| LBT failure probability (*pLBT*) |  | 0.25 |
| PDSCH configuration | Mapping type |  | Type A |
| k0 |  | 0 |
| Starting symbol (S) |  | 2 |
| PDSCH aggregation factor |  | 1 |
| PRB bundling type |  | Static |
| PRB bundling size |  | 2 |
| 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 |
| dmrs-AdditionalPosition |  | pos1 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 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 |
| Note 1: If DL Transmission duration is 2 Slot, the occupied OFDM symbols in the last slot of the downlink duration is 14. | | | |

**Table 5.2.3.2.15-3: 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)** |
| 1-1 | R.PDSCH.2-18.1 TDD | 20 / 30 | 16QAM, 0.48 | FR1.30-7 | TDLA30-10 | 2x4, ULA Low | 70 | 8.7 |
| 1-2 | R.PDSCH.2-18.2 TDD | 40 / 30 | 16QAM, 0.48 | FR1.30-7 | TDLA30-10 | 2x4, ULA Low | 70 | 8.7 |
| 1-3 | R.PDSCH.2-18.3 TDD | 60 / 30 | 16QAM, 0.48 | FR1.30-7 | TDLA30-10 | 2x4, ULA Low | 70 | 8.9 |
| 1-4 | R.PDSCH.2-18.4 TDD | 80 / 30 | 16QAM, 0.48 | FR1.30-7 | TDLA30-10 | 2x4, ULA Low | 70 | 9.1 |

##### 5.2.3.2.16 Minimum requirements for PDSCH with inter-cell interference

The performance requirements are specified in Table 5.2.3.2.16-3, with the addition of test parameters in Table 5.2.3.2.16-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.2.16-1.

Table 5.2.3.2.16-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH performance under 4 receive antenna conditions, when the PDSCH transmission from the serving cell is interfered by 1 or 2 interfering cells. | 1-1, 1-2 |

Table 5.2.3.2.16-2: Test parameters

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | | Unit | Value | | |
|  | |  | Cell 1 | Cell 2 | Cell 3 |
|  | |  | Enabled | Enabled | Enabled for test 1-1  Disabled for test 1-2 |
| Duplex mode | |  | TDD | | |
| TDD UL-DL pattern | |  | FR1.30-1 | | |
| Active DL BWP index | |  | 1 | | |
| Physical cell ID | |  | 0 | 1 | 2 |
| Transmission rank | |  | 1 | Random rank with 70% and 30% probability for rank 1 and rank 2 | Random rank with 70% and 30% probability for rank 1 and rank 2 for Test 1-1  N/A for Test 1-2 |
| Time offset to Cell 1 | | us | N/A | 1.5 | -0.5 |
| Frequency shift to Cell 1 | | Hz | N/A | 300 | -100 |
| Interference Model | |  | N/A | As specified in B.6.2 | |
| INR (Note 2) | | dB | N/A | 7.77 for Test 1-1  7.58 for Test 1-2 | 2.29 for Test 1-1  N/A for Test 1-2 |
| SSB configuration | SSB position in burst |  | First SSB in Slot #0 | First SSB in Slot #0 for Test 1-1  Second SSB in Slot #0 for Test 1-2 | First SSB in Slot #0 for Test 1-1  N/A for Test 1-2 |
|  | SSB periodicity | ms | 20 | 20 | 20 |
| 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 |  | 2 | | |
|  | 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 |  | 1 | | |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 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 | | |
| Note 1: Cell 1 is the serving cell, Cell 2 , 3 are interference cells.  Note 2: INR is defined in Annex B.6.1 | | | | | |

Table 5.2.3.2.16-3: Minimum performance for PDSCH with rank 1 and with inter-cell interference

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test num | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
| Cell1 | Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.2-2.1 TDD | 40 / 30 | 16QAM, 0.48 | TDLC300-100 | 2x4, ULA Low | 70 | 10.7 |
| 1-2 | R.PDSCH.2-2.1 TDD | 40 / 30 | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 7.6 |
| Note 1: The propagation conditions for Cell 1, Cell 2 and Cell 3 are statistically independent.  Note 2: Bandwidth/ Subcarrier spacing, Propagation Condition, Correlation matrix and antenna configuration parameters apply for each of Cell 1, Cell 2 and Cell 3. | | | | | | | |

##### 5.2.3.2.17 Minimum requirements for PDSCH with intra-cell inter-user interference

The performance requirements are specified in Table 5.2.3.2.17-3 and and Table 5.2.3.2.17-4, with the addition of test parameters in Table 5.2.3.2.17-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.2.17-1.

Table 5.2.3.2.17-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify PDSCH performance under 4 receive antenna conditions, when the PDSCH transmission of target UE is interfered by co-scheduled UE. | 1-1, 2-1 |

Table 5.2.3.2.17-2: Test parameters

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | Unit | Target UE | Co-scheduled UE |
| Duplex mode | |  | TDD | |
| 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 |  | 2 | |
| 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 (Note 1) | DMRS Type |  | Type 1 | |
| Number of additional DMRS |  | 1 | |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 | |
| Antenna ports indexes |  | {1000} for test 1-1  {1000, 1001} for test 2-1 | {1001} for test 1-1  {1002, 1003} for test 2-1 |
| Number of PDSCH DMRS CDM group(s) without data |  | 1 for test 1-1  2 for test 2-1 | 1 for test 1-1  2 for test 2-1 |
| PDSCH & PDSCH DMRS Precoding configuration | |  | Single Panel Type I, Randomized precoder selection for every PRB bundle and updated per slot, with equal probability of each applicable i1/i2 combination or codebook  Index, chosen from section 5.2.2.2.1 of TS 38.214 [12]. | Single Panel Type I, Randomized precoder selection for every PRB bundle and updated per slot, with equal probability of each applicable i1/i2 combination or codebook  Index, chosen from section 5.2.2.2.1 of TS 38.214 [12].  Any column of precoder matrix is not equal to any column of precoder matrix of Target UE for test 1-1  Select the precoder to ensure any column of precoder is orthogonal to any column of precoder for the target PDSCH for test 2-1 |
| MU-MIMO Beamforming Model | |  | As specified in B.4.2 | |
| Number of HARQ Processes | |  | 8 | N/A |
| 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 | N/A |
| Note 1: DMRS scrambling ID is the same for both target and co-shceduled UEs. | | | | |

Table5.2.3.1.17-3: Minimum performance for target UE with 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 | |
| Target UE | Co-scheduled UE | Fraction of  maximum  throughput  (%) | SNR (dB) |
| 1-1 | R.PDSCH.7-1.1 TDD | 40 / 30 | 16QAM, 0.48 | Random 16QAM symbols | FR1.30-1 | TDLC300-100 | 2x4, ULA Low | 70 | 11.8 |

Table 5.2.3.2.17-4: Minimum performance for target UE with 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 | |
| Target UE | Co-scheduled UE | Fraction of  maximum  throughput  (%) | SNR (dB) |
| 2-1 | R.PDSCH.7-1.2 TDD | 40 / 30 | 16QAM, 0.48 | Random 16QAM symbols | FR1.30-1 | TDLA30-10 | 4x4, ULA Low | 70 | 15.5 |

##### 5.2.3.2.18 Minimum requirements for PDSCH CRS interference mitigation under NR-LTE coexistence scenario

The performance requirements are specified in Table 5.2.3.2.18-4, with the addition of test parameters in Table 5.2.3.2.18-2 for the serving cell and Table 5.2.3.2.18-3 for the LTE interference cells and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.2.18-1.

**Table 5.2.3.2.18-1: Tests purpose**

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify PDSCH CRS interference mitigation performance under 4 receive antenna conditions with CRS rate matching configured for the serving cell. | 1-1 |

Table 5.2.3.2.18-2: Test parameters for the serving cell

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Value** |
| Duplex mode | |  | TDD |
| Active DL BWP index | |  | 1 |
| PDSCH configuration | Mapping type |  | Type A |
|  | k0 |  | 0 |
|  | Starting symbol (S) |  | 3 |
|  | Length (L) |  | 9 |
|  | PDSCH aggregation factor |  | 1 |
|  | PRB bundling type |  | Static |
|  | PRB bundling size |  | 2 |
|  | 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 |  | 1 |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| CRS for rate  Matchin (Note 1) | LTE carrier centre subcarrier location |  | Same as NR carrier centre subcarrier location |
| LTE carrier BW | Hz | 20 |
| Number of antenna ports |  | 4 |
| v-shift |  | 0 |
| 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 |
| Note 1: No MBSFN is configured on LTE carrier.  Note 2: Network-based CRS interference mitigation is disabled on LTE carrier | | | |

Table 5.2.3.2.18-3: Test parameters for the LTE interference cells

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Cell 1** | **Cell 2** |
| Duplex mode | |  | TDD | TDD |
| TDD UL-DL pattern | |  | DSUDDDSUDD  S = 10D + 2G + 2U | DSUDDDSUDD  S = 10D + 2G + 2U |
| INR (Note 1) | | dB | 10.45 | 4.6 |
| LTE Bandwidth | | MHz | 20 | 20 |
| Carrier centre subcarrier location | |  | Same as the NR serving carrier centre subcarrier location | Same as the NR serving carrier centre subcarrier location |
| Cyclic Prefix | |  | Normal | Normal |
| Physical cell ID | |  | 1 | 2 |
| CRS pattern | Number of antenna ports |  | 4 | 4 |
| v-shift |  | 1 | 2 |
| Downlink power allocation |  | dB | -6 | -6 |
|  | dB | -6 | -6 |
| σ | dB | 0 | 0 |
| PDSCH transmission mode | |  | TM4 | TM4 |
| PDSCH loading level | | % | 20% probability of occurrence of LTE data transmission in time domain, and full bandwidth allocation in frequency domain. | 20% probability of occurrence of LTE data transmission in time domain, and full bandwidth allocation in frequency domain. |
| Transmission rank | | % | 80% and 20% probability for rank 1 and rank 2 respectively | 80% and 20% probability for rank 1 and rank 2 respectively |
| Interference model | |  | As specified in clause B.7 | As specified in clause B.7 |
| Time offset to the serving cell | | us | 3 | -1 |
| Frequency offset to the serving cell | | Hz | 300 | -100 |
| Propagation conditions and MIMO configuration (Note 2) | |  | TDLA30-10 ULA Low | TDLA30-10 ULA Low |
| Precoding granularity | | PRB | 8 | 8 |
| Note 1: Defined in B.6.1  Note 2: The channel for the LTE interference cells and the serving cell are independent. | | | | |

Table 5.2.3.2.18-4: 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.1-1.3 TDD | 20 / 15 | 16QAM, 0.48 | FR1.15-1 | TDLA30-10 | 4x4, ULA Low | 70 | 8.8 |

##### 5.2.3.2.19 Minimum requirements for PDSCH with inter cell CRS interference

The performance requirements are specified in Table 5.2.3.2.19-4 and Table 5.2.3.2.19-6, with the addition of test parameters in Table 5.2.3.2.19-2 for the serving cell and Table 5.2.3.2.19-3 for the LTE interference cells and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.2.19-1.

**Table 5.2.3.2.19-1: Tests purpose**

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify PDSCH performance under 4 receive antenna conditions when PDSCH is interfered by inter cell CRS signal | 1-1, 1-2, 2-1 and 2-2 |

Table 5.2.3.2.19-2: Tests parameter for serving cell PDSCH

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Value** |
| Duplex mode | |  | TDD |
| TDD UL-DL pattern | |  | FR1.15-1 |
| 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 |  | 2 |
|  | 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 |  | 1 |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 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 5.2.3.2.19-3: Tests parameter for interference cells

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Cell 1** | **Cell 2** |
| Duplex mode | |  | TDD | TDD |
| TDD UL-DL pattern | |  | DSUDDDSUDD  S = 10D + 2G + 2U | DSUDDDSUDD  S = 10D + 2G + 2U |
| INR | | dB | 10.45 | 4.6 |
| LTE Bandwidth (Note 5) | | MHz | 20 | 20 |
| Carrier centre subcarrier location (Note 6) | |  | Same as the NR serving carrier centre subcarrier location | Same as the NR serving carrier centre subcarrier location |
| Cyclic Prefix | |  | Normal | Normal |
| Physical cell ID | |  | 1 | 2 |
| CRS pattern | Number of antenna ports |  | 4 | 4 |
| v-shift |  | 1 | 2 |
| Downlink power allocation |  | dB | -6 | -6 |
|  | dB | -6 | -6 |
| σ | dB | 0 | 0 |
| PDSCH transmission mode | |  | TM4 | TM4 |
| PDSCH loading level | | % | 20% probability of occurrence of LTE data transmission in time domain, and full bandwidth allocation in frequency domain for test 1-1.  10% probability of occurrence of LTE data transmission in time domain, and full bandwidth allocation in frequency domain for test 1-2. | 20% probability of occurrence of LTE data transmission in time domain, and full bandwidth allocation in frequency domain for test 1-1.  10% probability of occurrence of LTE data transmission in time domain, and full bandwidth allocation in frequency domain for test 1-2. |
| Transmission rank | | % | 80% and 20% probability for rank 1 and rank 2 respectively | 80% and 20% probability for rank 1 and rank 2 respectively |
| Interference model | |  | As specified in clause B.7 | As specified in clause B.7 |
| Time offset to the serving cell | | us | 3 for test 1-1  1.5 for test 1-2 | -1 for test 1-1  -0.5 for test 1-2 |
| Frequency offset to the serving cell | | Hz | 300 | -100 |
| Propagation conditions and MIMO configuration (Note 1) | |  | TDLA30-10 ULA Low | TDLA30-10 ULA Low |
| Precoding granularity | | PRB | 8 | 8 |
| Note 1: The channel for the LTE interference cells and the serving cell are independent.  Note 2: No MBSFN is configured on LTE carrier.  Note 3: Network-based CRS interference mitigation is disabled on LTE carrier.  Note 4: The start of transmission of LTE frame is delayed by 2 LTE subframes with respect to the start of transmission of NR frame  Note 5: This parameter is informed to UE via network assistance signalling for Test 1-1 and 1-2 in Table 5.2.3.2.18-4.  Note 6: Single entry is included in IE *LTE-NeighCellsCRS-AssistInfoList-r17* that applies for both cells for cases with network signalling assistance | | | | |

The requirements for UE capable of performing CRS-IM with the assistance of network signaling on LTE channel bandwidth are specified in Table 5.2.3.2.19-4:

Table 5.2.3.2.19-4 Minimum performance for Rank 1 with the assistance of network signaling on LTE channel bandwidth

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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.1-4.1 TDD | 20 / 15 | 16QAM, 0.48 | FR1.15-1 | TDLA30-10 | 4x4, ULA Low | 70 | 8.6 |
| 1-2 | R.PDSCH.2-25.1 TDD | 20 / 30 | 16QAM, 0.48 | FR1.30-1 | TDLA30-10 | 4x4, ULA Low | 70 | 8.2 |

The requirements for UE capable of performing CRS-IM without the assistance of network signaling on LTE channel bandwidth are specified in Table 5.2.3.2.19-6 with following test procedure:

The network configures an inter-RAT LTE measurement object of the interfering cells to the tested UE. Inter-RAT measurement is configured at the beginning of the test and applied throughout the test with gap pattern configurations according to Table 5.2.3.2.19-5. PDSCH is not scheduled and throughput is not counted during 4.64s after the beginning of test. PDSCH is not scheduled in the measurement gaps.

Table 5.2.3.2.19-5: Measurement Gap configurations

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Value** |
| Measurement Gap Length (mgl) | ms | 6 |
| Measurement Gap Repetition Period (mgrp) | ms | 40 |
| Gap offset (gapoffset) | ms | 1 |
| Measurement gap timeing advance (mgta) | ms | 0 |

Table 5.2.3.2.19-6: Minimum performance for Rank 1 without the assistance of network signaling on LTE channel bandwidth

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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.1-4.2 TDD | 20 / 15 | 16QAM, 0.48 | FR1.15-1 | TDLA30-10 | 4x4, ULA Low | 70 | 8.6 |
| 2-2 | R.PDSCH.2-26.1 TDD | 20 / 30 | 16QAM, 0.48 | FR1.30-1 | TDLA30-10 | 4x4, ULA Low | 70 | 8.2 |

##### 5.2.3.2.20 Minimum requirements for HST-SFN Scheme A

The performance requirements are specified in Table 5.2.3.2.20-3, with the addition of test parameters in Table 5.2.3.2.20-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.2.20-1.

Table 5.2.3.2.20-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify UE performance in the HST-SFN Scheme A scenario defined in B.3.5 | 1-1 |

Table 5.2.3.2.20-2: Test parameters

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | | Unit | Value |
| Duplex mode | | |  | TDD |
| Active DL BWP index | | |  | 1 |
| PDCCH configuration | TCI state | |  | Note 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 | |  | 2 |
| Resource allocation type | |  | Type 0 |
| RBG size | |  | Config2 |
| VRB-to-PRB mapping type | |  | Non-interleaved |
| VRB-to-PRB mapping interleaver bundle size | |  | N/A |
| TCI state | |  | Note 1 |
| PDSCH DMRS configuration | DMRS Type | |  | Type 1 |
| Number of additional DMRS | |  | 2 |
| Maximum number of OFDM symbols for DL front loaded DMRS | |  | 1 |
| CSI-RS for tracking | Resource set #1 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 5 for CSI-RS resource 1 and 3  l0 = 9 for CSI-RS resource 2 and 4 |
| CSI-RS periodicity | Slots | 20 for CSI-RS resource 1,2,3,4. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4 |
| QCL info |  | TCI state #3 |
| Resource set #2 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 6 for CSI-RS resource 5 and 7  l0 = 10 for CSI-RS resource 6 and 8 |
| CSI-RS periodicity | Slots | 20 for CSI-RS resource 5,6,7,8. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 5 and 6 2 for CSI-RS resource 7 and 8 |
| QCL info |  | TCI state #4 |
| Resource set #3 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 4 for CSI-RS resource 9 and 11  l0 = 8 for CSI-RS resource 10 and 12 |
| CSI-RS periodicity | Slots | 20 for CSI-RS resource 9,10,11,12. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 9 and 10 2 for CSI-RS resource 11 and 12 |
| QCL info |  | TCI state #5 |
| NZP CSI-RS for CSI acquisition | Resource set #4 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 12 |
| CSI-RS periodicity | Slots | 40 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #0 |
| Resource set #5 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 13 |
| CSI-RS periodicity | Slots | 40 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #1 |
| Resource set #6 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 7 |
| CSI-RS periodicity | Slots | 40 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #2 |
| TCI state #0 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking Resource set #1' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #1 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #2 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 9 from 'CSI-RS for tracking Resource set #3' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #3 | Type 1 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| TCI state #4 | Type 1 QCL information | SSB index |  | SSB #1 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| TCI state #5 | Type 1 QCL information | SSB index |  | SSB #2 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| 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 |
| Note 1: SSB # (k mod 3) , CSI-RS (for tracking) resource set # ((k mod 3) + 1) and CSI-RS (for CSI acquisition) resource set # ((k mod 3) + 4) are transmitted by kth RRH.  Codepoint #0 is activated when UE receives PDCCH/PDSCH from RRH#3k and RRH#3k+1 with TCI States TCI state #0, TCI State #1.  Codepoint #1 is activated when UE receives PDCCH/PDSCH from RRH#3k+1 and RRH#3k+2 with TCI States TCI state #1, TCI State #2.  Codepoint #2 is activated when UE receives PDCCH/PDSCH from RRH#3k+2 and RRH#3k+3 with TCI States TCI state #2, TCI State #0. | | | | |

**Table 5.2.3.2.20-3: Minimum performance for HST-SFN Scheme A**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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.2-30.1 TDD | 40 / 30 | 16QAM, 0.48 | FR1.30-1 | HST-SFN Scheme A | 2x4 | 70 | 10.3 |

##### 5.2.3.2.21 Minimum requirements for HST-SFN Scheme B

The performance requirements are specified in Table 5.2.3.2.21-3, with the addition of test parameters in Table 5.2.3.2.21-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.2.21-1.

Table 5.2.3.2.21-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify UE performance in the HST-SFN Scheme B scenario defined in B.3.6 | 1-1 |

Table 5.2.3.2.21-2: Test parameters

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | | Unit | Value |
| Duplex mode | | |  | TDD |
| Active DL BWP index | | |  | 1 |
| PDCCH configuration | TCI state | |  | Note 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 | |  | 2 |
| Resource allocation type | |  | Type 0 |
| RBG size | |  | Config2 |
| VRB-to-PRB mapping type | |  | Non-interleaved |
| VRB-to-PRB mapping interleaver bundle size | |  | N/A |
| TCI state | |  | Note 1 |
| PDSCH DMRS configuration | DMRS Type | |  | Type 1 |
| Number of additional DMRS | |  | 2 |
| Maximum number of OFDM symbols for DL front loaded DMRS | |  | 1 |
| CSI-RS for tracking | Resource set #1 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 5 for CSI-RS resource 1 and 3  l0 = 9 for CSI-RS resource 2 and 4 |
| CSI-RS periodicity | Slots | 20 for CSI-RS resource 1,2,3,4. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4 |
| QCL info |  | TCI state #3 |
| Frequency Occupation |  | Start PRB 0 |
| Number of PRB = 52 |
| Resource set #2 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 6 for CSI-RS resource 5 and 7  l0 = 10 for CSI-RS resource 6 and 8 |
| CSI-RS periodicity | Slots | 20 for CSI-RS resource 5,6,7,8. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 5 and 6 2 for CSI-RS resource 7 and 8 |
| QCL info |  | TCI state #4 |
| Frequency Occupation |  | Start PRB 0 |
| Number of PRB = 52 |
| Resource set #3 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 4 for CSI-RS resource 9 and 11  l0 = 8 for CSI-RS resource 10 and 12 |
| CSI-RS periodicity | Slots | 20 for CSI-RS resource 9,10,11,12. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 9 and 10 2 for CSI-RS resource 11 and 12 |
| QCL info |  | TCI state #5 |
| Frequency Occupation |  | Start PRB 0 |
| Number of PRB = 52 |
| NZP CSI-RS for CSI acquisition | Resource set #4 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 12 |
| CSI-RS periodicity | Slots | 40 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #0 |
| Resource set #5 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 13 |
| CSI-RS periodicity | Slots | 40 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #1 |
| Resource set #6 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 7 |
| CSI-RS periodicity | Slots | 40 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #2 |
| TCI state #0 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking Resource set #1' configuration |
|  | QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #1 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #2 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 9 from 'CSI-RS for tracking Resource set #3' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #3 | Type 1 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| TCI state #4 | Type 1 QCL information | SSB index |  | SSB #1 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| TCI state #5 | Type 1 QCL information | SSB index |  | SSB #2 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| 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 | |
| Note 1: SSB # (k mod 3), CSI-RS (for tracking) resource set # ((k mod 3) + 1) and CSI-RS (for CSI acquisition) resource set # ((k mod 3) + 4) are transmitted by kth RRH.  Codepoint#0 {TCI state #0, TCI State #1} is activated when UE receives PDCCH/PDSCH from RRH#3k and RRH#3k+1.  Codepoint#1 {TCI state #1, TCI State #2} is activated when UE receives PDCCH/PDSCH from RRH#3k+1 and RRH#3k+2.  Codepoint#2 {TCI state #2, TCI State #0} is activated when UE receives PDCCH/PDSCH from RRH#3k+2 and RRH#3k+3.  The second indicated TCI state in each codepoint is not used for quasi co-location parameters {Doppler shift, Doppler spread}. | | | | |

**Table 5.2.3.2.21-3: Minimum performance for HST-SFN Scheme B**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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.2-30.1 TDD | 40/30 | 16QAM, 0.48 | FR1.30-1 | HST-SFN-SchemeB | 2x4 | 70 | 9.3 |

## 5.2A PDSCH demodulation requirements for CA

The parameters specified in Table 5.2-1 for PDSCH single carrier tests are reused for PDSCH CA tests unless otherwise stated.

Table 5.2A-1: Common test parameters for CA

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | Value |
| Duplex mode | |  | FDD and TDD |
| Active DL BWP index | |  | 1 |
| PDSCH configuration | Mapping type |  | Type A |
| k0 |  | 0 |
| Starting symbol (S) |  | 2 |
| Length (L) |  | FDD: 12TDD: Specific to each Reference channel |
| PDSCH aggregation factor |  | 1 |
| PRB bundling type |  | Static |
| PRB bundling size |  | 2 |
| 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 |  | 1 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| Number of HARQ Processes | |  | As defined in Table 5.2A-2 |
| TDD UL-DL pattern | |  | 15kHz SCS: FR1.15-1  30kHz SCS: FR1.30-1 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | As defined in Table 5.2A-3 |
| PUCCH format for HARQ-ACK feedback | |  | PUCCH format 1 for cases where the number of ACK/NACK to be transmitted on single PUCCH is 2 or less.  PUCCH format 3 for cases where the number of ACK/NACK to be transmitted on single PUCCH is more than 2. |

Table 5.2A-2: Test parameters for number of HARQ processes

|  |  |  |  |
| --- | --- | --- | --- |
| HARQ process number | | CCs with the same duplex mode & SCS with Pcell | CCs with different duplex mode / SCS with Pcell |
| FDD 15 kHz +  TDD 30 kHz CA | FDD PCell | 4 | 8 |
| TDD PCell | 10 | 8 |
| FDD 15 kHz +  TDD 15 kHz CA | FDD PCell | 4 | 4 |
| TDD PCell | 8 | 8 |
| TDD 15 kHz +  TDD 30 kHz CA | 15kHz PCell | 8 | 12 |
| 30kHz PCell | 8 | 8 |
| FDD 15 kHz +  FDD 15 kHz CA | FDD PCell | 4 | N/A |
| TDD 30 kHz +  TDD 30 kHz CA | TDD PCell | 8 | N/A |

Table 5.2A-3: Test parameters for K1 values

|  |  |  |  |
| --- | --- | --- | --- |
| The number of slots between PDSCH and corresponding HARQ-ACK information | | CCs with the same duplex mode and SCS with Pcell | CCs with different duplex mode and/or SCS with Pcell |
| FDD 15 kHz +  TDD 30 kHz CA | FDD PCell | {2} | {2} |
| TDD PCell | {8,7,6,5,5,4,3,11} | {7,5,4,11,9} |
| FDD 15 kHz +  TDD 15 kHz CA | FDD PCell | {2} | {2} |
| TDD PCell | {4,3,2,6} | {4,3,2,6,5} |
| TDD 15 kHz +  TDD 30 kHz CA | 15kHz PCell | {4,3,2,6} | {4,4,3,3,2,2,6,6} |
| 30kHz PCell | {8,7,6,5,5,4,3,2} | {7,5,4,11} |
| FDD 15 kHz +  FDD 15 kHz CA | FDD PCell | {2} | N/A |
| TDD 30 kHz +  TDD 30 kHz CA | TDD PCell | {8,7,6,5,5,4,3,2} | N/A |

### 5.2A.1 1RX requirements

(Void)

### 5.2A.2 2RX requirements

#### 5.2A.2.1 Minimum requirements

For CA with different numbers of DL component carriers, the requirements are defined in Table 5.2A.2.1-4 based on the single carrier requirements for different SCSs and different bandwidth specified in Table 5.2A.2.1-1 ~ Table 5.2A.2.1-3, with the parameters in Table 5.2A-1 ~ Table 5.2A-3 and the downlink physical channel setup according to Annex C.3.1. The performance requirements specified in this sub-clause do not apply for UE single carrier test.

Table 5.2A.2.1-1: Single carrier performance for FDD 15 kHz SCS for CA configurations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Bandwidth (MHz) | Reference channel | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB) |
| 5 | R.PDSCH.1-9.1 FDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.6 |
| 10 | R.PDSCH.1-2.2 FDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.6 |
| 15 | R.PDSCH.1-9.2 FDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.6 |
| 20 | R.PDSCH.1-9.3 FDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.8 |
| 25 | R.PDSCH.1-9.4 FDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 14.0 |
| 30 | R.PDSCH.1-9.5 FDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.8 |
| 35 | R.PDSCH.1-10.3 FDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.9 | |
| 40 | R.PDSCH.1-10.1 FDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 14.0 |
| 45 | R.PDSCH.1-10.4 FDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 14.5 | |
| 50 | R.PDSCH.1-10.2 FDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 14.4 |

Table 5.2A.2.1-2 Single carrier performance for TDD 15 kHz SCS for CA configurations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Bandwidth (MHz) | Reference channel | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB) |
| 5 | R.PDSCH.1-2.1 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.6 |
| 10 | R.PDSCH.1-2.2 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.8 |
| 15 | R.PDSCH.1-2.3 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.8 |
| 20 | R.PDSCH.1-2.4 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.9 |
| 25 | R.PDSCH.1-2.5 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 14.0 |
| 30 | R.PDSCH.1-3.1 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.9 |
| 40 | R.PDSCH.1-3.2 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 14.2 |
| 50 | R.PDSCH.1-3.3 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 14.5 |

Table 5.2A.2.1-3 Single carrier performance for TDD 30 kHz SCS for CA configurations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Bandwidth (MHz) | Reference channel | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB) |
| 5 | R.PDSCH.2-13.1 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.6 |
| 10 | R.PDSCH.2-13.2 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.6 |
| 15 | R.PDSCH.2-13.3 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.6 |
| 20 | R.PDSCH.2-13.4 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.7 |
| 25 | R.PDSCH.2-13.5 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.7 |
| 30 | R.PDSCH.2-14.1 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.7 |
| 40 | R.PDSCH.2-2.2 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 13.9 |
| 50 | R.PDSCH.2-14.2 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 14.1 |
| 60 | R.PDSCH.2-14.3 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 14.0 |
| 80 | R.PDSCH.2-14.4 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 14.5 |
| 90 | R.PDSCH.2-14.5 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 14.3 |
| 100 | R.PDSCH.2-15.1 TDD | 16QAM, 0.48 | TDLA30-10 | 2x2, ULA Low | 70 | 14.7 |

Table 5.2A.2.1-4: Minimum performance for multiple CA configurations

|  |  |  |
| --- | --- | --- |
| Test number | CA duplex mode | Minimum performance requirements |
| 1 | FDD 15 kHz + FDD 15 kHz | As defined in Table 5.2A.2.1-1 |
| 2 | TDD 30 kHz + TDD 30 kHz | As defined in Table 5.2A.2.1-3 |
| 3 | FDD 15 kHz + TDD 30 kHz | As defined in Table 5.2A.2.1-1 and Table 5.2A.2.1-3 per CC |
| 4 | FDD 15 kHz + TDD 15 kHz | As defined in Table 5.2A.2.1-1 and Table 5.2A.2.1-2 per CC |
| 5 | TDD 15 kHz + TDD 30 kHz | As defined in Table 5.2A.2.1-2 and Table 5.2A.2.1-3 per CC |
| Note 1: The applicability of requirements for different CA duplex modes, SCSs, CA configurations and bandwidth combination sets is defined in 5.1.1.7. | | |

#### 5.2A.2.2 Minimum requirements for carrier aggregation with power imbalance

The performance requirements are specified in Table 5.2A.2.2-3 and Table 5.2A.2.2-4, with the addition of test parameters in Table 5.2A.2.2-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2A.2.2-1.

Table 5.2A.2.2-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the ability of an intra-band adjacent carrier aggregation UE to demodulate the signal transmitted by the PCell or SCell in the presence of a stronger SCell or PCell signal on an adjacent frequency. Throughput is measured on the PCell or SCell only |  |

Table 5.2A.2.2-2: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | Value |
| Duplex mode | |  | FDD and TDD |
| Active DL BWP index | |  | 1 |
| Propagation condition | |  | Static propagation condition  No external noise sources are applied |
| Antenna configuration | |  | 1x2 |
| PDSCH configuration | Length (L) |  | FDD: 12TDD: 12 for DL slot, 4 for special slot |
| PRB bundling size |  | WB |
| Modulation and code rate | |  | 64QAM, MCS 26 |
| Number of HARQ Processes | |  | FDD: 4  TDD: 8 |
| Maximum number of HARQ transmission | |  | 1 |
| Redundancy version coding sequence | |  | {0} |
| TDD UL-DL pattern | |  | 30kHz SCS: FR1.30-1 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | As defined in Table A.1.2-2 for FR1.30-1 |
| PUCCH format for HARQ-ACK feedback | |  | PUCCH format 1 |
| Overhead for TBS determination | |  | 0 |
| SSB transmission | |  | Slot#0 with periodicity 20ms |
| RB assignment | |  | Full applicable test bandwidth as defined in Table 5.3.5-1 of TS 38.101-1 [6] |

Table 5.2A.2.2-3: Minimum performance for FDD CA with 15 kHz SCS

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test Number | Bandwidth (MHz) | | Reference channel | | Power at antenna port (dBm/Hz) | | Reference value  Fraction of Maximum  Throughput (%) | |
| PCell | SCell | PCell | SCell | for PCell | for Scell | PCell | SCell |
| 1 | Selected Channel bandwidth as per section 5.1.1.6 | | Derived as per section 5.1.3.2 of TS 38.214 [12] | NA | -112 | -106 | 85 | NA |

Table 5.2A.2.2-4: Minimum performance for TDD CA with 30 kHz SCS

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test Number | Bandwidth (MHz) | | Reference channel | | Power at antenna port (dBm/Hz) | | Reference value  Fraction of Maximum  Throughput (%) | |
| PCell | SCell | PCell | SCell | for PCell | for Scell | PCell | SCell |
| 1 | Selected Channel bandwidth as per section 5.1.1.6 | | Derived as per section 5.1.3.2 of TS 38.214 [12] | NA | -112 | -106 | 85 | NA |

#### 5.2A.2.3 Minimum requirements for PDSCH of SCell on band with shared spectrum access

The performance requirements for SCell on band with shared spectrum access are specified in Table 5.2.2.2.15-3, with the additional test parameters for SCell in Table 5.2.2.2.15-2, the test parameters for PCell in Table 5.2A.2.3-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2A.2.3-1. During the test, only the PDSCH performance of the SCell should be verified.

Table 5.2A.2.3-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH performance of SCell for UE supporting operations in shared spectrum access | 1-1, 1-2, 1-3, 1-4 |

Table 5.2A.2.3-2: Test parameters for PCell

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | Value |
| Duplex mode | |  | TDD |
| Bandwidth | | MHz | 20 |
| Subcarrier spacing | | kHz | 30 |
| Active DL BWP index | |  | 1 |
| TDD pattern | |  | FR1.30-1 |
| 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 |  | 2 |
|  | 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 |
|  | Dmrs-AdditionalPosition |  | pos1 |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 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 |

5.2A.2.4 Minimum requirements for HST-SFN CA

For HST-SFN CA with different numbers of DL component carriers, the requirements are defined in Table 5.2A.2.4-5 based on the single carrier requirements for different SCSs and different bandwidth specified in Table 5.2A.2.4-3 and Table 5.2A.2.4-4. Test parameters are specified in Table 5.2A.2.4-2, Table 5.2A-2, and Table 5.2A-3 with downlink physical channel setup according to Annex C.3.1. The performance requirements specified in this sub-clause do not apply for UE single carrier test.

The test purpose is specified in Table 5.2A.2.4-1.

Table 5.2A.2.4-1: Test purpose

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify PDSCH performance under 2 receive antenna conditions in the HST-SFN scenario defined in B.3.2 with CA | 1,2,3 |

Table 5.2A.2.4-2: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Value** |
| Duplex mode | |  | FDD and TDD |
| 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 |  | 2 |
|  | 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 |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| CSI-RS for tracking | CSI-RS periodicity | Slots | FDD: 10 for CSI-RS resource 1,2,3,4.  TDD: 20 for CSI-RS resource 1,2,3,4. |
|  | CSI-RS offset | Slots | 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4. |
| Number of HARQ Processes | |  | As defined in Table 5.2A-2 |
| TDD UL-DL pattern | |  | 15 kHz SCS: FR1.15-1  30 kHz SCS: FR1.30-1 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | As defined in Table 5.2A-3 |
| Number of PUCCH ResourceGroups | |  | 1 |
| PUCCH format for HARQ-ACK feedback | |  | PUCCH format 1 for cases with no more than 2 DL CCs  PUCCH format 3 for cases with more than 2 DL CCs |

Table 5.2A.2.4-3: Single carrier performance for FDD 15 kHz SCS for CA configurations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Bandwidth (MHz)** | **Reference channel** | **Modulation format and code rate** | **Propagation condition** | **Correlation matrix and antenna configuration** | **Reference value** | |
| **Fraction of maximum throughput (%)** | **SNR (dB)** |
| 5 | R.PDSCH.1-13.1 FDD | 16QAM, 0.48 | HST-SFN | 2x2 | 70 | 12.9 |
| 10 | R.PDSCH.1-8.3 FDD | 16QAM, 0.48 | HST-SFN | 2x2 | 70 | 13.1 |
| 15 | R.PDSCH.1-13.2 FDD | 16QAM, 0.48 | HST-SFN | 2x2 | 70 | 13.4 |
| 20 | R.PDSCH.1-13.3 FDD | 16QAM, 0.48 | HST-SFN | 2x2 | 70 | 13.9 |
| 25 | R.PDSCH.1-13.4 FDD | 16QAM, 0.48 | HST-SFN | 2x2 | 70 | 14.0 |
| 30 | R.PDSCH.1-13.5 FDD | 16QAM, 0.48 | HST-SFN | 2x2 | 70 | 13.9 |
| 35 | R.PDSCH.1-14.3 FDD | 16QAM, 0.48 | HST-SFN | 2x2 | 70 | 13.8 |
| 40 | R.PDSCH.1-14.1 FDD | 16QAM, 0.48 | HST-SFN | 2x2 | 70 | 14.0 |
| 45 | R.PDSCH.1-14.4 FDD | 16QAM, 0.48 | HST-SFN | 2x2 | 70 | 13.9 |
| 50 | R.PDSCH.1-14.2 FDD | 16QAM, 0.48 | HST-SFN | 2x2 | 70 | 14.0 |

Table 5.2A.2.4-4 Single carrier performance for TDD 30 kHz SCS for CA configurations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Bandwidth (MHz)** | **Reference channel** | **Modulation format and code rate** | **Propagation condition** | **Correlation matrix and antenna configuration** | **Reference value** | |
| **Fraction of maximum throughput (%)** | **SNR (dB)** |
| 5 | R.PDSCH.2-19.1 TDD | 16QAM, 0.48 | HST-SFN | 2x2 | 70 | 13.4 |
| 10 | R.PDSCH.2-19.2 TDD | 16QAM, 0.48 | HST-SFN | 2x2 | 70 | 13.7 |
| 15 | R.PDSCH.2-19.3 TDD | 16QAM, 0.48 | HST-SFN | 2x2 | 70 | 13.8 |
| 20 | R.PDSCH.2-19.4 TDD | 16QAM, 0.48 | HST-SFN | 2x2 | 70 | 13.8 |
| 25 | R.PDSCH.2-19.5 TDD | 16QAM, 0.48 | HST-SFN | 2x2 | 70 | 14.1 |
| 30 | R.PDSCH.2-20.1 TDD | 16QAM, 0.48 | HST-SFN | 2x2 | 70 | 14.4 |
| 40 | R.PDSCH.2-10.4 TDD | 16QAM, 0.48 | HST-SFN | 2x2 | 70 | 14.6 |
| 50 | R.PDSCH.2-20.2 TDD | 16QAM, 0.48 | HST-SFN | 2x2 | 70 | 14.7 |
| 60 | R.PDSCH.2-20.3 TDD | 16QAM, 0.48 | HST-SFN | 2x2 | 70 | 14.4 |
| 80 | R.PDSCH.2-20.4 TDD | 16QAM, 0.48 | HST-SFN | 2x2 | 70 | 14.9 |
| 90 | R.PDSCH.2-20.5 TDD | 16QAM, 0.48 | HST-SFN | 2x2 | 70 | 15.4 |
| 100 | R.PDSCH.2-21.1 TDD | 16QAM, 0.48 | HST-SFN | 2x2 | 70 | 14.8 |

Table 5.2A.2.4-5: Minimum performance for multiple CA configurations

|  |  |  |
| --- | --- | --- |
| **Test number** | **CA duplex mode** | **Minimum performance requirements** |
| 1 | FDD 15 kHz + FDD 15 kHz | As defined in Table 5.2A.2.4-3 |
| 2 | TDD 30 kHz + TDD 30 kHz | As defined in Table 5.2A.2.4-4 |
| 3 | FDD 15 kHz + TDD 30 kHz | As defined in Table 5.2A.2.4-3 and Table 5.2A.2.4-4 per CC |
| Note 1: The applicability of requirements for different CA duplex modes, SCSs, CA configurations and bandwidth combination sets is defined in 5.1.1.7.4. | | |

5.2A.2.5 Minimum requirements for PDSCH HST-DPS CA

For HST-DPS CA with different numbers of DL component carriers, the requirements are defined in Table 5.2A.2.5-7 and Table 5.2A.2.5-8 based on the single carrier requirements for different SCSs and different bandwidth specified in Table 5.2A.2.5-3 ~ Table 5.2A.2.5-6, with the parameters in Table 5.2A.2.5-2, Table 5.2A-2 and Table 5.2A-3 and the downlink physical channel setup according to Annex C.3.1. The performance requirements specified in this sub-clause do not apply for UE single carrier test.

The test purpose is specified in Table 5.2A.2.5-1.

Table 5.2A.2.5-1: Test purpose

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify UE performance in the HST-DPS scenario defined in B.3.3 with CA with 1 active PDSCH TCI states | 1-1, 1-2, 1-3 |
| Verify UE performance in the HST-DPS scenario defined in B.3.3 with CA with 2 active PDSCH TCI states | 2-1, 2-2, 2-3 |

Table 5.2A.2.5-2: Test parameters

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Value** |
| Duplex mode | | |  | FDD and TDD |
| Active DL BWP index | | |  | 1 |
| PDCCH configuration | TCI state | |  | Note 1 |
| PDSCH configuration | Mapping type | |  | Type A |
| k0 | |  | 0 |
| Starting symbol (S) | |  | 2 |
| Length (L) | |  | FDD: 12  TDD: Specific to each Reference channel |
| PDSCH aggregation factor | |  | 1 |
| PRB bundling type | |  | Static |
| PRB bundling size | |  | 2 |
| Resource allocation type | |  | Type 0 |
| RBG size | |  | Config2 |
| VRB-to-PRB mapping type | |  | Non-interleaved |
| VRB-to-PRB mapping interleaver bundle size | |  | N/A |
| TCI state | |  | Note 1 |
| PDSCH DMRS configuration | DMRS Type | |  | Type 1 |
| Number of additional DMRS | |  | 2 |
| Maximum number of OFDM symbols for DL front loaded DMRS | |  | 1 |
| CSI-RS for tracking | Resource set #1 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 5 for CSI-RS resource 1 and 3  l0 = 9 for CSI-RS resource 2 and 4 |
| CSI-RS periodicity | Slots | 15kHz SCS: 10 for CSI-RS resource 1,2,3,4.  30kHz SCS: 20 for CSI-RS resource 1,2,3,4 |
| CSI-RS offset | Slots | 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4 |
| QCL info |  | TCI state #2 |
| Frequency Occupation |  | Start PRB 0  Number of PRB = min(52, ceil(BWP size/4)\*4) |
| Resource set #2 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 6 for CSI-RS resource 5 and 7  l0 = 10 for CSI-RS resource 6 and 8 |
| CSI-RS periodicity | Slots | 15kHz SCS: 10 for CSI-RS resource 5,6,7,8.  30kHz SCS: 20 for CSI-RS resource 5,6,7,8. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 5 and 6 2 for CSI-RS resource 7 and 8 |
| QCL info |  | TCI state #3 |
| Frequency Occupation |  | Start PRB 0  Number of PRB = min(52, ceil(BWP size/4)\*4) |
| NZP CSI-RS for CSI acquisition | Resource set #3 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 12 |
| CSI-RS periodicity | Slots | 15kHz SCS:20  30kHz SCS: 40 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #0 |
| Resource set #4 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 13 |
| CSI-RS periodicity | Slots | 15kHz SCS:20  30kHz SCS: 40 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #1 |
| TCI state #0 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking Resource set #1' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #1 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #2 | Type 1 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| TCI state #3 | Type 1 QCL information | SSB index |  | SSB #1 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| Number of HARQ Processes | | |  | As defined in Table 5.2A-2 |
| TDD UL-DL pattern | | |  | 15kHz SCS: FR1.15-1  30kHz SCS: FR1.30-1 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | | |  | As defined in Table 5.2A-3 |
| Number of PUCCH ResourceGroups | | |  | 1 |
| PUCCH format for HARQ-ACK feedback | | |  | PUCCH format 1 for cases with no more chan 2 DL CCs  PUCCH format 3 for cases with more than 2 DL CCs |
| Note 1: SSB # (k mod 2), CSI-RS (for tracking) resource set # ((k mod 2) + 1) and CSI-RS (for CSI acquisition) resource set # ((k mod 2) + 3) are transmitted by kth RRH.  For Test 1-1, TCI state switching command scheduled by MAC CE with MCS 4 is transmitted in slot #i that satisfy. PDCCH and PDSCH associated with TCI # (k mod 2) is transmitted by kth RRH from slot#  to slot#  ,  PDCCH and PDSCH are DTXed in other slots in which throughput statistics are not considered.  For Test 1-2, TCI state switching command scheduled by MAC CE with MCS 4 is transmitted in slot #i that satisfy. PDCCH and PDSCH associated with TCI # (k mod 2) is transmitted by kth RRH from slot#  to slot#  Where k=0, 1, 2… is the RRH number, n = 2520 is half of the number of slots between two RRH, = 2 is the number of slots between PDSCH and corresponding HARQ-ACK information, = 3 is the number of slots for MAC CE processing, = 6 is the number of slots to first TRS transmission occasion after MAC CE command is decoded by the UE, = 2 is the number of slots for TRS processing. | | | | |

Table 5.2A.2.5-3: Single carrier performance for FDD 15 kHz SCS for HST-DPS CA configurations with 1 active PDSCH TCI states

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Bandwidth (MHz)** | **Reference channel** | **Modulation format and code rate** | **Propagation condition** | **Number of active PDSCH TCI states** | **Correlation matrix and antenna configuration** | **Reference value** | |
| **Fraction of maximum throughput (%)** | **SNR (dB)** |
| 5 | R.PDSCH.1-15.1 | 64QAM, 0.43 | HST-DPS | 1 | 2x2 | 70 | 13.2 |
| 10 | R.PDSCH.1-8.4 FDD | 64QAM, 0.43 | HST-DPS | 1 | 2x2 | 70 | 13.6 |
| 15 | R.PDSCH.1-15.2 | 64QAM, 0.43 | HST-DPS | 1 | 2x2 | 70 | 13.6 |
| 20 | R.PDSCH.1-15.3 | 64QAM, 0.43 | HST-DPS | 1 | 2x2 | 70 | 13.4 |
| 25 | R.PDSCH.1-15.4 | 64QAM, 0.43 | HST-DPS | 1 | 2x2 | 70 | 13.6 |
| 30 | R.PDSCH.1-15.5 | 64QAM, 0.43 | HST-DPS | 1 | 2x2 | 70 | 13.6 |
| 35 | R.PDSCH.1-16.3 | 64QAM, 0.43 | HST-DPS | 1 | 2x2 | 70 | 13.4 |
| 40 | R.PDSCH.1-16.1 | 64QAM, 0.43 | HST-DPS | 1 | 2x2 | 70 | 13.6 |
| 45 | R.PDSCH.1-16.4 | 64QAM, 0.43 | HST-DPS | 1 | 2x2 | 70 | 13.4 |
| 50 | R.PDSCH.1-16.2 | 64QAM, 0.43 | HST-DPS | 1 | 2x2 | 70 | 13.7 |

Table 5.2A.2.5-4: Single carrier performance for FDD 15 kHz SCS for HST-DPS CA configurations with 2 active PDSCH TCI states

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Bandwidth (MHz)** | **Reference channel** | **Modulation format and code rate** | **Propagation condition** | **Number of active PDSCH TCI states** | **Correlation matrix and antenna configuration** | **Reference value** | |
| **Fraction of maximum throughput (%)** | **SNR (dB)** |
| 5 | R.PDSCH.1-15.1 | 64QAM, 0.43 | HST-DPS | 2 | 2x2 | 70 | 13.2 |
| 10 | R.PDSCH.1-8.4 FDD | 64QAM, 0.43 | HST-DPS | 2 | 2x2 | 70 | 13.6 |
| 15 | R.PDSCH.1-15.2 | 64QAM, 0.43 | HST-DPS | 2 | 2x2 | 70 | 13.6 |
| 20 | R.PDSCH.1-15.3 | 64QAM, 0.43 | HST-DPS | 2 | 2x2 | 70 | 13.4 |
| 25 | R.PDSCH.1-15.4 | 64QAM, 0.43 | HST-DPS | 2 | 2x2 | 70 | 13.6 |
| 30 | R.PDSCH.1-15.5 | 64QAM, 0.43 | HST-DPS | 2 | 2x2 | 70 | 13.6 |
| 35 | R.PDSCH.1-16.3 | 64QAM, 0.43 | HST-DPS | 2 | 2x2 | 70 | 13.4 |
| 40 | R.PDSCH.1-16.1 | 64QAM, 0.43 | HST-DPS | 2 | 2x2 | 70 | 13.6 |
| 45 | R.PDSCH.1-16.4 | 64QAM, 0.43 | HST-DPS | 2 | 2x2 | 70 | 13.4 |
| 50 | R.PDSCH.1-16.2 | 64QAM, 0.43 | HST-DPS | 2 | 2x2 | 70 | 13.7 |

Table 5.2A.2.5-5 Single carrier performance for TDD 30 kHz SCS for HST-DPS CA configurations with 1 active PDSCH TCI states

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Bandwidth (MHz)** | **Reference channel** | **Modulation format and code rate** | **Propagation condition** | **Number of active PDSCH TCI states** | **Correlation matrix and antenna configuration** | **Reference value** | |
| **Fraction of maximum throughput (%)** | **SNR (dB)** |
| 5 | R.PDSCH.2-22.1 | 64QAM, 0.43 | HST-DPS | 1 | 2x2 | 70 | 13.3 |
| 10 | R.PDSCH.2-22.2 | 64QAM, 0.43 | HST-DPS | 1 | 2x2 | 70 | 13.3 |
| 15 | R.PDSCH.2-22.3 | 64QAM, 0.43 | HST-DPS | 1 | 2x2 | 70 | 13.2 |
| 20 | R.PDSCH.2-22.4 | 64QAM, 0.43 | HST-DPS | 1 | 2x2 | 70 | 13.3 |
| 25 | R.PDSCH.2-22.5 | 64QAM, 0.43 | HST-DPS | 1 | 2x2 | 70 | 13.4 |
| 30 | R.PDSCH.2-23.1 | 64QAM, 0.43 | HST-DPS | 1 | 2x2 | 70 | 13.4 |
| 40 | R.PDSCH.2-10.5 TDD | 64QAM, 0.43 | HST-DPS | 1 | 2x2 | 70 | 13.3 |
| 50 | R.PDSCH.2-23.2 | 64QAM, 0.43 | HST-DPS | 1 | 2x2 | 70 | 13.5 |
| 60 | R.PDSCH.2-23.3 | 64QAM, 0.43 | HST-DPS | 1 | 2x2 | 70 | 13.5 |
| 80 | R.PDSCH.2-23.4 | 64QAM, 0.43 | HST-DPS | 1 | 2x2 | 70 | 13.4 |
| 90 | R.PDSCH.2-23.5 | 64QAM, 0.43 | HST-DPS | 1 | 2x2 | 70 | 13.6 |
| 100 | R.PDSCH.2-24.1 | 64QAM, 0.43 | HST-DPS | 1 | 2x2 | 70 | 13.5 |

Table 5.2A.2.5-6 Single carrier performance for TDD 30 kHz SCS for HST-DPS CA configurations with 2 active PDSCH TCI states

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Bandwidth (MHz)** | **Reference channel** | **Modulation format and code rate** | **Propagation condition** | **Number of active PDSCH TCI states** | **Correlation matrix and antenna configuration** | **Reference value** | |
| **Fraction of maximum throughput (%)** | **SNR (dB)** |
| 5 | R.PDSCH.2-22.1 | 64QAM, 0.43 | HST-DPS | 2 | 2x2 | 70 | 13.3 |
| 10 | R.PDSCH.2-22.2 | 64QAM, 0.43 | HST-DPS | 2 | 2x2 | 70 | 13.3 |
| 15 | R.PDSCH.2-22.3 | 64QAM, 0.43 | HST-DPS | 2 | 2x2 | 70 | 13.2 |
| 20 | R.PDSCH.2-22.4 | 64QAM, 0.43 | HST-DPS | 2 | 2x2 | 70 | 13.3 |
| 25 | R.PDSCH.2-22.5 | 64QAM, 0.43 | HST-DPS | 2 | 2x2 | 70 | 13.4 |
| 30 | R.PDSCH.2-23.1 | 64QAM, 0.43 | HST-DPS | 2 | 2x2 | 70 | 13.4 |
| 40 | R.PDSCH.2-10.5 TDD | 64QAM, 0.43 | HST-DPS | 2 | 2x2 | 70 | 13.3 |
| 50 | R.PDSCH.2-23.2 | 64QAM, 0.43 | HST-DPS | 2 | 2x2 | 70 | 13.5 |
| 60 | R.PDSCH.2-23.3 | 64QAM, 0.43 | HST-DPS | 2 | 2x2 | 70 | 13.5 |
| 80 | R.PDSCH.2-23.4 | 64QAM, 0.43 | HST-DPS | 2 | 2x2 | 70 | 13.4 |
| 90 | R.PDSCH.2-23.5 | 64QAM, 0.43 | HST-DPS | 2 | 2x2 | 70 | 13.6 |
| 100 | R.PDSCH.2-24.1 | 64QAM, 0.43 | HST-DPS | 2 | 2x2 | 70 | 13.5 |

Table 5.2A.2.5-7: Minimum performance for HST-DPS CA configurations with 1 active PDSCH TCI states

|  |  |  |
| --- | --- | --- |
| **Test number** | **CA duplex mode** | **Minimum performance requirements** |
| 1-1 | FDD 15 kHz + FDD 15 kHz | As defined in Table 5.2A.2.5-3 |
| 1-2 | TDD 30 kHz + TDD 30 kHz | As defined in Table 5.2A.2.5-5 |
| 1-3 | FDD 15 kHz + TDD 30 kHz | As defined in Table 5.2A.2.5-3 and Table 5.2A.2.5-5 per CC |
| Note 1: The applicability of requirements for different CA duplex modes, SCSs, CA configurations and bandwidth combination sets is defined in 5.1.1.7.4. | | |

Table 5.2A.2.5-8: Minimum performance for HST-DPS CA configurations with 2 active PDSCH TCI states

|  |  |  |
| --- | --- | --- |
| **Test number** | **CA duplex mode** | **Minimum performance requirements** |
| 2-1 | FDD 15 kHz + FDD 15 kHz | As defined in Table 5.2A.2.5-4 |
| 2-2 | TDD 30 kHz + TDD 30 kHz | As defined in Table 5.2A.2.5-6 |
| 2-3 | FDD 15 kHz + TDD 30 kHz | As defined in Table 5.2A.2.5-4 and Table 5.2A.2.5-6 per CC |
| Note 1: The applicability of requirements for different CA duplex modes, SCSs, CA configurations and bandwidth combination sets is defined in 5.1.1.7.4. | | |

### 5.2A.3 4RX requirements

#### 5.2A.3.1 Minimum requirements

For CA with different numbers of DL component carriers, the requirements are defined in Table 5.2A.3.1-4 based on the single carrier requirements for different SCSs and different bandwidth specified in Table 5.2A.3.1-1 ~ Table 5.2A.3.1-3, with the parameters in Table 5.2A-1 ~ Table 5.2A-3 and the downlink physical channel setup according to Annex C.3.1. The performance requirements specified in this sub-clause do not apply for UE single carrier test.

Table 5.2A.3.1-1: Single carrier performance for FDD 15 kHz SCS for CA configurations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Bandwidth (MHz) | Reference channel | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB) |
| 5 | R.PDSCH.1-9.1 FDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 8.5 |
| 10 | R.PDSCH.1-2.2 FDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 8.5 |
| 15 | R.PDSCH.1-9.2 FDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 8.6 |
| 20 | R.PDSCH.1-9.3 FDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 8.6 |
| 25 | R.PDSCH.1-9.4 FDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 8.7 |
| 30 | R.PDSCH.1-9.5 FDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 8.6 |
| 40 | R.PDSCH.1-10.1 FDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 8.7 |
| 50 | R.PDSCH.1-10.2 FDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 8.9 |

Table 5.2A.3.1-2: Single carrier performance for TDD 15 kHz SCS for CA configurations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Bandwidth (MHz) | Reference channel | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB) |
| 5 | R.PDSCH.1-2.1 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 8.5 |
| 10 | R.PDSCH.1-2.2 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 8.6 |
| 15 | R.PDSCH.1-2.3 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 8.7 |
| 20 | R.PDSCH.1-2.4 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 8.6 |
| 25 | R.PDSCH.1-2.5 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 8.8 |
| 30 | R.PDSCH.1-3.1 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 8.6 |
| 40 | R.PDSCH.1-3.2 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 8.8 |
| 50 | R.PDSCH.1-3.3 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 9.0 |

Table 5.2A.3.1-3: Single carrier performance for TDD 30 kHz SCS for CA configurations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Bandwidth (MHz) | Reference channel | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB) |
| 5 | R.PDSCH.2-13.1 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 8.5 |
| 10 | R.PDSCH.2-13.2 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 8.5 |
| 15 | R.PDSCH.2-13.3 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 8.5 |
| 20 | R.PDSCH.2-13.4 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 8.6 |
| 25 | R.PDSCH.2-13.5 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 8.6 |
| 30 | R.PDSCH.2-14.1 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 8.6 |
| 40 | R.PDSCH.2-2.2 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 8.7 |
| 50 | R.PDSCH.2-14.2 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 8.9 |
| 60 | R.PDSCH.2-14.3 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 8.8 |
| 80 | R.PDSCH.2-14.4 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 9.1 |
| 90 | R.PDSCH.2-14.5 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 9.0 |
| 100 | R.PDSCH.2-15.1 TDD | 16QAM, 0.48 | TDLA30-10 | 2x4, ULA Low | 70 | 9.3 |

Table 5.2A.3.1-4: Minimum performance for multiple CA configurations

|  |  |  |
| --- | --- | --- |
| Test number | CA duplex mode | Minimum performance requirements |
| 1 | FDD 15 kHz + FDD 15 kHz | As defined in Table 5.2A.3.1-1 |
| 2 | TDD 30 kHz + TDD 30 kHz | As defined in Table 5.2A.3.1-3 |
| 3 | FDD 15 kHz + TDD 30 kHz | As defined in Table 5.2A.3.1-1 and Table 5.2A.3.1-3 per CC |
| 4 | FDD 15 kHz + TDD 15 kHz | As defined in Table 5.2A.3.1-1 and Table 5.2A.3.1-2 per CC |
| 5 | TDD 15 kHz + TDD 30 kHz | As defined in Table 5.2A.3.1-2 and Table 5.2A.3.1-3 per CC |
| Note 1: The applicability of requirements for different CA duplex modes, SCSs, CA configurations and bandwidth combination sets is defined in 5.1.1.7. | | |

#### 5.2A.3.2 Minimum requirements for carrier aggregation with power imbalance

The performance requirements are specified in Table 5.2A.3.2-3 and Table 5.2A.3.2-4, with the addition of test parameters in Table 5.2A.3.2-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2A.3.2-1.

Table 5.2A.3.2-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the ability of an intra-band adjacent carrier aggregation UE to demodulate the signal transmitted by the PCell or SCell in the presence of a stronger SCell or PCell signal on an adjacent frequency. Throughput is measured on the PCell or SCell only |  |

Table 5.2A.3.2-2: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | Value |
| Duplex mode | |  | FDD and TDD |
| Active DL BWP index | |  | 1 |
| Propagation condition | |  | Static propagation condition  No external noise sources are applied |
| Antenna configuration | |  | 1x4 |
| PDSCH configuration | Length (L) |  | FDD: 12TDD: 12 for DL slot, 4 for special slot |
| PRB bundling size |  | WB |
| Modulation and code rate | |  | 64QAM, MCS 27 |
| Number of HARQ Processes | |  | FDD: 4  TDD: 8 |
| Maximum number of HARQ transmission | |  | 1 |
| Redundancy version coding sequence | |  | {0} |
| TDD UL-DL pattern | |  | 30kHz SCS: FR1.30-1 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | As defined in Table A.1.2-2 for FR1.30-1 |
| PUCCH format for HARQ-ACK feedback | |  | PUCCH format 1 |
| Overhead for TBS determination | |  | 0 |
| SSB transmission | |  | Slot#0 with periodicity 20ms |
| RB assignment | |  | Full applicable test bandwidth as defined in Table 5.3.5-1 of TS 38.101-1 [6] |

Table 5.2A.3.2-3: Minimum performance for FDD CA with 15 kHz SCS

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test Number | Bandwidth (MHz) | | Reference channel | | Power at antenna port (dBm/Hz) | | Reference value  Fraction of Maximum  Throughput (%) | |
| PCell | SCell | PCell | SCell | for PCell | for Scell | PCell | SCell |
| 1 | Selected Channel bandwidth as per section 5.1.1.6 | | Derived as per section 5.1.3.2 of TS 38.214 [12] | NA | -112 | -106 | 85 | NA |

Table 5.2A.3.2-4: Minimum performance for TDD CA with 30 kHz SCS

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test Number | Bandwidth (MHz) | | Reference channel | | Power at antenna port (dBm/Hz) | | Reference value  Fraction of Maximum  Throughput (%) | |
| PCell | SCell | PCell | SCell | for PCell | for Scell | PCell | SCell |
| 1 | Selected Channel bandwidth as per section 5.1.1.6 | | Derived as per section 5.1.3.2 of TS 38.214 [12] | NA | -112 | -106 | 85 | NA |

#### 5.2A.3.3 Minimum requirements for PDSCH of SCell on band with shared spectrum access

The performance requirements for SCell on band with shared spectrum access are specified in Table 5.2.3.2.15-3, with the additional test parameters for SCell in Table 5.2.3.2.15-2, the test parameters for PCell in Table 5.2A.3.3-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2A.3.3-1. During the test, only the PDSCH performance of the SCell should be verified.

Table 5.2A.3.3-1: Tests purpose

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify the PDSCH performance of SCell for UE supporting operations in shared spectrum access | 1-1, 1-2, 1-3, 1-4 |

Table 5.2A.3.3-2: Test parameters for PCell

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Value** |
| Duplex mode | |  | TDD |
| Bandwidth | | MHz | 20 |
| Subcarrier spacing | | kHz | 30 |
| Active DL BWP index | |  | 1 |
| TDD pattern | |  | FR1.30-1 |
| 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 |  | 2 |
|  | 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 |
|  | Dmrs-AdditionalPosition |  | pos1 |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 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 |

#### 5.2A.3.4 Minimum requirements for HST-SFN CA

For HST-SFN CA with different numbers of DL component carriers, the requirements are defined in Table 5.2A.3.4-5 based on the single carrier requirements for different SCSs and different bandwidth specified in Table 5.2A.3.4-3 ~ Table 5.2A.3.4-4, with the parameters in Table 5.2A.3.4-2, Table 5.2A-2, Table 5.2A-3, and the downlink physical channel setup according to Annex C.3.1. The performance requirements specified in this sub-clause do not apply for UE single carrier test.

The test purpose is specified in Table 5.2A.3.4-1.

Table 5.2A.3.4-1: Test purpose

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify PDSCH performance under 4 receive antenna conditions in the HST-SFN scenario defined in B.3.2 with CA | 1, 2, 3 |

Table 5.2A.3.4-2: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Value** |
| Duplex mode | |  | FDD and TDD |
| 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 |  | 2 |
|  | 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 |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| CSI-RS for tracking | CSI-RS periodicity | Slots | FDD: 10 for CSI-RS resource 1,2,3,4.  TDD: 20 for CSI-RS resource 1,2,3,4. |
|  | CSI-RS offset | Slots | 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4. |
| Number of HARQ Processes | |  | As defined in Table 5.2A-2 |
| TDD UL-DL pattern | |  | 15 kHz SCS: FR1.15-1  30 kHz SCS: FR1.30-1 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | As defined in Table 5.2A-3 |
| Number of PUCCH ResourceGroups | |  | 1 |
| PUCCH format for HARQ-ACK feedback | |  | PUCCH format 1 for cases with no more than 2 DL CCs  PUCCH format 3 for cases with more than 2 DL CCs |

Table 5.2A.3.4-3: Single carrier performance for FDD 15 kHz SCS for CA configurations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Bandwidth (MHz)** | **Reference channel** | **Modulation format and code rate** | **Propagation condition** | **Correlation matrix and antenna configuration** | **Reference value** | |
| **Fraction of maximum throughput (%)** | **SNR (dB)** |
| 5 | R.PDSCH.1-13.1 FDD | 16QAM, 0.48 | HST-SFN | 2x4 | 70 | 10.5 |
| 10 | R.PDSCH.1-8.3 FDD | 16QAM, 0.48 | HST-SFN | 2x4 | 70 | 10.7 |
| 15 | R.PDSCH.1-13.2 FDD | 16QAM, 0.48 | HST-SFN | 2x4 | 70 | 11.1 |
| 20 | R.PDSCH.1-13.3 FDD | 16QAM, 0.48 | HST-SFN | 2x4 | 70 | 11.5 |
| 25 | R.PDSCH.1-13.4 FDD | 16QAM, 0.48 | HST-SFN | 2x4 | 70 | 11.6 |
| 30 | R.PDSCH.1-13.5 FDD | 16QAM, 0.48 | HST-SFN | 2x4 | 70 | 11.8 |
| 35 | R.PDSCH.1-14.3 FDD | 16QAM, 0.48 | HST-SFN | 2x4 | 70 | 11.7 |
| 40 | R.PDSCH.1-14.1 FDD | 16QAM, 0.48 | HST-SFN | 2x4 | 70 | 11.9 |
| 45 | R.PDSCH.1-14.4 FDD | 16QAM, 0.48 | HST-SFN | 2x4 | 70 | 11.7 |
| 50 | R.PDSCH.1-14.2 FDD | 16QAM, 0.48 | HST-SFN | 2x4 | 70 | 11.9 |

Table 5.2A.3.4-4: Single carrier performance for TDD 30 kHz SCS for CA configurations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Bandwidth (MHz)** | **Reference channel** | **Modulation format and code rate** | **Propagation condition** | **Correlation matrix and antenna configuration** | **Reference value** | |
| **Fraction of maximum throughput (%)** | **SNR (dB)** |
| 5 | R.PDSCH.2-19.1 TDD | 16QAM, 0.48 | HST-SFN | 2x4 | 70 | 12.0 |
| 10 | R.PDSCH.2-19.2 TDD | 16QAM, 0.48 | HST-SFN | 2x4 | 70 | 11.8 |
| 15 | R.PDSCH.2-19.3 TDD | 16QAM, 0.48 | HST-SFN | 2x4 | 70 | 12.1 |
| 20 | R.PDSCH.2-19.4 TDD | 16QAM, 0.48 | HST-SFN | 2x4 | 70 | 11.8 |
| 25 | R.PDSCH.2-19.5 TDD | 16QAM, 0.48 | HST-SFN | 2x4 | 70 | 11.9 |
| 30 | R.PDSCH.2-20.1 TDD | 16QAM, 0.48 | HST-SFN | 2x4 | 70 | 12.2 |
| 40 | R.PDSCH.2-10.4 TDD | 16QAM, 0.48 | HST-SFN | 2x4 | 70 | 12.4 |
| 50 | R.PDSCH.2-20.2 TDD | 16QAM, 0.48 | HST-SFN | 2x4 | 70 | 12.6 |
| 60 | R.PDSCH.2-20.3 TDD | 16QAM, 0.48 | HST-SFN | 2x4 | 70 | 12.5 |
| 80 | R.PDSCH.2-20.4 TDD | 16QAM, 0.48 | HST-SFN | 2x4 | 70 | 12.7 |
| 90 | R.PDSCH.2-20.5 TDD | 16QAM, 0.48 | HST-SFN | 2x4 | 70 | 12.7 |
| 100 | R.PDSCH.2-21.1 TDD | 16QAM, 0.48 | HST-SFN | 2x4 | 70 | 12.7 |

Table 5.2A.3.4-5: Minimum performance for multiple CA configurations

|  |  |  |
| --- | --- | --- |
| **Test number** | **CA duplex mode** | **Minimum performance requirements** |
| 1 | FDD 15 kHz + FDD 15 kHz | As defined in Table 5.2A.3.4-3 |
| 2 | TDD 30 kHz + TDD 30 kHz | As defined in Table 5.2A.3.4-4 |
| 3 | FDD 15 kHz + TDD 30 kHz | As defined in Table 5.2A.3.X1-3 and Table 5.2A.3.4-4 per CC |
| Note 1: The applicability of requirements for different CA duplex modes, SCSs, CA configurations and bandwidth combination sets is defined in Section 5.1.1.7.4. | | |

#### 5.2A.3.5 Minimum requirements for PDSCH HST-DPS CA

For HST-DPS CA with different numbers of DL component carriers, the requirements are defined in Table 5.2A.3.5-7 and Table 5.2A.3.5-8 based on the single carrier requirements for different SCSs and different bandwidth specified in Table 5.2A.3.5-3 - Table 5.2A.3.5-6, with the parameters in Table 5.2A.3.5-2, Table 5.2A-2 and Table 5.2A-3 and the downlink physical channel setup according to Annex C.3.1. The performance requirements specified in this sub-clause do not apply for UE single carrier test.

The test purpose is specified in Table 5.2A.3.5-1.

Table 5.2A.3.5-1: Test purpose

|  |  |
| --- | --- |
| **Purpose** | **Test index** |
| Verify PDSCH performance of UE under 4 receive antenna conditions in the HST-DPS scenario defined in B.3.3 with CA with 1 active TCI state | 1-1, 1-2, 1-3 |
| Verify PDSCH performance of UE under 4 receive antenna conditions in the HST-DPS scenario defined in B.3.3 with CA with 2 active TCI states | 2-1, 2-2, 2-3 |

Table 5.2A.3.5-2: Test parameters

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Value** |
| Duplex mode | | |  | FDD and TDD |
| Active DL BWP index | | |  | 1 |
| PDCCH configuration | TCI state | |  | Note 1 |
| PDSCH configuration | Mapping type | |  | Type A |
| k0 | |  | 0 |
| Starting symbol (S) | |  | 2 |
| Length (L) | |  | FDD: 12  TDD: Specific to each Reference channel |
| PDSCH aggregation factor | |  | 1 |
| PRB bundling type | |  | Static |
| PRB bundling size | |  | 2 |
| Resource allocation type | |  | Type 0 |
| RBG size | |  | Config2 |
| VRB-to-PRB maping type | |  | Non-interleaved |
| VRB-to-PRB mapping interleaver bundle size | |  | N/A |
| TCI state | |  | Note 1 |
| PDSCH DMRS configuration | DMRS Type | |  | Type 1 |
| Number of additional DMRS | |  | 2 |
| Maximum number of OFDM symbols for DL front loaded DMRS | |  | 1 |
| CSI-RS for tracking | Resource set #1 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 5 for CSI-RS resource 1 and 3  l0 = 9 for CSI-RS resource 2 and 4 |
| CSI-RS periodicity | Slots | 15kHz SCS: 10 for CSI-RS resource 1,2,3,4.  30kHz SCS: 20 for CSI-RS resource 1,2,3,4 |
| CSI-RS offset | Slots | 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4 |
| QCL info |  | TCI state #2 |
| Frequency Occupation |  | Start PRB 0  Number of PRB = min(52, ceil(BWP size/4)\*4) |
| Resource set #2 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 6 for CSI-RS resource 5 and 7  l0 = 10 for CSI-RS resource 6 and 8 |
| CSI-RS periodicity | Slots | 15kHz SCS: 10 for CSI-RS resource 5,6,7,8.  30kHz SCS: 20 for CSI-RS resource 5,6,7,8. |
| CSI-RS offset | Slots | 1 for CSI-RS resource 5 and 6 2 for CSI-RS resource 7 and 8 |
| QCL info |  | TCI state #3 |
| Frequency Occupation |  | Start PRB 0  Number of PRB = min(52, ceil(BWP size/4)\*4) |
| NZP CSI-RS for CSI acquisition | Resource set #3 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 12 |
| CSI-RS periodicity | Slots | 15kHz SCS:20  30kHz SCS: 40 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #0 |
| Resource set #4 | First OFDM symbol in the PRB used for CSI-RS |  | l0 = 13 |
| CSI-RS periodicity | Slots | 15kHz SCS:20  30kHz SCS: 40 |
| CSI-RS offset | Slots | 0 |
| QCL info |  | TCI state #1 |
| TCI state #0 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking Resource set #1' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #1 | Type 1 QCL information | CSI-RS resource |  | CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration |
| QCL Type |  | Type A |
| Type 2 QCL information | CSI-RS resource |  | N/A |
| QCL Type |  | N/A |
| TCI state #2 | Type 1 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| TCI state #3 | Type 1 QCL information | SSB index |  | SSB #1 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| Number of HARQ Processes | | |  | As defined in Table 5.2A-2 |
| TDD UL-DL pattern | | |  | 15kHz SCS: FR1.15-1  30kHz SCS: FR1.30-1 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | | |  | As defined in Table 5.2A-3 |
| Number of PUCCH ResourceGroups | | |  | 1 |
| PUCCH format for HARQ-ACK feedback | | |  | PUCCH format 1 for cases with no more chan 2 DL CCs  PUCCH format 3 for cases with more than 2 DL CCs |
| Note 1: SSB # (k mod 2), CSI-RS (for tracking) resource set # ((k mod 2) + 1) and CSI-RS (for CSI acquisition) resource set # ((k mod 2) + 3) are transmitted by kth RRH.  For Test 1-1, TCI state switching command scheduled by MAC CE with MCS 4 is transmitted in slot #i that satisfy. PDCCH and PDSCH associated with TCI # (k mod 2) is transmitted by kth RRH from slot#  to slot#  ,  PDCCH and PDSCH are DTXed in other slots in which throughput statistics are not considered.  For Test 1-2, TCI state switching command scheduled by MAC CE with MCS 4 is transmitted in slot #i that satisfy. PDCCH and PDSCH associated with TCI # (k mod 2) is transmitted by kth RRH from slot#  to slot#  Where k=0, 1, 2… is the RRH number, n = 2520 is half of the number of slots between two RRH, = 2 is the number of slots between PDSCH and corresponding HARQ-ACK information, = 3 is the number of slots for MAC CE processing, = 6 is the number of slots to first TRS transmission occasion after MAC CE command is decoded by the UE, = 2 is the number of slots for TRS processing. | | | | |

Table 5.2A.3.5-3: Single carrier performance for FDD 15 kHz SCS for HST-DPS CA configurations with 1 active PDSCH TCI states

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Bandwidth (MHz) | Reference channel | Modulation format and code rate | Propagation condition | Number of active PDSCH TCI states | Correlation matrix and antenna configuration | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB) |
| 5 | R.PDSCH.1-15.1 | 64QAM, 0.43 | HST-DPS | 1 | 2x4 | 70 | 10.5 |
| 10 | R.PDSCH.1-8.4 FDD | 64QAM, 0.43 | HST-DPS | 1 | 2x4 | 70 | 10.8 |
| 15 | R.PDSCH.1-15.2 | 64QAM, 0.43 | HST-DPS | 1 | 2x4 | 70 | 10.7 |
| 20 | R.PDSCH.1-15.3 | 64QAM, 0.43 | HST-DPS | 1 | 2x4 | 70 | 10.5 |
| 25 | R.PDSCH.1-15.4 | 64QAM, 0.43 | HST-DPS | 1 | 2x4 | 70 | 10.8 |
| 30 | R.PDSCH.1-15.5 | 64QAM, 0.43 | HST-DPS | 1 | 2x4 | 70 | 10.9 |
| 35 | R.PDSCH.1-16.3 | 64QAM, 0.43 | HST-DPS | 1 | 2x4 | 70 | 10.6 |
| 40 | R.PDSCH.1-16.1 | 64QAM, 0.43 | HST-DPS | 1 | 2x4 | 70 | 10.7 |
| 45 | R.PDSCH.1-16.4 | 64QAM, 0.43 | HST-DPS | 1 | 2x4 | 70 | 10.6 |
| 50 | R.PDSCH.1-16.2 | 64QAM, 0.43 | HST-DPS | 1 | 2x4 | 70 | 11.0 |

Table 5.2A.3.5-4: Single carrier performance for FDD 15 kHz SCS for HST-DPS CA configurations with 2 active PDSCH TCI states

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bandwidth (MHz) | Reference channel | Modulation format and code rate | | Propagation condition | Number of active PDSCH TCI states | Correlation matrix and antenna configuration | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB) |
| 5 | R.PDSCH.1-15.1 | 64QAM, 0.43 | | HST-DPS | 2 | 2x4 | 70 | 10.5 |
| 10 | R.PDSCH.1-8.4 FDD | 64QAM, 0.43 | | HST-DPS | 2 | 2x4 | 70 | 10.8 |
| 15 | R.PDSCH.1-15.2 | 64QAM, 0.43 | | HST-DPS | 2 | 2x4 | 70 | 10.7 |
| 20 | R.PDSCH.1-15.3 | 64QAM, 0.43 | | HST-DPS | 2 | 2x4 | 70 | 10.5 |
| 25 | R.PDSCH.1-15.4 | 64QAM, 0.43 | | HST-DPS | 2 | 2x4 | 70 | 10.8 |
| 30 | R.PDSCH.1-15.5 | 64QAM, 0.43 | | HST-DPS | 2 | 2x4 | 70 | 10.9 |
| 35 | R.PDSCH.1-16.3 | 64QAM, 0.43 | | HST-DPS | 2 | 2x4 | 70 | 10.6 |
| 40 | R.PDSCH.1-16.1 | 64QAM, 0.43 | | HST-DPS | 2 | 2x4 | 70 | 10.7 |
| 45 | R.PDSCH.1-16.4 | | 64QAM, 0.43 | HST-DPS | 2 | 2x4 | 70 | 10.6 |
| 50 | R.PDSCH.1-16.2 | 64QAM, 0.43 | | HST-DPS | 2 | 2x4 | 70 | 11.0 |

Table 5.2A.3.5-5 Single carrier performance for TDD 30 kHz SCS for HST-DPS CA configurations with 1 active PDSCH TCI states

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Bandwidth (MHz) | Reference channel | Modulation format and code rate | Propagation condition | Number of active PDSCH TCI states | Correlation matrix and antenna configuration | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB) |
| 5 | R.PDSCH.2-22.1 | 64QAM, 0.43 | HST-DPS | 1 | 2x4 | 70 | 10.4 |
| 10 | R.PDSCH.2-22.2 | 64QAM, 0.43 | HST-DPS | 1 | 2x4 | 70 | 10.5 |
| 15 | R.PDSCH.2-22.3 | 64QAM, 0.43 | HST-DPS | 1 | 2x4 | 70 | 10.5 |
| 20 | R.PDSCH.2-22.4 | 64QAM, 0.43 | HST-DPS | 1 | 2x4 | 70 | 10.5 |
| 25 | R.PDSCH.2-22.5 | 64QAM, 0.43 | HST-DPS | 1 | 2x4 | 70 | 10.6 |
| 30 | R.PDSCH.2-23.1 | 64QAM, 0.43 | HST-DPS | 1 | 2x4 | 70 | 10.5 |
| 40 | R.PDSCH.2-10.5 TDD | 64QAM, 0.43 | HST-DPS | 1 | 2x4 | 70 | 10.5 |
| 50 | R.PDSCH.2-23.2 | 64QAM, 0.43 | HST-DPS | 1 | 2x4 | 70 | 10.7 |
| 60 | R.PDSCH.2-23.3 | 64QAM, 0.43 | HST-DPS | 1 | 2x4 | 70 | 10.7 |
| 80 | R.PDSCH.2-23.4 | 64QAM, 0.43 | HST-DPS | 1 | 2x4 | 70 | 10.5 |
| 90 | R.PDSCH.2-23.5 | 64QAM, 0.43 | HST-DPS | 1 | 2x4 | 70 | 10.7 |
| 100 | R.PDSCH.2-24.1 | 64QAM, 0.43 | HST-DPS | 1 | 2x4 | 70 | 10.7 |

Table 5.2A.3.5-6 Single carrier performance for TDD 30 kHz SCS for HST-DPS CA configurations with 2 active PDSCH TCI states

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Bandwidth (MHz) | Reference channel | Modulation format and code rate | Propagation condition | Number of active PDSCH TCI states | Correlation matrix and antenna configuration | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB) |
| 5 | R.PDSCH.2-22.1 | 64QAM, 0.43 | HST-DPS | 2 | 2x4 | 70 | 10.4 |
| 10 | R.PDSCH.2-22.2 | 64QAM, 0.43 | HST-DPS | 2 | 2x4 | 70 | 10.5 |
| 15 | R.PDSCH.2-22.3 | 64QAM, 0.43 | HST-DPS | 2 | 2x4 | 70 | 10.5 |
| 20 | R.PDSCH.2-22.4 | 64QAM, 0.43 | HST-DPS | 2 | 2x4 | 70 | 10.5 |
| 25 | R.PDSCH.2-22.5 | 64QAM, 0.43 | HST-DPS | 2 | 2x4 | 70 | 10.6 |
| 30 | R.PDSCH.2-23.1 | 64QAM, 0.43 | HST-DPS | 2 | 2x4 | 70 | 10.5 |
| 40 | R.PDSCH.2-10.5 TDD | 64QAM, 0.43 | HST-DPS | 2 | 2x4 | 70 | 10.5 |
| 50 | R.PDSCH.2-23.2 | 64QAM, 0.43 | HST-DPS | 2 | 2x4 | 70 | 10.7 |
| 60 | R.PDSCH.2-23.3 | 64QAM, 0.43 | HST-DPS | 2 | 2x4 | 70 | 10.7 |
| 80 | R.PDSCH.2-23.4 | 64QAM, 0.43 | HST-DPS | 2 | 2x4 | 70 | 10.5 |
| 90 | R.PDSCH.2-23.5 | 64QAM, 0.43 | HST-DPS | 2 | 2x4 | 70 | 10.7 |
| 100 | R.PDSCH.2-24.1 | 64QAM, 0.43 | HST-DPS | 2 | 2x4 | 70 | 10.7 |

Table 5.2A.3.5-7: Minimum performance for multiple CA configurations for HST-DPS with 1 active TCI state

|  |  |  |
| --- | --- | --- |
| **Test number** | **CA duplex mode** | **Minimum performance requirements** |
| 1-1 | FDD 15 kHz + FDD 15 kHz | As defined in Table 5.2A.3.5-3 |
| 1-2 | TDD 30 kHz + TDD 30 kHz | As defined in Table 5.2A.3.5-5 |
| 1-3 | FDD 15 kHz + TDD 30 kHz | As defined in Table 5.2A.3.5-3 and Table 5.2A.3.5-5 per CC |
| Note 1: The applicability of requirements for different CA duplex modes, SCSs, CA configurations and bandwidth combination sets is defined in 5.1.1.7.4. | | |

Table 5.2A.3.5-8: Minimum performance for multiple CA configurations for HST-DPS with 2 active TCI states

|  |  |  |
| --- | --- | --- |
| **Test number** | **CA duplex mode** | **Minimum performance requirements** |
| 2-1 | FDD 15 kHz + FDD 15 kHz | As defined in Table 5.2A.3.5-4 |
| 2-1 | TDD 30 kHz + TDD 30 kHz | As defined in Table 5.2A.3.5-6 |
| 2-3 | FDD 15 kHz + TDD 30 kHz | As defined in Table 5.2A.3.5-4 and Table 5.2A.3.5-6 per CC |
| Note 1: The applicability of requirements for different CA duplex modes, SCSs, CA configurations and bandwidth combination sets is defined in 5.1.1.7.4. | | |

## 5.3 PDCCH demodulation requirements

The receiver characteristics of the PDCCH are determined by the probability of miss-detection of the Downlink Scheduling Grant (Pm-dsg).

The parameters specified in Table 5.3-1 are valid for all PDCCH tests unless otherwise stated.

Table 5.3-1: Common test Parameters

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Value** |
| Carrier configuration | Offset between Point A and the lowest usable subcarrier on this carrier (Note 1) | |  | 0 |
| DL BWP configuration #1 | Cyclic prefix | |  | Normal |
| RB offset | | RBs | 0 |
| Common serving cell parameters | Physical Cell ID | |  | 0 |
| SSB position in burst | |  | First SSB in Slot #0 |
| SSB periodicity | | ms | 20 |
| PDCCH configuration | Slots for PDCCH monitoring | |  | Each slot |
| Number of PDCCH candidates | |  | 1 |
| Frequency domain resource allocation for CORESET | |  | Start from RB = 0 with contiguous RB allocation |
| TCI state | |  | TCI state #1 |
| CSI-RS for tracking | First subcarrier index in the PRB used for CSI-RS (*k0*) | |  | 0 |
| First OFDM symbol in the PRB used for CSI-RS (*l0*) | |  | CSI-RS resource 1: 4 CSI-RS resource 2: 8 CSI-RS resource 3: 4 CSI-RS resource 4: 8 |
| Number of CSI-RS ports (*X*) | |  | 1 |
| CDM Type | |  | No CDM |
| Density (*ρ*) | |  | 3 |
| CSI-RS periodicity | | Slots | 15 kHz SCS: 20  30 kHz SCS: 40 |
| CSI-RS offset | | Slots | 15 kHz SCS:  10 for CSI-RS resource 1 and 2  11 for CSI-RS resource 3 and 4  30 kHz SCS:  20 for CSI-RS resource 1 and 2  21 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 |
| 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 |
| PDCCH & PDCCH DMRS Precoding configuration | | |  | For number of TX = 1: No precoding;  For number of TX > 1: Single Panel Type I, Randomized precoder selection for every REG bundle and updated per slot with equal probability of each applicable i1/i2 combination or codebook  index, chosen from section 5.2.2.2.1 of TS 38.214 [12]. |
| Physical signals, channels mapping and precoding | | |  | As specified in Annex B.4.1 |
| 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 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | | |  | 2 for FDD  For TDD, specific to each TDD UL-DL pattern and as defined in Annex A.1.2. |
| Note 1: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-1 [6] for tested channel bandwidth and subcarrier spacing.  Note 2: The high layer parameter *precoderGranularity* equals to *sameAsREG-bundle* as defined in clause 7.4.1.3 of TS 38.211 [9]. | | | | |

### 5.3.1 1RX requirements

#### 5.3.1.1 FDD

The parameters specified in Table 5.3.1.1-1 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 | 5.8 |

#### 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 | 8.6 |

### 5.3.2 2RX requirements

#### 5.3.2.1 FDD

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

Table 5.3.2.1-1: Test Parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Unit** | **1 Tx Antenna** | **2 Tx Antenna** |
| CCE to REG mapping type |  | nonInterleaved | |
| REG bundle size |  | 6 | |
| Shift index |  | 0 | |

##### 5.3.2.1.1 1 Tx Antenna performances

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 5.3.2.1.1-1. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.3.2.1.1-1: 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 | 24 | 2 | 2 | R.PDCCH. 1-2.1 FDD | TDLA30-10 | 1x2 Low | 1 | 8.1 |
| 2 | 10 | 24 | 2 | 2 | R.PDCCH. 1-2.3 FDD | TDLC300-100 | 1x2 Low | 1 | 8.2 |
| 3 | 10 | 48 | 2 | 4 | R.PDCCH. 1-2.4 FDD | TDLA30-10 | 1x2 Low | 1 | 5.5 |
| 4 | 10 | 48 | 1 | 4 | R.PDCCH.1-1.1 FDD | TDLA30-10 | 1x2 Low | 1 | 4.4 |
| 5 | 10 | 48 | 2 | 16 | R.PDCCH. 1-2.6 FDD | TDLA30-10 | 1x2 Low | 1 | -2.1 |

##### 5.3.2.1.2 2 Tx Antenna performances

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 5.3.2.1.2-1. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.3.2.1.2-1: 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 | 24 | 2 | 4 | R.PDCCH. 1-2.2 FDD | TDLC300-100 | 2x2 Low | 1 | 2.0 |
| 2 | 10 | 48 | 2 | 8 | R.PDCCH. 1-2.5 FDD | TDLC300-100 | 2x2 Low | 1 | -1.3 |
| 3 | 10 | 48 | 1 | 8 | R.PDCCH.1-1.3 FDD | TDLA30-10 | 2x2 Low | 1 | -0.2 |

##### 5.3.2.1.3 Minimum requirements for power saving

During the test the UE shall monitor the *DCI format 2\_6* PDCCH in DRX off state and decide whether to receive the following PDCCH in DRX on period.

The parameters specified in Table 5.3.2.1.3-1 are valid for FDD test unless otherwise stated.

Table 5.3.2.1.3-1: Test Parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | 1 Tx Antenna |
| CCE to REG mapping type | |  | nonInterleaved |
| REG bundle size | |  | 6 |
| Shift Index | |  | 0 |
| DRX cycle | | ms | 10 |
| ps-WakeUp-r16 | |  | absent |
| Wake-up indication bit in DCI format 2\_6 | |  | 1 |
| PDCCH DCI format 2\_6 configuration | PS-offset |  |  |
| Number of PDCCH candidates |  | 1 |
| Frequency domain resource allocation for CORESET |  | Start from RB = 0 with contiguous RB allocation |
| TCI state |  | TCI state #1 |
| PDCCH configuration | Slots for PDCCH monitoring |  | Each slot during DRX-on period |
|  | |  |  |
| Note: TminimumTimeGap­ is signaled as a part of *drx-Adaptation-r16*UE capability. | | | |

For the parameters specified in Table 5.3.2.1.3-1, the average probability of a missed downlink scheduling grant (Pm-dsg) observed on PDCCH during DRX on shall be below the specified value in Table 5.3.2.1.3-2. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.3.2.1.3-2: 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 | 8 | R.PDCCH. 1-2.7 FDD |

##### 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 |

##### 5.3.2.1.5 Minimum requirements for PDCCH with intra-slot repetition

The performance requirements are specified in Table 5.3.2.1.5-2, with the addition of test parameters in Table 5.3.2.1.5-1. The downlink physical channel setup according to Annex C.3.1.

Table 5.3.2.1.5-1: Tests parameters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | | | | Unit | Value | |
| TRxP #1(Note 1) | TRxP #2(Note 1) |
| Transmit TRxP of SSB | | | |  | TRxP #1 | |
| PDCCH configuration | | TCI state | |  | TCI State #1 | TCI State #2 |
| CORESETPoolIndex | |  | 0,1 | |
| Repetition transmission schemes | |  | FDM | |
| CCE to REG mapping type | |  | nonInterleaved | |
| REG bundle size | |  | 6 | |
| Time offset/Frequency offset of the second TxRP from the first TxRP | |  | timing offset = -0.5us, frequency offset = 200Hz | |
| Frequency domain resource allocation for CORSET | |  | Frequency non-overlapping | |
| CSI-RS for tracking | | First subcarrier index in the PRB used for CSI-RS | |  | k0=0 for CSI-RS resources 1,2,3,4 | k0=1 for CSI-RS resources 5,6,7,8 |
| First OFDM symbol in the PRB used for CSI-RS | |  | l0 = 6 for CSI-RS resources 1 and 3  l0 = 10 for CSI-RS resources 2 and 4 | l0 = 6 for CSI-RS resources 5 and 7  l0 = 10 for CSI-RS resources 6 and 8 |
| Number of CSI-RS ports (X) | |  | 1 for CSI-RS resource 1,2,3,4 | 1 for CSI-RS resource 5,6,7,8 |
| CDM Type | |  | ‘No CDM’ for CSI-RS resource 1,2,3,4,5,6,7,8 | |
| Density | |  | 3 | |
| CSI-RS periodicity | | Slots | 20 | |
| CSI-RS offset | | Slots | 10 for CSI-RS resources 1 and 2  11 for CSI-RS resources 3 and 4 | 10 for CSI-RS resources 5 and 6  11 for CSI-RS resources 7 and 8 |
| QCL info | |  | TCI state #0 | |
| TCI State #1 | Type 1 QCL information | | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking’ configuration | N/A |
| QCL Type |  | Type A | N/A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| TCI State #2 | Type 1 QCL information | | CSI-RS resource |  | N/A | CSI-RS resource 5 from 'CSI-RS for tracking’ configuration |
| QCL Type |  | N/A | Type A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| Note: PDCCH is transmitted from both TRxP #1 and TRxP #2 | | | | | | |

Table 5.3.2.1.5-2: Minimum performance for PDCCH with 15kHz SCS (Note 2)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Bandwidth(MHz) | CORESET RB (Note 4) | CORESET duration | Aggregation level | Reference Channel | Propagation Condition (Note 1) | Antenna configuration and correlation Matrix | Reference value | |
| Pm-dsg  (%) | SNR (dB) (Note 3) |
| 1 | 10 | 24 | 2 | 2 | R.PDCCH. 1-2.1 FDD | TDLA30-10 | 2x2, ULA Low | 1 | 2.7 |
| Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent.  Note 2: Bandwidth, CORESET parameters, reference channel, Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2.  Note 3: SNR corresponds to SNR of TRxP #1 and TRxP #2 as defined in 4.4.2  Note 4: CORESETs from TRxP #1 and TRxP #2 should not be overlapped | | | | | | | | | |

#### 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 | est 1 in Table 5.3.2.2.2-1: 6  Other tests: 2 | | |
| Shift Index |  | 0 | | | |

##### 5.3.2.2.1 1 Tx Antenna performances

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 5.3.2.2.1-1. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.3.2.2.1-1: 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 | 40 | 102 | 1 | 2 | R.PDCCH. 2-1.1 TDD | TDLA30-10 | 1x2 Low | 1 | 7.0 |
| 2 | 40 | 102 | 1 | 4 | R.PDCCH. 2-1.2 TDD | TDLC300- 100 | 1x2 Low | 1 | 3.0 |
| 3 | 40 | 48 | 2 | 16 | R.PDCCH. 2-2.1 TDD | TDLC300- 100 | 1x2 Low | 1 | -3.8 |

##### 5.3.2.2.2 2 Tx Antenna performances

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 5.3.2.2.2-1. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.3.2.2.2-1: 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 | 40 | 90 | 1 | 8 | R.PDCCH. 2-1.3 TDD | TDLC300-100 | 2x2 Low | 1 | -1.2 |

##### 5.3.2.2.3 Minimum requirements for power saving

During the test the UE shall monitor the *DCI format 2\_6* PDCCH in DRX off state and decide whether to receive the following PDCCH in DRX on period.

The parameters specified in Table 5.3.2.2.3-1 are valid for all TDD tests for power saving unless otherwise stated.

Table 5.3.2.2.3-1: Test Parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | 1 Tx Antenna |
| TDD UL-DL pattern | |  | FR1.30-1 |
| CCE to REG mapping type | |  | interleaved |
| Interleaver size | |  | 3 |
| REG bundle size | |  | 2 |
| Shift Index | |  | 0 |
| DRX cycle | | ms | 10 |
| ps-WakeUp-r16 | |  | absent |
| Wake-up indication bit in DCI format 2\_6 | |  | 1 |
| PDCCH DCI format 2\_6 configuration | PS-offset |  | (TminimumTimeGap+1)//0.125 |
| Number of PDCCH candidates |  | 1 |
| Frequency domain resource allocation for CORESET |  | Start from RB = 0 with contiguous RB allocation |
| TCI state |  | TCI state #1 |
| PDCCH configuration | Slots for PDCCH monitoring |  | Each slot during DRX-on period |
| Note: TminimumTimeGap­ is signaled as a part of *drx-Adaptation-r16*UE capability | | | |

For the parameters specified in Table 5.3.2.2.3-1, the average probability of a missed downlink scheduling grant (Pm-dsg) observed on PDCCH during DRX on shall be below the specified value in Table 5.3.2.2.3-2. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.3.2.2.3-2: Minimum performance 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 | 40 | 102 | 1 | 4 | R.PDCCH. 2-1.2 TDD | TDLC300- 100 | 1x2 Low | 1 | 3.0 |
| 8 | R.PDCCH. 2-1.4 TDD |

##### 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 | 4 | R.PDCCH. 2-1.5 TDD | TDLC300-100 | 1x2 Low | 1 | 3.6 |
| 2 | 20 | 48 | 1 | 8 | R.PDCCH. 2-1.6 TDD | TDLC300- 100 | 2x2 Low | 1 | 0.0 |

##### 5.3.2.2.5 Minimum requirements for PDCCH with intra-slot repetition

The performance requirements are specified in Table 5.3.2.2.5-2, with the addition of test parameters in Table 5.3.2.2.5-1. The downlink physical channel setup according to Annex C.3.1.

Table 5.3.2.2.5-1: Tests parameters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | | | | Unit | Value | |
| TRxP #1(Note 1) | TRxP #2(Note 1) |
| Transmit TRxP of SSB | | | |  | TRxP #1 | |
| PDCCH configuration | | TCI state | |  | TCI State #1 | TCI State #2 |
| CORESETPoolIndex | |  | 0,1 | |
| Repetition transmission schemes | |  | FDM | |
| CCE to REG mapping type | |  | nonInterleaved | |
| REG bundle size | |  | 6 | |
| Time offset/Frequency offset of the second TxRP from the first TxRP | |  | timing offset = -0.25us, frequency offset = 300Hz | |
| Frequency domain resource allocation for CORSET | |  | Frequency non-overlapping | |
| CSI-RS for tracking | | First subcarrier index in the PRB used for CSI-RS | |  | k0=0 for CSI-RS resources 1,2,3,4 | k0=1 for CSI-RS resources 5,6,7,8 |
| First OFDM symbol in the PRB used for CSI-RS | |  | l0 = 6 for CSI-RS resources 1 and 3  l0 = 10 for CSI-RS resources 2 and 4 | l0 = 6 for CSI-RS resources 5 and 7  l0 = 10 for CSI-RS resources 6 and 8 |
| Number of CSI-RS ports (X) | |  | 1 for CSI-RS resource 1,2,3,4 | 1 for CSI-RS resource 5,6,7,8 |
| CDM Type | |  | ‘No CDM’ for CSI-RS resource 1,2,3,4,5,6,7,8 | |
| Density | |  | 3 | |
| CSI-RS periodicity | | Slots | 40 | |
| CSI-RS offset | | Slots | 20 for CSI-RS resources 1 and 2  21 for CSI-RS resources 3 and 4 | 20 for CSI-RS resources 5 and 6  21 for CSI-RS resources 7 and 8 |
| QCL info | |  | TCI state #0 | |
| TCI State #1 | Type 1 QCL information | | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking’ configuration | N/A |
| QCL Type |  | Type A | N/A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| TCI State #2 | Type 1 QCL information | | CSI-RS resource |  | N/A | CSI-RS resource 5 from 'CSI-RS for tracking’ configuration |
| QCL Type |  | N/A | Type A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| Note: PDCCH is transmitted from both TRxP #1 and TRxP #2 | | | | | | |

Table 5.3.2.2.5-2: Minimum performance for PDCCH with 30kHz SCS (Note 2)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Bandwidth(MHz) | CORESET RB (Note 4) | CORESET duration | Aggregation level | Reference Channel | Propagation Condition (Note 1) | Antenna configuration and correlation Matrix | Reference value | |
| Pm-dsg  (%) | SNR (dB) (Note 3) |
| 1 | 40 | 48 | 2 | 2 | R.PDCCH. 2-2.2 TDD | TDLA30-10 | 2x2, ULA Low | 1 | 3.5 |
| Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent.  Note 2: Bandwidth, CORESET parameters, reference channel, Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2.  Note 3: SNR corresponds to SNR of TRxP #1 and TRxP #2 as defined in 4.4.2  Note 4: CORESETs from TRxP #1 and TRxP #2 should not be overlapped | | | | | | | | | |

### 5.3.3 4RX requirements

#### 5.3.3.1 FDD

The parameters specified in Table 5.3.3.1-1 are valid for all FDD tests unless otherwise stated.

Table 5.3.3.1-1: Test Parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Unit** | **1 Tx Antenna** | **2 Tx Antenna** |
| CCE to REG mapping type |  | nonInterleaved | |
| REG bundle size |  | 6 | |
| Shift index |  | 0 | |

##### 5.3.3.1.1 1 Tx Antenna performances

For the parameters specified in Table 5.3.3.1-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 5.3.3.1.1-1. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.3.3.1.1-1: 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 | 24 | 2 | 2 | R.PDCCH. 1-2.1 FDD | TDLA30-10 | 1x4 Low | 1 | 2.2 |
| 2 | 10 | 24 | 2 | 2 | R.PDCCH. 1-2.3 FDD | TDLC300- 100 | 1x4 Low | 1 | 2.7 |
| 3 | 10 | 48 | 2 | 4 | R.PDCCH. 1-2.4 FDD | TDLA30-10 | 1x4 Low | 1 | 0.2 |
| 4 | 10 | 48 | 1 | 4 | R.PDCCH.1-1.1 FDD | TDLA30-10 | 1x4 Low | 1 | -0.4 |
| 5 | 10 | 48 | 2 | 16 | R.PDCCH. 1-2.6 FDD | TDLA30-10 | 1x4 Medium A | 1 | -3.2 |

##### 5.3.3.1.2 2 Tx Antenna performances

For the parameters specified in Table 5.3.3.1-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 5.3.3.1.2-1. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.3.3.1.2-1: 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 | 24 | 2 | 4 | R.PDCCH. 1-2.2 FDD | TDLC300-100 | 2x4 Low | 1 | -1.9 |
| 2 | 10 | 48 | 2 | 8 | R.PDCCH. 1-2.5 FDD | TDLC300-100 | 2x4 Low | 1 | -4.5 |
| 3 | 10 | 48 | 1 | 4 | R.PDCCH.1-1.2 FDD | TDLA30-10 | 2x4 Low | 1 | -1.0 |

##### 5.3.3.1.3 Minimum requirements for power saving

During the test the UE shall monitor the *DCI format 2\_6* PDCCH in DRX off state and decide whether to receive the following PDCCH in DRX on period.

The parameters specified in Table 5.3.3.1.3-1 are valid for FDD test unless otherwise stated.

Table 5.3.3.1.3-1: Test Parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | 1 Tx Antenna |
| CCE to REG mapping type | |  | nonInterleaved |
| REG bundle size | |  | 6 |
| Shift Index | |  | 0 |
| DRX cycle | | ms | 10 |
| ps-WakeUp-r16 | |  | absent |
| Wake-up indication bit in DCI format 2\_6 | |  | 1 |
| PDCCH DCI format 2\_6 configuration | PS-offset |  |  |
| Number of PDCCH candidates |  | 1 |
| Frequency domain resource allocation for CORESET |  | Start from RB = 0 with contiguous RB allocation |
| TCI state |  | TCI state #1 |
| Slots for PDCCH monitoring | |  | Each slot during DRX-on period |
| Note: TminimumTimeGap­ is signaled as a part of *drx-Adaptation-r16*UE capability. | | | |

For the parameters specified in Table 5.3.3.1.3-1, the average probability of a missed downlink scheduling grant (Pm-dsg) observed on PDCCH during DRX on shall be below the specified value in Table 5.3.3.1.3-2. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.3.3.1.3-2: 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 | 1x4 Low | 1 | 0.2 |
| 2 | 8 | R.PDCCH. 1-2.7 FDD |

##### 5.3.3.1.4 Minimum requirements for PDCCH with intra-slot repetition

The performance requirements are specified in Table 5.3.3.1.4-2, with the addition of test parameters in Table 5.3.3.1.4-1. The downlink physical channel setup according to Annex C.3.1.

Table 5.3.3.1.4-1: Tests parameters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | | | | Unit | Value | |
| TRxP #1(Note 1) | TRxP #2(Note 1) |
| Transmit TRxP of SSB | | | |  | TRxP #1 | |
| PDCCH configuration | | TCI state | |  | TCI State #1 | TCI State #2 |
| CORESETPoolIndex | |  | 0,1 | |
| Repetition transmission schemes | |  | FDM | |
| CCE to REG mapping type | |  | nonInterleaved | |
| REG bundle size | |  | 6 | |
| Time offset/Frequency offset of the second TxRP from the first TxRP | |  | timing offset = -0.5us, frequency offset = 200Hz | |
| Frequency domain resource allocation for CORSET | |  | Frequency non-overlapping | |
| CSI-RS for tracking | | First subcarrier index in the PRB used for CSI-RS | |  | k0=0 for CSI-RS resources 1,2,3,4 | k0=1 for CSI-RS resources 5,6,7,8 |
| First OFDM symbol in the PRB used for CSI-RS | |  | l0 = 6 for CSI-RS resources 1 and 3  l0 = 10 for CSI-RS resources 2 and 4 | l0 = 6 for CSI-RS resources 5 and 7  l0 = 10 for CSI-RS resources 6 and 8 |
| Number of CSI-RS ports (X) | |  | 1 for CSI-RS resource 1,2,3,4 | 1 for CSI-RS resource 5,6,7,8 |
| CDM Type | |  | ‘No CDM’ for CSI-RS resource 1,2,3,4,5,6,7,8 | |
| Density | |  | 3 | |
| CSI-RS periodicity | | Slots | 20 | |
| CSI-RS offset | | Slots | 10 for CSI-RS resources 1 and 2  11 for CSI-RS resources 3 and 4 | 10 for CSI-RS resources 5 and 6  11 for CSI-RS resources 7 and 8 |
| QCL info | |  | TCI state #0 | |
| TCI State #1 | Type 1 QCL information | | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking’ configuration | N/A |
| QCL Type |  | Type A | N/A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| TCI State #2 | Type 1 QCL information | | CSI-RS resource |  | N/A | CSI-RS resource 5 from 'CSI-RS for tracking’ configuration |
| QCL Type |  | N/A | Type A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| Note: PDCCH is transmitted from both TRxP #1 and TRxP #2 | | | | | | |

Table 5.3.3.1.4-2: Minimum performance for PDCCH with 15kHz SCS (Note 2)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Bandwidth(MHz) | CORESET RB (Note 4) | CORESET duration | Aggregation level | Reference Channel | Propagation Condition (Note 1) | Antenna configuration and correlation Matrix | Reference value | |
| Pm-dsg  (%) | SNR (dB) (Note 3) |
| 1 | 10 | 24 | 2 | 2 | R.PDCCH. 1-2.1 FDD | TDLA30-10 | 2x4, ULA Low | 1 | -1.2 |
| Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent.  Note 2: Bandwidth, CORESET parameters, reference channel, Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2.  Note 3: SNR corresponds to SNR of TRxP #1 and TRxP #2 as defined in 4.4.2  Note 4: CORESETs from TRxP #1 and TRxP #2 should not be overlapped | | | | | | | | | |

#### 5.3.3.2 TDD

The parameters specified in Table 5.3.3.2-1 are valid for all TDD tests unless otherwise stated.

Table 5.3.3.2-1: Common 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 | 6 | |
| Shift Index |  | 0 | | |

##### 5.3.3.2.1 1 Tx Antenna performances

For the parameters specified in Table 5.3.3.2-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 5.3.3.2.1-1. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.3.3.2.1-1: 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 | 40 | 102 | 1 | 2 | R.PDCCH. 2-1.1 TDD | TDLA30-10 | 1x4 Low | 1 | 2.1 |
| 2 | 40 | 102 | 1 | 4 | R.PDCCH. 2-1.2 TDD | TDLC300-100 | 1x4 Low | 1 | -0.9 |
| 3 | 40 | 48 | 2 | 16 | R.PDCCH. 2-2.1 TDD | TDLA30-10 | 1x4 Medium A | 1 | -3.6 |

##### 5.3.3.2.2 2 Tx Antenna performances

For the parameters specified in Table 5.3.3.2-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 5.3.3.2.2-1. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.3.3.2.2-1: 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 | 40 | 90 | 1 | 8 | R.PDCCH. 2-1.3 TDD | TDLC300-100 | 2x4 Low | 1 | -4.3 |

##### 5.3.3.2.3 Minimum requirements for power saving

During the test the UE shall monitor the *DCI format 2\_6* PDCCH in DRX off state and decide whether to receive the following PDCCH in DRX on period.

For the parameters specified in Table 5.3.3.2.3-1, the average probability of a missed downlink scheduling grant (Pm-dsg) observed on PDCCH during DRX on shall be below the specified value in Table 5.3.3.2.3-2. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.3.3.2.3-1: Test Parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | 1 Tx Antenna |
| TDD UL-DL pattern | |  | FR1.30-1 |
| CCE to REG mapping type | |  | interleaved |
| Interleaver size | |  | 3 |
| REG bundle size | |  | 2 |
| Shift Index | |  | 0 |
| DRX cycle | | ms | 10 |
| ps-WakeUp-r16 | |  | absent |
| Wake-up indication bit in DCI format 2\_6 | |  | 1 |
| PDCCH DCI format 2\_6 configuration | PS-offset |  | (TminimumTimeGap+1)//0.125 |
| Number of PDCCH candidates |  | 1 |
| Frequency domain resource allocation for CORESET |  | Start from RB = 0 with contiguous RB allocation |
| TCI state |  | TCI state #1 |
| Slots for PDCCH monitoring | |  | Each slot during DRX-on period |
| Note: TminimumTimeGap­ is signaled as a part of *drx-Adaptation-r16*UE capability. | | | |

Table 5.3.3.2.3-2: Minimum performance 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 | 40 | 102 | 1 | 4 | R.PDCCH. 2-1.2 TDD | TDLC300- 100 | 1x4 Low | 1 | -0.9 |
| 8 | R.PDCCH. 2-1.4 TDD |

##### 5.3.3.2.4 Minimum requirements for PDCCH with intra-slot repetition

The performance requirements are specified in Table 5.3.3.2.4-2, with the addition of test parameters in Table 5.3.3.2.4-1. The downlink physical channel setup according to Annex C.3.1.

Table 5.3.3.2.4-1: Tests parameters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameter | | | | Unit | Value | |
| TRxP #1(Note 1) | TRxP #2(Note 1) |
| Transmit TRxP of SSB | | | |  | TRxP #1 | |
| PDCCH configuration | | TCI state | |  | TCI State #1 | TCI State #2 |
| CORESETPoolIndex | |  | 0,1 | |
| Repetition transmission schemes | |  | FDM | |
| CCE to REG mapping type | |  | nonInterleaved | |
| REG bundle size | |  | 6 | |
| Time offset/Frequency offset of the second TxRP from the first TxRP | |  | timing offset = -0.25us, frequency offset = 300Hz | |
| Frequency domain resource allocation for CORSET | |  | Frequency non-overlapping | |
| CSI-RS for tracking | | First subcarrier index in the PRB used for CSI-RS | |  | k0=0 for CSI-RS resources 1,2,3,4 | k0=1 for CSI-RS resources 5,6,7,8 |
| First OFDM symbol in the PRB used for CSI-RS | |  | l0 = 6 for CSI-RS resources 1 and 3  l0 = 10 for CSI-RS resources 2 and 4 | l0 = 6 for CSI-RS resources 5 and 7  l0 = 10 for CSI-RS resources 6 and 8 |
| Number of CSI-RS ports (X) | |  | 1 for CSI-RS resource 1,2,3,4 | 1 for CSI-RS resource 5,6,7,8 |
| CDM Type | |  | ‘No CDM’ for CSI-RS resource 1,2,3,4,5,6,7,8 | |
| Density | |  | 3 | |
| CSI-RS periodicity | | Slots | 40 | |
| CSI-RS offset | | Slots | 20 for CSI-RS resources 1 and 2  21 for CSI-RS resources 3 and 4 | 20 for CSI-RS resources 5 and 6  21 for CSI-RS resources 7 and 8 |
| QCL info | |  | TCI state #0 | |
| TCI State #1 | Type 1 QCL information | | CSI-RS resource |  | CSI-RS resource 1 from 'CSI-RS for tracking’ configuration | N/A |
| QCL Type |  | Type A | N/A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| TCI State #2 | Type 1 QCL information | | CSI-RS resource |  | N/A | CSI-RS resource 5 from 'CSI-RS for tracking’ configuration |
| QCL Type |  | N/A | Type A |
| Type 2 QCL information | | CSI-RS resource |  | N/A | N/A |
| QCL Type |  | N/A | N/A |
| Note: PDCCH is transmitted from both TRxP #1 and TRxP #2 | | | | | | |

Table 5.3.3.2.4-2: Minimum performance for PDCCH with 30kHz SCS

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Bandwidth(MHz) | CORESET RB (Note 4) | CORESET duration | Aggregation level | Reference Channel | Propagation Condition (Note 1) | Antenna configuration and correlation Matrix (Note 2) | Reference value | |
| Pm-dsg  (%) | SNR (dB) (Note 3) |
| 1 | 40 | 48 | 2 | 2 | R.PDCCH. 2-2.2 TDD | TDLA30-10 | 2x4, ULA Low | 1 | -1.0 |
| Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent.  Note 2: Bandwidth, CORESET parameters, reference channel, Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2.  Note 3: SNR corresponds to SNR of TRxP #1 and TRxP #2 as defined in 4.4.2  Note 4: CORESETs from TRxP #1 and TRxP #2 should not be overlapped | | | | | | | | | |

## 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 | -2.2 |

#### 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 5.4.2.1-1 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 | -0.8 |

### 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/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 | 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/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 | 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/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 | 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/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 | 40 / 30 | R.PBCH.2 | TDLA30-10 | 1 x 4 Low | 1 | -9.6 |

## 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 are 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.

For RedCap UE with HD-FDD mode, the additional test parameters are specified in Table 5.5.1-1.

Table 5.5.1-1: Additional test parameters for HD-FDD single carrier

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Value** |
| Duplex mode | |  | HD-FDD |
| PDSCH configuration | Starting symbol (S) |  | 1 |
| Length (L) |  | 13 |
| Number of HARQ Processes | |  | 4 |
| Full DL slots (Note 1, Note 2) | |  | For slots i, if mod(i, 5) = {0,1,2} |
| K1 value (Note 2) | |  | 4 if mod(i, 5) = 0  3 if mod(i, 5) = 1  2 if mod(i, 5) = 2 |
| Note 1: PDSCH is scheduled only on full DL slots.  Note 2: i is the slot index per frame; i = {1, 2, …, 19}. | | | |

## 5.5A Sustained downlink data rate provided by lower layers

### 5.5A.1 FR1 CA requirements

*<Editor*'*s note: Open issues to be resolved:*

*Whether same requirements apply for FR1 DC>*

The Sustained Data Rate (SDR) requirements in this clause are applicable to the FR1 CA.

The purpose of the test is to verify that the Layer 1 and Layer 2 correctly process in a sustained manner the received packets corresponding to the maximum data rate indicated by UE capabilities*.* The sustained downlink data rate shall be verified in terms of the success rate of delivered PDCP SDU(s) by Layer 2. The test case below specifies the RF conditions and the required success rate of delivered TB by Layer 1 to meet the sustained data rate requirement.

The test parameters are determined by the following procedure:

- Select one CA bandwidth combination among all supported CA configurations and set of per component carrier (CC) UE capabilities among all supported UE capabilities that provides the largest data rate in accordance with clause 4.1.2 of TS 38.306 [14].

- Set of per CC UE capabilities includes channel bandwidth, subcarrier spacing, number of PDSCH MIMO layers, modulation format and scaling factor in accordance with clause 4.1.2 of TS 38.306 [14].

- When there are multiple sets of CA bandwidth combinations and UE capabilities (channel bandwidth, subcarrier spacing, number of MIMO layer, modulation format, scaling factor) with same largest data rate, select one among sets with the smallest aggregated channel bandwidth.

- For UE not capable of 1024QAM (*pdsch-1024QAM-FR1*), for each CC in CA bandwidth combination, use Table 5.5A-5 to determine MCS based on test parameters and indicated UE capabilities.

- For UE capable of 1024QAM (*pdsch-1024QAM-FR1*), for each CC in CA bandwidth combination, use Table 5.5A-6 to determine MCS based on test parameters and indicated UE capabilities if the maximum modulation format is 10. If the maximum modulation format (*supportedModulationOrderDL*) is less than 10, use Table 5.5A-5 to determine MCS based on test parameters and indicated UE capabilities.

The TB success rate shall be higher than 85% when PDSCH is scheduled with MCS defined for the selected CA bandwidth combination and with the downlink physical channel setup according to Annex C.3.1.

The TB success rate is defined as 100%\*NDL\_correct\_rx/ (NDL\_newtx + NDL\_retx), where NDL\_newtx is the number of newly transmitted DL transport blocks, NDL\_retx is the number of retransmitted DL transport blocks, and NDL\_correct\_rx is the number of correctly received DL transport blocks.

The common test parameters are specified in Table 5.5A-1. The parameters specified in Table 5.5A-2 are applicable for tests on FDD CCs and parameters specified in Table 5.5A-3 are applicable for tests on TDD CCs.

Unless otherwise stated, no user data is scheduled on slot #0, 10 and 11 within 20 ms for SCS 15 kHz.

Unless otherwise stated, no user data is scheduled on slot #0, 20 and 21 within 20 ms for SCS 30 kHz.

Table 5.5A-1: Common test parameters for FDD and TDD component carriers

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | | | **Unit** | **Value** |
| PDSCH transmission scheme | | |  | Transmission scheme 1 |
| EPRE ratio of PTRS to PDSCH | | | dB | N/A |
| 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 2) | | RBs | 0 |
| Subcarrier spacing | | kHz | 15 or 30 |
| DL BWP configuration #1 | RB offset | | RBs | 0 |
| Number of contiguous PRB | |  | Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-1 [6] for tested channel bandwidth and subcarrier spacing |
| Subcarrier spacing | | kHz | 15 or 30 |
| Cyclic prefix | |  | Normal |
| PDCCH configuration | Slots for PDCCH monitoring | |  | Each slot |
| Symbols with PDCCH | |  | Symbols #0 |
| Number of PRBs in CORESET | |  | Table 5.5A-4 |
| Number of PDCCH candidates and aggregation levels | |  | 2/AL2 for 15 kHz / 5 MHz and 30 kHz / 15 MHz  2/AL4 for 15 kHz / 10 MHz, 30 kHz / 10 MHz and 30 kHz / 20 MHz  2/AL8 for other greater combinations |
| CCE-to-REG mapping type | |  | Non-interleaved |
| DCI format | |  | 1\_1 |
| TCI State | |  | TCI state #1 |
| PDCCH & PDCCH DMRS Precoding configuration | |  | For number of TX = 1: No precoding;  For Number of Tx = 2:  Single Panel Type I, Randomized precoder selection for every REG bundle and updated per slot with equal probability of precoder index 0 and 2  For Number of Tx= 4:  Single Panel Type I, Randomized precoder selection for every REG bundle and updated per slot with equal probability of i\_1,1 in {1,2,3,5,6,7} and i\_2 in {0,2} |
| 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 |
| 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 | |  | 1 |
| Length | |  | 1 |
| Antenna ports indexes | |  | {1000} for 1 Layer CCs {1000, 1001} for 2 Layers CCs  {1000 – 1003} for 4 Layers CCs |
| Number of PDSCH DMRS CDM group(s) without data | |  | 1 for 1 layer and 2 layers CCs  2 for 4 Layers CCs |
| PTRS configuration | | |  | PTRS is not configured |
| 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 | 15 kHz SCS: 20 for CSI-RS resource 1,2,3,4  30 kHz SCS: 40 for CSI-RS resource 1,2,3,4 |
| CSI-RS offset | | Slots | 15 kHz SCS:  10 for CSI-RS resource 1 and 2  11 for CSI-RS resource 3 and 4  30 kHz SCS:  20 for CSI-RS resource 1 and 2  21 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 = 12 |
| Number of CSI-RS ports (X) | |  | Same as number of transmit antenna |
| CDM Type | |  | 'FD-CDM2' |
| Density (ρ) | |  | 1 |
| CSI-RS periodicity | |  | 15 kHz SCS: 20  30 kHz SCS: 40 |
| 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 | |  | 15 kHz SCS: 20  30 kHz SCS: 40 |
| CSI-RS offset | |  | 0 |
| Frequency Occupation | |  | Start PRB 0  Number of PRB = ceil(BWP size/4)\*4 |
| TCI state #0 | Type 1 QCL information | SSB index |  | SSB #0 |
| QCL Type |  | Type C |
| Type 2 QCL information | SSB index |  | N/A |
| QCL Type |  | N/A |
| 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 |  | N/A |
| QCL Type |  | N/A |
| Maximum number of code block groups for ACK/NACK feedback | | |  | 1 |
| Maximum number of HARQ transmission | | |  | 4 |
| HARQ ACK/NACK bundling | | |  | Multiplexed |
| Redundancy version coding sequence | | |  | {0,2,3,1} |
| PDSCH & PDSCH DMRS Precoding configuration | | |  | For number of TX = 1: No precoding;  For number of TX > 1: Single Panel Type I; Randomized precoder selection for every PRB bundle and updated per slot, with equal probability of each applicable i1/i2 combination or codebook  index, chosen from section 5.2.2.2.1 of TS 38.214 [12]. |
| 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 |
| 4 layers CCs | |  | 4x4 |
| Physical signals, channels mapping and precoding | | |  | As specified in Annex B.4.1 |
| Note 1: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH transmission  Note 2: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-1 [6] for tested channel bandwidth and subcarrier spacing | | | | |

Table 5.5A-2: Additional test parameters for FDD CC

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Value** |
| Duplex mode | |  | FDD |
| PDSCH configuration | Starting symbol (S) |  | 1 |
| Length (L) |  | 13 |
| Number of HARQ Processes | |  | 4 |
| K1 value | |  | 2 |

Table 5.5A-3: Additional test parameters for TDD CC

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Value** |
| Duplex mode | |  | TDD |
| PDSCH configuration | Starting symbol (S) |  | 1 |
| Length (L) |  | 13 |
| Number of HARQ Processes | |  | 8 |
| K1 value | |  | Specific to each UL-DL pattern |
| TDD UL-DL pattern | |  | 15 kHz SCS: FR1.15-1  30 kHz SCS: FR1.30-1 |
| Note 1: PDSCH is scheduled only on full DL slots | | | |

Table 5.5A-4: Number of PRBs in CORESET

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SCS (kHz) | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 35 MHz | 40 MHz | 45 MHz | 50 MHz | 60 MHz | 80 MHz | 100 MHz |
| 15 | 24 | 48 | 78 | 102 | 132 | 156 | 186 | 216 | 240 | 270 | N/A | N/A | N/A |
| 30 | 6 | 24 | 36 | 48 | 60 | 78 | 90 | 102 | 114 | 132 | 162 | 216 | 270 |

Table 5.5A-5: MCS indexes for indicated UE capabilities

|  |  |  |  |
| --- | --- | --- | --- |
| **Maximum number of PDSCH MIMO layers** | **Maximum modulation format** | **Scaling factor** | **MCS** |
| 1 | 8 | 1 | 26 |
| 1 | 8 | 0.8 | 21 |
| 1 | 8 | 0.75 | 20 |
| 1 | 8 | 0.4 | 11 |
| 1 | 6 | 1 | 27 |
| 1 | 6 | 0.8 | 23 |
| 1 | 6 | 0.75 | 22 |
| 1 | 6 | 0.4 | 14 |
| 1 | 4 | 1 | 16 |
| 1 | 4 | 0.8 | 16 |
| 1 | 4 | 0.75 | 16 |
| 1 | 4 | 0.4 | 10 |
| 1 | 2 | 1 | 9 |
| 1 | 2 | 0.8 | 9 |
| 1 | 2 | 0.75 | 9 |
| 1 | 2 | 0.4 | 4 |
| 2 | 8 | 1 | 26 |
| 2 | 8 | 0.8 | 21 |
| 2 | 8 | 0.75 | 20 |
| 2 | 8 | 0.4 | 11 |
| 2 | 6 | 1 | 27 |
| 2 | 6 | 0.8 | 23 |
| 2 | 6 | 0.75 | 22 |
| 2 | 6 | 0.4 | 14 |
| 2 | 4 | 1 | 16 |
| 2 | 4 | 0.8 | 16 |
| 2 | 4 | 0.75 | 16 |
| 2 | 4 | 0.4 | 10 |
| 2 | 2 | 1 | 9 |
| 2 | 2 | 0.8 | 9 |
| 2 | 2 | 0.75 | 9 |
| 2 | 2 | 0.4 | 4 |
| 4 | 8 | 1 | 26 |
| 4 | 8 | 0.8 | 23 |
| 4 | 8 | 0.75 | 22 |
| 4 | 8 | 0.4 | 12 |
| 4 | 6 | 1 | 27 |
| 4 | 6 | 0.8 | 24 |
| 4 | 6 | 0.75 | 23 |
| 4 | 6 | 0.4 | 14 |
| 4 | 4 | 1 | 16 |
| 4 | 4 | 0.8 | 16 |
| 4 | 4 | 0.75 | 16 |
| 4 | 4 | 0.4 | 11 |
| 4 | 2 | 1 | 9 |
| 4 | 2 | 0.8 | 9 |
| 4 | 2 | 0.75 | 9 |
| 4 | 2 | 0.4 | 5 |
| Note 1: MCS Index for maximum modulation format 2,4 and 6 is based on MCS index Table 1 defined in clause 5.1.3.1 of TS 38.214 [12]  Note 2: MCS Index for maximum modulation format 8 is based on MCS index Table 2 defined in clause 5.1.3.1 of TS 38.214 [12] | | | |

Table 5.5A-6: 1024QAM MCS indexes for indicated UE capabilities

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Supported RX  antenna ports | Maximum number of PDSCH MIMO layers | Maximum modulation format | Scaling factor | MCS |
| 2RX | 1 | 10 | 1 | 23 |
|  | 1 | 10 | 0.8 | 21 |
|  | 1 | 10 | 0.75 | 19 |
|  | 1 | 10 | 0.4 | 9 |
| 4RX | 1 | 10 | 1 | 24 |
|  | 1 | 10 | 0.8 | 21 |
|  | 1 | 10 | 0.75 | 19 |
|  | 1 | 10 | 0.4 | 9 |
|  | 2 | 10 | 1 | 23 |
|  | 2 | 10 | 0.8 | 21 |
|  | 2 | 10 | 0.75 | 19 |
|  | 2 | 10 | 0.4 | 9 |
| Note 1: MCS Index for maximum modulation format 10 is based on MCS index Table 4 defined in clause 5.1.3.1 of TS 38.214 [12]  Note 2: For the band(s) on which UE supporting “Maximum modulation format” of 10, with 2 RX and 2 MIMO layers, the MCS index is derived from the rows with “Maximum modulation format” of 8 in Table 5.5A-5 | | | | |

## 5.6 PDSCH absolute physical layer throughput requirements

The common parameters for PDSCH absolute physical layer throughput requirements specified in Table 6.1.2-1 are valid for all absolute physical layer throughput requirements unless otherwise stated.

### 5.6.1 1RX requirements

(Void)

### 5.6.2 2RX requirements

#### 5.6.2.1 FDD

##### 5.6.2.1.1 Minimum requirements with Link Adaptation

The performance requirements are specified in Table 5.6.2.1.1-2, with additional test parameters in Table 5.6.2.1.1-1 and the downlink physical channel setup according to Annex C.3.1.

The purpose of the test is to verify PDSCH absolute phycial layer performance with link adaptation.

Table 5.6.2.1.1-1: Test parameters

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | | Unit | Test 1 |
| Bandwidth | | | MHz | 10 |
| Subcarrier spacing | | | kHz | 15 |
| Duplex Mode | | |  | FDD |
| Propagation channel | | |  | TDLA30-5 |
| Antenna configuration | | |  | 2×2 |
| Correlation configuration | | |  | ULA Low |
| 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 | 5/1 |
| 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 | 5/1 |
| CSI-IM configuration | CSI-IM resource Type | |  | Periodic |
| CSI-IM RE pattern | |  | Pattern 0 |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) | |  | (4,9) |
| CSI-IM timeConfig  periodicity and offset | | slot | 5/1 |
| ReportConfigType | | |  | Periodic |
| CQI-table | | |  | Table 2 |
| 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 | 5/0 |
| Codebook configuration | | Codebook Type |  | typeI-SinglePanel |
| Codebook Mode |  | 1 |
| (CodebookConfig-N1,CodebookConfig-N2) |  | N/A |
| CodebookSubsetRestriction |  | 111111 |
| RI Restriction |  | N/A |
| Physical channel for CSI report | | |  | PUCCH |
| CQI/RI/PMI delay | | | ms | 8 |
| Maximum number of HARQ transmission | | |  | 4 |
| Measurement channel | | |  | As specified in Table A.4-2  TBS.2-2 |
| Note1: For retransmission number 4 including initial transmission, RV {0,2,3,1} with same MCS and rank as initial transmission; follow the latest UE reported PMI whose rank is same as the initial transmission | | | | |

Table 5.2.2.1.1-2: Minimum performance requirement

|  |  |  |
| --- | --- | --- |
| Test num. | Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | 35% | [19.3] |
| Note 1: Measurements channels are specified in Table A.4-2.  Note 2: The maximum throughout is defined as with TBS corresponding to CQI index 15 with rank 2. | | |

#### 5.6.2.2 TDD

##### 5.6.2.2.1 Minimum requirements with Link Adaptation

The purpose of the requirements is to verify the PDSCH absolute physical layer throughput with link adaptation performance under 2 receive antenna conditions.

The minimum performance requirements are specified in Table 5.6.2.2.1-2, with the addition of test parameters in Table 5.6.2.2.1-1 and the downlink physical channel setup according to Annex C.3.1.

Table 5.6.2.2.1-1: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | Test 1 |
| Bandwidth | | MHz | 40 |
| Subcarrier spacing | | kHz | 30 |
| Duplex Mode | |  | TDD |
| TDD Slot Configuration | |  | FR1.30-1 |
| Propagation channel | |  | TDLA30-5 |
| Antenna configuration | |  | 2x2 |
| Correlation configuration | |  | ULA Low |
| 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 |  | Pattern 0 |
| CSI-IM Resource Mapping (kCSI-IM,lCSI-IM) |  | (4,9) |
| CSI-IM timeConfig periodicity and offset | slot | 10/1 |
| ReportConfigType | |  | Aperiodic |
| CQI-table | |  | Table 2 |
| 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 | Not configured |
| Aperiodic Report Slot Offset | |  | 9 |
| CSI request | |  | 1 in slots i, where mod(i, 10) = 0, 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) |  | N/A |
| CodebookSubsetRestriction |  | Not configured |
| RI Restriction |  | N/A |
| Physical channel for CSI report | |  | PUSCH |
| CQI/RI/PMI delay | | ms | 5.5 |
| Maximum number of HARQ transmission (Note 1) | |  | 4 |
| 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 |
| CSI Measurement channel | |  | As specified in Table A.4-2,  Rank 2: TBS.2-4 |
| Note1: For retransmission number 4 including initial transmission, RV {0,2,3,1} with same MCS and rank as initial transmission; follow the latest UE reported PMI whose rank is same as the initial transmission | | | |

Table 5.6.2.2.1-2: Minimum performance requirements

|  |  |  |
| --- | --- | --- |
|  | Fraction of maximum throughput (Note 1) | SNR(dB) |
|
| Test 1 | 35% | [20.4] |
| Note 1: The maximum throughput is defined as the throughput using the TBS corresponding to CQI index 15 with rank 2. | | |

### 5.6.3 4Rx requirements

#### 5.6.3.1 FDD

##### 5.6.3.1.1 Minimum requirements with Link Adaptation

The purpose of the requirements is to verify the PDSCH absolute physical layer throughput with link adaptation performance under 4 receive antenna conditions.

For the parameters specified in Table 5.6.3.1.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 5.6.3.1.1-2.

Table 5.6.3.1.1-1: Test parameters

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | | Unit | Test 1 |
| Bandwidth | | | MHz | 10 |
| Subcarrier spacing | | | kHz | 15 |
| Duplex Mode | | |  | FDD |
| Propagation channel | | |  | TDLA30-5 |
| Antenna configuration | | |  | 2×4 |
| Correlation configuration | | |  | ULA Low |
| 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 | 5/1 |
| 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 | 5/1 |
| 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 | 5/1 |
| ReportConfigType | | |  | Aperiodic |
| CQI-table | | |  | Table 2 |
| 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 |
| aperiodicTriggeringOffset | | |  | 5 |
| Codebook configuration | | Codebook Type |  | typeI-SinglePanel |
| Codebook Mode |  | 1 |
| (CodebookConfig-N1,CodebookConfig-N2) |  | N/A |
| CodebookSubsetRestriction |  | Not configured |
| RI Restriction |  | N/A |
| Physical channel for CSI report | | |  | PUSCH |
| CQI/RI/PMI delay | | | ms | 6 |
| Maximum number of HARQ transmission (Note 1) | | |  | 4 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | | |  | 2 |
| Measurement channel | | |  | As specified in Table A.4-2  Rank 2: TBS.2-2 |
| Note 1: For retransmission including initial transmission, RV {0,2,3,1} with same MCS and rank as initial transmission; follow the latest UE reported PMI whose rank is same as the initial transmission. | | | | |

Table 5.6.3.1.1-2: Minimum requirements

|  |  |  |
| --- | --- | --- |
|  | Fraction of maximum throughput (Note 1) | SNR (dB) |
| Test 1 | 50% | [18.0] |
| Note 1: The maximum throughput is defined as the throughput using the TBS corresponding to CQI index 15 with rank 2. | | |

#### 5.6.3.2 TDD

##### 5.6.3.2.1 Minimum requirements with Link Adaptation

The purpose of the requirements is to verify the PDSCH absolute physical layer throughput with link adaptation performance under 4 receive antenna conditions.

For the parameters specified in Table 5.6.3.2.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 5.6.3.2.1-2.

Table 5.6.3.2.1-1: Test parameters

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | | | Unit | Test 1 |
| Bandwidth | | | MHz | 40 |
| Subcarrier spacing | | | kHz | 30 |
| Duplex Mode | | |  | TDD |
| TDD UL-DL pattern | | |  | FR1.30-1 |
| Propagation channel | | |  | TDLA30-5 |
| Antenna configuration | | |  | 2×4 |
| Correlation configuration | | |  | ULA Low |
| 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 | | |  | Aperiodic |
| CQI-table | | |  | Table 2 |
| 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 | Not configured |
| aperiodicTriggeringOffset | | |  | 9 |
| CSI request | | |  | 1 in slots i, where mod(i, 10) = 0, 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) |  | N/A |
| CodebookSubsetRestriction |  | Not configured |
| RI Restriction |  | N/A |
| Physical channel for CSI report | | |  | PUSCH |
| CQI/RI/PMI delay | | | ms | 5.5 |
| Maximum number of HARQ transmission (Note 1) | | |  | 4 |
| 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 |
| Measurement channel | | |  | As specified in Table A.4-2,  TBS.2-4 |
| Note 1: For retransmission including initial transmission, RV {0,2,3,1} with same MCS and rank as initial transmission; follow the latest UE reported PMI whose rank is same as the initial transmission. | | | | |

Table 5.6.3.2.1-2: Minimum requirements

|  |  |  |
| --- | --- | --- |
|  | Fraction of maximum throughput (Note 1) | SNR (dB) |
| Test 1 | 50% | [18.2] |
| Note 1: The maximum throughput is defined as the throughput using the TBS corresponding to CQI index 15 with rank 2. | | |