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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*.
- 3GPP TR 21.905: "Vocabulary for 3GPP Specifications". [1] [2] 3GPP TS 38.521-4: "NR; User Equipment (UE) radio transmission and reception; Part 4: Performance requirements". Recommendation ITU-R M.1545: "Measurement uncertainty as it applies to test limits for the [3] 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". 3GPP TR 38.901: "Study on channel model for frequencies from 0.5 to 100 GHz". [5] [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". 3GPP TS 38.101-3: "NR; User Equipment (UE) radio transmission and reception; Part 3: Range 1 [8] 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] 3GPP TS38.521-4, "User Equipment (UE) conformance specification; Radio transmission and reception; Part 4: Performance"

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].

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:

E_s 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

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

 N_{oc} 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].

CA Carrier Aggregation
CC Component Carrier
CCE Control Channel Element
CORESET Control Resource Set

CP Cyclic Prefix

CSI Channel-State Information
CSI-IM CSI Interference Measurement

CSI-RS CSI Reference Signal

CW Codeword

CQI Channel Quality Indicator CRC Cyclic Redundancy Check CRI CSI-RS Resource Indicator

DC Dual Connectivity

DCI Downlink Control Information

DL Downlink

DMRS Demodulation Reference Signal EPRE Energy Per Resource Element EN-DC E-UTRA-NR Dual Connectivity

FR Frequency Range

FRC Fixed Reference Channel

HARQ Hybrid Automatic Repeat Request

LI Layer Indicator

MAC Medium Access Control
MCS Modulation and Coding Scheme
MIB Master Information Block

NR New Radio

NSA Non-Standalone Operation Mode 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
PSS Primary Synchronization Signal
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

SCS Subcarrier Spacing

SINR Signal-to-Interference-and-Noise Ratio

SNR Signal-to-Noise Ratio
SS Synchronization Signal
SSB Synchronization Signal Block
SSS Secondary Synchronization Signal
TCI Transmission Configuration Indicator

TDM Time division multiplexing TTI Transmission Time Interval

UL Uplink

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.

Clause suffix

None
Single Carrier

A
Carrier Aggregation (CA)

B
Dual-Connectivity (DC)

C
Supplement Uplink (SUL)

Table 4.3-1: Definition of suffixes

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:

$$SNR = \frac{\sum_{j=1}^{N_{RX}} E_s^{(j)}}{\sum_{j=1}^{N_{RX}} N_{oc}^{(j)}}$$

Where

- N_{RX} 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:

 $Noc_{Band_X,\ SCS_Y,\ CBW_Z} = REFSENS_{Band_X,\ SCS_Y,\ CBW_Z} - 10*log10(12*SCS_Y*nPRB) + D - SNR_{REFSENS} + \Delta_{thermal} +$

where

- REFSENS_{Band_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

- SNR_{REFSENS} = -1 dB is the SNR used for simulation of REFSENS
- Δ_{thermal} is the amount of dB that the wanted noise is set above UE thermal noise, giving a defined rise in total noise. $\Delta_{\text{thermal}} = 16$ dB, 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:

 $Es_{Band_X,\ SCS_Y,\ CBW_Z} = REFSENS_{Band_X,\ SCS_Y,\ CBW_Z} - 10*log10(12*SCS_Y*nPRB) + D - SNR_{REFSENS} + dB_{EVM} + \Delta_{thermal} \\ where:$

- REFSENS_{Band_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
- SNR_{REFSENS} = -1 dB is the SNR used for simulation of REFSENS
- dB_{EVM} is the SNR of the applied signal due to EVM impairment on the wanted Es. An allowed EVM of 3% gives a dB_{EVM} of 30.5dB, derived as 20*log10(1/0.03).
- $\Delta_{thermal}$ 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. $\Delta_{thermal} = 7.6 dB$, 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.

4.5 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.

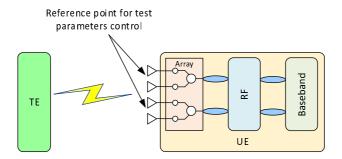


Figure 4.5.1-1: Reference point for radiated Demodulation and CSI requirements

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 SNR_{BB}. The SNR at the reference point is defined as

$$SNR = SNR_{BB} + \Delta_{BB}$$

where Δ_{BB} is specified in clause 4.5.3.

The reference point SNR is defined as:

$$SNR = \frac{\sum_{j=1}^{N_{RX}} E_s^{(j)}}{\sum_{j=1}^{N_{RX}} N_{oc}^{(j)}}$$

- N_{RX} 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 Δ_{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 $\Delta_{BB} = 1$ dB.

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

| Operating band | | UE Pov | ver class | |
|------------------|----------------------|--------|-----------|--------|
| | 1 | 2 | 3 | 4 |
| n257 | -166.8 | -161.3 | -157.6 | -166.3 |
| n258 | -166.8 | -161.3 | -157.6 | -166.3 |
| n260 | -163.8 | | -155.0 | -164.3 |
| n261 | -166.8 | -161.3 | -157.6 | -166.3 |
| Note 1: Noc leve | els are specified in | dBm/Hz | | |

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

$$Noc_{MB} = Noc_{SB} + \Delta MB_{P,n}$$

- Noc_{SB} is the Noc defined in Table 4.5.3.2-1
- Δ MB_{P,n} values are specified in TS 38.101-2 [7].

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

$$Noc_{CA} = Noc_{SC} + \Delta R_{IB}$$

- Noc_{SC} is derived by assuming UE supports single carrier.
- ΔR_{IB} 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 and on the UE Power class, and taking a baseline of UE Power class 3 in Band n260.

$$Noc = REFSENS_{PC3, \, n260, \, 50MHz} - 10Log_{10}(SCS_{REFSENS} \, x \, PRB_{REFSENS} \, x \, 12) - SNR_{REFSENS} + \Delta_{thermal} +$$

where:

- REFSENS_{PC3, n260, 50MHz} is the REFSENS value in dBm specified for Power Class 3 UE in Band n260 for 50MHz Channel bandwidth in Table 7.3.2.3-1 of TS 38.101-2 [7].
- SCS_{REFSENS} is a subcarrier spacing associated with N_{RB} for 50MHz in Table 5.3.2-1 of TS 38.101-2 [7], chosen as 120 kHz.
- PRB_{REFSENS} is N_{RB} associated with subcarrier spacing 120 kHz for 50MHz in Table 5.3.2-1 of TS 38.101-2 [7] and is 32.
- 12 is the number of subcarriers in a PRB

- SNR_{REFSENS} = -1 dB is the SNR used for simulation of REFSENS
- Δ_{thermal} is the amount of dB that the wanted noise is set above UE thermal noise, giving a rise in total noise of Δ_{BB} . $\Delta_{\text{thermal}} = 6 \text{dB}$, giving a rise in total noise of 1 dB.

The calculated Noc value for the baseline of UE Power class 3 in Band n260 is rounded to -155 dBm/Hz.

The following methodology to define the Noc level for UE power class X (PC_X) and operating band Y (Band_Y) is used for the single carrier case and single band devices:

Noc(PC_X, Band_Y) = -155 dBm/Hz + REFSENS_{PC} X, Band Y, 50MHz - REFSENS_{PC}3, n260, 50MHz

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

4.5.4 Angle of arrival

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

- Select the known Rx beam peak direction reused from RF testing if available, as far as it satisfies the minimum isolation requirement defined in TS 38.521-4 [16] and rank number in TS 38.521-4 [16] corresponding to the test cases
- Otherwise select one direction which satisfies the REFSENS defined in TS 38.101-2 [7], minimum isolation requirement defined in TS 38.521-4 [16] and rank number in TS 38.521-4 [16] corresponding to the test cases.

4.5.5 Es

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

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

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.

5.1.1.2 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 | PDSCH | All tests in Clause 5.2.2 |
| 2RX | PDCCH | All tests in Clause 5.3.2 |
| | PBCH | All tests in Clause 5.4.2 |
| UE supports only | PDSCH | All tests in Clause 5.2.3 |
| 4RX or both 2RX | PDCCH | All tests in Clause 5.3.3 |
| and 4RX | PBCH | All tests in Clause 5.4.2 or 5.4.3 (Note) |
| Note: Requireme | ents for PBCH with 4Rx | is up to UE declaration |

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 ty | /pe | 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- | FR1 FDD | PDSCH | Clause 5.2.2.1.4 (Test 1-2) | |
| Alt) | | | Clause 5.2.3.1.4 (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 |

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 t | уре | Test list | Applicability notes |
|--|---------|----------|--|---------------------------------------|
| 256QAM modulation scheme | FR1 FDD | PDSCH | Clause 5.2.2.1.1 (Test 1-3) | |
| for PDSCH for FR1 (pdsch- | | | Clause 5.2.3.1.1 (Test 1-3) | |
| 256QAM-FR1) | 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 | FR1 FDD | PDSCH | Clause 5.2.2.1.3 | |
| (pdsch-MappingTypeB) | | | Clause 5.2.3.1.3 | |
| | FR1 TDD | PDSCH | Clause 5.2.2.2.3 | |
| | | | Clause 5.2.3.2.3 | |
| | FR1 FDD | PDSCH | Clause 5.2.2.1.4 | For UEs supporting |
| | | | Clause 5.2.3.1.4 | "Alternative |
| | | | | additional DMRS |
| | | | | position for co- |
| | | | | existence with LTE |
| Rate-matching around LTE | | | | CRS", if Test 1-2 is |
| CRS (rateMatchingLTE-CRS) | | | | tested, the test |
| erre (raternaterning=r= erre) | | | | coverage can be |
| | | | | considered fulfilled |
| | | | | without executing |
| | | | | Test 1-1. Otherwise, |
| | | | | only Test 1-1 is |
| | ED4 EDD | DD 0011 | OL 50044/T + 44 | tested. |
| Supported maximum number of | FR1 FDD | PDSCH | Clause 5.2.2.1.4 (Tests 1-1, | The requirements |
| ports across all configured | | | 1-2) | apply only in case the number of NZP- |
| NZP-CSI-RS resources per CC (maxConfigNumberPortsAcros | | | Clause 5.2.3.1.1 (Tests 3-1, 4-1, 5-1) | CSI-RS ports in the |
| sNZP-CSI-RS-PerCC) | | | Clause 5.2.3.1.4 (Tests 1-1, | test case satisfies UE |
| 31/27-031-13-76100) | | | 1-2) | capability on |
| | FR1 TDD | PDSCH | Clause 5.2.3.2.1 (Test 3-1, | maximum number of |
| | TRITOD | I Doci i | 4-1, 5-1) | NZP-CSI-RS ports |
| Supported maximum number of | FR1 FDD | PDSCH | Clause 5.2.2.1.1 (Tests 2-1, | The requirements |
| PDSCH MIMO layers | TRITOD | 1 00011 | 2-2, 3-1) | apply only in case |
| (maxNumberMIMO- | | | Clause 5.2.2.1.2 | the PDSCH MIMO |
| LayersPDSCH) | | | Clause 5.2.3.1.1 (Tests 2-1, | rank in the test case |
| | | | 2-2, 3-1, 4-1, 5-1) | does not exceed UE |
| | | | Clause 5.2.3.1.2 | PDSCH MIMO layers |
| | FR1 TDD | PDSCH | Clause 5.2.2.2.1 (Tests 2-1, | capability |
| | | | 2-2, 3-1) | |
| | | | Clause 5.2.2.2 | |
| | | | Clause 5.2.3.2.1 (Tests 2-1, | |
| | | | 2-2, 3-1, 4-1, 5-1) | |
| | | | Clause 5.2.3.2.2 | |

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

| PDSCH transmission scheme |
|---|
| Usable subcarrier on this carrier (Note 2) RBS U |
| Subcarrier spacing Subcarrier spacing Cyclic prefix RB offset RBs O |
| DL BWP configuration #1 Number of contiguous PRB PRBs PRBs Description = 1 |
| DL BWP configuration #1 Number of contiguous PRB PRBs Aximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-1 [6] for tested channel bandwidth and subcarrier spacing Physical Cell ID SB position in burst SB periodicity SB periodicity SB periodicity SB periodicity SB periodicity SIots for PDCCH monitoring Symbols with PDCCH Number of PRBs in CORESET Number of PDCCH candidates and aggregation levels PDCCH configuration PDCCH aggregation levels PDCCH & PDCCH DMRS Precoding Configuration Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-1 [6] for tested channel bandwidth and subcarrier spacing Raymont Table 5.2-2 for tested channel bandwidth and subcarrier spacing 1/AL8 CCE-to-REG mapping type Non-interleaved DCI format TCI state TCI state #1 Single Panel Type I, Random per slow with equal probability of each applicable i1, i2 combination, and with applicable i |
| Number of contiguous PRB PRBs 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 SSB position in burst SSB periodicity SSB position in burst SSB periodicity SSB periodicity SSB periodicity SpB periodicity Symbols O, 1 Table 5.2-2 for tested channel bandwidth and subcarrier spacing 1/AL8 Single parameters Single Panel Type I, Random per slow with equal probability of each applicable i ₁ , i ₂ combination, and with applicable i ₁ , i ₂ combination, and with |
| cell parameters SSB periodicity Sab II Slot #0 20 Table 5.2-2 for tested channel bandwidth and subcarrier spacing 1/AL8 PDCCH candidates and aggregation levels CCE-to-REG mapping type CCE-to-REG mapping type DCI format TCI state Single Panel Type I, Random per slot with equal probability of each applicable i ₁ , i ₂ combination, and with applicable i ₁ , i ₂ combination, and with |
| SSB periodicity Slots for PDCCH monitoring Symbols with PDCCH Symbols Number of PRBs in CORESET Number of PDCCH candidates and aggregation levels PDCCH configuration PDCCH aggregation to the configuration PDCCH by the configuration SSB periodicity Each slot Symbols O, 1 Table 5.2-2 for tested channel bandwidth and subcarrier spacing 1/AL8 Non-interleaved CCE-to-REG mapping type Non-interleaved TCI state TCI state #1 Single Panel Type I, Random per slot with equal probability of each applicable i ₁ , i ₂ combination, and with equal probability of each applicable i ₁ , i ₂ combination, and with equal probability of each applicable i ₁ , i ₂ combination, and with equal probability of each applicable i ₁ , i ₂ combination, and with equal probability of each applicable i ₁ , i ₂ combination, and with equal probability of each applicable i ₁ , i ₂ combination, and with equal probability of each applicable i ₁ , i ₂ combination, and with equal probability of each applicable i ₁ , i ₂ combination, and with equal probability of each applicable i ₁ , i ₂ combination, and with equal probability of each applicable i ₁ , i ₂ combination, and with equal probability of each applicable i ₁ , i ₂ combination, and with equal probability of each applicable i ₁ , i ₂ combination, and with equal probability of each applicable i ₁ , i ₂ combination, and with equal probability of each applicable i ₁ , i ₂ combination, and with equal probability of each applicable i ₁ , i ₂ combination, and with equal probability of each applicable i ₁ , i ₂ combination, and with equal probability of each applicable i ₁ , i ₂ combination, and with equal probability of each applicable i ₁ , i ₂ combination, and with equal probability of each applicable i ₁ , i ₂ combination equal probability of each applicable i ₁ , i ₂ combination equal probability in the equal probability is equal probability of each applicable i ₁ , i ₂ combination equal probability is equal probability in the equal probability is equal probability |
| Symbols with PDCCH Number of PRBs in CORESET Number of PDCCH candidates and aggregation levels PDCCH configuration Symbols O, 1 Table 5.2-2 for tested channel bandwidth and subcarrier spacing 1/AL8 Non-interleaved DCI format TCI state PDCCH & PDCCH DMRS Precoding configuration Symbols O, 1 Table 5.2-2 for tested channel bandwidth and subcarrier spacing Non-interleaved TCI state #1 Single Panel Type I, Random per slow with equal probability of each applicable i ₁ , i ₂ combination, and with applicable i ₂ combination i ₁ applicable i ₂ combination i ₂ combination i ₁ applicable i ₂ combination i ₂ combination i ₂ combination i ₃ combination i ₄ co |
| Number of PRBs in CORESET Number of PDCCH candidates and aggregation levels PDCCH configuration Number of PDCCH candidates and aggregation levels CCE-to-REG mapping type DCI format TCI state PDCCH & PDCCH DMRS Precoding configuration Table 5.2-2 for tested channel bandwidth and subcarrier spacing Non-interleaved TCI state #1 Single Panel Type I, Random per slow with equal probability of each applicable i ₁ , i ₂ combination, and with applicable i ₁ , i ₂ combination, and applicable i ₁ |
| PDCCH CCE-to-REG mapping type configuration Number of PDCCH candidates and aggregation levels CCE-to-REG mapping type DCI format TCI state PDCCH & PDCCH DMRS Precoding configuration Non-interleaved 1_1 TCI state #1 Single Panel Type I, Random per slow with equal probability of each applicable i ₁ , i ₂ combination, and with applicable i ₁ , i ₂ combination, and with aggregation levels Non-interleaved Single Panel Type I, Random per slow with equal probability of each applicable i ₁ , i ₂ combination, and with aggregation levels Non-interleaved 1/AL8 |
| PDCCH configuration CCE-to-REG mapping type DCI format TCI state PDCCH & PDCCH DMRS Precoding configuration CCE-to-REG mapping type Non-interleaved 1_1 TCI state #1 Single Panel Type I, Random per slow with equal probability of each applicable i ₁ , i ₂ combination, and with applicable i ₁ , i ₂ combination, and with applicable i ₁ , i ₂ combination, and with applicable i ₂ , i ₃ combination, and with applicable i ₄ , i ₄ combination, and with applicable i ₄ , i ₅ combination i ₆ co |
| configuration DCI format TCI state TCI state TCI state #1 Single Panel Type I, Random per slow with equal probability of each applicable i ₁ , i ₂ combination, and with a configuration and with |
| TCI state #1 Single Panel Type I, Random per slow with equal probability of each applicable i ₁ , i ₂ combination, and with |
| PDCCH & PDCCH DMRS Precoding configuration Single Panel Type I, Random per slo with equal probability of each applicable i ₁ , i ₂ combination, and with |
| of Tx larger than 1 |
| Cross carrier scheduling Not configured |
| First subcarrier index in the PRB used for CSI-RS resource 1,2,3,4 |
| First OFDM symbol in the PRB used for $I_0 = 6$ for CSI-RS resource 1 and 3 $I_0 = 10$ 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, |
| CDM Type'No CDM' for CSI-RS resource 1,2,3,Density (ρ)3 for CSI-RS resource 1,2,3,4 |
| 15 kHz SCS: 20 for CSI-RS resource |
| CSI-RS periodicity Slots 1,2,3,4 30 kHz SCS: 40 for CSI-RS resource 1,2,3,4 |
| 15 kHz SCS: 10 for CSI-RS resource 1 and 2 11 for CSI-RS resource 3 and 4 CSI-RS offset Slots |
| 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 = BWP size |
| QCL info TCl state #0 |
| First subcarrier index in the PRB used for CSI-RS $k_0 = 0$ |
| First OFDM symbol in the PRB used for CSI-RS |
| Number of CSI-RS ports (X) Same as number of transmit antenna |
| NZP CSI-RS for CSI acquisition CDM Type 'No CDM' for 1 transmit antenna 'FD-CDM2' for 2 and 4 transmit antenna |
| CSI acquisition Density (ρ) |
| 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 = BWP size |
| QCL info TCl state #1 |

| | Final and | index in the DDD | | 1 |
|--|--------------------------------|---------------------------|-------|---|
| | CSI-RS | index in the PRB used for | | k ₀ = 4 |
| | First OFDM syr | mbol in the PRB used for | | I ₀ = 12 |
| | Number of CSI | -RS ports (X) | | 4 |
| ZP CSI-RS for CSI | CDM Type | , , | | 'FD-CDM2' |
| acquisition | Density (ρ) | | | 1 |
| | CSI-RS periodi | city | Slots | 15 kHz SCS: 20 30 kHz SCS: 40 |
| | CSI-RS offset | | Slots | 0 |
| | Frequency Occ | cupation | | Start PRB 0 Number of PRB = BWP size |
| PDSCH DMRS | 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 |
| configuration | Position of the mapping type A | first DMRS for PDSCH | | 2 |
| | Number of PDS | SCH DMRS CDM group(s) | | 1 for Rank 1 and Rank 2 tests |
| | without data | OOD in day. | | 2 for Rank 3 and Rank 4 tests |
| | Type 1 QCL | SSB index | | SSB #0 |
| TCI state #0 | information Type 2 QCL | QCL Type SSB index | | Type C N/A |
| | information | QCL Type | | N/A N/A |
| | IIIIOIIIIalioii | | | CSI-RS resource 1 from 'CSI-RS for |
| | Type 1 QCL | CSI-RS resource | | tracking' configuration |
| TCI state #1 | information | QCL Type | | Type A |
| Torotato #1 | Type 2 QCL | CSI-RS resource | | N/A |
| | information | QCL Type | | N/A |
| PT-RS configuration | | 71 | | PT-RS is not configured |
| | code block group | os for ACK/NACK feedback | | 1 |
| Maximum number of | | | | 4 |
| HARQ ACK/NACK b | undling | | | Multiplexed |
| Redundancy version | | Э | | {0,2,3,1} |
| PDSCH & PDSCH DMRS Precoding configuration | | | | Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i ₁ , i ₂ combination, and with PRB bundling granularity |
| Symbols for all unus | | | | OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1 |
| Physical signals, cha | innels mapping a | nd 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 5.2-2: Number of PRBs in CORESET

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

5.2.1 1RX requirements

(Void)

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

Table 5.2.2.1.1-2: Test parameters

| Parameter | | | Value |
|--|---|-------|--------------------------------------|
| Duplex mode | | | FDD |
| Active DL BWP index | | | 1 |
| | Mapping type | | Type A |
| | k0 | | 0 |
| | Starting symbol (S) | | 2 |
| | Length (L) | | 12 |
| | PDSCH aggregation factor | | 1 |
| | PRB bundling type | | Static |
| | DDD hundling size | | 4 for Test 1-1 |
| PDSCH | PRB bundling size | | 2 for other tests |
| configuration | | | Test 1-2: Type 1 with start RB = 23, |
| | Resource allocation type | | $L_{RBs} = 6$ |
| | | | 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 |
| | DMRS Type | | Type 1 |
| PDSCH DMRS | Number of additional DMRS | | 2 for Tests 1-1, 1-5 |
| configuration | Number of additional DIVIRS | | 1 for other tests |
| Configuration | Maximum number of OFDM symbols for DL front loaded DMRS | | 1 |
| | | | Test 1-5: |
| | CSI-RS periodicity | Slots | 10 for CSI-RS resource 1,2,3,4. |
| | | | Other tests: Table 5.2-1. |
| CSI-RS for tracking | | | Test 1-5: |
| | | | 1 for CSI-RS resource 1 and 2 |
| | CSI-RS offset | Slots | 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 I ACK information | between PDSCH and corresponding HARQ- | | 2 |

Table 5.2.2.1.1-3: Minimum performance for Rank 1

| | | Bandwidth | Mandadatian | | Correlation | Reference value | |
|--------------|----------------------|---|---------------------------------|-----------------------|--|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | matrix and antenna configuration | 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 |

Table 5.2.2.1.1-4: Minimum performance for Rank 2

| | Bandwidth | | | Correlation | Reference value | | |
|--------------|----------------------|---|---------------------------------|-----------------------|--|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | matrix and antenna configuration | 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

| | | Bandwidth | | | Correlation | Reference value | |
|------------|----------------------|---|---------------------------------|-----------------------|----------------------------------|------------------------------------|-------------|
| Tes nun | | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | matrix and antenna configuration | 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 |
| | Mapping type | | Type A |
| | k0 | | 0 |
| | Starting symbol (S) | | 2 |
| | Length (L) | | 12 |
| | PDSCH aggregation factor | | 1 |
| PDSCH | PRB bundling type | | Static |
| configuration | 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 | | N/A |
| | size | | • |
| | DMRS Type | | Type 1 |
| PDSCH DMRS | Number of additional DMRS | | 1 |
| configuration | Maximum number of OFDM symbols for DL front loaded DMRS | | 1 |
| NZP CSI-RS for | OFDM symbols in the PRB used for CSI-RS | | l ₀ = 13 |
| CSI acquisition | CSI-RS periodicity | Slots | 5 |
| ZP CSI-RS for CSI | Subcarrier index in the PRB used for CSI-RS | | $(k_0, k_1, k_2, k_3)=(2, 4, 6, 8)$ |
| acquisition | Number of CSI-RS ports (X) | | 8 |
| 1 | CSI-RS periodicity | Slots | 5 |
| Number of HARQ Pr | | | 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

| | Bandwidth | | Correlation | Reference value | | | |
|--------------|----------------------|---|---------------------------------|-----------------------|--|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | matrix and antenna configuration | 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 inde | X | | 1 |
| | Mapping type | | Type B |
| | k0 | | 0 |
| | Starting symbol (S) | | 5 |
| | Length (L) | | 7 |
| | PDSCH aggregation factor | | 1 |
| PDSCH | PRB bundling type | | Static |
| configuration | 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 |
| | DMRS Type | | Type 1 |
| PDSCH DMRS | Number of additional DMRS | | 1 |
| configuration | Maximum number of OFDM symbols for DL front loaded DMRS | | 1 |
| Number of HARQ Processes | | | 4 |
| The number of slots ACK information | between PDSCH and corresponding HARQ- | | 2 |

Table 5.2.2.1.3-3: Minimum performance for Rank 1

| | | Bandwidth | | | Correlation | Reference value | |
|--------------|----------------------|---|---------------------------------|--------------------------|----------------------------------|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | matrix and antenna configuration | 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 | 1-1 |

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 | 1-1, 1-2 |
| matching configured | |

Table 5.2.2.1.4-2: Test parameters

| Duplex mode | | Parameter | Unit | Value |
|--|--------------------|--|------|-----------------|
| Active DL BWP index 1 | Duplex mode | | | FDD |
| PDCCH configuration | | (| | 1 |
| Mapping type | NR UL transmission | with a 7.5 kHz shift to the LTE raster | | true |
| Number of HARQ Processes Hard Market Number of slots between PDSCH and some stations Number of HARQ Processes A the hard market Number of slots between PDSCH and corresponding HARQ-ACK information Number of slots between PDSCH and corresponding HARQ-ACK information Number of slots between PDSCH and corresponding HARQ-ACK information Number of slots between PDSCH and corresponding HARQ-ACK information Number of slots between PDSCH and corresponding HARQ-ACK information Number of slots between PDSCH and corresponding HARQ-ACK information Number of slots between PDSCH and corresponding HARQ-ACK information Number of slots between PDSCH and corresponding HARQ-ACK information Number of slots between PDSCH and corresponding HARQ-ACK information Number of slots between PDSCH and corresponding HARQ-ACK information Number of slots between PDSCH and corresponding HARQ-ACK information Number of slots between PDSCH and corresponding HARQ-ACK information Number of slots between PDSCH and corresponding HARQ-ACK information Number of slots between PDSCH and corresponding HARQ-ACK information Number of slots between PDSCH and corresponding HARQ-ACK information Number of slots between PDSCH and corresponding HARQ-ACK information Number of slots between PDSCH and corresponding HARQ-ACK information Number of slots between PDSCH and corresponding HARQ-ACK information Number of slots between PDSCH and corresponding HARQ-ACK information Number of slots between PDSCH and corresponding HARQ-ACK information Number of slots between PDSCH and corresponding HARQ-ACK information Number of slots between PDSCH and corresponding HARQ-ACK information Number of slots between PDSCH and corresponding HARQ-ACK information Number of slots between PDSCH and corresponding HARQ-ACK information Number of slots between PDSCH and corresponding HARQ-ACK information Number of slots between PDSCH and corresponding HARQ-ACK information Number of slots between PDSCH and corresponding HARQ-ACK inf | | Symbols with PDCCH | | Symbol# 2 |
| PDSCH configuration | Coringulation | Mapping type | | Type A |
| Length (L) | | k0 | | 0 |
| PDSCH configuration | | Starting symbol (S) | | 3 |
| PDSCH configuration 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 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 number of antenna ports MHz 10 Number of HARQ Processes 4 The number of slots between PDSCH and corresponding HARQ-ACK information 2 | | Length (L) | | |
| 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 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 Adams 4 0 Number of HARQ Processes 4 The number of slots between PDSCH and corresponding HARQ-ACK information 2 | DDCCII | PDSCH aggregation factor | | 1 |
| PRB building size | | PRB bundling type | | Static |
| RBG size | configuration | PRB bundling size | | 2 |
| VRB-to-PRB mapping type VRB-to-PRB mapping interleaver bundle size DMRS Type Position of the first DM-RS for downlink Number of additional DMRS Maximum number of OFDM symbols for DL front loaded DMRS CRS for rate matching (Note 1) LTE carrier centre subcarrier location LTE carrier BW Number of antenna ports v-shift Number of Slots between PDSCH and corresponding HARQ- ACK information Non-interleaved N/A N/A Same as NR carrier location Same as NR carrier centre subcarrier location MHz 10 NHz 0 ACK information Non-interleaved N/A | | Resource allocation type | | Type 0 |
| 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 subcarrier location Same as NR carrier centre subcarrier location LTE carrier BW MHz 10 Number of antenna ports v-shift 4 Number of Slots between PDSCH and corresponding HARQ-ACK information 2 | | RBG size | | Config2 |
| PDSCH DMRS DMRS Type Type 1 | | VRB-to-PRB mapping type | | Non-interleaved |
| PDSCH DMRS configuration 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 | | | | N/A |
| PDSCH DMRS configuration 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 | | DMRS Type | | Type 1 |
| Configuration 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 v-shift 0 Number of HARQ Processes 4 The number of slots between PDSCH and corresponding HARQ-ACK information 2 | DD0011 D14D0 | Position of the first DM-RS for downlink | | |
| CRS for rate matching (Note 1) LTE carrier centre subcarrier location LTE carrier BW MHz 10 | | Number of additional DMRS | | 1 |
| CRS for rate matching (Note 1) LTE carrier centre subcarrier location 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 | configuration | | | 1 |
| matching (Note 1) 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 | 0001 | LTE carrier centre subcarrier location | | |
| Number of antenna ports v-shift 0 Number of HARQ Processes The number of slots between PDSCH and corresponding HARQ- ACK information 2 | | LTE carrier BW | MHz | 10 |
| v-shift 0 Number of HARQ Processes 4 The number of slots between PDSCH and corresponding HARQ-ACK information 2 | matching (Note 1) | Number of antenna ports | | 4 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | | • | | 0 |
| ACK information | Number of HARQ Pr | ocesses | | 4 |
| Note 1. No MDCFN is configured on LTC corrier | | between PDSCH and corresponding HARQ- | | 2 |
| NOTE 1. NO MIDDEN IS CONFIGURED ON LIE CARRIER | Note 1: No MBSFI | N is configured on LTE carrier | | |

Table 5.2.2.1.4-3: Minimum performance for Rank 1

| | | Bandwidth | | | Correlation | Reference value | |
|--------------|----------------------|---|---------------------------------|-----------------------|--|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | matrix and antenna configuration | 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 |

5.2.2.2 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 | 1-1, 1-2, 1-3, 1-5, 1-6, 1-7, 1-8, 1-9, 2-1, 2-2 |
| under 2 receive antenna conditions and with different | |
| channel models, MCSs and number of MIMO layers | |
| Verify the PDSCH mapping Type A HARQ soft combining | 1-4 |
| performance under 2 receive antenna conditions. | |
| Verify the PDSCH mapping Type A performance | 3-1 |
| requirements for Enhanced Receiver Type 1 under 2 | |
| receive antenna conditions. | |

Table 5.2.2.2.1-2: Test parameters

| | Parameter | Unit | Value |
|-------------------------------------|---|-------|---|
| Duplex mode | | | TDD |
| Active DL BWP index | X | | 1 |
| | 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 |
| configuration | Resource allocation type | | Test 1-2: Type 1 with start RB = 50, $L_{RBs} = 6$ 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 |
| | DMRS Type | | Type 1 |
| | Number of additional DMRS | | 2 for Tests 1-1, 1-7, 1-8, 1-9 1 for other tests |
| configuration | Maximum number of OFDM symbols for DL front loaded DMRS | | 1 |
| | First OFDM symbol in the PRB used for CSI-RS | | Tests 1-8, 1-9: $l_0 = 4$ for CSI-RS resource 1 and 3 $l_0 = 8$ for CSI-RS resource 2 and 4 |
| | | | Other tests; Table 5.2-1. |
| | CSI-RS periodicity | Slots | Test 1-7: 20 for CSI-RS resource 1,2,3,4. |
| | | | Other tests: Table 5.2-1. |
| CSI-RS for tracking | CSI-RS offset | Slots | Test 1-7: 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: Start PRB 0 Number of PRB = 52 |
| | | | Other tests: Table 5.2-1. |
| Number of HARQ Pro | ocesses | | 16 for Test 1-4 10 for Test 1-9 8 for other tests |
| The number of slots ACK information | between PDSCH and corresponding HARQ- | | 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

| | | Bandwidth | | | | Correlation | Reference v | value |
|--------------|------------------------|---|---------------------------------|--------------------------|-----------------------|--|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL- DL pattern | Propagation condition | matrix and antenna configuration | 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 |

Table 5.2.2.2.1-4: Minimum performance for Rank 2

| | В | Bandwidth | | | | Correlation | Reference value | |
|--------------|-----------------------|---|---------------------------------|-------------------------|-----------------------|--|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL-DL pattern | Propagation condition | matrix and antenna configuration | 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

| | | Bandwidth | | T 00 | | Correlation | Reference | value |
|--------------|-----------------------|---|---------------------------------------|--------------------------|-----------------------|--|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL- DL pattern | Propagation condition | matrix and antenna configuration | 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 5.2.2.2.1.

Table 5.2.2.2-1: 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: Test parameters

| | Parameter | Unit | Value |
|-------------------------------------|---|-------|--|
| Duplex mode | | | TDD |
| Active DL BWP index | (| | 1 |
| | Mapping type | | Type A |
| | k0 | | 0 |
| | Starting symbol (S) | | 2 |
| | Length (L) | | Specific to each Reference channel |
| | PDSCH aggregation factor | | 1 |
| PDSCH | PRB bundling type | | Static |
| configuration | 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 | | N/A |
| | size | | · |
| | DMRS Type | | Type 1 |
| PDSCH DMRS | Number of additional DMRS | | 1 |
| configuration | Maximum number of OFDM symbols for DL front loaded DMRS | | 1 |
| NZP CSI-RS for | OFDM symbols in the PRB used for CSI-RS | | l ₀ = 13 |
| CSI acquisition | CSI-RS periodicity | Slots | 5 |
| ZP CSI-RS for CSI | Subcarrier index in the PRB used for CSI-RS | | $(k_0, k_1, k_2, k_3)=(2, 4, 6, 8)$ |
| acquisition | Number of CSI-RS ports (X) | | 8 |
| | CSI-RS periodicity | Slots | 5 |
| Number of HARQ Pr | ocesses | | 8 |
| The number of slots ACK information | between PDSCH and corresponding HARQ- | | Specific to each TDD UL-DL pattern and as defined in Annex A.1.2 |

Table 5.2.2.2-3: Minimum performance for Rank 2

| | | Bandwidth | Madulatian | TDD | | Correlation | Reference v | /alue |
|--------------|-----------------------|---|---------------------------------|--------------------------|-----------------------|--|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL- DL pattern | Propagation condition | matrix and antenna configuration | 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 | 1-1 |
| receive antenna conditions | |

Table 5.2.2.3-2: Test parameters

| Parameter | | Unit | Value |
|--|---|------|--|
| Duplex mode | | | TDD |
| Active DL BWP index | | | 1 |
| | Mapping type | | Туре В |
| | k0 | | 0 |
| | Starting symbol (S) | | 5 |
| | Length (L) | | 7 |
| | PDSCH aggregation factor | | 1 |
| PDSCH configuration | 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 |
| | DMRS Type | | Type 1 |
| PDSCH DMRS configuration | Number of additional DMRS | | 1 |
| | Maximum number of OFDM symbols for DL front loaded DMRS | | 1 |
| Number of HARQ Pr | ocesses | | 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 5.2.2.3-3: Minimum performance for Rank 1

| | | Bandwidth | | | | Correlation matrix and antenna configuration | Reference value | |
|--------------|-----------------------|---|---------------------------------|-------------------------|-----------------------|---|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL-DL pattern | Propagation condition | | 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 |

5.2.3 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, 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 | | | Value |
|--|---|-------|--|
| Duplex mode | | | FDD |
| Active DL BWP index | | | 1 |
| | Mapping type | | Type A |
| | k0 | | 0 |
| | Starting symbol (S) | | 2 |
| | Length (L) | | 12 |
| | PDSCH aggregation factor | | 1 |
| | PRB bundling type | | Static |
| PDSCH configuration | PRB bundling size | | 4 for Test 1-1 WB for Test 3-1 2 for other tests |
| | Resource allocation type | | Test 1-2: Type 1 with start RB = 23, $L_{RBs} = 6$ 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 |
| | DMRS Type | | Type 1 |
| PDSCH DMRS | Number of additional DMRS | | 2 for Test 1-1, 1-5 1 for other tests |
| configuration | Maximum number of OFDM symbols for DL front loaded DMRS | | 1 |
| | CSI-RS periodicity | Slots | Test 1-5: 10 for CSI-RS resource 1,2,3,4. |
| CSI-RS for tracking | | | Other tests: Table 5.2-1. |
| | CSI-RS offset | Slots | Test 1-5: 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 5.2.3.1.1-3: Minimum performance for Rank 1

| | | Bandwidth | Madadatian | | Correlation | Reference va | alue |
|--------------|----------------------|---|---------------------------------|-----------------------|--|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | matrix and antenna configuration | 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 |

Table 5.2.3.1.1-4: Minimum performance for Rank 2

| | | Bandwidth | Madulation | Correlation | | Reference | value |
|--------------|----------------------|---|---------------------------------|-----------------------|--|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | matrix and antenna configuration | 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

| | | Bandwidth (MHz) / | h Modulation | | Correlation | Reference | value |
|--------------|----------------------|--------------------------------|----------------------|-----------------------|--|---|-------------|
| Test num. | Reference channel | Subcarrier spacing (kHz) | format and code rate | Propagation condition | matrix and antenna configuration | 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

| | | Bandwidth | Mandadatian | Mandadatian | Correlation | Reference va | alue |
|--------------|----------------------|---|---------------------------------|-----------------------|--|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | matrix and antenna configuration | 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

| | | Bandwidth | Mandadatian | a dedation | Correlation | Reference value | | |
|--------------|----------------------|---|---------------------------------|-----------------------|--|------------------------------------|-------------|--|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | matrix and antenna configuration | 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 |
| | Mapping type | | Type A |
| | k0 | | 0 |
| | Starting symbol (S) | | 2 |
| | Length (L) | | 12 |
| | PDSCH aggregation factor | | 1 |
| PDSCH | PRB bundling type | | Static |
| configuration | 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 | | N/A |
| | size | | · |
| | DMRS Type | | Type 1 |
| PDSCH DMRS | Number of additional DMRS | | 1 |
| configuration | Maximum number of OFDM symbols for DL front loaded DMRS | | 1 |
| NZP CSI-RS for | OFDM symbols in the PRB used for CSI-RS | | l ₀ = 13 |
| CSI acquisition | CSI-RS periodicity | Slots | 5 |
| ZP CSI-RS for CSI | Subcarrier index in the PRB used for CSI-RS | | $(k_0, k_1, k_2, k_3)=(2, 4, 6, 8)$ |
| acquisition | Number of CSI-RS ports (X) | | 8 |
| | CSI-RS periodicity | Slots | 5 |
| Number of HARQ Pr | ocesses | | 4 |
| The number of slots ACK information | between PDSCH and corresponding HARQ- | | 2 |

Table 5.2.3.1.2-3: Minimum performance for Rank 2

| Test | Reference | Bandwidth (MHz) / Subcarrier spacing | Modulation format and | Propagation condition | Correlation matrix and antenna configuration | Reference va | lue |
|------|----------------------|---|-----------------------|-----------------------|---|------------------------------------|-------------|
| num. | channel | (kHz) | code rate | | | Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.1-5.1 FDD | 10 / 15 | 16QAM, 0.48 | TDLC300- 100 | 4x4, 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 | 1-1 |
| antenna conditions | |

Table 5.2.3.1.3-2: Test parameters

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

Table 5.2.3.1.3-3: Minimum performance for Rank 1

| | | Bandwidth | Madulation | | Correlation | | Reference va | lue |
|--------------|----------------------|---|---------------------------------|-----------------------|--|------------------------------------|--------------|-----|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | matrix and antenna configuration | 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 | 1-1 | |

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

Table 5.2.3.1.4-3: Minimum performance for Rank 1

| | | Bandwidth (MHz) / | | | Correlation | Reference value | | |
|--------------|----------------------|--------------------------------|---------------------------------|-----------------------|--|------------------------------------|-------------|--|
| Test num. | Reference channel | Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | matrix and antenna configuration | 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 | |

5.2.3.2 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 | 1-1, 1-2, 1-3, 1-5, 1-6, 1-7, 1-8, 1-9, 2-1, 2-2, 3-1, 4-1 |
| under4 receive antenna conditions and with different | |
| channel models, MCSs and number of MIMO layers | |
| Verify the PDSCH mapping Type A HARQ soft combining | 1-4 |
| performance under 4 receive antenna conditions. | |
| Verify the PDSCH mapping Type A performance | 5-1 |
| requirements for Enhanced Receiver Type 1 under 4 | |
| receive antenna conditions. | |

Table 5.2.3.2.1-2: Test parameters

| | Parameter | Unit | Value |
|---------------------|---|-------|--|
| Duplex mode | | | TDD |
| Active DL BWP index | | | 1 |
| | 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 |
| PDSCH configuration | PRB bundling size | | 4 for Tests 1-1, 1-8, 1-9 WB for Test 3-1 2 for other tests |
| configuration | Resource allocation type | | Test 1-2: Type 1 with start RB = 50, L _{RBs} = 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 |
| | DMRS Type | | Type 1 |
| PDSCH DMRS | Number of additional DMRS | | 2 for Tests 1-1, 1-7, 1-8, 1-9 1 for other tests |
| configuration | Maximum number of OFDM symbols for DL front loaded DMRS | | 1 |
| | First OFDM symbol in the PRB used for CSI-RS | | Tests 1-8, 1-9: $l_0 = 4$ for CSI-RS resource 1 and 3 $l_0 = 8$ for CSI-RS resource 2 and 4 Other tests; Table 5.2-1. |
| CSI-RS for tracking | CSI-RS periodicity | Slots | Test 1-7: 20 for CSI-RS resource 1,2,3,4. Other tests: Table 5.2-1. |
| | CSI-RS offset | Slots | Test 1-7: 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: Start PRB 0 Number of PRB = 52 |
|---|--|
| | Other tests: Table 5.2-1. |
| | 16 for Test 1-4 |
| Number of HARQ Processes | 10 for Test 1-9 |
| | 8 for other tests |
| The number of slots between PDSCH and corresponding HARQ- | Specific to each TDD UL-DL pattern |
| ACK information | and as defined in Annex A.1.2 |

Table 5.2.3.2.1-3: Minimum performance for Rank 1

| | | Bandwidth | | TDD | | Correlation | Reference | value |
|--------------|------------------------|---|---------------------------------|-------------------------|-----------------------|----------------------------------|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL-DL pattern | Propagation condition | matrix and antenna configuration | 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 |

Table 5.2.3.2.1-4: Minimum performance for Rank 2

| | Bandwidth (MHz) / Madulation TDD | | Correlation | Reference value | | | | |
|--------------|----------------------------------|---|---------------------------------|-------------------------|-----------------------|----------------------------------|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL-DL pattern | Propagation condition | matrix and antenna configuration | 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

| | | Bandwidth Madadata | | | Correlation | Reference value | | |
|--------------|-----------------------|---|---------------------------------|-----------------------|-----------------------|--|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL- DL pattern | Propagation condition | matrix and antenna configuration | 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

| | Bandwidth | TDD III | | Correlation | | value | | |
|--------------|-----------------------|---|---------------------------------|--------------------------|-----------------------|--|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL- DL pattern | Propagation condition | matrix and antenna configuration | 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

| | | Bandwidth | | TDD III | | Correlati | Correlation | Reference | /alue |
|--------------|-----------------------|---|---------------------------------------|--------------------------|-----------------------|--|------------------------------------|-------------|-------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL- DL pattern | Propagation condition | matrix and antenna configuration | 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 | 1-1 |
| under 4 receive antenna conditions and CSI-RS | |
| overlapped with PDSCH | |

Table 5.2.3.2.2-2: Test parameters

| | Parameter | Unit | Value |
|---|---|-------|---|
| Duplex mode | | | TDD |
| Active DL BWP index | X | | 1 |
| | Mapping type | | Type A |
| | k0 | | 0 |
| | Starting symbol (S) | | 2 |
| | Length (L) | | 12 |
| | PDSCH aggregation factor | | 1 |
| PDSCH | PRB bundling type | | Static |
| configuration | 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 | | N/A |
| | size | | IN/A |
| | DMRS Type | | Type 1 |
| PDSCH DMRS | Number of additional DMRS | | 1 |
| configuration | Maximum number of OFDM symbols for | | 1 |
| | DL front loaded DMRS | | * |
| NZP CSI-RS for | OFDM symbols in the PRB used for CSI-RS | | I ₀ = 13 |
| CSI acquisition | CSI-RS periodicity | Slots | 5 |
| | Subcarrier index in the PRB used for CSI- | | (1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1 |
| ZP CSI-RS for CSI | RS | | $(k_0, k_1, k_2, k_3)=(2, 4, 6, 8)$ |
| acquisition | 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- | | | Specific to each TDD UL-DL pattern |
| ACK information | | | and as defined in Annex A.1.2 |

Table 5.2.3.2.2-3: Minimum performance for Rank 2

| | | Bandwidth | Madulation | TDD UL- | | Correlation | Reference value | |
|--------------|-----------------------|---|---------------------------------------|------------------|-----------------------|--|------------------------------------|-------------|
| Test num. | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | DL DL pattern | Propagation condition | matrix and antenna configuration | 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 inde | ex | | 1 |
| | Mapping type | | Type B |
| | k0 | | 0 |
| | Starting symbol (S) | | 5 |
| | Length (L) | | 7 |
| | PDSCH aggregation factor | | 1 |
| PDSCH configuration | 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 |
| | DMRS Type | | Type 1 |
| PDSCH DMRS | Number of additional DMRS | | 1 |
| configuration | Maximum number of OFDM symbols for DL front loaded DMRS | | 1 |
| Number of HARQ P | rocesses | | 8 |
| The number of slots ACK information | between PDSCH and corresponding HARQ- | | 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

| | | Bandwidth (MHz) / Modulation TDD UL- | | Correlation | Reference value | | | |
|--------------|-----------------------|--------------------------------------|----------------------|--------------|-----------------------|--|------------------------------------|-------------|
| Test num. | Reference channel | Subcarrier spacing (kHz) | format and code rate | DL pattern | Propagation condition | matrix and antenna configuration | 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 |

5.3 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

| | Paramete | er | Unit | Value |
|------------------|------------------|-----------------------------------|-------|------------------------------------|
| Carrier | | een Point A and the | | 0 |
| configuration | lowest usab | le subcarrier on this | | |
| | carrier (Note | e 1) | | |
| DL BWP | Cyclic prefix | | | Normal |
| configuration #1 | RB offset | | RBs | 0 |
| Common | Physical Ce | | | 0 |
| serving cell | SSB position | | | 1 |
| parameters | SSB periodi | | ms | 20 |
| | | CCH monitoring PDCCH candidates | | Each slot |
| PDCCH | Number of F | DCCH candidates | | Start from RB = 0 |
| configuration | | domain resource | | with contiguous RB |
| oomigaration | allocation fo | r CORESET | | allocation |
| | TCI state | | | TCI state #1 |
| | | rier index in the PRB | | |
| | used for CS | I-RS (<i>k</i> ₀) | | 0 |
| | | | | CSI-RS resource 1: |
| | | | | 4 |
| | Circt OCDM | average at in the DDD | | CSI-RS resource 2: |
| | used for CS | symbol in the PRB | | 8 CSI-RS resource 3: |
| | used for CS | 1-13 (10) | | 4 |
| | | | | CSI-RS resource 4: |
| | | | | 8 |
| | Number of 0 | CSI-RS ports (X) | | 1 |
| | CDM Type | | | No CDM |
| | Density (ρ) | | | 3 |
| 001 00 (| CSI-RS peri | odicity | Slots | 15 kHz SCS: 20 |
| CSI-RS for | | | 0.010 | 30 kHz SCS: 40 |
| tracking | | | | 15 kHz SCS: 10 for CSI-RS |
| | | | | resource 1 and 2 |
| | | | | 11 for CSI-RS |
| | | | | resource 3 and 4 |
| | CSI-RS offs | et | Slots | |
| | | | | 30 kHz SCS: |
| | | | | 20 for CSI-RS |
| | | | | resource 1 and 2 |
| | | | | 21 for CSI-RS resource 3 and 4 |
| | | | | Start PRB 0 |
| | Frequency (| Occupation | | Number of PRB = |
| | 1,111,11 | · · · · · · · · · · · · · · · · · | | BWP size |
| | QCL info | | | TCI state #0 |
| | Type 1 | SSB index | | SSB #0 |
| | QCL | QCL Type | | Type C |
| TCI state #0 | information | | | |
| | Type 2 QCL | SSB index | | SSB #0 |
| | information | QCL Type | | Type D |
| | | | | CSI-RS resource 1 |
| | Type 1 | CSI-RS resource | | from 'CSI-RS for |
| | QCL | OOI NO TOSOUTOC | | tracking' |
| | information | OOL Torre | | configuration |
| TCI state #1 | | QCL Type | | Type A |
| | Type 2 | | | CSI-RS resource 1 from 'CSI-RS for |
| | QCL | CSI-RS resource | | tracking' |
| | information | | | configuration |
| | | QCL Type | | Type D |

| PDCCH Precoding configuration | Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i ₁ , i ₂ | | | | |
|--|---|--|--|--|--|
| | combination with REG bundling granularity for number of Tx larger than 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 | | | | |
| Physical signals, channels mapping and precoding | As specified in Annex B.4.1 | | | | |
| 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 | | | | | |

from TS 38.101-1 [6] for tested channel bandwidth and subcarrier spacing.

1RX requirements 5.3.1

(Void)

2RX requirements 5.3.2

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 | | nonInter | leaved |
| 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

| | | | CORES | | | | Antenna | Reference | value |
|--------------------|------------------------|-------------------|--------------------|-----------------------|-----------------------|--------------------------|---|---------------|-------------|
| Test numbe r | Bandw idth (MHz) | CORE SET RB | ET duratio n | Aggregati on level | Reference Channel | Propagation Condition | configurat ion and correlatio n Matrix | 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

| | | | CORES | | | Antenna | | Reference | value |
|--------------------|------------------------|-------------------|--------------------|-----------------------|----------------------|--------------------------|---|---------------|-------------|
| Test numbe r | Bandw idth (MHz) | CORE SET RB | ET duratio n | Aggregati on level | Reference Channel | Propagation Condition | configurat ion and correlatio n Matrix | Pm-dsg (%) | SNR (dB) |
| 1 | 10 | 24 | 2 | 4 | R.PDCCH. | TDLC300- | 2x2 Low | 1 | 2.0 |
| | | | | | 1-2.2 FDD | 100 | | | |
| 2 | 10 | 48 | 2 | 8 | R.PDCCH. | TDLC300- | 2x2 Low | 1 | -1.3 |
| | | | | | 1-2.5 FDD | 100 | | | |
| 3 | 10 | 48 | 1 | 8 | R.PDCCH. | TDLA30-10 | 2x2 Low | 1 | -0.2 |
| | | | | | 1-1.3 FDD | | | | |

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 | 6 |
| 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

| | | | CORES | | | | Antenna | Reference | value |
|--------------------|------------------------|-------------------|--------------------|-----------------------|----------------------|--------------------------|---|---------------|-------------|
| Test numbe r | Bandw idth (MHz) | CORE SET RB | ET duratio n | Aggregati on level | Reference Channel | Propagation Condition | configurat ion and correlatio n Matrix | Pm-dsg (%) | SNR (dB) |
| 1 | 40 | 102 | 1 | 2 | R.PDCCH. | TDLA30-10 | 1x2 Low | 1 | 7.0 |
| | | | | | 2-1.1 TDD | | | | |
| 2 | 40 | 102 | 1 | 4 | R.PDCCH. | TDLC300- | 1x2 Low | 1 | 3.0 |
| | | | | | 2-1.2 TDD | 100 | | | 3.0 |
| 3 | 40 | 48 | 2 | 16 | R.PDCCH. | TDLC300- | 1x2 Low | 1 | -3.8 |
| 3 | 40 | 40 | 2 | 10 | 2-2.1 TDD | 100 | IXZ LOW | ı | -3.0 |

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

| CO | | CORES | | | | Antenna | Reference | value | |
|--------------------|------------------------|-------------------|--------------------|-----------------------|-----------------------|--------------------------|---|---------------|-------------|
| Test numbe r | Bandw idth (MHz) | CORE SET RB | ET duratio n | Aggregati on level | Reference Channel | Propagation Condition | configurat ion and correlatio n Matrix | Pm-dsg (%) | SNR (dB) |
| 1 | 40 | 90 | 1 | 8 | R.PDCCH. 2-1.3 TDD | TDLC300- 100 | 2x2 Low | 1 | -1.2 |

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

| | | | _ CORES | | | Antenna | Reference | value | |
|--------------------|------------------------|-------------------|--------------------|-----------------------|-----------------------|--------------------------|---|---------------|-------------|
| Test numbe r | Bandw idth (MHz) | CORE SET RB | ET duratio n | Aggregati on level | Reference Channel | Propagation Condition | configurat ion and correlatio n Matrix | 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

| | | CORE SET RB | CORES ET duratio n | | | | Antenna | Reference | value |
|--------------------|------------------------|-------------------|-----------------------------|-----------------------|----------------------|--------------------|---|---------------|-------------|
| Test numbe r | Bandw idth (MHz) | | | Aggregati on level | Reference Channel | Condition ion corr | configurat ion and correlatio n Matrix | Pm-dsg (%) | SNR (dB) |
| 1 | 10 | 24 | 2 | 4 | R.PDCCH. | TDLC300- | 2x4 Low | 1 | -1.9 |
| | | | | | 1-2.2 FDD | 100 | | | |
| 2 | 10 | 48 | 2 | 8 | R.PDCCH. | TDLC300- | 2x4 Low | 1 | -4.5 |
| | | | | | 1-2.5 FDD | 100 | | | |
| 3 | 10 | 48 | 1 | 4 | R.PDCCH. | TDLA30-10 | 2x4 Low | 1 | -1.0 |
| | | | | | 1-1.2 FDD | | | | |

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

| | | | CORES | | | | Antenna | Reference | value |
|--------------------|------------------------|-------------------|-------|-----------------------|-----------------------|--------------------------|---|---------------|-------------|
| Test numbe r | Bandw idth (MHz) | CORE SET RB | E ET | Aggregati on level | Reference Channel | Propagation Condition | configurat ion and correlatio n Matrix | 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

| | | | CORES | | | | Antenna | Reference | e value |
|--------------------|------------------------|-------------------|--------------------|-----------------------|-----------------------|--------------------------|---|---------------|-------------|
| Test numbe r | Bandw idth (MHz) | CORE SET RB | ET duratio n | Aggregati on level | Reference Channel | Propagation Condition | configurat ion and correlatio n Matrix | Pm-dsg (%) | SNR (dB) |
| 1 | 40 | 90 | 1 | 8 | R.PDCCH. 2-1.3 TDD | TDLC300- 100 | 2x4 Low | 1 | -4.3 |

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

$$Pm - bch = 1 - \frac{A}{R}$$

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).

5.4.1 1RX requirements

(Void)

5.4.2 2RX requirements

5.4.2.1 FDD

Table 5.4.2.1-1: Test parameters for PBCH

| 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] | | |

For the parameters specified in Table 5.4.2.1-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified values in Table 5.4.2.1-2 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 | Reference channel | Propagation condition | Antenna configuration and correlation matrix | Refer val | |
|----------------|---|-------------------|-----------------------|--|--------------|-------------|
| | (kHz) | | | | 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

| ĺ | Test | Bandwidth (MHz) / | Reference | Propagation | Antenna configuration | Reference value | |
|---|--------|-----------------------------|-----------|-------------|------------------------|-------------------|-------------|
| | number | Subcarrier spacing (kHz) | channel | condition | and correlation matrix | 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 |
|---|------|---------------------|
| 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 |
| TDD UL-DL pattern | | FR1.30-1 |
| Note 1: as specified in clause 4.1 of TS 38.213 [11] | | |
| Note 2: as specified in clause 11.1 of TS 38.213 [11] | | |

For the parameters specified in 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 in case SS/PBCH block index is not known and below the specified values in Table.5.4.2.2-3 in case SS/PBCH block index is known. The downlink physical setup is in accordance with Annex C.3.1.

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

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

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

| | Test number | Bandwidth (MHz) / Subcarrier spacing | Reference channel | Propagation condition | Antenna configuration and correlation matrix | Refer val | |
|---|----------------|---|-------------------|-----------------------|--|-------------------|-------------|
| | | (kHz) | | | | Pm- bch (%) | SNR (dB) |
| I | 1 | 40 / 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: Test parameters for PBCH

| 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 11.1 of TS 38.213 [11] | | |

For the parameters specified in Table 5.4.3.1-1 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 | Reference channel | Propagation condition | Antenna configuration and correlation matrix | Refer val | |
|----------------|---|-------------------|-----------------------|--|-------------------|-------------|
| | (kHz) | | | | 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 | Reference channel | Propagation condition | Antenna configuration and correlation matrix | Refer val | |
|----------------|---|-------------------|-----------------------|--|-------------------|-------------|
| | (kHz) | | | | 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 |
|---|------|---------------------|
| 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 |
| TDD UL-DL pattern | | FR1.30-1 |
| Note 1: as specified in clause 4.1 of TS 38.213 [11] | | |
| Note 2: as specified in clause 11.1 of TS 38.213 [11] | | |

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

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

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

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

| Test number | Bandwidth (MHz) / Subcarrier spacing | Reference channel | Propagation condition | Antenna configuration and correlation matrix | Reference value | |
|-------------|---|-------------------|-----------------------|--|-----------------|------|
| | (kHz) | | | | Pm- | SNR |
| | | | | | bch | (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.

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 each CC in CA bandwidth combination, 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 |
| | Physical Cell ID | | 0 |
| Common serving | SSB position in burst | | First SSB in Slot #0 |
| cell parameters | SSB periodicity First DMRS position for Type A PDSCH | ms | 20 |
| | mapping | | 2 |
| Cross carrier schedu | ů . | | 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 |
| - comigaration | Subcarrier spacing | kHz | 15 or 30 |
| | RB offset | RBs | 0 |
| DL BWP configuration #1 | 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 |
| | 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 | | 1/AL 1 for 30 kHz / 5 MHz 1/AL4 for 15 kHz / 5 MHz, 30 kHz / 10 MHz and 30 kHz / 15 MHz 1/AL 8 for other combinations |
| | CCE-to-REG mapping type | | Non-interleaved |
| | DCI format | | 1_1 |
| PDCCH | TCI State | | TCI state #1 |
| configuration | PDCCH & PDCCH DMRS Precoding configuration | | For 2Tx: Single Panel Type I, Random precoder chosen from precoder index 0 and 2, selection updated per slot For 4Tx: Single Panel Type I, Random precoder chosen from precoders with i_1,1 in {1,2,3,5,6,7} and i_2 in {0,2}, selection updated per slot |
| | Mapping type | | Type A |
| | k0 | | 0 |
| | PDSCH aggregation factor | + | 1 |
| PDSCH | PRB bundling type | | Static WB |
| configuration | PRB bundling size Resource allocation type | | Type 0 |
| | VRB-to-PRB mapping type | | Non-interleaved |
| | VRB-to-PRB mapping interleaver bundle | | N/A |
| | size DMRS Type | | Type 1 |
| | Number of additional DMRS | | 1 1 1 |
| | Length | | 1 |
| PDSCH DMRS configuration | 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 |
| | Subcarrier indexes in the PRB used for CSI-RS | | k ₀ = 3 for CSI-RS resource 1,2,3,4 |
| CSI-RS for tracking | OFDM symbols in the PRB used for CSI-RS | | $l_0 = 6$ for CSI-RS resource 1 and 3 $l_0 = 10$ 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 CSLBS recourse 1.2.2.4 |
|--|-------------------------|-----------------------------|-------|--|
| | CDM Type Density (ρ) | | | 'No CDM' for CSI-RS resource 1,2,3,4 3 for CSI-RS resource 1,2,3,4 |
| | Density (p) | | | 15 kHz SCS: 20 for CSI-RS resource |
| | CSI-RS period | dicity | Slots | 1,2,3,4 30 kHz SCS: 40 for CSI-RS resource |
| | | | | 1,2,3,4 15 kHz SCS: |
| | | | | 10 for CSI-RS resource 1 and 2 11 for CSI-RS resource 3 and 4 |
| | CSI-RS offset | | Slots | 30 kHz SCS: |
| | | | | 20 for CSI-RS resource 1 and 2 21 for CSI-RS resource 3 and 4 |
| | Frequency Od | ccupation | | Start PRB 0 Number of PRB = BWP size |
| | QCL info | | | TCI state #0 |
| | Subcarrier inc | lexes in the PRB used for | | k ₀ = 4 |
| | | ls in the PRB used for CSI- | | I ₀ = 12 |
| | | SI-RS ports (X) | | Same as number of transmit antenna |
| NZD COL DO 4 | CDM Type | | | 'FD-CDM2' |
| NZP CSI-RS for CSI acquisition | Density (ρ) | | | 1 |
| CSI acquisition | CSI-RS period | dicity | | 15 kHz SCS: 20 30 kHz SCS: 40 |
| | CSI-RS offset | | | 0 KHZ SCS. 40 |
| | | | | Start PRB 0 |
| | Frequency Od | ccupation | | Number of PRB = BWP size |
| | QCL info | | | TCI state #1 |
| | Subcarrier inc | lexes in the PRB used for | | $k_0 = 0$ |
| | | ls in the PRB used for CSI- | | I ₀ = 12 |
| | | SI-RS ports (X) | | 4 |
| ZP CSI-RS for CSI | CDM Type | | | 'FD-CDM2' |
| acquisition | Density (ρ) | | | 1 |
| | CSI-RS period | dicity | | 15 kHz SCS: 20 30 kHz SCS: 40 |
| | CSI-RS offset | | | 0 |
| | Frequency Oc | ccupation | | Start PRB 0 Number of PRB = BWP size |
| | Type 1 QCL | SSB index | | SSB #0 |
| TCI atata #0 | information | QCL Type | | Type C |
| TCI state #0 | Type 2 QCL | SSB index | | N/A |
| | information | QCL Type | | N/A |
| | Type 1 QCL | CSI-RS resource | | CSI-RS resource 1 from 'CSI-RS for tracking' configuration |
| TCI state #1 | information | QCL Type | | Type A |
| | Type 2 QCL | CSI-RS resource | | N/A |
| | information | QCL Type | | N/A |
| Maximum number of | code block grou | ups for ACK/NACK feedback | | 1 |
| Maximum number of | HARQ transmis | ssion | | 4 |
| HARQ ACK/NACK bu | | | | Multiplexed |
| Redundancy version coding sequence | | | | {0,2,3,1} |
| | | | | Single Panel Type I, Random precoder selection updated per slot, with equal |
| PDSCH & PDSCH DMRS Precoding configuration | | | | probability of each applicable i ₁ , i ₂ combination with PRB bundling granularity |
| 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 | n | | | Static propagation condition No external noise sources are applied |
| Antenna | 1 layer CCs | | | 1x2 or 1x4 |
| configuration | 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 identicated | I to the TO | CI state applied for the PDCCH |
| | transmission | | |
| Note 2: | Point A coincides with minimum guard band as specified | in Table 5 | 5.3.3-1 from TS 38.101-1 [6] for tested |
| 1 | channel handwidth and subcarrier spacing | | |

Table 5.5A-2: Additional test parameters for FDD CC

| | Parameter | Unit | Value |
|--------------------------|---------------------|------|-------|
| Duplex mode | | | FDD |
| PDSCH | Starting symbol (S) | | 1 |
| configuration | 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 | PDSCH Starting symbol (S) | | 1 |
| configuration | Length (L) | | 13 |
| Number of HARQ | Processes | | 8 |
| K1 value | | | Specific to each UL-DL pattern |
| TDD III DI potto | rn | | 15 kHz SCS: FR1.15-1 |
| TDD UL-DL pattern | | | 30 kHz SCS: FR1.30-1 |
| Note 1: PDSCH | l 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 | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 100MHz |
|--------------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 15 | 24 | 48 | 78 | 102 | 132 | 156 | 216 | 270 | N/A | N/A | N/A |
| 30 | 6 | 24 | 36 | 48 | 60 | 78 | 102 | 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 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]

6 CSI reporting requirements (Conducted requirements)

6.1 General

This clause includes conducted requirements for the reporting of channel state information (CSI).

6.1.1 Applicability of requirements

6.1.1.1 General

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

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

6.1.1.2 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 6.1.1.2-1.

| Supported RX antenna ports | Test type | Test list |
|----------------------------|-----------|---------------------------|
| UE supports only | CQI | All tests in Clause 6.2.2 |
| 2RX | PMI | All tests in Clause 6.3.2 |
| | RI | All tests in Clause 6.4.2 |
| UE supports only | CQI | All tests in Clause 6.2.3 |
| 4RX or both 2RX | PMI | All tests in Clause 6.3.3 |
| and 4RX | RI | All tests in Clause 6.4.3 |

Table 6.1.1.2-1: Requirements applicability

6.1.1.3 Applicability of requirements for optional UE features

6.1.1.4 Applicability of requirements for mandatory UE features with capability signalling

The performance requirements in Table 6.1.1.4-1 shall apply for UEs which support mandatory UE features with capability signalling only.

Table 6.1.1.4-1: Requirements applicability for mandatory features with UE capability signalling

| UE feature/capability [14] | Test t | уре | Test list | Applicability notes |
|---|---------|-----|----------------------------------|---|
| | FR1 FDD | CQI | Clause 6.2.3.1.1.1 | The requirements |
| | | PMI | Clause 6.3.3.1.2 | apply only in case |
| | | RI | Clause 6.4.2.1 | the PDSCH MIMO |
| | | | Clause 6.4.3.1 | rank in the test case |
| Supported maximum number of PDSCH MIMO layers (maxNumberMIMO- | FR1 TDD | CQI | Clause 6.2.3.2.1.1 | does not exceed UE PDSCH MIMO layers capability |
| LayersPDSCH) | | PMI | Clause 6.3.3.2.2 | |
| | | RI | Clause 6.4.2.2 Clause 6.4.3.2 | |
| Supported maximum number of | FR1 FDD | PMI | Clause 6.3.2.1.1 | The requirements |
| ports across all configured | | | Clause 6.3.2.1.2 | apply only in case |
| NZP-CSI-RS resources per CC | | | Clause 6.3.3.1.1 | the number of NZP- |
| (maxConfigNumberPortsAcros | | | Clause 6.3.3.1.2 | CSI-RS ports in the |
| sNZP-CSI-RS-PerCC) | | RI | Clause 6.4.3.1 (Test 4) | test case satisfies UE |
| | FR1 TDD | PMI | Clause 6.3.2.2.1 | capability on |
| | | | Clause 6.3.2.2.2 | maximum number of |
| | | | Clause 6.3.3.2.1 | NZP-CSI-RS ports |
| | | | Clause 6.3.3.2.2 | |
| | | RI | Clause 6.4.3.2 (Test 4) | |

6.1.2 Common test parameters

Parameters specified in Table 6.1.2-1 are applied for all test cases in this clause unless otherwise stated.

Table 6.1.2-1: Test parameters for CSI test cases

| | Parameter | Unit | Value |
|--------------------------------------|--|------|---|
| PDSCH transmission scheme | | | Transmission |
| | Offset between Point A and the | | scheme 1 |
| Actual carrier | lowest usable subcarrier on this | RBs | 0 |
| configuration | carrier (Note 3) Subcarrier spacing | kHz | 15 or 30 |
| | Cyclic prefix | KLIZ | Normal |
| | RB offset | RBs | 0 |
| DL BWP configuration #1 | 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 |
| Active DL BWP in | | | 1 |
| Common | Physical Cell ID | | 0 |
| serving cell | SSB position in burst | | First SSB in Slot #0 |
| parameters | SSB periodicity | ms | 20 |
| | Slots for PDCCH monitoring | | Each slot |
| | Symbols with PDCCH | | 0,1 |
| | Number of PDCCH candidates | | 1/AL8 |
| | and aggregation levels DCI format | | 1 1 |
| | TCI state | | TCI state #1 |
| PDCCH configuration | PDCCH & PDCCH DMRS Precoding configuration | | Multi-path fading propagation conditions: Single Panel Type I, Random per slot with equal probability of each applicable i1, i2 combination, and with REG bundling granularity for number of Tx larger than 1 Static propagation conditions: Single Panel Type I, Random precoder chosen from precoder index 0 and |
| Additional PDCCH Configuration | Slots for PDCCH monitoring Symbols with PDCCH Number of PDCCH candidates | | 2, selection updated per slot Each slot 0,1 |
| for Aperiodic | and aggregation levels | | 1/AL8 |
| Reporting (Note | DCI format | | 0_1 |
| 4) | TCI state | | TCI state #1 |

| | PDCCH & PDCCH DMRS Precoding configuration | | Multi-path fading propagation conditions: Single Panel Type I, Random per slot with equal probability of each applicable i1, i2 combination, and with REG bundling granularity for number of Tx larger than 1 |
|--------------------------|---|------|---|
| Cross carrier sch | edulina | | Not configured |
| | Mapping type | | Type A |
| | k0 | | 0 |
| | Starting symbol (S) | | 2 |
| | Length (L) | | 12 |
| | | | |
| PDSCH | PDSCH aggregation factor | | 1 |
| configuration | PRB bundling type | | Static |
| | PRB bundling size | | 2 |
| | Resource allocation type | | type 0 |
| | VRB-to-PRB mapping type | | Non-interleaved |
| | VRB-to-PRB mapping interleaver | | N/A |
| | bundle size | | IN/A |
| | DMRS Type | | Type 1 |
| | Number of additional DMRS | | 1 |
| | Maximum number of OFDM symbols for DL front loaded DMRS | | 1 |
| PDSCH DMRS configuration | DMRS ports indexes | | {1000} for Rank1 {1000,1001} for Rank2 {1000,1001,1002} for Rank3 {1000,1001,1002,100 3} for Rank4 |
| | Number of PDSCH DMRS CDM group(s) without data | | 2 |
| PTRS | Frequency density (K _{PT-RS}) | | N/A |
| configuration | Time density (<i>L_{PT-RS}</i>) | | N/A |
| J | First subcarrier index in the PRB | | 0 for CSI-RS |
| | used for CSI-RS (k_0) | | resource 1,2,3,4 |
| | (1.5) | | 4 for CSI-RS |
| | First OFDM symbol in the PRB | | resource 1 and 3 |
| | used for CSI-RS (I ₀) | | 8 for CSI-RS |
| | used for CSI-KS (10) | | |
| | | | resource 2 and 4 |
| | Number of CSI-RS ports (X) | | 1 for CSI-RS |
| CSI-RS for tracking | CDM Type | | resource 1,2,3,4 |
| | | | 'No CDM' for CSI-RS |
| 3 | | | resource 1,2,3,4 |
| | Density (ρ) | | 3 for CSI-RS resource 1,2,3,4 |
| | CSI-RS periodicity | | 15 kHz SCS: 20 for |
| | | slot | CSI-RS resource |
| | | | 1,2,3,4 |
| | | | 30 kHz SCS: 40 for |
| | | | CSI-RS resource |

| - | | | | |
|--|---|---|---|---|
| CSI-RS offset | | slot | 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 Oc | ccupation | | Start PRB 0 Number of PRB = BWP size |
| | QCL info | | | TCI state #0 |
| NZP CSI-RS for CSI acquisition | Frequency Od | ecupation | | Start PRB 0 Number of PRB = BWP size |
| | QCL info | | | TCI state #1 |
| ZP CSI-RS for CSI acquisition | Frequency Oc | • | | Start PRB 0 Number of PRB = BWP size |
| | Type 1 QCL | SSB index | | SSB #0 |
| TOI | information | QCL Type | | Type C |
| TCI state #0 | Type 2 QCL | SSB index | | N/A |
| | information | QCL Type | | N/A |
| | Type 1 QCL information | CSI-RS resource | | CSI-RS resource 1 from 'CSI-RS for tracking' configuration |
| TCI state #1 | | QCL Type | | Type A |
| | Type 2 QCL information | CSI-RS resource | | N/A |
| | | QCL Type | | N/A |
| Number of HARC | | | | 4 For FDD 8 for TDD |
| HARQ ACK/NAC | | | | Multiplexed |
| Redundancy vers | sion coaing sequ | uence | | {0,2,3,1} 2 for FDD |
| K1 value (PDSCH-to-HARQ-timing-indicator) | | | For FR1.30-1: 8 if mod(i,10) = 0 6 if mod(i,10) = 2 5 if mod(i,10) = 3 5 if mod(i,10) = 4 4 if mod(i,10) = 5 3 if mod(i,10) = 6 Where i is slot index per radio frame with 0~19 OP.1 FDD as defined | |
| Symbols for unused REs | | 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: PDSCH is not scheduled on slots containing CSI-RS or slots which are not fu | | | | |
| DL. Note 2: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH transmission. | | | | al to the TCI state |
| Note 3: Point A | Note 3: 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 4: Additional PDCCH configuration for aperiodic reporting is only for test cases with aperiodic CSI reporting configured. | | | | |

6.2 Reporting of Channel Quality Indicator (CQI)

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

6.2.1 1RX requirements

(Void)

6.2.2 2RX requirements

This sub-clause includes the requirements for reporting of CQI for UE equipped with 2 receiver antennas.

6.2.2.1 FDD

6.2.2.1.1 CQI reporting definition under AWGN conditions

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

6.2.2.1.1.1 Minimum requirement for periodic CQI reporting

For the parameters specified in Table 6.2.2.1.1.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) The reported CQI value according to the reference channel shall be in the range of ± 1 of the reported median more than 90% of the time.
- b) If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 0.1.

Table 6.2.2.1.1.1-1: CQI reporting definition test

| Parameter | | Unit | Test 1 | Test 2 |
|---------------------------------|---|------|--|------------------|
| Bandwidth | | MHz | 10 | |
| Duplex Mode | | | FDD | |
| Subcarrier spacing | g | kHz | 15 | |
| SNR | | dB | 8 9 | 14 15 |
| Propagation chan | nel | | AWG | |
| Antenna configura | ation | | 2x2 with static channel specified i Annex B.1 | |
| Beamforming Mod | del | | As specified in | |
| | CSI-RS resource Type | | Perio | |
| | Number of CSI-RS ports (X) | | 4 | |
| | CDM Type | | FD-CDM2 | |
| 7D 001 D0 | Density (ρ) | | 1 | |
| ZP CSI-RS configuration | First subcarrier index in the PRB used for CSI-RS (k ₀) | | Row | 5,4 |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀) | | 9 | |
| | CSI-RS | | | |
| | periodicity and offset | slot | 5/1 | |
| | CSI-RS resource Type | | Perio | dic |
| | Number of CSI-RS ports (X) | | 2 | |
| | CDM Type | | FD-CD | M2 |
| | Density (p) | | 1 | |
| NZP CSI-RS for | First subcarrier index in the PRB | | Б 0 | (0.) |
| CSI acquisition | used for CSI-RS (k ₀ , k ₁) | | Row 3, | (6,-) |
| | First OFDM symbol in the PRB used | | 40 | |
| | for CSI-RS (I ₀) | | 13 | |
| | NZP CSI-RS-timeConfig | slot | 5/1 | |
| | periodicity and offset | SIOL | 3/1 | |
| | CSI-IM resource Type | | Perio | dic |
| | CSI-IM RE pattern | | 0 | |
| CSI-IM configuration | CSI-IM Resource Mapping (kcsi-im,lcsi-im) | | (4, 9 | 9) |
| | CSI-IM timeConfig | | | |
| | periodicity and offset | slot | 5/1 | |
| ReportConfigType | | | Perio | dic |
| CQI-table | | | Table | e 2 |
| reportQuantity | | | cri-RI-PN | |
| | rChannelMeasurements | | Not conf | igured |
| timeRestrictionFor | rInterferenceMeasurements | | Not conf | |
| cqi-FormatIndicate | | | Wideb | and |
| pmi-FormatIndicat | tor | | Wideb | and |
| Sub-band Size | | RB | 8 | |
| Csi-ReportingBan | d | | 11111 | 111 |
| CSI-Report period | | slot | 5/0 |) |
| aperiodicTriggeringOffset | | | Not conf | igured |
| | Codebook Type | | typel-Sing | lePanel |
| | Codebook Mode | | 1 | |
| Codebook configuration | (CodebookConfig- N1,CodebookConfig-N2) | | Not conf | igured |
| | CodebookSubsetRestriction | | 0100 | 00 |
| | RI Restriction | | N/A | |
| Physical channel for CSI report | | | PUC | |
| CQI/RI/PMI delay | - | ms | 8 | |
| | of HARQ transmission | | 1 | |
| Measurement cha | | | As specified in Tab | le A.4-2, TBS.2- |
| | | 1 | | |

6.2.2.1.2 CQI reporting under fading conditions

6.2.2.1.2.1 Minimum requirement for wideband CQI reporting

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

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

For the parameters specified in Table 6.2.2.1.2.1-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) A CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least α % of the time where α % is specified in Table 6.2.2.1.2.1-2;
- b) The ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be $\geq \gamma$, where γ is specified in Table 6.2.2.1.2.1-2;
- c) When transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater than or equal to 0.02.

Table 6.2.2.1.2.1-1: Wideband CQI reporting test under frequency non-selective fading conditions

| | Parameter | Unit | Test 1 Test 2 |
|-------------------------------------|--|----------|-------------------------------------|
| Bandwidth | | MHz | 10 |
| Subcarrier spacing | | kHz | 15 |
| Duplex Mode | | | FDD |
| SNR | | | 6 7 12 13 |
| Propagation chan | nel | | TDLA30-5 |
| Antenna configura | | | 2×2 |
| Correlation config | | | ULA high |
| Beamforming Mod | | | As specified in Annex B.4.1 |
| | CSI-RS resource Type | | Periodic |
| | Number of CSI-RS ports (X) | | 4 |
| | CDM Type | | FD-CDM2 |
| 7D CCL DC | Density (ρ) | | 1 |
| ZP CSI-RS | First subcarrier index in the PRB | | D |
| configuration | used for CSI-RS (k ₀) | | Row 5,4 |
| | First OFDM symbol in the PRB used | | 0 |
| | for CSI-RS (I ₀) | | 9 |
| | CSI-RS | alat | F/4 |
| | periodicity and offset | slot | 5/1 |
| | CSI-RS resource Type | | Periodic |
| | Number of CSI-RS ports (X) | | 2 |
| | CDM Type | | FD-CDM2 |
| NZD COLDC for | Density (p) | | 1 |
| NZP CSI-RS for | First subcarrier index in the PRB | | Day: 2 (C.) |
| CSI acquisition | used for CSI-RS (k ₀ , k ₁) | | Row 3,(6,-) |
| | First OFDM symbol in the PRB used | | 13 |
| | for CSI-RS (I ₀) | | 13 |
| | NZP CSI-RS-timeConfig | slot | 5/1 |
| | periodicity and offset | SIOL | 5/1 |
| | CSI-IM resource Type | | Periodic |
| | CSI-IM RE pattern | | 0 |
| CSI-IM | CSI-IM Resource Mapping | | |
| configuration | (Ксы-ім,Ісы-ім) | | (4, 9) |
| garano | | | |
| | CSI-IM timeConfig | slot | 5/1 |
| | periodicity and offset | | |
| ReportConfigType |) | | Periodic |
| CQI-table | | | Table 2 |
| reportQuantity | | | cri-RI-PMI-CQI |
| | rChannelMeasurements | | Not configured |
| | rInterferenceMeasurements | | Not configured |
| cqi-FormatIndicate | | | Wideband |
| pmi-FormatIndica | tor | | Wideband |
| Sub-band Size | | RB | 8 |
| Csi-ReportingBan | | | 1111111 |
| CSI-Report period | | slot | 5/0 |
| aperiodicTriggerin | | | Not configured |
| | Codebook Type | | typel-SinglePanel |
| | Codebook Mode | | 1 |
| Codebook | (CodebookConfig- | | Not configured |
| configuration | N1,CodebookConfig-N2) | | |
| | CodebookSubsetRestriction | | 000001 |
| RI Restriction | | | N/A |
| Physical channel | tor CSI report | | PUCCH |
| CQI/RI/PMI delay | | ms | 8 |
| Maximum number of HARQ transmission | | | 1 |
| Measurement cha | innel | | As specified in Table A.4-2, TBS.2- |
| | | <u> </u> | 1 |

Table 6.2.2.1.2.1-2: Minimum requirements

| Parameters | Test 1 | Test 2 |
|------------|--------|--------|
| α[%] | 20 | 20 |
| γ | 1.05 | 1.05 |

6.2.2.1.2.2 Minimum requirement for sub-band CQI reporting

The purpose of the requirements is to verify that the preferred sub-bands can be used for frequency-selective scheduling under the frequency-selective fading conditions.

The accuracy of sub-band channel CQI reporting under the frequency-selective fading conditions is determined by a double-sided percentile of the reported differential CQI offset level 0 per sub-band, and the relative increase of the throughput obtained when transmitting the transport format indicated by the corresponding reported sub-band CQI on a randomly selected sub-band among the sub-bands with the highest reported differential CQI offset level compared to the throughput when transmitting a fixed transport format according to the wideband CQI median on a randomly selected sub-band among all the sub-bands. To account for sensitivity of the input SNR the sub-band CQI reporting under frequency selective fading conditions is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

For the parameters specified in Table 6.2.2.1.2.2-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) A sub-band differential CQI offset level of 0 shall be reported at least $\alpha\%$ of the time but less than $\beta\%$ of the time for each sub-band, where α and β are specified in Table 6.2.2.1.2.2-2;
- b) The ratio of the throughput obtained when transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level and that obtained when transmitting the transport format indicated by the reported wideband CQI median on a randomly selected sub-band among all the sub-bands shall be $\geq \gamma$, where γ is specified in Table 6.2.2.1.2.2-2;
- c) When transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level, the average BLER for the indicated transport format shall be greater than or equal to 0.02.

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each TTI for FDD.

Table 6.2.2.1.2.2-1: Sub-band CQI reporting test under frequency-selective fading conditions

| Parameter | | Unit | Test 1 | Test 2 |
|-------------------------------|--|------|---|--------------------------|
| Bandwidth | | MHz | 10 | 0 |
| Subcarrier spacing | | kHz | 1: | 5 |
| Duplex Mode | ode FDD | |)D | |
| SNR | | dB | 8 9 | 14 15 |
| Propagation chan | | | Two tap model sp B.2.4 with a=1, td=0.4 | , $f_D = 5$ Hz, and |
| Antenna configura | ation | | 2× | :2 |
| Correlation config | | | As per Ar | |
| Beamforming Mod | | | As specified in | |
| | CSI-RS resource Type | | Perio | |
| | Number of CSI-RS ports (X) | | 4 | |
| | CDM Type Density (ρ) | | FD-C | |
| ZP CSI-RS configuration | First subcarrier index in the PRB used for CSI-RS (k ₀) | | Row | |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀) | | 9 |) |
| | CSI-RS periodicity and offset | slot | 5/1 Periodic 2 FD-CDM2 | |
| | CSI-RS resource Type | | Perio | odic |
| | Number of CSI-RS ports (X) | | 2 |) |
| | CDM Type | | FD-C | DM2 |
| NZP CSI-RS for | Density (ρ) | | 1 | |
| CSI acquisition | First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | Row 3 | 3,(6,-) |
| | First OFDM symbol in the PRB used for CSI-RS (Io) | | 1: | 3 |
| | NZP CSI-RS-timeConfig periodicity and offset | slot | 5/ | |
| | CSI-IM resource Type | | Perio | |
| | CSI-IM RE pattern | | 0 | |
| CSI-IM configuration | CSI-IM Resource Mapping (kcsi-im,lcsi-im) | | (4, | 9) |
| | CSI-IM timeConfig periodicity and offset | slot | 5/ | |
| ReportConfigType | 9 | | Aperi | |
| CQI-table | | | Tab | |
| reportQuantity | | | cri-RI-P | |
| | rChannelMeasurements rInterferenceMeasurements | | Not con | |
| cgi-FormatIndicate | | | Not con Subb | |
| pmi-FormatIndica | | | Widel | |
| Sub-band Size | | RB | 8 | |
| csi-ReportingBand | d | | 1111 | 111 |
| CSI-Report interva | | slot | Not con | figured |
| Aperiodic Report | | - | 5 | |
| CSI request | | | 1 in slots i, wher otherwise it i | |
| reportTriggerSize | | | 1 | |
| CSI-AperiodicTriggerStateList | | | One State with on Report Configurat Associated Repo | ion ort Configuration |
| | | | contains pointers and C | SI-IM |
| aperiodicTriggerin | | | Not con | |
| | Codebook Type | | typel-Sing | gieranei |
| Codebook | Codebook Mode (CodebookConfig- | | 1 | |
| configuration | N1,CodebookConfig-N2) | | Not con | figured |
| Comiguration | CodebookSubsetRestriction | | 0000 | 001 |
| | RI Restriction | | N/ | |
| Physical channel | | | PUS | |
| CQI/RI/PMI delay | | ms | 8 | |
| | | | | |

| Maximum number of HARQ transmission | 1 |
|-------------------------------------|--|
| Measurement channel | As specified in Table A.4-2, TBS.2- 5 |

Table 6.2.2.1.2.2-2: Minimum requirements

| Parameters | Test 1 | Test 2 |
|------------|--------|--------|
| a [%] | 2 | 2 |
| β [%] | 55 | 55 |
| γ | 1.05 | 1.05 |

6.2.2.2 TDD

6.2.2.2.1 CQI reporting definition under AWGN conditions

6.2.2.2.1.1 Minimum requirement for periodic CQI reporting

The purpose of the requirements is to verify that the reported CQI values are in accordance with the CQI definition given in TS 38.214 [12]. The reporting accuracy of CQI under AWGN condition is determined by the reporting variance and BLER performance using the transport format indicated by the reported CQI median.

For the parameters specified in Table 6.2.2.2.1.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) The reported CQI value according to the reference channel shall be in the range of ± 1 of the reported median more than 90% of the time.
- b) If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 0.1.

Table 6.2.2.2.1.1-1: CQI reporting definition test

| Parameter | | Unit | Test 1 | Test 2 |
|------------------------|--|------|--------------------------|--------------------|
| Bandwidth | | MHz | 40 | |
| Subcarrier spacin | | | 30 | • |
| Duplex Mode | | | TDD | |
| TDD UL-DL patte | rn | | FR1. | 30-1 |
| SNR | | dB | 8 9 | 14 15 |
| Propagation chan | nel | - | AWO | |
| Antenna configura | | | 2×2 with static cha | annel specified in |
| Beamforming Mod | del | | As specified in | |
| 3 | CSI-RS resource Type | | Perio | |
| | Number of CSI-RS ports (X) | | 4 | |
| | CDM Type | | FD-CI | DM2 |
| 7D 001 D0 | Density (ρ) | | 1 | |
| ZP CSI-RS | First subcarrier index in the PRB | | D | F 4 |
| configuration | used for CSI-RS (k ₀) | | Row | 5,4 |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀) | | 9 | |
| | CSI-RS | alat | 10 | /4 |
| | periodicity and offset | slot | 10/ | <u> </u> |
| | CSI-RS resource Type | | Perio | odic |
| | Number of CSI-RS ports (X) | | 2 | |
| | CDM Type | | FD-CI | DM2 |
| NZP CSI-RS for | Density (ρ) | | 1 | |
| CSI acquisition | First subcarrier index in the PRB | | Dow 2 | (C.) |
| COI acquisition | used for CSI-RS (k ₀ , k ₁) | | Row 3 | ,(0,-) |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀) | | 13 | |
| | NZP CSI-RS-timeConfig | slot | 10/ | /4 |
| | periodicity and offset | SIOL | 10/ | 1 |
| | CSI-IM resource Type | | Perio | odic |
| | CSI-IM RE pattern | | 0 | |
| CSI-IM configuration | CSI-IM Resource Mapping (kcsi-im,lcsi-im) | | (4, | 9) |
| | CSI-IM timeConfig periodicity and offset | slot | 10/ | /1 |
| ReportConfigType | e | | Perio | |
| CQI-table | | | Tabl | |
| reportQuantity | | | cri-RI-PI | |
| | rChannelMeasurements | | Not con | figured |
| timeRestrictionFo | rInterferenceMeasurements | | Not con | |
| cqi-FormatIndicat | | | Widek | |
| pmi-FormatIndica | tor | | Widel | |
| Sub-band Size | | RB | 16 | |
| Csi-ReportingBan | | | 1111 | |
| CSI-Report period | | slot | 10/ | |
| aperiodicTriggerin | | | Not con | |
| | Codebook Type | | typel-Sing | glePanel |
| | Codebook Mode | | 1 1 | |
| Codebook configuration | (CodebookConfig- N1,CodebookConfig-N2) | | Not con | <u> </u> |
| | CodebookSubsetRestriction | | 0100 | |
| | RI Restriction | | N/A | |
| Physical channel | | | PUC | |
| CQI/RI/PMI delay | | ms | 9.9 | 5 |
| Maximum number | r of HARQ transmission | | 1 | |
| Measurement cha | annel | | As specified in Tal 4 | |

6.2.2.2.2 CQI reporting under fading conditions

6.2.2.2.2.1 Minimum requirement for wideband CQI reporting

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

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

For the parameters specified in Table 6.2.2.2.2.1-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) A CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least α % of the time where α % is specified in Table 6.2.2.2.1-2;
- b) The ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be $\geq \gamma$, where γ is specified in Table 6.2.2.2.2.1-2;
- c) When transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater than or equal to 0.02.

Table 6.2.2.2.1-1: Wideband CQI reporting test under frequency non-selective fading conditions

| | Parameter | Unit | Test 1 Test 2 | | |
|--|--|------|----------------------------------|------------|--|
| Bandwidth | | MHz | 40 | | |
| Subcarrier spacing | | kHz | 30 | | |
| Duplex Mode | | | TDD | | |
| TDD UL-DL patte | TDD UL-DL pattern | | FR1.30-1 | | |
| SNR | SNR | | - | 13 | |
| Propagation chan | | | TDLA30-5 | | |
| Antenna configura | | | 2×2 | | |
| Correlation config | | | ULA high | | |
| Beamforming Mod | | | As specified in Annex B.4.1 | | |
| | CSI-RS resource Type | | Periodic | | |
| | Number of CSI-RS ports (X) | | 4 | | |
| | CDM Type | | FD-CDM2 | | |
| ZP CSI-RS | Density (ρ) First subcarrier index in the PRB | | 1 | | |
| configuration | used for CSI-RS (k ₀) | | Row 5,4 | | |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀) | | 9 | | |
| | CSI-RS periodicity and offset | slot | 10/1 | | |
| | CSI-RS resource Type | | Periodic | | |
| | Number of CSI-RS ports (X) | | 2 | | |
| | CDM Type | | FD-CDM2 | | |
| NZP CSI-RS for | Density (ρ) | | 1 | | |
| CSI acquisition | First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | Row 3,(6,-) | | |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀) | | 13 | | |
| | NZP CSI-RS-timeConfig periodicity and offset | slot | 10/1 | | |
| | CSI-IM resource Type | | Periodic | | |
| | CSI-IM RE pattern | | 0 | | |
| CSI-IM configuration | CSI-IM Resource Mapping (kcsi-im,lcsi-im) | | (4, 9) | | |
| | CSI-IM timeConfig periodicity and offset | slot | 10/1 | | |
| ReportConfigType | | | Periodic | | |
| CQI-table | | | Table 2 | | |
| reportQuantity | | | cri-RI-PMI-CQI | | |
| timeRestrictionFo | rChannelMeasurements | | Not configured | | |
| | rInterferenceMeasurements | | Not configured | | |
| cqi-FormatIndicate | | | Wideband | | |
| pmi-FormatIndica | tor | | Wideband | | |
| Sub-band Size | | RB | 16 | | |
| Csi-ReportingBan | d III ii | | 111111 | | |
| CSI-Report period | | slot | 10/9 | | |
| aperiodicTriggerin | | | Not configured | | |
| | Codebook Type | | typel-SinglePanel | | |
| Codebook | Codebook Mode (CodebookConfig- | | 1 | | |
| configuration | N1,CodebookConfig-N2) | | Not configured | | |
| | CodebookSubsetRestriction | | 000001 | | |
| RI Restriction Physical channel for CSI report | | | N/A | | |
| | ior CSI report | | PUCCH | | |
| CQI/RI/PMI delay | of LIADO transmissism | ms | 9.5 | | |
| iviaximum numbei | r of HARQ transmission | | 1 | <u> </u> | |
| Measurement cha | nnel | | As specified in Table A.4-2, TB3 | J.∠- —— | |

Table 6.2.2.2.1-2: Minimum requirements

| Parameters | Test 1 | Test 2 |
|--------------|--------|--------|
| <i>α</i> [%] | 20 | 20 |
| γ | 1.05 | 1.05 |

6.2.2.2.2.2 Minimum requirement for sub-band CQI reporting

The purpose of the requirements is to verify that the preferred sub-bands can be used for frequency-selective scheduling under the frequency-selective fading conditions.

The accuracy of sub-band channel CQI reporting under the frequency-selective fading conditions is determined by a double-sided percentile of the reported differential CQI offset level 0 per sub-band, and the relative increase of the throughput obtained when transmitting the transport format indicated by the corresponding reported sub-band CQI on a randomly selected sub-band among the sub-bands with the highest reported differential CQI offset level compared to the throughput when transmitting a fixed transport format according to the wideband CQI median on a randomly selected sub-band among all the sub-bands. To account for sensitivity of the input SNR the sub-band CQI reporting under frequency selective fading conditions is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

For the parameters specified in Table 6.2.2.2.2-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) A sub-band differential CQI offset level of 0 shall be reported at least $\alpha\%$ of the time but less than $\beta\%$ of the time for each sub-band, where α and β are specified in Table 6.2.2.2.2.2;
- b) The ratio of the throughput obtained when transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level and that obtained when transmitting the transport format indicated by the reported wideband CQI median on a randomly selected sub-band among all the sub-bands shall be $\geq \gamma$, where γ is specified in Table 6.2.2.2.2.2;
- c) When transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level, the average BLER for the indicated transport format shall be greater than or equal to 0.02.

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each available downlink transmission instance for TDD.

Table 6.2.2.2.2-1: Sub-band CQI reporting test under frequency-selective fading conditions

| | Parameter | Unit | Test 1 Test 2 | |
|------------------------|---|------|--|--|
| Bandwidth | | MHz | 40 | |
| Subcarrier spacing | | kHz | 30 | |
| Duplex Mode | | | TDD | |
| TDD UL-DL patte | rn | | FR1.30-1 | |
| SNR | | dB | 8 9 14 15 | |
| Propagation chan | anal | | Two tap model specified in Annex B.2.4 with a=1, f _D = 5Hz, and | |
| i Topagation Chai | inei | | $\tau_{d}=0.1125\mu s$ | |
| Antenna configura | | | 2×2 | |
| Correlation config | | | As per Annex B.1 | |
| Beamforming Mo | | | As specified in Annex B.4.1 | |
| | CSI-RS resource Type | | Periodic | |
| | Number of CSI-RS ports (X) | | 4 | |
| | CDM Type | | FD-CDM2 | |
| ZP CSI-RS | Density (p) | | 1 | |
| configuration | First subcarrier index in the PRB used for CSI-RS (k ₀) | | Row 5,4 | |
| | First OFDM symbol in the PRB used | | | |
| | for CSI-RS (I ₀) | | 9 | |
| | CSI-RS | | 40/4 | |
| | periodicity and offset | slot | 10/1 | |
| | CSI-RS resource Type | | Periodic | |
| | Number of CSI-RS ports (X) | | 2 | |
| | CDM Type | | FD-CDM2 | |
| NZD COLDC for | Density (ρ) | | 1 | |
| NZP CSI-RS for | First subcarrier index in the PRB | | D0 (0) | |
| CSI acquisition | used for CSI-RS (k ₀ , k ₁) | | Row 3,(6,-) | |
| | First OFDM symbol in the PRB used | | 40 | |
| | for CSI-RS (I ₀) | | 13 | |
| | NZP CSI-RS-timeConfig | slot | 10/1 | |
| | periodicity and offset CSI-IM resource Type | | Periodic | |
| | CSI-IM RE pattern | | • | |
| | CSI-IM RE pattern CSI-IM Resource Mapping | | 0 | |
| CSI-IM configuration | (kcsi-im,lcsi-im) | | (4, 9) | |
| | CSI-IM timeConfig | slot | 10/1 | |
| D | periodicity and offset | | A so a si a si a | |
| ReportConfigType | e | | Aperiodic | |
| CQI-table | | | Table 2 cri-RI-PMI-CQI | |
| reportQuantity | orChannelMeasurements | | Not configured | |
| | orInterferenceMeasurements | | Not configured Not configured | |
| cqi-FormatIndicat | | | Subband | |
| pmi-FormatIndicat | | | Wideband | |
| Sub-band Size | ittoi | RB | 16 | |
| csi-ReportingBan | d | IND. | 1111111 | |
| CSI-Report interv | | slot | Not configured | |
| Aperiodic Report | | 3101 | 8 | |
| CSI request | Ciot Choct | | 1 in slots i, where mod(i, 10) = 1, | |
| reportTriggerSize | | | otherwise it is equal to 0 | |
| report riggersize | | | One State with one Associated | |
| | | | Report Configuration | |
| CSI-AperiodicTrig | ngerStateList | | Associated Report Configuration | |
| CO. Aponodio ing | 990.014102.01 | | contains pointers to NZP CSI-RS | |
| | | | and CSI-IM | |
| aperiodicTriggerin | ngOffset | | Not configured | |
| , | Codebook Type | | typel-SinglePanel | |
| | Codebook Mode | | 1 | |
| | | | <u> </u> | |
| Codebook | | | Not configured | |
| Codebook configuration | (CodebookConfig- | | Not configured | |
| | | | Not configured 000001 | |
| | (CodebookConfig- N1,CodebookConfig-N2) | | <u> </u> | |

| CQI/RI/PMI delay | ms | 9.5 |
|-------------------------------------|----|--------------------------------------|
| Maximum number of HARQ transmission | | 1 |
| Measurement channel | | As specified in Table A.4-2, TBS.2-6 |

Table 6.2.2.2.2-2: Minimum requirements

| Parameters | Test 1 | Test 2 |
|--------------|--------|--------|
| <i>α</i> [%] | 2 | 2 |
| β [%] | 55 | 55 |
| γ | 1.05 | 1.05 |

6.2.3 4RX requirements

This sub-clause includes the requirements for reporting of CQI for UE equipped with 4 receiver antennas.

6.2.3.1 FDD

6.2.3.1.1 CQI reporting definition under AWGN conditions

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

6.2.3.1.1.1 Minimum requirement for period CQI reporting

For the parameters specified in Table 6.2.3.1.1.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) The reported CQI value according to the reference channel shall be in the range of ± 1 of the reported median more than 90 % of the time.
- b) If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 0.1.

Table 6.2.2.1.1.1-1: CQI reporting definition test

| Parameter | | Unit | Test 1 | Test 2 |
|------------------------|--|------|-------------------------------|--|
| Bandwidth | width MHz 10 | | | |
| Subcarrier spacing | g | kHz | 15 | |
| Duplex Mode | | | FDD | |
| SNR | | dB | 5 6 | 11 12 |
| Propagation chan | nel | | AWG | |
| Antenna configura | ation | | 2x4 with static char Annex | |
| Beamforming Mod | del | | As specified in A | |
| J | CSI-RS resource Type | | Period | |
| | Number of CSI-RS ports (X) | | 4 | |
| | CDM Type | | FD-CD | M2 |
| ZP CSI-RS | Density (ρ) | | 1 | |
| configuration | First subcarrier index in the PRB used for CSI-RS (k ₀) | | Row 5 | 5,4 |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀) | | 9 | |
| | CSI-RS periodicity and offset | slot | 5/1 | |
| | CSI-RS resource Type | | Period | dic |
| | Number of CSI-RS ports (X) | | 2 | |
| | CDM Type | | FD-CD | M2 |
| NZP CSI-RS for | Density (ρ) | | 1 | |
| CSI acquisition | First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | Row 3,(| (6,-) |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀) | | 13 | |
| | NZP CSI-RS-timeConfig periodicity and offset | slot | 5/1 | |
| | CSI-IM resource Type | | Period | dic |
| | CSI-IM RE pattern | | 0 | |
| CSI-IM configuration | CSI-IM Resource Mapping (kcsi-im,lcsi-im) | | (4, 9 |) |
| | CSI-IM timeConfig periodicity and offset | slot | 5/1 | |
| ReportConfigType | | | Period | dic |
| CQI-table | | | Table | |
| reportQuantity | | | cri-RI-PM | |
| | rChannelMeasurements | | Not config | |
| timeRestrictionFo | rInterferenceMeasurements | | Not config | |
| cqi-FormatIndicate | | | Wideba | |
| pmi-FormatIndicat | tor | | Wideba | and |
| Sub-band Size | | RB | 8 | |
| csi-ReportingBand | | | 11111 | <u>11 </u> |
| CSI-Report period | • | slot | 5/0 | |
| aperiodicTriggerin | | | Not config | |
| | Codebook Type | | typel-Singl | eranel |
| Codobooli | Codebook Mode | | 1 | |
| Codebook configuration | (CodebookConfig- N1,CodebookConfig-N2) | | Not config | |
| | CodebookSubsetRestriction | | 01000 | |
| RI Restriction | | | N/A | |
| Physical channel | for USI report | | PUCC | Н |
| CQI/RI/PMI delay | of LIADO transcriction | ms | 8 | |
| iviaximum number | of HARQ transmission | | 1 | 0 A 4 2 TDC 2 |
| Measurement cha | nnel | | As specified in Tabl | € A.4-2, IBS.2- |

6.2.3.1.2 CQI reporting under fading conditions

6.2.3.1.2.1 Minimum requirement for wideband CQI reporting

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

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

For the parameters specified in Table 6.2.3.1.2.1-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) A CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least α % of the time where α % is specified in Table 6.2.3.1.2.1-2;
- b) The ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be $\geq \gamma$, where γ is specified in Table 6.2.3.1.2.1-2;
- c) When transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater than or equal to 0.02.

Table 6.2.3.1.2.1-1: Wideband CQI reporting test under frequency non-selective fading conditions

| | Parameter | Unit | Test 1 | Test 2 |
|---------------------|--|------|----------------------|----------|
| Bandwidth | | MHz | 1 | 0 |
| Subcarrier spacing | | | 15 | |
| Duplex Mode | | | FDD | |
| SNR | | dB | 3 4 | 9 10 |
| Propagation chan | nel | | TDLA | \30-5 |
| | Antenna configuration | | 2> | |
| Correlation configu | | | XP I | |
| Beamforming Mod | | | As specified in | |
| | CSI-RS resource Type | | Peri | |
| | Number of CSI-RS ports (X) | | 4 | 1 |
| | CDM Type | | FD-C | DM2 |
| ZP CSI-RS | Density (ρ) | | 1 | |
| | First subcarrier index in the PRB | | D | . 5. 4 |
| configuration | used for CSI-RS (k ₀) | | Row | 7 5,4 |
| | First OFDM symbol in the PRB used | | | ` |
| | for CSI-RS (I ₀) | | 9 | 1 |
| | CSI-RS | slot | 5/ | /1 |
| | periodicity and offset | SIOL | 3/ | 1 |
| | CSI-RS resource Type | | Peri | odic |
| | Number of CSI-RS ports (X) | | 2 | 2 |
| | CDM Type | | FD-C | DM2 |
| NZP CSI-RS for | Density (ρ) | | 1 | |
| CSI acquisition | First subcarrier index in the PRB | | Dow (| 2 (6) |
| CSI acquisition | used for CSI-RS (k ₀ , k ₁) | | Row | 5,(6,-) |
| | First OFDM symbol in the PRB used | | 1 | 2 |
| | for CSI-RS (I ₀) | | Ī | 3 |
| | NZP CSI-RS-timeConfig | slot | 5/ | /1 |
| | periodicity and offset | SIOL | | |
| | CSI-IM resource Type | | Peri | odic |
| | CSI-IM RE pattern | | (|) |
| CSI-IM | CSI-IM Resource Mapping | | | |
| configuration | (Ксы-ім,Ісы-ім) | | (4, | 9) |
| garaner. | | | | |
| | CSI-IM timeConfig | slot | 5/ | /1 |
| D (0 (" T | periodicity and offset | | 5 | P |
| ReportConfigType |) | | Peri | |
| CQI-table | | | Tab | |
| reportQuantity | Ol IM | | cri-RI-P | |
| | ChannelMeasurements | | Not con | |
| | InterferenceMeasurements | | Not con | |
| cqi-FormatIndicato | | | Wide | |
| pmi-FormatIndicat | or | DD | Wide | |
| Sub-band Size | | RB | 3 | |
| csi-ReportingBand | | | 1111 | |
| CSI-Report period | | slot | 5/ | |
| aperiodicTriggerin | | | | nfigured |
| | Codebook Type | | typel-Sin | |
| Cadabast | Codebook Mode | | 1 | l |
| Codebook | (CodebookConfig- | | Not con | nfigured |
| configuration | N1,CodebookConfig-N2) CodebookSubsetRestriction | | | |
| | | | 000 N/ | |
| Dhysical shares 14 | RI Restriction | | | |
| Physical channel f | ог Сы героп | | PUC | |
| CQI/RI/PMI delay | of LIADO transmissis | ms | 8 | |
| iviaximum number | of HARQ transmission | | As an acifical in To | |
| Measurement cha | nnel | | As specified in Ta | |
| | | | 1 | l |

Table 6.2.3.1.2.1-2: Minimum requirements

| Parameters | Test 1 | Test 2 |
|------------|--------|--------|
| α[%] | 5 | 5 |
| γ | 1.05 | 1.05 |

6.2.3.1.2.2 Minimum requirement for sub-band CQI reporting

The purpose of the requirements is to verify that the preferred sub-bands can be used for frequency-selective scheduling under the frequency-selective fading conditions.

The accuracy of sub-band channel CQI reporting under the frequency-selective fading conditions is determined by a double-sided percentile of the reported differential CQI offset level 0 per sub-band, and the relative increase of the throughput obtained when transmitting the transport format indicated by the corresponding reported sub-band CQI on a randomly selected sub-band among the sub-bands with the highest reported differential CQI offset level compared to the throughput when transmitting a fixed transport format according to the wideband CQI median on a randomly selected sub-band among all the sub-bands. To account for sensitivity of the input SNR the sub-band CQI reporting under frequency selective fading conditions is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

For the parameters specified in Table 6.2.3.1.2.2-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) A sub-band differential CQI offset level of 0 shall be reported at least $\alpha\%$ of the time but less than $\beta\%$ of the time for each sub-band, where α and β are specified in Table 6.2.3.1.2.2-2;
- b) The ratio of the throughput obtained when transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level and that obtained when transmitting the transport format indicated by the reported wideband CQI median on a randomly selected sub-band among all the sub-bands shall be $\geq \gamma$, where γ is specified in Table 6.2.3.1.2.2-2;
- c) When transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level, the average BLER for the indicated transport format shall be greater than or equal to 0.02.

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each TTI for FDD.

Table 6.2.3.1.2.2-1: Sub-band CQI reporting test under frequency-selective fading conditions

| | Parameter | Unit | Test 1 | Test 2 |
|----------------------|--|------------|---|----------------------------------|
| Bandwidth | | | 10 | |
| Subcarrier spacing | g | MHz kHz | 15 | |
| Duplex Mode | 5 | | FDI | |
| SNR | | dB | 5 6 | 11 12 |
| | Propagation channel | | Two tap model sp B.2.4 with a=1, td=0.4 | f _D = 5Hz, and 5μs |
| Antenna configura | ation | | 2×4 | 4 |
| Correlation config | | | As per An | |
| Beamforming Mod | | | As specified in | |
| | CSI-RS resource Type | | Perio | dic |
| | Number of CSI-RS ports (X) | | 4 | |
| | CDM Type | | FD-CI | DM2 |
| ZP CSI-RS | Density (ρ) | | 1 | |
| configuration | First subcarrier index in the PRB used for CSI-RS (k ₀) | | Row | 5,4 |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀) | | 9 | |
| | CSI-RS periodicity and offset | slot | 5/1 | |
| | CSI-RS resource Type | | Perio | dic |
| | Number of CSI-RS ports (X) | | 2 | |
| | CDM Type | | FD-C | DM2 |
| NZP CSI-RS for | Density (ρ) | | 1 | |
| CSI acquisition | First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | Row 3 | (6,-) |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀) | | 13 | |
| | NZP CSI-RS-timeConfig periodicity and offset | slot | 5/1 | |
| | CSI-IM resource Type | | Perio | dic |
| | CSI-IM RE pattern | | 0 | |
| CSI-IM configuration | CSI-IM Resource Mapping (kcsi-im,lcsi-im) | | (4, 9 | 9) |
| | CSI-IM timeConfig periodicity and offset | slot | 5/1 | |
| ReportConfigType |) | | Aperio | odic |
| CQI-table | | | Table | e 2 |
| reportQuantity | | | cri-RI-PN | |
| | rChannelMeasurements | | Not conf | |
| | rInterferenceMeasurements | | Not conf | |
| cqi-FormatIndicate | | | Subba | |
| pmi-FormatIndicat | tor | | Wideb | and |
| Sub-band Size | | RB | 8 | |
| csi-ReportingBand | | | 11111 | |
| CSI-Report interva | | slot | Not conf | igured |
| Aperiodic Report S | Slot Offset | | 1 in slots i, where | |
| · | | | otherwise it is | equal to 0 |
| reportTriggerSize | | | One State with one | Associated |
| CSI-AperiodicTrig | gerStateList | | Report Configuration Associated Report | on |
| - | | | contains pointers and CS | to NZP CSI-RS |
| aperiodicTriggerin | aperiodicTriggeringOffset | | Not conf | |
| | Codebook Type | | typel-Sing | lePanel |
| | Codebook Mode | | 1 | |
| Codebook | (CodebookConfig- | | Not conf | igured |
| configuration | N1,CodebookConfig-N2) | | Not conf | |
| | CodebookSubsetRestriction | | 0000 | |
| RI Restriction | | | N/A | |
| Physical channel to | or CSI report | | PUS | JH |
| CQI/RI/PMI delay | | ms | 8 | |

| Maximum number of HARQ transmission | 1 |
|-------------------------------------|--------------------------------------|
| Measurement channel | As specified in Table A.4-2, TBS.2-5 |

Table 6.2.3.1.2.2-2: Minimum requirements

| Parameters | Test 1 | Test 2 |
|------------|--------|--------|
| a [%] | 2 | 2 |
| β [%] | 55 | 55 |
| γ | 1.05 | 1.05 |

6.2.3.2 TDD

6.2.3.2.1 CQI reporting definition under AWGN

6.2.3.2.1.1 Minimum requirement for CQI periodic reporting

The purpose of the requirements is to verify that the reported CQI values are in accordance with the CQI definition given in TS38.214 [12]. The reporting accuracy of CQI under AWGN condition is determined by the reporting variance and BLER performance using the transport format indicated by the reported CQI median. To account for sensitivity of the input SNR the reporting definition is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

For the parameters specified in Table 6.2.3.2.1.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) The reported CQI value according to the reference channel shall be in the range of ± 1 of the reported median more than 90% of the time.
- b) If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 0.1.

Table 6.2.3.2.1.1-1: CQI reporting definition test

| | Parameter | Unit | Test 1 | Test 2 |
|------------------------|--|------|------------------------------|-------------------|
| Bandwidth | | | 40 | |
| Subcarrier spacin | g | kHz | 30 | |
| Duplex Mode | _ | | TD | D |
| TDD UL-DL patte | rn | | FR1.3 | 30-1 |
| SNR | | dB | 5 6 | 11 12 |
| Propagation chan | nel | | AWC | SN . |
| Antenna configura | ation | | 2x4 with static cha Annex | |
| Beamforming Mod | del | | As specified in | |
| G | CSI-RS resource Type | | Perio | |
| | Number of CSI-RS ports (X) | | 4 | |
| | CDM Type | | FD-CI | DM2 |
| ZP CSI-RS | Density (ρ) | | 1 | |
| | First subcarrier index in the PRB | | Daw | Γ Λ |
| configuration | used for CSI-RS (k ₀) | | Row | 5,4 |
| | First OFDM symbol in the PRB used | | 0 | |
| | for CSI-RS (I ₀) | | 9 | |
| | CSI-RS | | 404 | 4 |
| | periodicity and offset | slot | 10/ | 1 |
| | CSI-RS resource Type | | Perio | dic |
| | Number of CSI-RS ports (X) | | 2 | |
| | CDM Type | | FD-CI | DM2 |
| | Density (ρ) | | 1 | |
| NZP CSI-RS for | Definity (b) | | | |
| CSI acquisition | First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | Row 3 | ,(6,-) |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀) | | 13 | } |
| | NZP CSI-RS-timeConfig periodicity and offset | slot | 10/ | 1 |
| | CSI-IM resource Type | | Perio | dic |
| | CSI-IM RE pattern | | 0 | |
| CSI-IM configuration | CSI-IM Resource Mapping (kcsi-im,lcsi-im) | | (4, | 9) |
| | CSI-IM timeConfig periodicity and offset | slot | 10/ | 1 |
| ReportConfigType | 9 | | Perio | dic |
| CQI-table | | | Table | e 2 |
| reportQuantity | | | cri-RI-PI | /II-CQI |
| timeRestrictionFo | rChannelMeasurements | | Not conf | igured |
| timeRestrictionFo | rInterferenceMeasurements | | Not conf | igured |
| cqi-FormatIndicate | or | | Wideb | |
| pmi-FormatIndica | tor | | Wideb | and |
| Sub-band Size | | RB | 16 | |
| csi-ReportingBand | d | | 1111 | 111 |
| CSI-Report period | | slot | 10/ | |
| aperiodicTriggerin | | | Not conf | |
| 1 335 | Codebook Type | | typel-Sing | |
| | Codebook Mode | | 1 | |
| Codebook configuration | (CodebookConfig- N1,CodebookConfig-N2) | | Not conf | igured |
| · | CodebookSubsetRestriction | | 0100 | |
| | RI Restriction | | N/A | <i>H</i> |
| Physical channel | | | PUC | CH |
| CQI/RI/PMI delay | · | ms | 9.5 | |
| | r of HARQ transmission | - | 1 | |
| Measurement cha | | | As specified in Tab | ole A.4-2, TBS.2- |
| | | | · · | |

6.2.3.2.2 CQI reporting under fading conditions

6.2.3.2.2.1 Minimum requirement for wideband CQI reporting

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

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

For the parameters specified in Table 6.2.3.2.2.1-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) A CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least α % of the time where α % is specified in Table 6.2.3.2.2.1-2;
- b) The ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be $\geq \gamma$, where γ is specified in Table 6.2.3.2.2.1-2;
- c) When transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater than or equal to 0.02.

Table 6.2.3.2.2.1-1: Wideband CQI reporting test under frequency non-selective fading conditions

| | Parameter | Unit | Test 1 Test 2 |
|-----------------------------------|--|------|-------------------------------------|
| Bandwidth | Bandwidth | | 40 |
| Subcarrier spacing | g | kHz | 30 |
| | Duplex Mode | | TDD |
| TDD UL-DL patter | rn | | FR1.30-1 |
| SNR | | dB | 3 4 9 10 |
| Propagation chan | | | TDLA30-5 |
| Antenna configura | | | 2×4 |
| Correlation config | | | XP High |
| Beamforming Mod | | | As specified in Annex B.4.1 |
| | CSI-RS resource Type | | Periodic |
| | Number of CSI-RS ports (X) | | 4 FD-CDM2 |
| | CDM Type Density (p) | | 1 1 |
| ZP CSI-RS | First subcarrier index in the PRB | | l l |
| configuration | used for CSI-RS (k ₀) | | Row 5,4 |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀) | | 9 |
| | CSI-RS periodicity and offset | slot | 10/1 |
| | CSI-RS resource Type | | Periodic |
| | Number of CSI-RS ports (X) | | 2 |
| | CDM Type | | FD-CDM2 |
| NZP CSI-RS for | Density (ρ) | | 1 |
| CSI acquisition | First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | Row 3,(6,-) |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀) | | 13 |
| | NZP CSI-RS-timeConfig periodicity and offset | slot | 10/1 |
| | CSI-IM resource Type | | Periodic |
| | CSI-IM RE pattern | | 0 |
| CSI-IM configuration | CSI-IM Resource Mapping (kcsi-im,lcsi-im) | | (4, 9) |
| | CSI-IM timeConfig periodicity and offset | slot | 10/1 |
| ReportConfigType | | | Periodic |
| CQI-table | | | Table 2 |
| reportQuantity | | | cri-RI-PMI-CQI |
| timeRestrictionFo | rChannelMeasurements | | Not configured |
| | rInterferenceMeasurements | | Not configured |
| cqi-FormatIndicate | | | Wideband |
| pmi-FormatIndica | tor | | Wideband |
| Sub-band Size | | RB | 16 |
| csi-ReportingBand | | | 111111 |
| CSI-Report period | | slot | 10/9 |
| aperiodicTriggerin | <u> </u> | | Not configured |
| | Codebook Type | | typel-SinglePanel |
| Codebook | Codebook Mode (CodebookConfig- | | 1 |
| configuration | N1,CodebookConfig-N2) | | Not configured |
| | CodebookSubsetRestriction | | 000001 |
| Dhysical shapes | RI Restriction | | N/A PUCCH |
| Physical channel CQI/RI/PMI delay | ioi coi report | mo | 9.5 |
| | of HARQ transmission | ms | 9.5 |
| iviaxiiiiuiii iiuiiiDel | OF FIANG HAIISHIIISSIUH | | As specified in Table A.4-2, TBS.2- |
| Measurement channel | | | 3 |

Table 6.2.3.2.2.1-2: Minimum requirements

| Parameters | Test 1 | Test 2 |
|------------|--------|--------|
| α[%] | 5 | 5 |
| γ | 1.05 | 1.05 |

6.2.3.2.2.2 Minimum requirement for sub-band CQI reporting

The purpose of the requirements is to verify that the preferred sub-bands can be used for frequency-selective scheduling under the frequency-selective fading conditions.

The accuracy of sub-band channel CQI reporting under the frequency-selective fading conditions is determined by a double-sided percentile of the reported differential CQI offset level 0 per sub-band, and the relative increase of the throughput obtained when transmitting the transport format indicated by the corresponding reported sub-band CQI on a randomly selected sub-band among the sub-bands with the highest reported differential CQI offset level compared to the throughput when transmitting a fixed transport format according to the wideband CQI median on a randomly selected sub-band among all the sub-bands. To account for sensitivity of the input SNR the sub-band CQI reporting under frequency selective fading conditions is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

For the parameters specified in Table 6.2.3.2.2.2-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) A sub-band differential CQI offset level of 0 shall be reported at least $\alpha\%$ of the time but less than $\beta\%$ of the time for each sub-band, where α and β are specified in Table 6.2.3.2.2.2-2;
- b) The ratio of the throughput obtained when transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level and that obtained when transmitting the transport format indicated by the reported wideband CQI median on a randomly selected sub-band among all the sub-bands shall be $\geq \gamma$, where γ is specified in Table 6.2.3.2.2.2-2;
- c) When transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level, the average BLER for the indicated transport format shall be greater than or equal to 0.02.

The requirements only apply for sub-bands of full size and the random scheduling across the sub-bands is done by selecting a new sub-band in each available downlink transmission instance for TDD.

Table 6.2.3.2.2.1: Sub-band CQI reporting test under frequency-selective fading conditions

| | Parameter | Unit | Test 1 Test 2 |
|-------------------------------------|--|------|---|
| Bandwidth | | MHz | 40 |
| Subcarrier spacin | g | kHz | 30 |
| Duplex Mode | | | TDD |
| TDD UL-DL patte | rn | | FR1.30-1 |
| SNR | | dB | 5 6 11 12 |
| Propagation chan | nnel | | Two tap model specified in Annex B.2.4 with $a=1$, $f_D=5$ Hz, and $\tau_d=0.1125\mu s$ |
| Antenna configura | ation | | 2×4 |
| Correlation config | | | As per Annex B.1 |
| Beamforming Mod | del | | As specified in Annex B.4.1 |
| | CSI-RS resource Type | | Periodic |
| | Number of CSI-RS ports (X) | | 4 |
| | CDM Type | | FD-CDM2 |
| ZD COLDO | Density (ρ) | | 1 |
| ZP CSI-RS configuration | First subcarrier index in the PRB used for CSI-RS (k ₀) | | Row 5,4 |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀) | | 9 |
| | CSI-RS periodicity and offset | slot | 10/1 |
| | CSI-RS resource Type | | Periodic |
| | Number of CSI-RS ports (X) | | 2 |
| | CDM Type | | FD-CDM2 |
| NZP CSI-RS for | Density (ρ) | | 1 |
| CSI acquisition | First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | Row 3,(6,-) |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀) | | 13 |
| | NZP CSI-RS-timeConfig periodicity and offset | slot | 10/1 |
| | CSI-IM resource Type | | Periodic |
| | CSI-IM RE pattern | | 0 |
| CSI-IM configuration | CSI-IM Resource Mapping (kcsi-im,lcsi-im) | | (4, 9) |
| | CSI-IM timeConfig periodicity and offset | slot | 10/1 |
| ReportConfigType | e | | Aperiodic |
| CQI-table | | | Table 2 |
| reportQuantity | | | cri-RI-PMI-CQI |
| | rChannelMeasurements | | Not configured |
| timeRestrictionFo | orInterferenceMeasurements | | Not configured |
| cqi-FormatIndicat | | | Subband |
| pmi-FormatIndica | tor | | Wideband |
| Sub-band Size | | RB | 16 |
| csi-ReportingBan | | | 1111111 |
| CSI-Report interv | | slot | Not configured |
| Aperiodic Report | Slot Offset | | 8 1 in slots i, where mod(i, 10) = 1, |
| CSI request | | | otherwise it is equal to 0 |
| reportTriggerSize CSI-AperiodicTrig | | | One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM |
| aperiodicTriggerin | ngOffset | | 0 |
| aponodio miggeni | Codebook Type | | typel-SinglePanel |
| | Codebook Node | | 1 |
| Codebook | (Codebook Config- | | 1 |
| configuration | N1,CodebookConfig-N2) | | Not configured |
| Somgaration | CodebookSubsetRestriction | | 000001 |
| | RI Restriction | | N/A |
| | TO RESUICION | | 14/73 |

| CQI/RI/PMI delay | ms | 9.5 |
|-------------------------------------|----|--------------------------------------|
| Maximum number of HARQ transmission | | 1 |
| Measurement channel | | As specified in Table A.4-2, TBS.2-6 |

Table 6.2.2.1.2.2-2: Minimum requirements

| Parameters | Test 1 | Test 2 |
|--------------|--------|--------|
| α [%] | 2 | 2 |
| β [%] | 55 | 55 |
| γ | 1.05 | 1.05 |

6.3 Reporting of Precoding Matrix Indicator (PMI)

The minimum performance requirements of PMI reporting are defined based on the precoding gain, expressed as the relative increase in throughput when the transmitter is configured according to the UE reported PMI compared to the case when the transmitter is using random precoding, respectively. When the transmitter uses random precoding, for each PDSCH allocation a precoder is randomly generated with equal propability of each applicable i_1 and i_2 combination and applied to the PDSCH. A fixed transport format (FRC) is configured for all requirements.

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

$$\gamma = \frac{t_{ue, follow 1, follow 2}}{t_{rnd1, rnd2}}$$

In the definition of γ , for 4TX and 8TX PMI requirements, $t_{follow1,follow2}$ is 90 % of the maximum throughput obtained at $SNR_{follow1,follow2}$ using the precoders configured according to the UE reports, and $t_{rnd1,rnd2}$ is the throughput measured at $SNR_{follow1,follow2}$ with random precoding.

6.3.1 1RX requirements

(Void)

6.3.2 2RX requirements

6.3.2.1 FDD

6.3.2.1.1 Single PMI with 4TX Typel-SinglePanel Codebook

For the parameters specified in Table 6.3.2.1.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.1.1-2.

Table 6.3.2.1.1-1: Test parameters (single layer)

| Pai | rameter | Unit | Test 1 |
|------------------|---|------|---------------------------------------|
| Bandwidth | | MHz | 10 |
| Subcarrier space | ing | kHz | 15 |
| Duplex Mode | | | FDD |
| Propagation cha | annel | | TDLA30-5 |
| Antenna configu | ıration | | High XP 4 x 2 |
| | | | (N1,N2) = (2,1) |
| Beamforming M | | | As specified in Annex B.4.1 |
| | CSI-RS resource | | Periodic |
| | Type Number of CSI- | | |
| | | | 4 |
| | RS ports (X) CDM Type | | FD-CDM2 |
| | Density (ρ) | | 1 D-05W2 |
| | First subcarrier | | ' |
| ZP CSI-RS | index in the PRB | | 5 5 (4) |
| configuration | used for CSI-RS | | Row 5, (4,-) |
| | (k_0, k_1) | | |
| | First OFDM | | |
| | symbol in the PRB | | (9,-) |
| | used for CSI-RS | | (9,-) |
| | (l ₀ , l ₁) | | |
| | CSI-RS | slot | 5/1 |
| | interval and offset | | |
| | CSI-RS resource | | Aperiodic |
| | Type Number of CSI- | | · |
| | RS ports (X) | | 4 |
| | CDM Type | | FD-CDM2 |
| | Density (ρ) | | 1 D-05/W2 |
| | First subcarrier | | ' |
| NZP CSI-RS | index in the PRB | | |
| for CSI | used for CSI-RS | | Row 4, (0,-) |
| acquisition | (k_0, k_1) | | |
| | First OFDM | | |
| | symbol in the PRB | | (13,-) |
| | used for CSI-RS | | (13,-) |
| | (l ₀ , l ₁) | | |
| | CSI-RS | | Not configured |
| | interval and offset | | |
| | aperiodicTriggerin | | 0 |
| | gOffset CSI-IM resource | | |
| | Type | | Aperiodic |
| | CSI-IM RE pattern | | Pattern 0 |
| CSI-IM | CSI-IM Resource | | 1 attern 0 |
| configuration | Mapping | | (4,9) |
| garamen. | (k _{CSI-IM} ,l _{CSI-IM}) | | (1,0) |
| | CSI-IM timeConfig | -1-4 | Niet een Groone d |
| | interval and offset | slot | Not configured |
| ReportConfigTy | pe | | Aperiodic |
| CQI-table | | | Table 1 |
| reportQuantity | | | cri-RI-PMI-CQI |
| | orChannelMeasure | | Not configured |
| ments | | | . ist somigatod |
| | ForInterferenceMeas | | Not configured |
| urements | | | |
| cqi-FormatIndic | | | Wideband |
| pmi-FormatIndio | JaiUI | RB | Wideband 8 |
| csi-ReportingBa | and | מא | 1111111 |
| CSI-Report inte | | slot | Not configured |
| Aperiodic Repo | | 3101 | 4 |
| CSI request | 5.01 511001 | | 1 in slots i, where $mod(i, 5) = 1$, |
| - | • | | otherwise it is equal to 0 |
| reportTriggerSiz | <u>re</u> | | 1 |

| CSI-AperiodicT | riggerStateList | | One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM |
|--|---|----|---|
| | Codebook Type | | typel-SinglePanel |
| | Codebook Mode | | 1 |
| Codebook | (CodebookConfig- N1,CodebookConfig-N2) | | (2,1) |
| configuration | (CodebookConfig- O1,CodebookCon fig-O2) | | (4,1) |
| | CodebookSubset Restriction | | 11111111 |
| | RI Restriction | | 0000001 |
| Physical channe | el for CSI report | | PUSCH |
| CQI/RI/PMI delay | | ms | 6 |
| Maximum number of HARQ transmission | | | 4 |
| Measurement c | Measurement channel | | R.PDSCH.1-6.1 FDD |
| Note 1: When Throughput is measured using random preceder selection, the | | | |

Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable i₁, i₂ combination.

Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-3), this reported PMI cannot be applied at the gNB downlink before slot#(n+3)

Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.

Table 6.3.2.1.1-2: Minimum requirement

| Parameter | Test 1 |
|-----------|--------|
| γ | 1.3 |

6.3.2.1.2 Single PMI with 8TX TypeI-SinglePanel Codebook

For the parameters specified in Table 6.3.2.1.2-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.1.2-2.

T Table 6.3.2.1.2-1: Test parameters (dual-layer)

| Bandwidth | Parameter | | Unit | Test 1 |
|--|------------------|---------------------|------|-----------------------------|
| Duplex Mode | Bandwidth | | | 10 |
| Propagation channel | | | kHz | 15 |
| Antenna configuration | | | | |
| Reamforming Mode As specified in Annex B.4.1 | | | | |
| CSI-RS resource Type Periodic | | | | |
| CSI-RS resource | | | | (N1,N2) = (4,1) |
| Type | Beamforming M | | | As specified in Annex B.4.1 |
| Number of CSI-R R ports (X) CDM Type FD-CDM2 | | | | Periodic |
| RS ports (X) | | | | |
| CDM Type | | | | 4 |
| Density (p) | | | | ED-CDM2 |
| First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | | | |
| Index in the PRB Index in the Index in | | 2 31 / | | ' |
| Used for CSI-RS | | | | 5 5 (4) |
| First OFDM symbol in the PRB used for CSI-RS (lo, lr) | configuration | | | Row 5, (4,-) |
| First OFDM symbol in the PRB used for CSI-RS (lo, lr) | | (k_0, k_1) | | |
| Used for CSI-RS (I0, In) (I | | First OFDM | | |
| Used tot CSI-RS (I0, I1) CSI-RS interval and offset interval interval and offset interval interval and offset interval i | | | | (9 -) |
| CSI-RS interval and offset CSI-RS resource Type Number of CSI-RS ports (X) RS ports (X) Density (p) 1 First subcarrier index in the PRB used for CSI-RS (ko, k1) CSI-RS interval and offset aperiodicTriggerin gOffset CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Type CSI-IM Resou | | | | (9,-) |
| Interval and offset CSI-RS resource Type Aperiodic Type CDM Type CDM4 (FD2, TD2) Density (p) 1 First subcarrier index in the PRB used for CSI-RS (ko, k1) First OFDM symbol in the PRB used for CSI-RS (lo, l1) CSI-RS interval and offset aperiodic Triggerin gOffset CSI-IM CSI-IM Resource Type Aperiodic CSI-IM Resource Mapping (KcsI-IM.IcsI-IM) CSI-IM TimeConfig interval and offset ImeRestrictionForChannelMeasure ments ReportConfiguration ReportConfigtType Aperiodic Table 1 ReportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForChannelMeasure ments under the Aperiodic Type Aperiodic Coll-table Table 1 reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForChannelMeasure ments urements variety Aperiodic Coll-table Table 1 reportQuantity timeRestrictionForChannelMeasure ments urements variety Aperiodic Coll-table Table 1 reportQuantity timeRestrictionForChannelMeasure ments urements variety Aperiodic Coll-table Not configured | | | | |
| CSI-RS resource Type | | | slot | 5/1 |
| Type | | | | |
| Number of CSI-RS ports (X) CDM Type Density (p) First subcarrier index in the PRB used for CSI-RS (ko, kt.) First OFDM symbol in the PRB used for CSI-RS (lo, lt) CSI-RS interval and offset aperiodicTriggerin gOffset CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (kcsi-iM, lcsi-iM) CSI-IM timeConfig interval and offset SIot Not configured Aperiodic CSI-IM resource Type CSI-IM Resource Mapping (kcsi-iM, lcsi-iM) CSI-IM timeConfig interval and offset Table 1 reportQuantity TimeRestrictionForChannelMeasure ments ItimeRestrictionForChannelMeasure ments TimeRestrictionForInterferenceMeas urements CSI-PormatIndicator Wideband Sub-band Size RB RB Row 8, (4,6) (5,-) (5,-) Not configured Not configured Not configured Not configured Not configured Not configured Table 1 | | | | Aperiodic |
| RS ports (X) | | Number of CSI | | · |
| CDM Type | | | | 8 |
| Density (p) First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) First OFDM symbol in the PRB used for CSI-RS (l ₀ , l ₁) CSI-RS interval and offset aperiodicTriggerin gOffset CSI-IM resource Type CSI-IM RE pattern CSI-IM RE pattern CSI-IM Resource Mapping (KcSI-IM, lcSI-IM) CSI-IM timeConfig interval and offset sinterval and offset seportConfigtType ReportConfigtType ReportC | | | | CDM4 (ED2 TD2) |
| First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) First OFDM symbol in the PRB used for CSI-RS (l ₀ , l ₁) CSI-RS (l ₀ , l ₁) | | | | 1 |
| NZP CSI-RS for CSI acquisition Index in the PRB used for CSI-RS (ko, k1) | | | | ' |
| Second content of the content of t | NZP CSI-RS | | | |
| acquisition Rirst OFDM Symbol in the PRB Used for CSI-RS ([0, 1+) Aperiodic Triggerin ([0, 1+) GOFT GOFT ([0, 1+) CSI-IM resource ([0, 1+) CSI-IM RE pattern Pattern ([0, 1+) CSI-IM Resource ([0, 1+) CSI-IM Resource ([0, 1+) CSI-IM Resource ([0, 1+) CSI-IM Resource ([0, 1+) Mapping ([0, 1+) ([0, 1+) ([0, 1+ | | | | Row 8, (4,6) |
| First OFDM symbol in the PRB used for CSI-RS (lo, l₁) CSI-RS interval and offset aperiodicTriggerin gOffset CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (kcsi-iiii) CSI-IM timeConfig interval and offset ReportConfigType CQI-table ReportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size CSI-request First OFDM symbol in the PRB used for CSI-RS (lo, l₁) Slot Not configured | | | | |
| used for CSI-RS (lo, l1) CSI-RS interval and offset aperiodicTriggerin gOffset CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (kcsI-IM, lcsI-IM) CSI-IM timeConfig interval and offset ReportConfigType CQI-table reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Sub-band Size RB RS | | | | |
| CSI-RS (lo, 1r) CSI-RS interval and offset aperiodicTriggerin gOffset CSI-IM resource Type Aperiodic | | symbol in the PRB | | (5.) |
| CSI-RS interval and offset aperiodicTriggerin gOffset CSI-IM resource Type CSI-IM RE pattern Pattern 0 CSI-IM Resource Mapping (4,9) CSI-IM timeConfig interval and offset SIot Not configured ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband Sub-band Size RB 8 csi-Report interval and offset slot Not configured Aperiodic RB 8 CSI-Report interval and offset slot Not configured Aperiodic Report Slot Offset Slot Not configured Table 1 Not configured Not configured Not configured Not configured Not configured Table 1 RB 8 Slot Not configured Not configured Not configured Table 1 | | used for CSI-RS | | (5,-) |
| interval and offset aperiodic Triggerin gOffset CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (kcsi-im,lcsi-im) CSI-IM timeConfig interval and offset ReportConfigType CQI-table reportQuantity timeRestrictionForChannelMeasure ments urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size Report Configured interval and offset Slot Not configured Aperiodic Table 1 rein-Table 1 rein-Table 1 rein-Table 1 rein-Table 1 Not configured Not configured Not configured Not configured Not configured Table 1 ReportConfigured Table 1 ReportConfigured Table 1 ReportConfigured Table 1 ReportConfigured Not configured Not configured Not configured Table 1 ReportInterferenceMeas ReportInterferenceMeas Total Report interval and offset Not configured Not configured Table 1 Not configured Not configured Not configured Not configured Sub-band Size ReportIngBand Till1111 CSI-Report interval and offset Aperiodic Report Slot Offset Tin slots i, where mod(i, 5) = 1, | | | | |
| CSI-IM resource Aperiodic | | | slot | Not configured |
| GSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (kcsi-im,lcsi-im) CSI-IM timeConfig interval and offset ReportConfigType CQI-table reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-Report interval and offset Aperiodic ReportConfigType Aperiodic CI-table Table 1 Table 1 Table 1 TreportQuantity tori-RI-PMI-CQI timeRestrictionForInterferenceMeas urements Totic Mideband Wideband Wideband Sub-band Size RB | | | | |
| CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (kcsi-im, lcsi-im) CSI-IM timeConfig interval and offset ReportConfigType CQI-table reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator sub-band Size csi-Report Slot Offset CSI-IM Resource Mapping (kcsi-im, lcsi-im) CSI-IM timeConfig interval and offset slot Not configured Not configured Not configured Wideband Wideband Sub-band Size csi-Report interval and offset Aperiodic Report Slot Offset CSI request Aperiodic Aperiodic Not configured Table 1 CSI-IM Tesource Not configured Not configured Not configured Table 1 Table 1 Table 1 Table 1 Torical Table 1 Table 1 Table 1 Torical Table 1 Table 1 Table 1 Table 1 Table 1 Table 1 Torical Table 1 Torical Table 1 Table 1 Torical Table 1 Torical Table 1 Table 1 Table 1 Torical Table 1 Table 1 Table 1 Torical Table 1 Tor | | | | 0 |
| Type CSI-IM RE pattern CSI-IM Resource Mapping (k _{CSI-IM} ,l _{CSI-IM}) CSI-IM timeConfig interval and offset ReportConfigType CQI-table reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-Report interval and offset Type CSI-IM RE pattern Pattern 0 (4,9) (4,9) Not configured Not configured Not configured Not configured Wideband Wideband Sub-band Size RB 8 csi-ReportingBand CSI-Report interval and offset Aperiodic SI request Table 1 Not configured Not configured Not configured Wideband Sub-band Size Size Size Size Size Size Size Size | | | | |
| CSI-IM RE pattern CSI-IM Resource Mapping (kcsi-IM, lcsi-IM) CSI-IM timeConfig interval and offset ReportConfigType CQI-table reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Sub-band Size CSI-IM RE pattern Pattern 0 (4,9) (4,9) Not configured Not configured Not configured Not configured Wideband Wideband Sub-band Size RB 8 csi-ReportingBand CSI-Report interval and offset Aperiodic Report Slot Offset SI request CSI-IM RE pattern Pattern 0 (4,9) Not configured Not configured Not configured Videband Sub-band Size RB 8 CSI-Report interval and offset Aperiodic Report Slot Offset SI request 1 in slots i, where mod(i, 5) = 1, | | | | Aperiodic |
| CSI-IM configuration CSI-IM Resource Mapping (kcsi-im,lcsi-im) CSI-IM timeConfig interval and offset ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report interval and offset slot Not configured Aperiodic Report Slot Offset 5 CSI request 1 in slots i, where mod(i, 5) = 1, | | | | Pattern 0 |
| configuration Mapping (kcsi-im,lcsi-im) CSI-IM timeConfig interval and offset ReportConfigType CQI-table reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Sub-band Size csi-Report interval and offset Aperiodic Table 1 Table 1 Table 1 Not configured Not configured Not configured Wideband Wideband Sub-band Size RB 8 csi-ReportingBand CSI-Report interval and offset Aperiodic Report Slot Offset 5 1 in slots i, where mod(i, 5) = 1, | CSI-IM | | | 1 attern 0 |
| CSI-IM, CSI-IM CSI-I | | | | (4.9) |
| CSI-IM timeConfig interval and offset Not configured ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments Not configured timeRestrictionForInterferenceMeas urements Not configured cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report interval and offset slot Not configured Aperiodic Report Slot Offset 5 CSI request 1 in slots i, where mod(i, 5) = 1, | garanon | | | (1,0) |
| Interval and offset Siot Not configured | | | | |
| ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report interval and offset Slot Not configured Aperiodic Report Slot Offset 5 CSI request 1 in slots i, where mod(i, 5) = 1, | | | slot | Not configured |
| reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-Report interval and offset Aperiodic Report Slot Offset reportQuantity cri-RI-PMI-CQI Not configured Not configured Wideband Wideband Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report interval and offset Aperiodic Report Slot Offset 5 1 in slots i, where mod(i, 5) = 1, | | | | Aperiodic |
| timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-Report interval and offset Aperiodic Report Slot Offset Not configured Wideband Wideband 1111111 CSI-Report interval and offset Aperiodic Report Slot Offset 1 in slots i, where mod(i, 5) = 1, | | | | Table 1 |
| ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-Report interval and offset Aperiodic Report Slot Offset Not configured Wideband Wideband 1111111 CSI-Report interval and offset Aperiodic Report Slot Offset 1 in slots i, where mod(i, 5) = 1, | reportQuantity | | | cri-RI-PMI-CQI |
| timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-Report interval and offset Aperiodic Report Slot Offset CSI request Not configured Not configured Not configured Not configured Not configured 1 in slots i, where mod(i, 5) = 1, | | | | Not configured |
| urements Not configured cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report interval and offset slot Not configured Aperiodic Report Slot Offset 5 CSI request 1 in slots i, where mod(i, 5) = 1, | | | | Not configured |
| cqi-FormatIndicator pmi-FormatIndicator Sub-band Size RB CSi-Report interval and offset Aperiodic Report Slot Offset CSI request CSI request Wideband Wideband Not configured Not configured 1 in slots i, where mod(i, 5) = 1, | | ForInterferenceMeas | | Not configured |
| pmi-FormatIndicator Wideband Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report interval and offset slot Not configured Aperiodic Report Slot Offset 5 CSI request 1 in slots i, where mod(i, 5) = 1, | | | | |
| Sub-band Size CSI-ReportingBand CSI-Report interval and offset Aperiodic Report Slot Offset CSI-request RB 8 1111111 Not configured 5 1 in slots i, where mod(i, 5) = 1, | | | | |
| csi-ReportingBand CSI-Report interval and offset Aperiodic Report Slot Offset CSI request 111111 Not configured 5 1 in slots i, where mod(i, 5) = 1, | | | | |
| CSI-Report interval and offset slot Not configured Aperiodic Report Slot Offset 5 CSI request 1 in slots i, where mod(i, 5) = 1, | | | KR | |
| Aperiodic Report Slot Offset 5 CSI request 1 in slots i, where mod(i, 5) = 1, | | | 0104 | |
| CSI request 1 in slots i, where $mod(i, 5) = 1$, | | | SIOT | |
| | | | | _ |
| Otherwise it is equal to 0 | CSI request | | | |
| reportTriggerSize 1 | reportTriggerSiz | | | |

| CSI-AperiodicTriggerStateList | | | One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM |
|--|---|----|---|
| | Codebook Type | | typel-SinglePanel |
| | Codebook Mode | | 1 |
| Codebook configuration | (CodebookConfig- N1,CodebookConfig-N2) | | (4,1) |
| | (CodebookConfig- O1,CodebookCon fig-O2) | | (4,1) |
| | CodebookSubset Restriction | | 0x FFFF |
| | RI Restriction | | 0000010 |
| Physical channel for CSI report | | | PUSCH |
| CQI/RI/PMI delay | | ms | 8 |
| Maximum number of HARQ transmission | | | 4 |
| Measurement channel | | | R.PDSCH.1-6.2 |
| Note 1: When Throughput is measured using random precoder selection, the | | | |

Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable i₁, i₂ combination.

Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-4), this reported PMI cannot be applied at the gNB downlink before slot#(n+4).

Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.

Table 6.3.2.1.2-2: Minimum requirement

| Parameter | Test 1 |
|-----------|--------|
| γ | 1.5 |

6.3.2.2 TDD

6.3.2.2.1 Single PMI with 4TX TypeI-SinglePanel Codebook

For the parameters specified in Table 6.3.2.2.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.2.1-2.

Table 6.3.2.2.1-1: Test parameters (single layer)

| Pai | rameter | Unit | Test 1 |
|---|--|------|----------------------------------|
| Bandwidth | | MHz | 40 |
| Subcarrier spacing | | kHz | 30 |
| Duplex Mode | | | TDD |
| TDD DL-UL configuration | | | FR1.30-1 as specified in Annex A |
| Propaga | ation channel | | TDLA30-5 |
| Antenna | configuration | | High XP 4 x 2 (N1,N2) = (2,1) |
| Beamfo | rming Model | | As specified in Annex B.4.1 |
| | CSI-RS resource | | Periodic |
| | Type Number of CSI- | | |
| | RS ports (X) | | 4 |
| | CDM Type | | FD-CDM2 |
| | Density (ρ) | | 1 |
| ZP CSI-RS | First subcarrier | | |
| configuration | index in the PRB | | Row 5, (4,-) |
| Comigaration | used for CSI-RS | | 10W 5, (4,) |
| | (k_0, k_1) | | |
| | First OFDM | | |
| | symbol in the PRB | | (9,-) |
| | used for CSI-RS | | (0,) |
| | (l ₀ , l ₁) | | |
| | CSI-RS | slot | 10/1 |
| | interval and offset | | |
| | CSI-RS resource Type | | Aperiodic |
| | Number of CSI- | | 4 |
| | RS ports (X) | | • |
| | CDM Type | | FD-CDM2 |
| | Density (ρ) | | 1 |
| | First subcarrier | | |
| NZP CSI-RS | index in the PRB | | Row 4, (0,-) |
| for CSI | used for CSI-RS | | 1, (6,) |
| acquisition | (k ₀ , k ₁) | | |
| | First OFDM | | |
| | symbol in the PRB | | (13,-) |
| | used for CSI-RS | | |
| | (l ₀ , l ₁) CSI-RS | | |
| | interval and offset | slot | Not configured |
| | aperiodicTriggerin | | |
| | gOffset | | 0 |
| | CSI-IM resource | | A |
| | Type | | Aperiodic |
| | CSI-IM RE pattern | | Pattern 0 |
| CSI-IM | CSI-IM Resource | | |
| configuration | Mapping | | (4,9) |
| | (kcsi-im,lcsi-im) | | |
| | CSI-IM timeConfig | slot | Not configured |
| interval and offset | | | Aperiodic |
| ReportConfigType CQI-table | | | Table 1 |
| reportQuantity | | | cri-RI-PMI-CQI |
| timeRestrictionForChannelMeasure | | | |
| ments | | | Not configured |
| timeRestrictionForInterferenceMeas urements | | | Not configured |
| | cqi-FormatIndicator | | - |
| pmi-FormatIndicator | | | Wideband |
| Sub-band Size | | DD | Wideband |
| csi-ReportingBand | | RB | 16 1111111 |
| | | slot | Not configured |
| CSI-Report interval and offset Aperiodic Report Slot Offset | | SIUL | Not configured 8 |
| | it Giot Oliset | | 1 in slots i, where mod(i, 10) = |
| CSI request | | | 1, otherwise it is equal to 0 |

| reportTriggerSize | | | 1 |
|---|--|-----|---|
| CSI-AperiodicTriggerStateList | | | One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM |
| | Codebook Type | | typel-SinglePanel |
| | Codebook Mode | | 1 |
| Codobook | (CodebookConfig- N1,CodebookConfig-N2) | | (2,1) |
| Codebook configuration | (CodebookConfig- O1,CodebookCon fig-O2) | | (4,1) |
| | CodebookSubset Restriction | | 11111111 |
| | RI Restriction | | 0000001 |
| Physical channe | el for CSI report | | PUSCH |
| CQI/RI/PMI dela | ау | ms | 5.5 |
| Maximum number of HARQ | | | 4 |
| transmission | | | D DDCCIL C C 4 TDD |
| Measurement channel | | L., | R.PDSCH.2-8.1 TDD |
| Note 1: When Throughput is measured using random precoder selection, the | | | • |
| precoder shall be updated in each slot (0.5 ms granularity) with equa | | | |
| probability of each applicable i ₁ , i ₂ combination. | | | |
| | Note 2: If the UE reports in an available uplink reporting instance at slot #n | | |

Note 2: If the UE reports in an available uplink reporting instance at slot #n based on PMI estimation at a downlink slot not later than slot#(n-4), this reported PMI cannot be applied at the gNB downlink before slot#(n+4).

Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.

Table 6.3.2.2.1-2: Minimum requirement

| Parameter | Test 1 |
|-----------|--------|
| γ | 1.3 |

6.3.2.2.2 Single PMI with 8TX TypeI-SinglePanel Codebook

For the parameters specified in Table 6.3.2.2.2-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.2.2-2.

Table 6.3.2.2.2-1: Test parameters (dual-layer)

| Parameter | | Unit | Test 1 |
|---|---|------|--|
| Bandwidth | | MHz | 40 |
| Subcarrier spacing | | kHz | 30 |
| Duplex Mode | | | TDD |
| TDD DL-UL configurations | | | FR1.30-1 as specified in Annex A |
| Propaga | ation channel | | TDLA30-5 |
| Antenna | configuration | | High XP 8 x 2 |
| | | | (N1,N2) = (4,1) |
| Beamfo | rming Model CSI-RS resource | | As specified in Annex B.4.1 |
| | Type | | Periodic |
| | Number of CSI- | | , |
| | RS ports (X) | | 4 |
| | CDM Type | | FD-CDM2 |
| | Density (ρ) | | 1 |
| ZP CSI-RS | First subcarrier | | |
| configuration | index in the PRB used for CSI-RS | | Row 5, (4,-) |
| | (k ₀ , k ₁) | | |
| | First OFDM | | |
| | symbol in the PRB | | (0.) |
| | used for CSI-RS | | (9,-) |
| | (l ₀ , l ₁) | | |
| | CSI-RS | slot | 10/1 |
| | interval and offset | | 10,1 |
| | CSI-RS resource Type | | Aperiodic |
| | Number of CSI- | | |
| | RS ports (X) | | 8 |
| | CDM Type | | CDM4 (FD2, TD2) |
| | Density (ρ) | | 1 |
| NIZD OOL DO | First subcarrier | | |
| NZP CSI-RS for CSI | index in the PRB | | Row 8, (4,6) |
| acquisition | used for CSI-RS (k ₀ , k ₁) | | |
| acquisition | First OFDM | | |
| | symbol in the PRB | | (=) |
| | used for CSI-RS | | (5,-) |
| | (l ₀ , l ₁) | | |
| | CSI-RS | slot | Not configured |
| | interval and offset aperiodicTriggerin | | 3 |
| | gOffset | | 0 |
| | CSI-IM resource | | Apariadia |
| | Туре | | Aperiodic |
| | CSI-IM RE pattern | | Pattern 0 |
| CSI-IM | CSI-IM Resource | | (4.0) |
| configuration | Mapping | | (4,9) |
| | (kcsi-im,lcsi-im) CSI-IM timeConfig | | |
| | interval and offset | slot | Not configured |
| ReportConfigType | | | Aperiodic |
| CQI-table | | | Table 1 |
| reportQuantity | | | cri-RI-PMI-CQI |
| timeRestrictionForlChannelMeasur ements | | | Not configured |
| timeRestrictionForInterferenceMeas | | | - |
| urements | | | Not configured |
| cqi-FormatIndic | ator | | Wideband |
| pmi-FormatIndicator | | | Wideband |
| Sub-band Size | | RB | 16 |
| csi-ReportingBand | | | 1111111 |
| CSI-Report interval and offset | | slot | Not configured |
| Aperiodic Report Slot Offset | | | 8 |
| CSI request | | | 1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0 |

| reportTriggerSi | ze | | 1 |
|---|---|----|---|
| CSI-AperiodicTriggerStateList | | | One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM |
| | Codebook Type | | typel-SinglePanel |
| | Codebook Mode | | 1 |
| Cadabaak | (CodebookConfig- N1,CodebookConfig-N2) | | (4,1) |
| Codebook configuration | (CodebookConfig- O1,CodebookCon fig-O2) | | (4,1) |
| | CodebookSubset Restriction | | 0x FFFF |
| | RI Restriction | | 0000010 |
| Physical channel for CSI report | | | PUSCH |
| CQI/RI/PMI delay | | ms | 6.5 |
| Maximum number of HARQ transmission | | | 4 |
| Measurement channel | | | R.PDSCH.2-8.2 TDD |
| Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable i ₁ , i ₂ combination. | | | |
| Note 2: If the UE reports in an available uplink reporting instance at slot#n | | | |

Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-6), this reported PMI cannot be applied at the gNB downlink before slot#(n+6).

Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.

Table 6.3.2.2.2: Minimum requirement

| Parameter | Test 1 |
|-----------|--------|
| γ | 1.5 |

6.3.3 4RX requirements

6.3.3.1 FDD

6.3.3.1.1 Single PMI with 4TX TypeI-SinglePanel Codebook

For the parameters specified in Table 6.3.3.1.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.1.1-2.

Table 6.3.3.1.1-1: Test parameters (single layer)

| Parameter | | Unit | Test 1 |
|----------------------------------|--|------|--|
| Bandwidth | | MHz | 10 |
| Subcarrier space | ing | kHz | 15 |
| Duplex Mode | | | FDD |
| Propagation cha | annel | | TDLA30-5 |
| Antenna configu | ıration | | High XP 4 x 4 |
| | | | (N1,N2) = (2,1) |
| Beamforming M | | | As specified in Annex B.4.1 |
| | CSI-RS resource | | Periodic |
| | Type | | |
| | Number of CSI- | | 4 |
| | RS ports (X) | | FD-CDM2 |
| | CDM Type Density (ρ) | | FD-CDIVI2 |
| | First subcarrier | | ' |
| ZP CSI-RS | index in the PRB | | |
| configuration | used for CSI-RS | | Row 5, (4,-) |
| | (k ₀ , k ₁) | | |
| | First OFDM | | |
| | symbol in the PRB | | (0.) |
| | used for CSI-RS | | (9,-) |
| | (l ₀ , l ₁) | | |
| | CSI-RS | slot | 5/1 |
| | interval and offset | SIOL | 5/1 |
| | CSI-RS resource | | Aperiodic |
| | Туре | | Apendalo |
| | Number of CSI- | | 4 |
| | RS ports (X) | | - |
| | CDM Type | | FD-CDM2 |
| | Density (ρ) | | 1 |
| NZP CSI-RS | First subcarrier | | |
| for CSI | index in the PRB used for CSI-RS | | Row 4, (0,-) |
| acquisition | (k ₀ , k ₁) | | |
| acquisition | First OFDM | | |
| | symbol in the PRB | | 4.5 |
| | used for CSI-RS | | (13,-) |
| | (l ₀ , l ₁) | | |
| | CSI-RS | alat | Not configured |
| | interval and offset | slot | Not configured |
| | aperiodicTriggerin | | 0 |
| | gOffset | | Ů |
| | CSI-IM resource | | Aperiodic |
| | Туре | | |
| | CSI-IM RE pattern | | Pattern 0 |
| CSI-IM | CSI-IM Resource | | (4.5) |
| configuration | Mapping | | (4,9) |
| | (k _{CSI-IM} , l _{CSI-IM}) | | |
| | CSI-IM timeConfig | slot | Not configured |
| interval and offset | | | Aporiodic |
| ReportConfigType CQI-table | | - | Aperiodic Table 1 |
| reportQuantity | | | cri-RI-PMI-CQI |
| timeRestrictionForChannelMeasure | | | |
| ments | | | Not configured |
| | orInterferenceMeas | | Net C |
| urements | | | Not configured |
| cqi-FormatIndicator | | | Wideband |
| pmi-FormatIndicator | | | Wideband |
| Sub-band Size | | RB | 8 |
| csi-ReportingBand | | | 1111111 |
| CSI-Report interval and offset | | slot | Not configured |
| Aperiodic Repo | Aperiodic Report Slot Offset | | 4 |
| CSI request | | | 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0 |
| reportTriggerSiz | ze | | 1 |
| | | | |

| CSI-AperiodicTriggerStateList | | | One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM |
|--|---|----|---|
| | Codebook Type | | typeI-SinglePanel |
| | Codebook Mode | | 1 |
| Codebook | (CodebookConfig- N1,CodebookConfig-N2) | | (2,1) |
| configuration | (CodebookConfig- O1,CodebookCon fig-O2) | | (4,1) |
| | CodebookSubset Restriction | | 11111111 |
| | RI Restriction | | 0000001 |
| Physical channel for CSI report | | | PUSCH |
| CQI/RI/PMI delay | | ms | 6 |
| Maximum number of HARQ transmission | | | 4 |
| Measurement channel | | | R.PDSCH.1-6.1 FDD |
| Note 1: When Throughput is measured using random precoder selection, the | | | |

- Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable i₁, i₂ combination.
- Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-3), this reported PMI cannot be applied at the gNB downlink before slot#(n+3).
- Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.

Table 6.3.3.1.1-2: Minimum requirement

| Parameter | Test 1 |
|-----------|--------|
| γ | 1.3 |

6.3.3.1.2 Single PMI with 8TX TypeI-SinglePanel Codebook

For the parameters specified in Table 6.3.3.1.2-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.1.2-2.

Table 6.3.3.1.2-1: Test parameters (dual-layer)

| Bandwidth | Parameter | | Unit | Test 1 |
|--|------------------------------|-------------------|------|-----------------------------|
| Duplex Mode | Bandwidth | | | 10 |
| Propagation channel | | | kHz | 15 |
| Antenna configuration | Duplex Mode | | | |
| Reamforming Model | Propagation cha | annel | | • |
| CSI-RS resource Type | Antenna configu | ıration | | |
| CSI-RS resource | | | | (N1,N2) = (4,1) |
| Type | Beamforming M | | | As specified in Annex B.4.1 |
| Number of CSI-R R ports (X) CDM Type FD-CDM2 | | | | Periodic |
| RS ports (X) | | | | |
| CDM Type | | | | 4 |
| Density (p) | | | | ED-CDM2 |
| First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | | | |
| Index in the PRB Index in the Index in the Index in the Index in t | | 2 31 / | | ' |
| Used for CSI-RS | | | | |
| First OFDM symbol in the PRB used for CSI-RS (lo, l1) CSI-RS (lo, l2) CSI-RS (lo, l3) CSI-RS (lo, l4) CSI-RS (la, l4) CSI-RS (l4, l4) CSI-RS (| configuration | | | Row 5, (4,-) |
| Symbol in the PRB used for CSI-RS ([0, 1)) | | (k_0, k_1) | | |
| Used for CSI-RS (I0, In) | | First OFDM | | |
| CSI-RS slot | | | | (0 -) |
| CSI-RS slot slot slot S/1 | | | | (9,-) |
| Interval and offset CSI-RS resource Type Aperiodic Type CDM Type CDM4 (FD2, TD2) Density (p) 1 First subcarrier index in the PRB used for CSI-RS (lo, l1) CSI-RS interval and offset aperiodic Tiggerin gOffset CSI-IM Resource Type Aperiodic CSI-IM Resource Mapping (KcsI-IM-ILSI-IM) CSI-IM CSI-IM TimeConfig interval and offset ments timeRestrictionForChannelMeasure ments used for CSI-RS (lo, l1) ReportConfigured ReportC | | | | |
| CSI-RS resource Type | | | slot | 5/1 |
| Type | | | | |
| Number of CSI-RS ports (X) CDM Type Density (p) First subcarrier index in the PRB used for CSI-RS (ko, kt.) First OFDM symbol in the PRB used for CSI-RS (lo, lt) CSI-RS interval and offset aperiodicTriggerin gOffset CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (kcsI-IM.IcsI-IM) CSI-IM timeConfig interval and offset Slot Not configured Aperiodic CSI-IM resource Type CSI-IM Resource Mapping (kcsI-IM.IcsI-IM) CSI-IM timeConfig interval and offset Table 1 reportQuantity TimeRestrictionForChannelMeasure ments timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband Sub-band Size RB RB Row 8, (4,6) 1 Total (5,-) Not configured Not configured Not configured Not configured Table 1 CSI-RIPMI-CQI Wideband Wideband Sub-band Size RB RB RB RB RB RCSI-request 1 in slots i, where mod(i, 5) = 1, | | | | Aperiodic |
| RS ports (X) | | Number of CSI | | · |
| CDM Type | | | | 8 |
| Density (p) | | | | CDM4 (FD2 TD2) |
| First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | | | 1 |
| NZP CSI-RS for CSI acquisition Index in the PRB used for CSI-RS (ko, k1) | | | | ' |
| Second content of the content of t | NZP CSI-RS | | | |
| acquisition Rirst OFDM Symbol in the PRB Used for CSI-RS (Io, It) | | | | Row 8, (4,6) |
| First OFDM symbol in the PRB used for CSI-RS (lo, l₁) CSI-RS interval and offset aperiodicTriggerin gOffset CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (kcsi-im.lcsi-im) CSI-IM timeConfig interval and offset ReportConfigType CQI-table ReportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator pmi-FormatIndicator SI report Si of Not configured Table 1 Table 1 Table 1 Tori-RI-PMI-CQI TimeRestrictionForChannelMeasure Mot configured Not configured Not configured Not configured Table 1 Ta | | | | |
| used for CSI-RS (lo, l1) CSI-RS interval and offset aperiodicTriggerin gOffset CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (kcsI-IM, lcsI-IM) CSI-IM timeConfig interval and offset ReportConfigType Aperiodic ReportQuantity Table 1 reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Sub-band Size RB RCSI-Report interval and offset Slot Not configured Aperiodic CI-table Table 1 Table 1 Table 1 Table 1 Trin-RI-PMI-CQI Wideband Wideband Not configured Tourier RB | | | | |
| CSI-RS (lo, It) CSI-RS interval and offset aperiodicTriggerin gOffset CSI-IM resource Type Aperiodic | | symbol in the PRB | | (5.) |
| CSI-RS interval and offset aperiodicTriggerin gOffset CSI-IM resource Type CSI-IM RE pattern Pattern 0 CSI-IM Resource Mapping (KcSI-IM, IcSI-IM) CSI-IM timeConfig interval and offset SIot Not configured ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband Sub-band Size RB 8 csi-Report interval and offset slot Not configured Aperiodic RB 8 CSI-request Slot Offset 5 1 in slots i, where mod(i, 5) = 1, | | used for CSI-RS | | (5,-) |
| interval and offset aperiodic Triggerin gOffset CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (kcsi-im,lcsi-im) CSI-IM timeConfig interval and offset ReportConfigType CQI-table reportQuantity timeRestrictionForChannelMeasure ments urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size ReportConfiggand interval and offset Slot Not configured Interval and offset Not configured Not configured Not configured Not configured Interval and offset Not configured | | | | |
| CSI-IM resource Aperiodic | | | slot | Not configured |
| GSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (kcsi-im, lcsi-im) CSI-IM timeConfig interval and offset Table 1 reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-Report Slot Offset ReportConfigured Aperiodic Not configured | | | | |
| CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (kcsi-im, lcsi-im) CSI-IM timeConfig interval and offset ReportConfigType CQI-table reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator sub-band Size csi-Report Slot Offset CSI-IM Resource Mapping (kcsi-im, lcsi-im) CSI-IM timeConfig interval and offset slot Not configured Not configured Not configured Wideband Wideband Sub-band Size csi-ReportingBand CSI-Report interval and offset Aperiodic Report Slot Offset CSI request Aperiodic Aperi | | | | 0 |
| Type CSI-IM RE pattern CSI-IM Resource Mapping (k _{CSI-IM} ,l _{CSI-IM}) CSI-IM timeConfig interval and offset ReportConfigType CQI-table reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-Report interval and offset Type CSI-IM RE pattern Pattern 0 (4,9) (4,9) Not configured Not configured Not configured Not configured Wideband Wideband Sub-band Size RB 8 csi-ReportingBand CSI-Report interval and offset Aperiodic SI request Table 1 Not configured Not configured Not configured Wideband Sub-band Size Size Size Size Size Size Size Size | | | | |
| CSI-IM RE pattern CSI-IM Resource Mapping (kcsi-IM, lcsi-IM) CSI-IM timeConfig interval and offset ReportConfigType CQI-table reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Sub-band Size CSI-IM RE pattern Pattern 0 (4,9) (4,9) Not configured Not configured Not configured Not configured Wideband Wideband Sub-band Size RB 8 csi-ReportingBand CSI-Report interval and offset Aperiodic Report Slot Offset SIot Not configured 1 in slots i, where mod(i, 5) = 1, | | | | Aperiodic |
| CSI-IM Resource Mapping (kcsi-im,lcsi-im) CSI-IM timeConfig interval and offset ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 8 csi-Report interval and offset Slot Not configured Aperiodic Report Slot Offset 5 CSI request 1 in slots i, where mod(i, 5) = 1, | | | | Pattern 0 |
| configuration Mapping (kcsi-im,lcsi-im) CSI-IM timeConfig interval and offset ReportConfigType CQI-table reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-Report interval and offset Aperiodic SIot Not configured Not configured Wideband Wideband Sub-band Size RB 8 csi-ReportingBand CSI-Report interval and offset Aperiodic Report Slot Offset 5 1 in slots i, where mod(i, 5) = 1, | CSI-IM | | | 1 attern 0 |
| CSI-IM, IcSI-IM) CSI-IM timeConfig interval and offset slot Not configured | | | | (4.9) |
| CSI-IM timeConfig interval and offset Not configured ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments Not configured timeRestrictionForInterferenceMeas urements Not configured cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report interval and offset slot Not configured Aperiodic Report Slot Offset 5 CSI request 1 in slots i, where mod(i, 5) = 1, | garanon | | | (1,0) |
| Interval and offset Siot Not configured | | | | |
| ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report interval and offset Aperiodic Report Slot Offset 5 CSI request 1 in slots i, where mod(i, 5) = 1, | | | slot | Not configured |
| reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report interval and offset slot Not configured Aperiodic Report Slot Offset 5 CSI request 1 in slots i, where mod(i, 5) = 1, | | | | Aperiodic |
| timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-Report interval and offset Aperiodic Report Slot Offset Not configured Wideband Wideband 1111111 CSI-Report interval and offset Aperiodic Report Slot Offset 1 in slots i, where mod(i, 5) = 1, | | | | Table 1 |
| ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-Report interval and offset Aperiodic Report Slot Offset Not configured Wideband Wideband Sub-band Size RB RB RB S Csi-ReportingBand T1111111 CSI-Report interval and offset Aperiodic Report Slot Offset 1 in slots i, where mod(i, 5) = 1, | reportQuantity | | | cri-RI-PMI-CQI |
| timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-Report interval and offset Aperiodic Report Slot Offset CSI request Not configured Not configured Not configured Not configured 1 in slots i, where mod(i, 5) = 1, | | | | Not configured |
| urements Not configured cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB csi-ReportingBand 1111111 CSI-Report interval and offset slot Not configured Aperiodic Report Slot Offset 5 CSI request 1 in slots i, where mod(i, 5) = 1, | | | | 140t configured |
| cqi-FormatIndicator pmi-FormatIndicator Sub-band Size RB CSi-Report interval and offset Aperiodic Report Slot Offset CSI request CSI request Wideband Wideband Not configured Not configured 1 in slots i, where mod(i, 5) = 1, | | | | Not configured |
| pmi-FormatIndicator Wideband Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report interval and offset slot Not configured Aperiodic Report Slot Offset 5 CSI request 1 in slots i, where mod(i, 5) = 1, | | | | |
| Sub-band Size CSI-ReportingBand CSI-Report interval and offset Aperiodic Report Slot Offset CSI-request T in slots i, where mod(i, 5) = 1, | | | | |
| csi-ReportingBand CSI-Report interval and offset Aperiodic Report Slot Offset CSI request 1111111 Not configured 5 1 in slots i, where mod(i, 5) = 1, | | | | |
| CSI-Report interval and offset slot Not configured Aperiodic Report Slot Offset 5 CSI request 1 in slots i, where mod(i, 5) = 1, | | | KR | |
| Aperiodic Report Slot Offset 5 CSI request 1 in slots i, where mod(i, 5) = 1, | | | 0104 | |
| CSI request 1 in slots i, where $mod(i, 5) = 1$, | | | SIOT | |
| | Aperiodic Report Slot Offset | | | _ |
| otherwise it is equal to 0 | - | | | otherwise it is equal to 0 |
| reportTriggerSize 1 | reportTriggerSiz | ze | | 1 |

| CSI-AperiodicTriggerStateList | | | One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM |
|---|---|----|---|
| | Codebook Type | | typel-SinglePanel |
| | Codebook Mode | | 1 |
| Codebook configuration | (CodebookConfig- N1,CodebookConfig-N2) | | (4,1) |
| | (CodebookConfig- O1,CodebookCon fig-O2) | | (4,1) |
| | CodebookSubset Restriction | | 0x FFFF |
| | RI Restriction | | 0000010 |
| Physical chann | el for CSI report | | PUSCH |
| CQI/RI/PMI delay | | ms | 8 |
| Maximum number of HARQ transmission | | | 4 |
| Measurement channel | | | R.PDSCH.1-6.2 FDD |
| Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (1 ms granularity) with equal | | | |

probability of each applicable i₁, i₂ combination.

Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-4), this reported PMI cannot be applied at the gNB downlink before slot#(n+4).

Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.

Table 6.3.3.1.2-2: Minimum requirement

| Parameter | Test 1 |
|-----------|--------|
| γ | 1.5 |

6.3.3.2 **TDD**

6.3.3.2.1 Single PMI with 4TX TypeI-SinglePanel Codebook

For the parameters specified in Table 6.3.3.2.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.2.1-2.

Table 6.3.3.2.1-1: Test parameters (single layer)

| Parameter | | Unit | Test 1 |
|--|--|------|----------------------------------|
| Bandwidth | | MHz | 40 |
| Subcarrier space | ing | kHz | 30 |
| Duplex Mode | | | TDD |
| TDD DL-UL cor | figuration | | FR1.30-1 as specified in Annex A |
| Propagation cha | annel | | TDLA30-5 |
| Antenna configu | ıration | | High XP 4 x 4 |
| • | | | (N1,N2) = (2,1) |
| Beamforming M | CSI-RS resource | | As specified in Annex B.4.1 |
| | Type | | Periodic |
| | Number of CSI- | | 4 |
| | RS ports (X) | | - |
| | CDM Type | | FD-CDM2 |
| | Density (ρ) First subcarrier | | I |
| ZP CSI-RS | index in the PRB | | |
| configuration | used for CSI-RS | | Row 5, (4,-) |
| | (k_0, k_1) | | |
| | First OFDM | | |
| | symbol in the PRB | | (9,-) |
| | used for CSI-RS | | , , , |
| | CSI-RS | | |
| | interval and offset | slot | 10/1 |
| | CSI-RS resource | | Aperiodic |
| | Type | | Aperiodic |
| | Number of CSI- | | 4 |
| | RS ports (X) CDM Type | | FD-CDM2 |
| | Density (ρ) | | 1 D-0DIW2 |
| | First subcarrier | | |
| NZP CSI-RS | index in the PRB | | Row 4, (0,-) |
| for CSI | used for CSI-RS | | 10W 4, (0,-) |
| acquisition | (k ₀ , k ₁) First OFDM | | |
| | symbol in the PRB | | |
| | used for CSI-RS | | (13,-) |
| | (I_0, I_1) | | |
| | CSI-RS | | Not configured |
| | interval and offset | | . tot co.m.ga. ca |
| | aperiodicTriggerin gOffset | | 0 |
| | CSI-IM resource | | A |
| | Туре | | Aperiodic |
| | CSI-IM RE pattern | | Pattern 0 |
| CSI-IM configuration | CSI-IM Resource | | (4.0) |
| Configuration | Mapping (kcsі-ім,lcsі-ім) | | (4,9) |
| | CSI-IM timeConfig | -1-4 | Not confirmed |
| interval and offset | | slot | Not configured |
| ReportConfigType | | | Aperiodic |
| CQI-table | | | Table 1 |
| reportQuantity timeRestrictionForChannelMeasure | | | cri-RI-PMI-CQI |
| ments | | | Not configured |
| timeRestrictionForInterferenceMeas | | | Not configured |
| urements | | | Not configured |
| cqi-FormatIndicator | | | Wideband |
| pmi-FormatIndicator | | | Wideband |
| Sub-band Size | | RB | 16 1111111 |
| csi-ReportingBand CSI-Report interval and offset | | slot | Not configured |
| Aperiodic Report Slot Offset | | 3101 | 8 |
| CSI request | | | 1 in slots i, where mod(i, 10) = |
| | | | 1, otherwise it is equal to 0 |

| reportTriggerSize | | | 1 |
|---------------------------------|---|-------------|---|
| CSI-AperiodicTriggerStateList | | | One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM |
| | Codebook Type | | typel-SinglePanel |
| | Codebook Mode | | 1 |
| Codebook | (CodebookConfig- N1,CodebookConfig-N2) | | (2,1) |
| configuration | (CodebookConfig- O1,CodebookCon fig-O2) | | (4,1) |
| | CodebookSubset Restriction | | 11111111 |
| | RI Restriction | | 0000001 |
| Physical channel for CSI report | | | PUSCH |
| CQI/RI/PMI | delay | ms | 5.5 |
| | ımber of HARQ | | 4 |
| transmission | | | · |
| Measurement channel | | | R.PDSCH.2-8.1 TDD |
| | | in each slo | random precoder selection, the ot (0.5 ms granularity) with equal mbination. |
| Note 2: If | Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-4), | | |

- this reported PMI cannot be applied at the gNB downlink before slot#(n+4).
- Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.

Table 6.3.3.2.1-2: Minimum requirement

| Parameter | Test 1 |
|-----------|--------|
| γ | 1.3 |

Single PMI with 8TX TypeI-SinglePanel Codebook 6.3.3.2.2

For the parameters specified in Table 6.3.3.2.2-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.2.2-2.

Table 6.3.3.2.2-1: Test parameters (dual-layer)

| Parameter | | Unit | Test 1 |
|--|--|------|--|
| Bandwidth | | MHz | 40 |
| Subcarrier space | ing | kHz | 30 |
| Duplex Mode | | | TDD |
| TDD DL-UL cor | figurations | | FR1.30-1 as specified in Annex A |
| Propagation cha | annel | | TDLA30-5 |
| Antenna configu | ıration | | High XP 8 x 4 |
| • | | | (N1,N2) = (4,1) |
| Beamforming M | CSI-RS resource | | As specified in Annex B.4.1 |
| | Type | | Periodic |
| | Number of CSI- | | 4 |
| | RS ports (X) | | |
| | CDM Type Density (ρ) | | FD-CDM2 |
| | First subcarrier | | ' |
| ZP CSI-RS | index in the PRB | | 5 5 (1) |
| configuration | used for CSI-RS | | Row 5, (4,-) |
| | (k_0, k_1) | | |
| | First OFDM | | |
| | symbol in the PRB used for CSI-RS | | (9,-) |
| | (l ₀ , l ₁) | | |
| | CSI-RS | | 10/1 |
| | interval and offset | slot | 10/1 |
| | CSI-RS resource | | Aperiodic |
| | Type | | 7 (201100110 |
| | Number of CSI- RS ports (X) | | 8 |
| | CDM Type | | CDM4 (FD2, TD2) |
| | Density (ρ) | | 1 |
| | First subcarrier | | |
| NZP CSI-RS | index in the PRB | | Row 8, (4,6) |
| for CSI | used for CSI-RS | | 1.0.0 0, (1,0) |
| acquisition | (k ₀ , k ₁) First OFDM | | |
| | symbol in the PRB | | /- \ |
| | used for CSI-RS | | (5,-) |
| | (l ₀ , l ₁) | | |
| | CSI-RS | slot | Not configured |
| | interval and offset aperiodicTriggerin | | |
| | gOffset | | 0 |
| | CSI-IM resource | | Aperiodic |
| | Туре | | · |
| CCLIM | CSI-IM RE pattern | | Pattern 0 |
| CSI-IM configuration | CSI-IM Resource Mapping | | (4,9) |
| Comiguration | (kcsi-im,lcsi-im) | | (4,9) |
| | CSI-IM timeConfig | slot | Not configured |
| interval and offset | | SIOL | Not configured |
| ReportConfigType | | | Aperiodic |
| CQI-table reportQuantity | | | Table 1 cri-RI-PMI-CQI |
| timeRestrictionForChannnelMeasur | | | |
| ements | | | Not configured |
| timeRestrictionForInterferenceMeas | | | Not configured |
| urements | | | |
| cqi-FormatIndicator | | | Wideband |
| pmi-FormatIndicator | | DD | Wideband |
| Sub-band Size | | RB | 16 1111111 |
| csi-ReportingBand CSI-Report interval and offset | | slot | Not configured |
| Aperiodic Report Slot Offset | | 0.00 | 8 |
| CSI request | | | 1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0 |

| reportTrigge | erSize | | 1 |
|---------------------------------|---|--|---|
| CSI-AperiodicTriggerStateList | | | One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM |
| | Codebook Type | | typel-SinglePanel |
| | Codebook Mode | | 1 |
| Codebook | (CodebookConfig- N1,CodebookConfig-N2) | | (4,1) |
| configuration | n (CodebookConfig- O1,CodebookCon fig-O2) | | (4,1) |
| | CodebookSubset Restriction | | 0x FFFF |
| | RI Restriction | | 0000010 |
| Physical channel for CSI report | | | PUSCH |
| CQI/RI/PMI | CQI/RI/PMI delay | | 6.5 |
| | umber of HARQ | | 4 |
| transmission | | | · |
| | Measurement channel | | R.PDSCH.2-8.2 TDD |
| p p | When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable i_1 , i_2 combination. | | ot (0.5 ms granularity) with equal mbination. |
| b | ote 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-6), this reported PMI cannot be applied at the gNB downlink before | | |

Table 6.3.3.2.2-2: Minimum requirement

Randomization of the principle beam direction shall be used as

| Parameter | Test 1 |
|-----------|--------|
| γ | 1.5 |

6.4 Reporting of Rank Indicator (RI)

specified in Annex B.2.3.2.3.

The purpose of this test is to verify that the reported rank indicator accurately represents the channel rank. The accuracy of RI reporting is determined by the relative increase of the throughput obtained when transmitting based on the reported rank compared to the case for which a fixed rank is used for transmission.

6.4.1 1RX requirements

Note 3:

(Void)

6.4.2 2RX requirements

6.4.2.1 FDD

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

- a) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be $\geq \gamma_1$;
- b) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 2 shall be $\geq \gamma_2$;

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

Table 6.4.2.1-1: RI Test (FDD)

| | Parameter | Unit | Test 1 | Test 2 | Test 3 |
|---|--|------|------------------------------|------------------------------|------------------------------|
| Bandwidth | | MHz | 10 | 10 | 10 |
| Subcarrier spa | <u>_</u> | kHz | 15 | 15 | 15 |
| Duplex Mode | | | FDD | FDD | FDD |
| SNR | | dB | 0 | 20 | 20 |
| Propagation of | | | TDLA30-5 | TDLA30-5 | TDLA30-5 |
| Antenna confi | iguration | | ULA Low 2x2 | ULA Low 2x2 | ULA High 2x2 |
| Beamforming | Model | | As defined in Annex B.4.1 | As defined in Annex B.4.1 | As defined in Annex B.4.1 |
| | CSI-RS resource Type | | Periodic | Periodic | Periodic |
| | Number of CSI-RS ports (X) | | 4 | 4 | 4 |
| | CDM Type | | FD-CDM2 | FD-CDM2 | FD-CDM2 |
| ZP CSI-RS | Density (ρ) | | 1 | 1 | 1 |
| configuratio n | First subcarrier index in the PRB used for CSI-RS (k_0 , k_1) | | Row 5, (4,-) | Row 5, (4,-) | Row 5, (4,-) |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁) | | (9,-) | (9,-) | (9,-) |
| | CSI-RS periodicity and offset | slot | 5/1 | 5/1 | 5/1 |
| | CSI-RS resource Type | | Periodic | Periodic | Periodic |
| | Number of CSI-RS ports (X) | | 2 | 2 | 2 |
| NZP CSI- | CDM Type | | FD-CDM2 | FD-CDM2 | FD-CDM2 |
| RS for CSI | Density (ρ) | | 1 | 1 | 1 |
| acquisition | First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | Row 3 (6,-) | Row 3 (6,-) | Row 3 (6,-) |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁) | | (13,-) | (13,-) | (13,-) |
| | NZP CSI-RS-timeConfig periodicity and offset | slot | 5/1 | 5/1 | 5/1 |
| | CSI-IM resource Type | | Periodic | Periodic | Periodic |
| CSI-IM | CSI-IM RE pattern | | Pattern 0 | Pattern 0 | Pattern 0 |
| configuratio | CSI-IM Resource Mapping (kcsi-im,lcsi-im) | | (4,9) | (4,9) | (4,9) |
| | CSI-IM timeConfig periodicity and offset | slot | 5/1 | 5/1 | 5/1 |
| ReportConfig | Туре | | Periodic | Periodic | Periodic |
| CQI-table | | | Table 2 | Table 2 | Table 2 |
| reportQuantity | y | | cri-RI-PMI-CQI | cri-RI-PMI- CQI | cri-RI-PMI- CQI |
| timeRestrictio | nForChannelMeasurements | | not configured | not configured | not configured |
| | nForInterferenceMeasurements | | not configured | not configured | not configured |
| cqi-FormatInd | | | Wideband | Wideband | Wideband |
| pmi-FormatIn | | D.D. | Wideband | Wideband | Wideband |
| Sub-band Siz | | RB | 8 | 8 | 8 |
| csi-Reporting | | cl-+ | 1111111 | 1111111 | 1111111 |
| CSI-Report pe | eriodicity and offset | slot | 5/0 | 5/0 | 5/0 |
| | Codebook Type | | typel- SinglePanel | typel- SinglePanel | typel- SinglePanel |
| | Codebook Mode | | 1 | 1 | 1 |
| Codebook | (CodebookConfig- N1,CodebookConfig-N2) | | N/A | N/A | N/A |
| configuration | CodebookSubsetRestriction | | 010000 for | 000011 for | 000011 for |
| | | | fixed rank 2, | fixed rank 1, | fixed rank 1, |
| | | | 010011 for | 010011 for | 010011 for |
| | DI Postriation | | following rank | following rank | following rank |
| Dhysical shar | RI Restriction nel for CSI report | | N/A PUCCH | N/A PUCCH | N/A PUCCH |
| | | me | | | |
| CQI/RI/PMI de | elay mber of HARQ transmission | ms | 8 1 | 8 1 | 8 |
| iviaxiiiiuiii iiur | IIDEL OLDANG HAUSHIISSION | | Fixed RI = 2 | Fixed RI = 1 | Fixed RI = 1 |
| RI Configurati | ion | | and follow RI | and follow RI | and follow RI |
| NOTE 1: Measurements channels are specified in Table A.4-2. TBS.2-1 is used for Rank 1 ca | | | | | |

NOTE 1: Measurements channels are specified in Table A.4-2. TBS.2-1 is used for Rank 1 case. TBS.2-2 is used for Rank 2 case.

Table 6.4.2.1-2: Minimum requirement (FDD)

| | Test 1 | Test 2 | Test 3 |
|----|--------|--------|--------|
| 71 | N/A | 1.05 | 0.9 |
| 72 | 1.0 | N/A | N/A |

6.4.2.2 TDD

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

- a) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be $\geq \gamma_1$;
- b) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 2 shall be $\geq \gamma_2$;

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

Table 6.4.2.2-1: RI Test (TDD)

| | Parameter | Unit | Test 1 | Test 2 | Test 3 |
|----------------|--|------------|------------------|-----------------|----------------|
| Bandwidth | | MHz | 40 | 40 | 40 |
| Subcarrier sp | Subcarrier spacing | | 30 | 30 | 30 |
| Duplex Mode | | | TDD | TDD | TDD |
| TDD Slot Cor | figuration | | FR1.30-1 | FR1.30-1 | FR1.30-1 |
| SNR | | dB | 0 | 20 | 20 |
| Propagation of | channel | | TDLA30-5 | TDLA30-5 | TDLA30-5 |
| Antenna conf | | | ULA Low 2x2 | ULA Low 2x2 | ULA High 2x2 |
| | | | As defined in | As defined in | As defined in |
| Beamforming | Model | | Annex B.4.1 | Annex B.4.1 | Annex B.4.1 |
| | CSI-RS resource Type | | Periodic | Periodic | Periodic |
| | Number of CSI-RS ports (X) | | 4 | 4 | 4 |
| | CDM Type | | FD-CDM2 | FD-CDM2 | FD-CDM2 |
| ZP CSI-RS | Density (p) | | 1 | 1 | 1 |
| configuratio | First subcarrier index in the | | //) | //) | //) |
| n | PRB used for CSI-RS (k ₀ , k ₁) | | Row 5, (4,-) | Row 5, (4,-) | Row 5, (4,-) |
| | First OFDM symbol in the PRB | | 4- 1 | 4- > | 4-) |
| | used for CSI-RS (I ₀ , I ₁) | | (9,-) | (9,-) | (9,-) |
| | CSI-RS | _ | | | |
| | periodicity and offset | slot | 10/1 | 10/1 | 10/1 |
| | CSI-RS resource Type | | Periodic | Periodic | Periodic |
| | Number of CSI-RS ports (X) | | 2 | 2 | 2 |
| | CDM Type | | FD-CDM2 | FD-CDM2 | FD-CDM2 |
| NZP CSI- | Density (p) | | 1 | 1 | 1 |
| RS for CSI | First subcarrier index in the | | · | · | |
| acquisition | PRB used for CSI-RS (k ₀ , k ₁) | | Row 3 (6,-) | Row 3 (6,-) | Row 3 (6,-) |
| | First OFDM symbol in the PRB | | | | |
| | used for CSI-RS (I ₀ , I ₁) | | (13,-) | (13,-) | (13,-) |
| | NZP CSI-RS-timeConfig | _ | | | |
| | periodicity and offset | slot | 10/1 | 10/1 | 10/1 |
| | CSI-IM resource Type | | Periodic | Periodic | Periodic |
| | CSI-IM RE pattern | | Pattern 0 | Pattern 0 | Pattern 0 |
| CSI-IM | CSI-IM Resource Mapping | | | | |
| configuratio | (Kcsi-im, lcsi-im) | | (4,9) | (4,9) | (4,9) |
| n | CSI-IM timeConfig | | | | |
| | periodicity and offset | slot | 10/1 | 10/1 | 10/1 |
| ReportConfig | | | Periodic | Periodic | Periodic |
| CQI-table | -7F- | | Table 2 | Table 2 | Table 2 |
| | | | | cri-RI-PMI- | cri-RI-PMI- |
| reportQuantity | / | | cri-RI-PMI-CQI | CQI | CQI |
| 5 | 5 O. 114 | | | not | not |
| timeRestrictio | nForChannelMeasurements | | not configured | configured | configured |
| 5 | | | , , | not | not |
| timeRestrictio | nForInterferenceMeasurements | | not configured | configured | configured |
| cqi-FormatInc | licator | | Wideband | Wideband | Wideband |
| pmi-FormatIn | | | Wideband | Wideband | Wideband |
| Sub-band Siz | | RB | 16 | 16 | 16 |
| csi-Reporting | | İ | 1111111 | 1111111 | 1111111 |
| | eriodicity and offset | slot | 10/9 | 10/9 | 10/9 |
| 1 - 1 | Codebook Type | | typel- | typel- | typel- |
| | | | SinglePanel | SinglePanel | SinglePanel |
| | Codebook Mode | | 1 | 1 | 1 |
| | (CodebookConfig- | | N1/A | N1/A | NI/A |
| Codebook | N1,CodebookConfig-N2) | | N/A | N/A | N/A |
| configuration | CodebookSubsetRestriction | | 010000 for | 000011 for | 000011 for |
| 1 | | | fixed rank 2, | fixed rank 1, | fixed rank 1, |
| | | | 010011 for | 010011 for | 010011 for |
| | | | following rank | following rank | following rank |
| | RI Restriction | | N/Ä | N/A | N/A |
| Physical char | nel for CSI report | | PUCCH | PUCCH | PUCCH |
| CQI/RI/PMI d | | ms | 9.5 | 9.5 | 9.5 |
| | nber of HARQ transmission | İ | 1 | 1 | 1 |
| | | | Fixed RI = 2 | Fixed RI = 1 | Fixed RI = 1 |
| RI Configurati | OH | | and follow RI | and follow RI | and follow RI |
| NOTE 1: Ma | acuraments channels are enecified | d in Table | Λ Λ-2 TRS 2-3 ic | used for Pank 1 | |

NOTE 1: Measurements channels are specified in Table A.4-2. TBS.2-3 is used for Rank 1 case. TBS.2-4 is used for Rank 2 case.

Table 6.4.2.2-2: Minimum requirement (TDD)

| | Test 1 | Test 2 | Test 3 |
|----|--------|--------|--------|
| 71 | N/A | 1.05 | 0.9 |
| 72 | 1.0 | N/A | N/A |

6.4.3 4RX requirements

6.4.3.1 FDD

The minimum performance requirement in Table 6.4.3.1-2 is defined as

- a) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be $\geq \gamma_1$;
- b) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 2 shall be $\geq \gamma_2$;

For the parameters specified in Table 6.4.3.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.4.3.1-2.

Table 6.4.3.1-1: RI Test (FDD)

| | Parameter | Unit | Test 1 | Test 2 | Test 3 | Test 4 |
|-----------------|--|---------|----------------|------------------------|------------------------|---------------------------------------|
| Bandwidth | | MHz | 10 | 10 | 10 | 10 |
| Subcarrier spa | acing | kHz | 15 | 15 | 15 | 15 |
| Duplex Mode | | | FDD | FDD | FDD | FDD |
| SNR | | dB | -2 | 16 | 16 | 22 |
| Propagation c | | | TDLA30-5 | TDLA30-5 | TDLA30-5 | TDLA30-5 |
| Antenna confi | guration | | ULA Low 2x4 | ULA Low 2x4 | ULA High 2x4 | ULA Low 4x4 |
| Beamforming | Model | | As defined in | As defined in | As defined in | As defined in |
| Deamlonning | | | Annex B.4.1 | Annex B.4.1 | Annex B.4.1 | Annex B.4.1 |
| | CSI-RS resource Type | | Periodic | Periodic | Periodic | Periodic |
| | Number of CSI-RS ports (X) | | 4 | 4 | 4 | 4 |
| | CDM Type | | FD-CDM2 | FD-CDM2 | FD-CDM2 | FD-CDM2 |
| ZP CSI-RS | Density (ρ) | | 1 | 1 | 1 | 1 |
| configuratio | First subcarrier index in the | | Row 5, (4,-) | Row 5, (4,-) | Row 5, (4,-) | Row 5, (4,-) |
| n | PRB used for CSI-RS (k ₀ , k ₁) | | 10W 3, (+,-) | 110W 3, (+,-) | 110W 3, (+,-) | 110W 3, (+,-) |
| | First OFDM symbol in the PRB | | (9,-) | (9,-) | (9,-) | (9,-) |
| - | used for CSI-RS (I ₀ , I ₁) | | (0,) | (0,) | (0,) | (0,) |
| | CSI-RS | slot | 5/1 | 5/1 | 5/1 | 5/1 |
| | periodicity and offset | 0.01 | | | | - ' |
| - | CSI-RS resource Type | | Periodic | Periodic | Periodic | Periodic |
| | Number of CSI-RS ports (X) | | 2 | 2 | 2 | 4 |
| NZP CSI- | CDM Type | | FD-CDM2 | FD-CDM2 | FD-CDM2 | FD-CDM2 |
| RS for CSI | Density (ρ) | | 1 | 1 | 1 | 1 |
| acquisition | First subcarrier index in the | | Row 3 (6,-) | Row 3 (6,-) | Row 3 (6,-) | Row 4 (0,-) |
| aoquiomon | PRB used for CSI-RS (k ₀ , k ₁) | | 11011 0 (0,) | 11011 0 (0,) | 11011 0 (0,) | 11011 1 (0,) |
| | First OFDM symbol in the PRB | | (13,-) | (13,-) | (13,-) | (13,-) |
| - | used for CSI-RS (I ₀ , I ₁) | | (.0,) | (, / | (10,) | (10,) |
| | NZP CSI-RS-timeConfig | slot | 5/1 | 5/1 | 5/1 | 5/1 |
| | periodicity and offset | | | | | |
| | CSI-IM resource Type | | Periodic | Periodic | Periodic | Periodic |
| CSI-IM | CSI-IM RE pattern | | Pattern 0 | Pattern 0 | Pattern 0 | Pattern 0 |
| configuratio | CSI-IM Resource Mapping | | (4,9) | (4,9) | (4,9) | (4,9) |
| n Š | (KCSI-IM, ICSI-IM) | | (, , | (, , | (, , | . , , |
| | CSI-IM timeConfig | slot | 5/1 | 5/1 | 5/1 | 5/1 |
| DanartCartin | periodicity and offset | | Daviadia | Periodic | Daviadia | Daviadia |
| ReportConfig | туре | | Periodic | | Periodic | Periodic |
| CQI-table | | | Table 2 | Table 2 cri-RI-PMI- | Table 2 cri-RI-PMI- | Table 2 cri-RI-PMI- |
| reportQuantity | <i>'</i> | | cri-RI-PMI-CQI | CQI | CII-RI-PIVII- CQI | CII-RI-PIVII- CQI |
| | | | | not | not | not |
| timeRestriction | nForChannelMeasurements | | not configured | configured | configured | configured |
| | | | | not | not | not |
| timeRestriction | nForInterferenceMeasurements | | not configured | configured | configured | configured |
| cqi-FormatInd | icator | | Wideband | Wideband | Wideband | Wideband |
| pmi-FormatIng | | | Wideband | Wideband | Wideband | Wideband |
| Sub-band Size | | RB | 8 | 8 | 8 | 8 |
| csi-Reporting | | | 1111111 | 1111111 | 1111111 | 1111111 |
| | eriodicity and offset | slot | 5/0 | 5/0 | 5/0 | 5/0 |
| 23. Hoport pe | Codebook Type | 3.00 | typel- | typel- | typel- | typel- |
| | | | SinglePanel | SinglePanel | SinglePanel | SinglePanel |
| | Codebook Mode | | 1 | 1 | 1 | 1 |
| | (CodebookConfig- | | | | | · · · · · · · · · · · · · · · · · · · |
| | N1,CodebookConfig-N2) | | N/A | N/A | N/A | (2,1) |
| | CodebookSubsetRestriction | | 010000 for | 000011 for | 000011 for | |
| Codebook | | | fixed rank 2, | fixed rank 1, | fixed rank 1, | 1111111 |
| configuration | | | 010011 for | 010011 for | 010011 for | 11111111 |
| | | <u></u> | following rank | following rank | following rank | |
| | RI Restriction | | | | | 00000010 for |
| | | | | | | fixed Rank 2 |
| | | | N/A | N/A | N/A | and |
| | | | | | | 00001111 for |
| | | | | | _,, | follow RI |
| | nel for CSI report | | PUCCH | PUCCH | PUCCH | PUCCH |
| CQI/RI/PMI de | | ms | 8 | 8 | 8 | 8 |
| Maximum nun | nber of HARQ transmission | | 1 | 1 | 1 | 1 |

| RI Configuration | Fixed RI = 2 | Fixed RI = 1 | Fixed RI = 1 | Fixed RI = 2 | | |
|--|---------------|---------------|---------------|---------------|--|--|
| Ki Configuration | and follow RI | and follow RI | and follow RI | and follow RI | | |
| NOTE 1: Measurements channels are specified in Table A.4-2 and Table A.4-3. TBS.2-1 is used for Rank 1 case. TBS.2-2 | | | | | | |
| is used for Rank 2 case, TRS 3-1 is used for Rank 3 case, TRS 3-2 is used for Rank 4 case | | | | | | |

Table 6.4.3.1-2: Minimum requirement (FDD)

| | Test 1 | Test 2 | Test 3 | Test 4 |
|----|--------|--------|--------|--------|
| 21 | N/A | 1.05 | 0.9 | N/A |
| 72 | 0.9 | N/A | N/A | 0.9 |

6.4.3.2 TDD

The minimum performance requirement in Table 6.4.3.2-2 is defined as

- a) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be $\geq \gamma_1$;
- b) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 2 shall be $\geq \gamma_2$;

For the parameters specified in Table 6.4.3.2-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.4.3.2-2.

Table 6.4.3.2-1: RI Test (TDD)

| | Parameter | Unit | Test 1 | Test 2 | Test 3 | Test 4 |
|--------------------------------|--|----------|----------------|--------------------|--------------------|----------------------------------|
| Bandwidth | | MHz | 40 | 40 | 40 | 40 |
| Subcarrier sp | acing | kHz | 30 | 30 | 30 | 30 |
| Duplex Mode | | | TDD | TDD | TDD | TDD |
| TDD Slot Con | figuration | | FR1.30-1 | FR1.30-1 | FR1.30-1 | FR1.30-1 |
| SNR | | dB | -2 | 16 | 16 | 22 |
| Propagation of | | | TDLA30-5 | TDLA30-5 | TDLA30-5 | TDLA30-5 |
| Antenna confi | iguration | | ULA Low 2x4 | ULA Low 2x4 | ULA High 2x4 | ULA Low 4x4 |
| Beamforming | Model | | As defined in | As defined in | As defined in | As defined in |
| Doarmorning | | | Annex B.4.1 | Annex B.4.1 | Annex B.4.1 | Annex B.4.1 |
| - | CSI-RS resource Type | | Periodic | Periodic | Periodic | Periodic |
| - | Number of CSI-RS ports (X) | | 4 | 4 | 4 | 4 |
| 70.001.00 | CDM Type | | FD-CDM2 | FD-CDM2 | FD-CDM2 | FD-CDM2 |
| ZP CSI-RS | Density (p) | | 1 | 1 | 1 | 1 |
| configuratio | First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | Row 5, (4,-) | Row 5, (4,-) | Row 5, (4,-) | Row 5, (4,-) |
| n | First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁) | | (9,-) | (9,-) | (9,-) | (9,-) |
| | CSI-RS | slot | 10/1 | 10/1 | 10/1 | 10/1 |
| | periodicity and offset CSI-RS resource Type | | Periodic | Periodic | Periodic | Periodic |
| | Number of CSI-RS ports (X) | | 2 | 2 | 2 | 4 |
| | CDM Type | | FD-CDM2 | FD-CDM2 | FD-CDM2 | FD-CDM2 |
| NZP CSI- | Density (ρ) | | 1 | 1 | 1 | 1 |
| RS for CSI | First subcarrier index in the | | | | | |
| acquisition | PRB used for CSI-RS (k ₀ , k ₁) | | Row 3 (6,-) | Row 3 (6,-) | Row 3 (6,-) | Row 4 (0,-) |
| · | First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁) | | (13,-) | (13,-) | (13,-) | (13,-) |
| | NZP CSI-RS-timeConfig periodicity and offset | slot | 10/1 | 10/1 | 10/1 | 10/1 |
| | CSI-IM resource Type | | Periodic | Periodic | Periodic | Periodic |
| 001.1114 | CSI-IM RE pattern | | Pattern 0 | Pattern 0 | Pattern 0 | Pattern 0 |
| CSI-IM configuration | CSI-IM Resource Mapping (kcsi-im,lcsi-im) | | (4,9) | (4,9) | (4,9) | (4,9) |
| | CSI-IM timeConfig periodicity and offset | slot | 10/1 | 10/1 | 10/1 | 10/1 |
| ReportConfig | Туре | | Periodic | Periodic | Periodic | Periodic |
| CQI-table | | | Table 2 | Table 2 | Table 2 | Table 2 |
| reportQuantity | y | | cri-RI-PMI-CQI | cri-RI-PMI- CQI | cri-RI-PMI- CQI | cri-RI-PMI- CQI |
| timeRestrictio | nForChannelMeasurements | | not configured | not configured | not configured | not configured |
| timeRestrictio | nForInterferenceMeasurements | | not configured | not configured | not configured | not configured |
| cqi-FormatInd | | | Wideband | Wideband | Wideband | Wideband |
| pmi-FormatIn | | | Wideband | Wideband | Wideband | Wideband |
| Sub-band Siz | | RB | 16 | 16 | 16 | 16 |
| csi-Reporting | | | 1111111 | 1111111 | 1111111 | 1111111 |
| CSI-Report pe | eriodicity and offset | slot | 10/9 | 10/9 | 10/9 | 10/9 |
| | Codebook Type | | typel- | typel- | typel- | typel- |
| | Codebook Mode | | SinglePanel | SinglePanel | SinglePanel | SinglePanel |
| | (CodebookConfig- | | | 1 | l l | I |
| | N1,CodebookConfig-N2) | | N/A | N/A | N/A | (2,1) |
| | CodebookSubsetRestriction | | 010000 for | 000011 for | 000011 for | |
| Codebook | | | fixed rank 2, | fixed rank 1, | fixed rank 1, | 1111111 |
| configuration | | | 010011 for | 010011 for | 010011 for | 11111111 |
| - | | | following rank | following rank | following rank | |
| | RI Restriction | | | | | 00000010 for |
| | | | | | | fixed Rank 2 |
| | | | N/A | N/A | N/A | and 00001111 for follow RI |
| | 1 | | DUOQU | DUCCU | PUCCH | PUCCH |
| Physical char | nnel for CSI report | | PUCCH | PULLA | 1 100.00 | 700.00 |
| Physical char CQI/RI/PMI de | nnel for CSI report elav | ms | PUCCH 9.5 | PUCCH 9.5 | 9.5 | 9.5 |

| P.I. Configuration | | | Fixed RI = 2 | Fixed RI = 1 | Fixed RI = 1 | Fixed RI = 2 | |
|--------------------|--|--|---------------|---------------|---------------|---------------|--|
| | RI Configuration | | and follow RI | and follow RI | and follow RI | and follow RI | |
| | NOTE 1: Measurements channels are specified in Table A.4-2 and Table A.4-3. TBS.2-3 is used for Rank 1 case. TBS.2-4 | | | | | | |
| | is used for Rank 2 case, TRS 3-3 is used for Rank 3 case, TRS 3-4 is used for Rank 4 case | | | | | | |

Table 6.4.3.2-2: Minimum requirement (TDD)

| | Test 1 | Test 2 | Test 3 | Test 4 |
|----|--------|--------|--------|--------|
| 24 | N/A | 1.05 | 0.9 | N/A |
| 72 | 0.9 | N/A | N/A | 0.9 |

7 Demodulation performance requirements (Radiated requirements)

7.1 General

7.1.1 Applicability of requirements

7.1.1.1 General

The minimum performance requirements are applicable to the FR2 operating bands defined in TS 38.101-2 [7] with F_{DL_high} not exceeding 40000 MHz.

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

7.1.1.2 Applicability of requirements for different number of RX antenna ports

UE shall support 2 RX ports for different RF operating bands. The UE requirements applicability is defined in Table 7.1.1.2-1.

Table 7.1.1.2-1: Requirements applicability

| Supported RX antenna ports | Test type | Test list | | |
|----------------------------|-----------|---------------------------|--|--|
| UE supports 2RX | PDSCH | All tests in Clause 7.2.2 | | |
| antenna ports | PDCCH | All tests in Clause 7.3.2 | | |
| | PBCH | All tests in Clause 7.4.2 | | |

7.1.1.3 Applicability of requirements for optional UE features

The performance requirements in Table 7.1.1.3-1 shall apply for UEs which support optional UE features only..

Table 7.1.1.3-1: Requirements applicability for optional UE features

| UE feature/capability [14] | Test type | | Test list | Applicability notes |
|--|-----------|-------|---------------------------|--|
| SU-MIMO Interference Mitigation | FR2 | PDSCH | Clause 7.2.2.2.1 (Test 3- | |
| advanced receiver | TDD | | 1) | |
| Basic DL NR-NR CA operation (supportedBandCombinationList) | NR CA | SDR | Clause 7.5A.1 | Up to 16 DL carriers Same numerology across carrier for data/control channel at a given time |

7.1.1.4 Applicability of requirements for mandatory UE features with capability signalling

The performance requirements in Table 7.1.1.4-1 shall apply for UEs which support mandatory UE features with capability signalling only.

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Table 7.1.1.4-1: Requirements applicability for mandatory features with UE capability signalling

| UE feature/capability [14] | Test t | уре | Test list | Applicability notes |
|---|---------|-------|--|--|
| Supported maximum number of PDSCH MIMO layers (maxNumberMIMO-LayersPDSCH) | FR2 TDD | PDSCH | Clause 7.2.2.2.1 (Tests from 2-1 to 2-6) | The requirements apply only in case the PDSCH MIMO rank in the test case does not exceed UE PDSCH MIMO layers capability |
| Support of PT-RS with one antenna port for DL reception (onePortsPTRS) | FR2 TDD | PDSCH | Clause 7.5.1 Clause 7.5A.1 | |
| PCell operation on FR2 (<i>pCell-FR2</i>) | FR2 TDD | SDR | Clause 7.5A.1 | |
| | | | | |

7.2 PDSCH demodulation requirements

The parameters specified in Table 7.2-1 are valid for all PDSCH demodulation tests unless otherwise stated.

Table 7.2-1: Common Test Parameters

| | Parameter | Unit | Value |
|--------------------------------|--|-------------|---|
| PDSCH transmission | scheme | | Transmission scheme 1 |
| PTRS epre-Ratio | T | | 0 |
| Actual carrier configuration | Offset between Point A and the lowest usable subcarrier on this carrier (Note 2) | RBs | 0 |
| corniguration | Subcarrier spacing | kHz | 60 or 120 |
| | Cyclic prefix | 55 | Normal |
| DL BWP configuration #1 | RB offset Number of contiguous PRB | RBs PRBs | 0 Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-2 [7] for tested channel bandwidth and subcarrier spacing |
| Common conting | Physical Cell ID | | 0 |
| Common serving cell parameters | SSB position in burst | | 1 |
| cell parameters | SSB periodicity | ms | 20 |
| | Slots for PDCCH monitoring | | Each slot |
| | Symbols with PDCCH | | 0 |
| | Number of PRBs in CORESET | | Table 7.2-2 for tested channel bandwidth and subcarrier spacing |
| | Number of PDCCH candidates and aggregation levels | | 1/AL8 |
| DDCCL | CCE-to-REG mapping type | | Non-interleaved |
| PDCCH | DCI format | | 1_1 TOL 1 # #4 |
| configuration | TCI state | | TCI state #1 Single Panel Type I, |
| | PDCCH & PDCCH DMRS Precoding configuration | | Random per slot with equal probability of each applicable i ₁ , i ₂ combination, and with REG bundling granularity for number of Tx larger than 1 |
| Cross carrier schedul | | | Not configured |
| | First subcarrier index in the PRB used for CSI-RS (k_0) | | 0 for CSI-RS resource 1,2,3,4 |
| | First OFDM symbol in the PRB used for CSI-RS (<i>lo</i>) | | 6 for CSI-RS resource 1 and 3 10 for CSI-RS resource 2 and 4 |
| | Number of CSI-RS ports (X) | | 1 for CSI-RS resource 1,2,3,4 |
| | СDМ Туре | | 'No CDM' for CSI-RS resource 1,2,3,4 |
| | Density (ρ) | | 3 for CSI-RS resource 1,2,3,4 |
| CSI-RS for tracking | CSI-RS periodicity | Slots | 60 kHz SCS: 80 for CSI-RS resource 1,2,3,4 120 kHz SCS: 160 for CSI-RS resource 1,2,3,4 |
| | CSI-RS offset | Slots | 60 kHz SCS: 40 for CSI-RS resource 1 and 2 41 for CSI-RS resource 3 and 4 120 kHz SCS: 80 for CSI-RS resource 1 and 2 81 for CSI-RS resource 3 and 4 |

| | T | | | |
|--------------------------|-------------------------------|---------------------------------|-------|--|
| | Frequency Occ | upation | | Start PRB 0 Number of PRB = BWP size |
| | QCL info | | | TCI state #0 |
| | First subcarrier RS (k_0) | index in the PRB used for CSI- | | 0 |
| | First OFDM syr | mbol in the PRB used for CSI-RS | | 12 |
| | Number of CSI- | -RS ports (X) | | 2 |
| | CDM Type | | | FD-CDM2 |
| NZP CSI-RS for | Density (ρ) | | | 1 |
| CSI acquisition | CSI-RS periodi | city | Slots | 60 kHz SCS: 80 120 kHz SCS: 160 |
| | CSI-RS offset | | | 0 |
| | Frequency Occ | upation | | Start PRB 0 Number of PRB = BWP size |
| | QCL info | | | TCI state #1 |
| | First subcarrier | index in the PRB used for CSI- | | 4 |
| | RS (k ₀) | | | 4 |
| | (I_0) | nbol in the PRB used for CSI-RS | | 12 |
| | Number of CSI- | -RS ports (X) | | 4 |
| ZP CSI-RS for CSI | CDM Type | | | FD-CDM2 |
| acquisition | Density (ρ) | | | 1 60 kHz SCS: 80 |
| | CSI-RS periodi | city | Slots | 120 kHz SCS: 160 |
| | CSI-RS offset | | | 0 |
| | Frequency Occ | upation | | Start PRB 0 Number of PRB = BWP size |
| | First subcarrier RS | index in the PRB used for CSI- | | k ₀ =0 for CSI-RS resource 1,2 |
| | First OFDM syr | nbol in the PRB used for CSI-RS | | I ₀ = 8 for CSI-RS resource 1 I ₀ = 9 for CSI-RS resource 2 |
| | Number of CSI- | -RS ports (X) | | 1 for CSI-RS resource 1,2 |
| CSI-RS for beam | CDM Type | | | 'No CDM' for CSI-RS resource 1,2 |
| refinement | Density (ρ) | | | 3 for CSI-RS resource |
| | CSI-RS periodi | city | Slots | 60 kHz SCS: 80 for CSI- RS resource 1,2 120 kHz SCS: 160 for CSI-RS resource 1,2 |
| | CSI-RS offset | | Slots | 0 for CSI-RS resource 1,2 |
| | Repetition | | | ON |
| | QCL info | | | TCI state #1 |
| | Antenna ports i | ndexes | | {1000} for Rank 1 tests {1000, 1001} for Rank 2 tests |
| PDSCH DMRS configuration | Position of the t | first DMRS for PDSCH mapping | | 2 |
| | Number of PDS | SCH DMRS CDM group(s) without | | 1 |
| | Type 1 QCL | SSB index | | SSB #0 |
| TCI state #0 | information | QCL Type | | Type C |
| I OI SIAIE #U | | | | |
| | L | SSB index | | SSB #0 |

| | Type 2 QCL information | QCL Type | Type D |
|---|------------------------|--|---|
| | Type 1 QCL information | CSI-RS resource | CSI-RS resource 1 from 'CSI-RS for tracking' configuration |
| TOL state #4 | | QCL Type | Type A |
| TCI state #1 | Type 2 QCL information | CSI-RS resource | CSI-RS resource 1 from 'CSI-RS for tracking' configuration |
| | | QCL Type | Type D |
| | Frequency den | sity (K _{PT-RS}) | 2 |
| PTRS configuration | Time density (I | LPT-RS) | 1 |
| | Resource Elem | | 2 |
| | | os for ACK/NACK feedback | 1 |
| Maximum number of | | ion | 4 |
| HARQ ACK/NACK bu | ındling | | Multiplexed |
| Redundancy version | coding sequence |) | {0,2,3,1} |
| PDSCH & PDSCH DMRS Precoding configuration | | | Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i ₁ , i ₂ combination, andwith Wideband granularity |
| 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 B.4.1 | | | |
| Note 1: UE assum | es that the TCI st | tate for the PDSCH is identical to the | TCI state applied for the PDCCH |

Table 7.2-2: Number of PRBs in CORESET

Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-2 [7] for

| SCS (kHz) | 50 MHz | 100 MHz | 200 MHz | 400 MHz |
|-----------|--------|---------|---------|---------|
| 60 | 66 | 132 | 264 | N.A |
| 120 | 30 | 66 | 132 | 264 |

7.2.1 1RX requirements

transmission.

(Void)

Note 2:

7.2.2 2RX requirements

7.2.2.1 FDD

(Void)

7.2.2.2 TDD

7.2.2.2.1 Minimum requirements for PDSCH Mapping Type-A

tested channel bandwidth and subcarrier spacing.

For PDSCH Type-A scheduling, the requirements are specified in Table 7.2.2.2.1-3, 7.2.2.2.1-4 and 7.2.2.2.1-5, with the addition of the parameters in Table 7.2.2.2.1-2 and the downlink physical channel setup according to Annex C.5.1. The purpose is to verify the performance of PDSCH Type-A scheduling.

The test purposes are specified in Table 7.2.2.1.1-1.

Table 7.2.2.1.1-1: Tests purpose

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

Table 7.2.2.2.1-2: Test Parameters

| | Parameter | Unit | Value |
|---|---|-------|---|
| Duplex mode | | | TDD |
| Active DL BWP index | | | 1 |
| CSI-RS for tracking | First OFDM symbol in the PRB used for CSI-RS (I_0) | | For Test 1-1 and 1-2: 3 for CSI-RS resource 1 and 3 7 for CSI-RS resource 2 and 4 |
| | CSI-RS offset | Slots | For Test 1-2: 82 for CSI-RS resource 1 and 2 83 for CSI-RS resource 3 and 4 |
| PDCCH configuration | Number of PDCCH candidates and aggregation levels | | 1/AL4 for Test 2-3 1/AL8 for other tests |
| | Mapping type k0 Starting symbol (S) Length (L) PDSCH aggregation factor PRB bundling type | | Type A 0 1 Specific to each Reference channel as defined in A.3.2.2 1 Static WB for Test 1-1, |
| PDSCH configuration | PRB bundling size Resource allocation type RBG size | | 2 for other tests Test 2-1: Type 1 with start RB = 30, L _{RBs} = 6 Other tests: Type 0 Test 2-1: N/A |
| | VRB-to-PRB mapping type VRB-to-PRB mapping interleaver bundle size | | Other tests: Config2 Non-interleaved N/A |
| PDSCH DMRS configuration | DMRS Type Number of additional DMRS Maximum number of OFDM symbols for DL front loaded DMRS | | Type 1 1 1 |
| Number of HARQ Process | ses | | 8 for Test 1-1, 1-3, 2-2, 2-4 10 for Test 2-1, 2-3, 2-5, 2-6, 3-1 16 for Test 1-2 |
| The number of slots between information | een PDSCH and corresponding HARQ-ACK | | As defined in Annex A.1.3 |

Table 7.2.2.2.1-3: Minimum performance for Rank 1 (FRC)

| | | | | | Correlation | Reference value | | |
|-------------|--------------------------|---|---------------------------------|--------------------------|---------------------------|--|---|------------------------------------|
| Test num | Referenc e channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulatio n and code rate | TDD UL- DL pattern | Propagatio n condition | matrix and antenna configuratio n | Fraction of maximum throughpu t (%) | SNR _B _B (dB) |
| 1-1 | R.PDSCH .5-1.1 TDD | 100 / 120 | QPSK, 0.30 | FR2.120- 1A | TDLC60- 300 | 2x2 ULA Low | 70 | -0.4 |
| 1-2 | R.PDSCH .5-2.1 TDD | 100 / 120 | 16QAM, 0.48 | FR2.120- 1 | TDLA30- 300 | 2x2 ULA Low | 30 | 1.7 |
| 1-3 | R.PDSCH .5-3.1 TDD | 100 / 120 | 64QAM, 0.46 | FR2.120- 1 | TDLA30- 300 | 2x2 XPL Medium | 70 | 12.4 |

Table 7.2.2.2.1-4: Minimum performance for Rank 2 (FRC)

| | | Bandwidth | | | | Correlation | | e value |
|-------------|-----------------------|---|---------------------------------|-------------------------|------------------------------|--|---|---------------------------|
| Test num | Reference channel | (MHz) / Subcarrier spacing (kHz) | Modulatio n and code rate | TDD UL-DL pattern | Propagatio n condition | matrix and antenna configuratio n | Fraction of maximum throughp ut (%) | SNR _{BB} (dB) |
| 2-1 | R.PDSCH. 5-4.1 TDD | 100 / 120 | QPSK, 0.30 | FR2.12 0-2 | TDLA30-75 | 2x2 ULA Low | 70 | 4.1 |
| 2-2 | R.PDSCH. 5-2.2 TDD | 100 / 120 | 16QAM, 0.48 | FR2.12 0-1 | TDLA30- 300 | 2x2 ULA Low | 70 | 14.4 |
| 2-3 | R.PDSCH. 5-5.2 TDD | 50 / 120 | 16QAM,0.4 8 | FR2.12 0-2 | TDLA30-75 | 2x2 ULA Low | 70 | 14.0 |
| 2-4 | R.PDSCH. 5-2.3 TDD | 200 / 120 | 16QAM, 0.48 | FR2.12 0-1 | TDLA30- 300 | 2x2 ULA Low | 70 | 14.2 |
| 2-5 | R.PDSCH. 4-1.1 TDD | 50 / 60 | 16QAM, 0.48 | FR2.60- 1 | TDLA30-75 | 2x2 ULA Low | 70 | 14.3 |
| 2-6 | R.PDSCH. 5-6.1 TDD | 100 / 120 | 64QAM, 0.43 | FR2.12 0-2 | TDLA30-75 | 2x2 ULA Low | 70 | 18.6 |

Table 7.2.2.2.1-5: Minimum performance for Rank 2 (FRC) for Enhanced Receiver Type 1

| | | Bandwidt | | | Bandwidt | | | | | | Reference | value |
|-------------|-----------------------|---|---------------------------------|--------------------------|---------------------------|--|-------------------------------------|------------------------------------|--|--|-----------|-------|
| Test num | Reference channel | h (MHz) / Subcarrier spacing (kHz) | Modulatio n and code rate | TDD UL- DL pattern | Propagatio n condition | matrix and antenna configuratio n | Fraction of maximum throughpu t (%) | SNR _B _B (dB) | | | | |
| 3-1 | R.PDSCH.5 -5.1 TDD | 100 / 120 | 16QAM, 0.48 | FR2.120 -2 | TDLA30-75 | 2x2 ULA Medium | 70 | 19.0 | | | | |

7.3 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 7.3-1 are valid for all PDCCH tests unless otherwise stated.

Table 7.3-1: Common test Parameters

| | Parameter | | Unit | Value |
|-------------------------|-------------------------------|---------------------|-------|---|
| Carrier | | en Point A and the | | 0 |
| configuration | lowest usable carrier (Note | subcarrier on this | | |
| DL BWP | , | 1) | | Name |
| configuration #1 | Cyclic prefix | | | Normal |
| Common | Physical Cell | | | 0 |
| serving cell parameters | SSB position SSB periodici | | ms | 20 |
| parameters | | CH monitoring | 1113 | Each slot |
| | | OCCH candidates | | 1 |
| PDCCH | Frequency do | main resource | | Start from RB = 0 |
| configuration | allocation for | | | with contiguous RB allocation |
| | TCI state | | | TCI state #1 |
| | | er index in the PRB | | 0 |
| | used for CSI- | RS (k0) | | |
| | | | | CSI-RS resource 1: |
| | | | | CSI-RS resource 2: |
| | | ymbol in the PRB | | 8 |
| | used for CSI- | RS (10) | | CSI-RS resource 3: |
| | | | | CSI-RS resource 4: |
| | | | | 8 |
| CSI-RS for | | SI-RS ports (X) | | 1 |
| tracking | CDM Type Density (ρ) | | | No CDM 3 |
| | CSI-RS perio | dicity | Slots | 160 |
| | COLITIC POLICE | aronty | 0.0.0 | 80 for CSI-RS |
| | CSI-RS offset | ! | Slots | resource 1 and 2 |
| | OCI ITO CIIDO | • | 0.010 | 81 for CSI-RS |
| | | | | resource 3 and 4 Start PRB 0 |
| | Frequency Od | ccupation | | Number of PRB = |
| | - | · | | BWP size |
| | QCL info | er index in the PRB | | TCI state #0 |
| | used for CSI- | | | 0 |
| | 4334.3.33 | | | CSI-RS resource 1: |
| | | ymbol in the PRB | | 8 |
| | used for CSI- | RS (10) | | CSI-RS resource 2: |
| | Number of CS | SI-RS ports (X) | | 1 |
| NZP CSI-RS for | CDM Type | - 1 () | | No CDM |
| beam management | Density (ρ) | | | 3 |
| la.iagee.ii | CSI-RS perio | dicity | Slots | 120 kHz SCS: 160 for CSI-RS resource |
| | CSI-RS perior | uicity | 31018 | 1,2 |
| | CSI-RS offset | | Slots | 0 for CSI-RS |
| | | | 31018 | resource 1,2 |
| | Repetition QCL info | | - | ON TCI state #1 |
| | QCL INIO | | | Single Panel Type I, |
| | | | | Random per slot |
| | | | | with equal |
| | | | | probability of each |
| PDCCH & PDCCH | H DMRS Preco | ding configuration | | applicable i ₁ , i ₂ combination, and |
| | | | | with REG bundling |
| | | | | granularity for |
| | | | | number of Tx larger |
| | Type 1 QCL | SSB index | 1 | than 1 SSB #0 |
| TOL -1-1 "0 | information | QCL Type | | Type C |
| TCI state #0 | Type 2 QCL | SSB index | | SSB #0 |
| | information | QCL Type | | Type D |

| | Type 1 QCL information | CSI-RS resource | | CSI-RS resource 1 from 'CSI-RS for tracking' configuration |
|---|------------------------|------------------|--|---|
| TCI atata #1 | | QCL Type | | Type A |
| TCI state #1 | Type 2 QCL information | CSI-RS resource | | CSI-RS resource 1 from 'CSI-RS for tracking' configuration |
| | | QCL Type | | Type D |
| Physical signals, | channels mappi | ng 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 |
| 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. | | | | |

7.3.1 1RX requirements

(Void)

7.3.2 2RX requirements

7.3.2.1 FDD

(Void)

7.3.2.2 TDD

The parameters specified in Table 7.3.2.2-1 are valid for all TDD tests unless otherwise stated.

Table 7.3.2.2-1: Test Parameters

| Parameter | Unit | 1 Tx Antenna | 2 Tx Antenna | |
|-------------------------|------|----------------|--------------|--|
| TDD UL-DL pattern | | FR2.120-1 | | |
| CCE to REG mapping type | | Interleaved | | |
| REG bundle size | | 2 for test 1-1 | 2 | |
| REG buridle size | | 6 for test 1-2 | 2 | |
| Interlegyer size | | 3 for test 1-1 | 2 | |
| Interleaver size | | 2 for test 1-2 | 3 | |
| Shift index | 0 | | | |

7.3.2.2.1 1 Tx Antenna performances

For the parameters specified in Table 7.3.2.2-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 7.3.2.2.1-1. The downlink physical setup is in accordance with Annex C.5.1.

Table 7.3.2.2.1-1: Minimum performance requirements with 120 kHz SCS

| Test | Bandwidth | CORES | CORESET | Aggragation | Reference | Propagation | Antenna configuration | Reference value | |
|------------|-----------|-------|----------|-------------------|-----------------------|--------------------------|------------------------------|-------------------|------------------------|
| num ber | (MHz) | ET RB | duration | Aggregation level | Channel | Propagation Condition | and correlation Matrix | Pm- dsg (%) | SNR _{BB} (dB) |
| 1-1 | 100 | 60 | 1 | 2 | R.PDCCH. 5-1.1 TDD | TDLA30-75 | 1x2 Low | 1 | 6.4 |
| 1-2 | 100 | 60 | 1 | 4 | R.PDCCH. 5-1.2 TDD | TDLA30-300 | 1x2 Low | 1 | 3.0 |

7.3.2.2.2 2 Tx Antenna performances

For the parameters specified in Table 7.3.2.2-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 7.3.2.2.2-1. The downlink physical setup is in accordance with Annex C.5.1.

Table 7.3.2.2.2-1: Minimum performance requirements with 120 kHz SCS

| Test | Bandwidth (MHz) | CORESE T RB | CORESET duration | Aggregation level | Reference Channel | Propagation Condition | Antenna configuration and correlation Matrix | Reference value | |
|------------|--------------------|----------------|------------------|-------------------|-----------------------|--------------------------|--|-------------------|------------------------|
| num ber | | | | | | | | Pm- dsg (%) | SNR _{BB} (dB) |
| 2-1 | 100 | 60 | 1 | 8 | R.PDCCH. 5-1.3 TDD | TDLA30-75 | 2x2 Low | 1 | 0.1 |
| 2-2 | 100 | 60 | 2 | 16 | R.PDCCH. 5-2.1 TDD | TDLA30-75 | 2x2 Low | 1 | -3.0 |

7.4 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

$$Pm - bch = 1 - \frac{A}{B}$$

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).

7.4.1 1RX requirements

(Void)

7.4.2 2RX requirements

7.4.2.1 FDD

(Void)

7.4.2.2 TDD

Table 7.4.2.2-1: Test parameters for PBCH

| 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 |
| TDD UL-DL pattern | | FR2.120-1 |
| Note 1: as specified in clause 4.1 of TS 38.213 [11] | | |
| Note 2: as specified in clause 11.1 of TS 38.213 [11] | | |

For the parameters specified in Table 7.4.2.2-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified values in Table 7.4.2.2-2 in case SS/PBCH block index is not known and below the specified values in Table.7.4.2.2-3 in case SS/PBCH block index is known. The downlink physical setup is in accordance with Annex C.5.1.

Table 7.4.2.2-2: Minimum performance PBCH in case SS/PBCH block index is not known

| Test | Bandwidth (MHz) / | Reference | Propagation | Antenna configuration | Referer | nce value |
|--------|--------------------|-----------|-------------|------------------------|---------|-------------------|
| number | Subcarrier spacing | channel | condition | and correlation matrix | Pm- | SNR _{BB} |
| | (kHz) | | | | bch | (dB) |
| | | | | | (%) | |
| 1 | 100 / 120 | R.PBCH.5 | TDLA30-300 | 1 x 2 Low | 1 | -6.3 |
| 2 | 100 / 240 | R.PBCH.6 | TDLA30-75 | 1 x 2 Low | 1 | -6.1 |

Table 7.4.2.2-3 Minimum performance PBCH in case SS/PBCH block index is known

| Test | Bandwidth (MHz) / | Reference | Propagation | Antenna configuration | Refere | nce value |
|--------|--------------------|-----------|-------------|------------------------|--------|-----------|
| number | Subcarrier spacing | channel | condition | and correlation matrix | Pm- | PBCH |
| | (kHz) | | | | bch | SNR |
| | | | | | (%) | (dB) |
| 1 | 100 / 120 | R.PBCH.5 | TDLA30-300 | 1 x 2 Low | 1 | -7.9 |
| 2 | 100 / 240 | R.PBCH.6 | TDLA30-75 | 1 x 2 Low | 1 | -7.6 |

7.5 Sustained downlink data rate provided by lower layers

7.5.1 FR2 single carrier requirements

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

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

7.5A Sustained downlink data rate provided by lower layers

7.5A.1 FR2 CA requirements

The Sustained Data Rate (SDR) requirements in this clause are applicable to the FR2 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:

- Step 1: Calculate the date rate for all supported CA configurations and set of per component carrier (CC) UE capabilities among all supported UE capabilities:
 - Use Table 7.5A.1-3 to determine the MCS (=MCS1) achieving the largest data rate [clause 4.1.2 of TS 38.306 [14]] based on UE capabilities.
 - Use Table 7.5A.1-4 to determine the largest MCS (=MCS2) requiring SNR below test equipment maximum achievable SNR for that CA configuration.
 - Compute the data rate for CA configuration using the MCS = min(MCS1,MCS2) and the following equation for each CC in CA bandwidth combination.

$$DataRate = 10^{-3} \sum_{i=1}^{J} TBS_i 2^{\mu_j}$$

where

J is the number of aggregated component carriers in CA bandwidth combination

TBS_j is the total number of DL-SCH transport block bits calculated based on methodology in Clause 5.1.3.2 of TS 38.214 [12] and using parameters from Table 7.5A.1-1

μ_i is provided in Clause 4.2 of TS 38.211 for different subcarrier spacing values

- Step 2: Choose the CA bandwidth combination among all supported CA configurations that achieves maximum data rate in step 1 among all UE capabilities.
 - 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 data rate, select one among sets with the smallest aggregated channel bandwidth.
- Step 3: For each CC in chosen CA bandwidth combination, use determined MCS for each CC in step 1 for that CA configuration 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 test parameters are specified in Table 7.5A.1-1.

Unless otherwise stated, no user data is scheduled on slot #0, 40 and 41 within 20 ms for SCS 60 kHz.

Unless otherwise stated, no user data is scheduled on slot #0, 80 and 81 within 20 ms for SCS 120 kHz.

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

| | Parameter | Unit | Value | |
|---|--|------|---|--|
| PDSCH transmission | | | Transmission scheme 1 | |
| PTRS epre-Ratio | | | 0 | |
| Channel bandwidth | | MHz | Channel bandwidth from selected CA bandwidth combination | |
| | Physical Cell ID | | 0 | |
| Common serving | SSB position in burst | | First SSB in Slot #0 | |
| cell parameters | SSB periodicity First DMRS position for Type A PDSCH | ms | 20 | |
| | mapping | | 2 | |
| Cross carrier schedu | | | Not configured | |
| Active DL BWP inde | | | 1 | |
| Actual carrier configuration | Offset between Point A and the lowest usable subcarrier on this carrier (Note 3) | RBs | 0 | |
| comiguration | Subcarrier spacing | kHz | 60 or 120 | |
| | RB Offset | | 0 | |
| DL BWP configuration #1 | Number of contiguous PRB | | Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-2 [7] for tested channel bandwidth and subcarrier spacing | |
| | Subcarrier spacing | kHz | 60 or 120 | |
| | Cyclic prefix | | Normal | |
| | Slots for PDCCH monitoring | | Each slot | |
| | Symbols with PDCCH Number of PRBs in CORESET | | Symbols #0 Table 7.5A.1-2 | |
| | Number of PRBs in CORESET Number of PDCCH candidates and | | | |
| | aggregation levels | | 1/8 | |
| PDCCH | CCE-to-REG mapping type | | Non-interleaved | |
| configuration | DCI format | | 1-1 | |
| Comiguration | TCI State | | TCI state #1 | |
| | PDCCH &PDCCH DMRS Precoding configuration | | Single Panel Type I, Random per slot with equal probability of precoder index 0 and 2, and with REG bundling granularity for number of Tx larger than 1 | |
| | Mapping type | | Type A | |
| | k0 | | 0 | |
| | PDSCH aggregation factor | | 1 | |
| | PRB bundling type | | Static | |
| PDSCH | PRB bundling size Resource allocation type | | WB Type 0 | |
| configuration | RBG size | | Config2 | |
| 2093144011 | VRB-to-PRB mapping type | | Non-interleaved | |
| | VRB-to-PRB mapping interleaver bundle size | | N/A | |
| | Starting symbol (S) | | 1 | |
| | Length (L) | | 13 | |
| | DMRS Type | | Type 1 | |
| | Number of additional DMRS | | 1 | |
| PDSCH DMRS | Length | | 1 (4000) for 4 l 00- | |
| configuration | Antenna ports indexes | | {1000} for 1 Layer CCs {1000, 1001} for 2 Layers CCs | |
| | Number of PDSCH DMRS CDM group(s) without data | | 1 | |
| PTRS configuration | Frequency density (<i>K</i> _{PT-RS}) Time density (<i>L</i> _{PT-RS}) | | 2 | |
| - Comgaration | Subcarrier indexes in the PRB used for | | $k_0 = 3$ for CSI-RS resource 1,2,3,4 | |
| | CSI-RS OFDM symbols in the PRB used for CSI- | | l ₀ = 6 for CSI-RS resource 1 and 3 | |
| CSI-RS for tracking | RS | | l ₀ = 10 for CSI-RS resource 2 and 4 | |
| | Number of CSI-RS ports (X) | | 1 for CSI-RS resource 1,2,3,4 'No CDM' for CSI-RS resource | |
| | CDM Type Density (ρ) | | 1,2,3,4 3 for CSI-RS resource 1,2,3,4 | |
| Density (P) 3 for Col-No fesource 1,2,3,4 | | | | |

| CSI-RS periodicity | | | | | 60 kHz SCS: 80 for CSI-RS resource |
|--|-------------------|---------------------------------------|-----------------------|--------------|------------------------------------|
| CSI-RS pirituitity Silots 120 kHz SCS: 160 for CSI-RS resource 1.2.3.4 60 kHz SCS: 160 for CSI-RS resource 1.2.3.4 60 kHz SCS: 160 for CSI-RS resource 3 and 4 10 for CSI-RS for for CSI-R | | | | 01.1 | |
| CSI-RS offset | | CSI-RS periodicity | | Slots | |
| CSI-RS offset | | | | | resource 1,2,3,4 |
| CSI-RS offset | | | | | 60 kHz SCS: |
| CSI-RS offset | | | | | |
| 120 kHz SCS: 80 for CSI-RS resource 1 and 2 8t for CSI-RS re | | | | | 41 for CSI-RS resource 3 and 4 |
| Requency Occupation | | CSI-RS offset | | Slots | |
| Requency Occupation | | | | | |
| Frequency Occupation | | | | | |
| Frequency Occupation | | | | | |
| QCL info | | Frequency Occupa | tion | | |
| Subcarrier indexes in the PRB used for CSI-RS Superior CSI-RS Superior CSI-RS for CSI acquisition | | QCL info | | | |
| CSH-RS for CSI acquisition CSI-RS periodicity Slots Frequency Occupation CSI-RS periodicity Slots TCI state #1 | | | in the PRB used for | | |
| NZP CSI-RS for CSI acquisition | | | | | $K_0 = 4$ |
| Number of CSI-RS ports (X) Same as number of transmit antenna | | | the PRB used for CSI- | | lo = 13 |
| NZP CSI-RS for CSI acquisition CSI-RS periodicity Slots 120 kHz SCS: 80 1 | | | norto (V) | | |
| Density (p) | | | ports (A) | | |
| CSI-RS periodicity | | | | | |
| CSI-RS offset | CSI acquisition | 3 111 | | | • |
| Frequency Occupation | | CSI-RS periodicity | | Slots | |
| Frequency Occupation | | CSI-RS offset | | | I - |
| QCL info | | Frequency Occupa | tion | | |
| Subcarrier indexes in the PRB used for CSI-RS | | | | | |
| CSI-RS CSI-RS CSI-RS RS Number of CSI-RS ports (X) A A CDM Type FD-CDM2' | | | in the DDR used for | | TCI state #1 |
| OFDM symbols in the PRB used for CSI-RS | | | III tile FND useu ioi | | $k_0 = 0$ |
| Number of CSI-RS ports (X) | | OFDM symbols in the PRB used for CSI- | | | lo = 12 |
| ZP CSI-RS for CSI acquisition | | | | | 4 |
| Density (p) | 7D CSI DS for CSI | | | | • |
| CSI-RS periodicity | | | | | 1 1 |
| CSI-RS periodicity Siots 120 kHz SCS: 160 | acquicition | , , , , , , , , , , , , , , , , , , , | | 01.1 | 60 kHz SCS: 80 |
| Frequency Occupation | | | | Siots | |
| Frequency Occupation | | CSI-RS offset | | | <u> </u> |
| First subcarrier index in the PRB used for CSI-RS First OFDM symbol in the PRB used for CSI-RS First OFDM symbol in the PRB used for CSI-RS resource 1,2 10 = 8 for CSI-RS resource 1 10 = 9 for CSI-RS resource 2 | | Frequency Occupa | tion | | |
| CSI-RS | | | | | |
| CSI-RS Number of CSI-RS ports (X) 1 for CSI-RS resource 2 | | CSI-RS | | | |
| Number of CSI-RS ports (X) | | | I in the PRB used for | | |
| CSI-RS for beam refinement CSI-RS for beam refinement Density (p) 3 for CSI-RS resource 1,2 3 for CSI-RS resource 1,2 60 kHz SCS: 80 for CSI-RS resource 1,2 1,2 120 kHz SCS: 160 for CSI-RS resource 1,2 1,2 120 kHz SCS: 160 for CSI-RS resource 1,2 120 kHz SCS: 1 | | | | | |
| Density (ρ) 3 for CSI-RS resource 1,2 60 kHz SCS: 80 for CSI-RS resource 1,2 1,2 1,20 kHz SCS: 160 for CSI-RS resource 1,2 1,20 kHz SCS: 160 for CSI-RS for cSI-RS for cSI-RS for cSI-RS | | | ports (X) | | |
| CSI-RS periodicity | CSI DS for boom | | | | |
| CSI-RS periodicity | | Density (p) | | | |
| CSI-RS periodicity Slots 120 kHz SCS: 160 for CSI-RS resource 1,2 | | 001.00 | | O 1 4 | |
| CSI-RS offset | | CSI-RS periodicity | | Slots | |
| Repetition | | | | | |
| TCI state #1 Tyoe 1 QCL SSB index SSB #0 | | | | Slots | |
| Tyoe 1 QCL SSB index SSB #0 | | | | | |
| TCI state #0 Information QCL Type Type C | | | CCD in day | | |
| Tyoe 2 QCL information QCL Type Type D Tyoe 1 QCL information QCL Type CSI-RS resource 1 from 'CSI-RS for tracking' configuration Type A Tyoe 2 QCL information QCL Type CSI-RS resource 1 from 'CSI-RS for tracking' configuration Type A Tyoe 2 QCL information QCL Type CSI-RS resource 1 from 'CSI-RS for tracking' configuration Type A CSI-RS resource 1 from 'CSI-RS for tracking' configuration Type D Maximum number of code block groups for ACK/NACK 1 Mumber of HARQ Processes 10 for FR2.60-1 and 8 for FR2.120-1 | | | | | |
| TCI state #1 Tyoe 1 QCL information Tyoe 2 QCL information Acknowledge | TCI state #0 | | | | |
| TCI state #1 Tyoe 1 QCL information CSI-RS resource CSI-RS resource 1 from 'CSI-RS for tracking' configuration Type A CSI-RS resource 1 from 'CSI-RS for tracking' configuration Type A CSI-RS resource 1 from 'CSI-RS for tracking' configuration Type A CSI-RS resource 1 from 'CSI-RS for tracking' configuration Type D Maximum number of code block groups for ACK/NACK 1 feedback Number of HARQ Processes 10 for FR2.60-1 and 8 for FR2.120-1 | | | | | |
| TCI state #1 Type 1 QCL Type Type A Type 2 QCL information CSI-RS resource Type A CSI-RS resource 1 from 'CSI-RS for tracking' configuration CSI-RS resource 2 CSI-RS resource 1 from 'CSI-RS for tracking' configuration QCL Type Type D Maximum number of code block groups for ACK/NACK 1 feedback Number of HARQ Processes 10 for FR2.60-1 and 8 for FR2.120-1 | | | | | |
| TCI state #1 Tyoe 2 QCL information CSI-RS resource information CSI-RS resource CSI-RS resource 1 from 'CSI-RS for tracking' configuration Type D Maximum number of code block groups for ACK/NACK feedback Number of HARQ Processes 10 for FR2.60-1 and 8 for FR2.120-1 | | | | | |
| Tyoe 2 QCL information CSI-RS resource information CSI-RS resource tracking' configuration Type D Maximum number of code block groups for ACK/NACK feedback Number of HARQ Processes CSI-RS resource tracking' configuration Type D 1 1 10 for FR2.60-1 and 8 for FR2.120-1 | TCI state #1 | oauon | QCL Type | | |
| Information QCL Type Type D Maximum number of code block groups for ACK/NACK feedback Number of HARQ Processes 10 for FR2.60-1 and 8 for FR2.120-1 | | Tyoe 2 QCL | CSI-RS resource | | |
| Maximum number of code block groups for ACK/NACK feedback Number of HARQ Processes 10 for FR2.60-1 and 8 for FR2.120-1 | | | OCL Type | | |
| feedback Number of HARQ Processes 10 for FR2.60-1 and 8 for FR2.120-1 | Maximum number of | | | | • |
| | feedback | | | | 1 |
| K1 value Specific to each UL-DL pattern | | rocesses | | | |
| | K1 value | | | | Specific to each UL-DL pattern |

| Maximum number | r of HARQ transmission | 4 | | |
|---|---------------------------------------|---|--|--|
| HARQ ACK/NACK bundling | | Multiplexed | | |
| Redundancy versi | ion coding sequence | {0,2,3,1} | | |
| TDD UL-DL patter | rn | 60 kHz SCS: FR2.60-1 120 kHz SCS: FR2.120-1 | | |
| PDSCH & PDSCH | H DMRS Precoding configuration | Single Panel Type I, Precoder index 0 per slot with Wideband granularity for Rank 2 | | |
| Symbols for all unused REs | | OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1 | | |
| Propagation cond | ition | Static propagation condition No external noise sources are applied | | |
| Antenna | 1 layer CCs | 1x2 or 1x4 | | |
| configuration | configuration 2 layers CCs 2x2 or 2x4 | | | |
| Physical signals, channels mapping and precoding As specified in Annex B.4.1 | | | | |
| Note 1: PDSCH is scheduled only on full DL slots not containing SSB or TRS. | | | | |

Note 2: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH

transmission.

Note 3: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-2 [7] for tested

channel bandwidth and subcarrier spacing.

Table 7.5A.1-2: Number of PRBs in CORESET

| SCS (kHz) | 50 MHz | 100 MHz | 200 MHz | 400 MHz |
|-----------|--------|---------|---------|---------|
| 60 | 66 | 132 | 264 | N.A |
| 120 | 30 | 66 | 132 | 264 |

Table 7.5A.1-3: MCS indexes for indicated UE capabilities

| Maximum number of | Maximum | Scaling | MCS |
|-------------------|-------------------|---------|-----|
| PDSCH MIMO layers | modulation format | factor | |
| 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 | 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 |

Table 7.5A.1-4: SNR required to achieve 85% of peak throughput under AWGN conditions

| MCS Index (Note 1) | SNR _{BB} (dB) for maximum number of PDSCH MIMO Layers = 1 | SNR _{BB} (dB) for maximum number of PDSCH MIMO Layers = 2 |
|--------------------|---|---|
| 13 | 6,2 | 9.0 |
| | - | |
| 14 | 7.2 | 9.9 |
| 15 | 8.2 | 10.9 |
| 16 | 8.7 | 11.6 |
| 17 | 10.1 | 13.2 |
| 18 | 10.7 | 13.7 |
| 19 | 11.7 | 14.7 |
| 20 | 12.7 | 15.6 |
| 21 | 13.6 | 16.5 |
| 22 | 14.8 | 17.6 |
| 23 | 15.6 | 18.6 |
| 24 | 16.9 | 19.7 |
| 25 | 18.3 | 21.2 |
| 26 | 19.3 | 22.3 |
| 27 | 20.5 | 23.3 |

Note 1: MCS Index is based on MCS Table defined in clause 5.1.3 of TS 38.214 [12] when 256QAM is not enabled.

8 CSI reporting requirements (Radiated requirements)

8.1 General

This clause includes radiated requirements for the reporting of channel state information (CSI).

8.1.1 Applicability of requirements

8.1.1.1 General

The minimum performance requirements are applicable to the FR2 operating bands defined in TS 38.101-2 [7] with F_{DL_high} not exceeding 40000 MHz.

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

8.1.1.2 Applicability of requirements for different number of RX antenna ports

UE shall support 2 RX ports for different RF operating bands. The UE requirements applicability is defined in Table 8.1.1.2-1.

Table 8.1.1.2-1: Requirements applicability

| Supported RX antenna ports | Test type | Test list |
|----------------------------|-----------|---------------------------|
| UE supports 2RX | CQI | All tests in Clause 8.2.2 |
| antenna | PMI | All tests in Clause 8.3.2 |
| | RI | All tests in Clause 8.4.2 |

8.1.1.3 Applicability of requirements for optional UE features

8.1.1.4 Applicability of requirements for mandatory UE features with capability signalling

The performance requirements in Table 8.1.1.4-1 shall apply for UEs which support mandatory UE features with capability signalling only.

Table 8.1.1.4-1: Requirements applicability for mandatory features with UE capability signalling

| UE feature/capability [14] | Test t | уре | Test list | Applicability notes |
|---|---------|-----|--------------------|---|
| Supported maximum number of PDSCH MIMO layers (maxNumberMIMO-LayersPDSCH) | FR2 TDD | CQI | Clause 8.2.2.2.1.1 | The requirements apply only in case the PDSCH MIMO rank in the test case does not exceed UE |
| Layersi Booriy | | KI | Clause 6.4.2.2 | PDSCH MIMO layers capability |
| Cupport of 1 port DTDC | FR2 TDD | CQI | Clause 8.2 | |
| Support of 1 port PTRS (onePortsPTRS) | | PMI | Clause 8.3 | |
| (UNEFULSE INS) | | RI | Clause 8.4 | |

8.1.2 Common test parameters

Parameters specified in Table 8.1.2-1 are applied for all test cases in this clause unless otherwise stated.

Table 8.1.2-1: Test parameters for CSI test cases

| | Parameter | Unit | Value |
|-------------------------------|--|------|---|
| PDSCH transmi | ssion scheme | | Transmission |
| | | | scheme 1 |
| Duplex Mode | | | TDD |
| PTRS epre-Rati | | | 0 |
| Actual carrier configuration | Offset between Point A and the lowest usable subcarrier on this carrier (Note 3) | RBs | 0 |
| J | Subcarrier spacing | kHz | 120 |
| | Cyclic prefix | | Normal |
| | RB offset | RBs | 0 |
| DL BWP configuration #1 | Number of contiguous PRB | PRBs | Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-2 [7] for tested channel bandwidth and subcarrier spacing |
| Active DL BWP | index | | 1 |
| Common | Physical Cell ID | | 0 |
| serving cell | SSB position in burst | | First SSB in Slot #0 |
| parameters | SSB periodicity | ms | 20 |
| | Slots for PDCCH monitoring | | Each slot |
| | Symbols with PDCCH Number of PDCCH candidates and aggregation levels DCI format | | 0,1 1/AL8 |
| | TCI state | | 1_1 TCI state #1 |
| PDCCH configuration | PDCCH & PDCCH DMRS Precoding configuration | | Multi-path fading propagation conditions: Single Panel Type I, Random per slot with equal probability of each applicable i1, i2 combination, and with REG bundling granularity for number of Tx larger than 1 Static propagation |
| Additional PDCCH | Slots for PDCCH monitoring Symbols with PDCCH | | conditions: Single Panel Type I, Random precoder chosen from precoder index 0 and 2, selection updated per slot Each slot 0,1 |
| Configuration | Number of PDCCH candidates | | 1/AL8 |
| for Aperiodic | and aggregation levels | | |
| Reporting | DCI format | | 0_1 |
| (Note 4) | TCI state | | TCI state #1 |

| | T | | I |
|-------------------|---|------|--|
| | PDCCH & PDCCH DMRS Precoding configuration | | Multi-path fading propagation conditions: Single Panel Type I, Random per slot with equal probability of each applicable i1, i2 combination, and with REG bundling granularity for number of Tx larger |
| | | | than 1 |
| Cross carrier sch | | | Not configured |
| | Mapping type | | Type A |
| | kO | | 0 |
| | Starting symbol (S) | | 2 |
| | Length (L) | | 12 |
| | PDSCH aggregation factor | | 1 |
| PDSCH | PRB bundling type | | Static |
| | | | |
| configuration | PRB bundling size | | 2 |
| | Resource allocation type | | Type 0 |
| | RBG size | | Config2 |
| | VRB-to-PRB mapping type | | Non-interleaved |
| | VRB-to-PRB mapping interleaver | | NI/A |
| | bundle size | | N/A |
| | DMRS Type | | Type 1 |
| | Number of additional DMRS | | 1 |
| | Transcr or additional Bivine | | {1000} for Rank1 |
| | DMPS ports indexes | | {1000,1001} for |
| PDSCH DMRS | DMRS ports indexes | | Rank2 |
| | 14 | | Rankz |
| configuration | Maximum number of OFDM symbols for DL front loaded DMRS | | 1 |
| | Number of PDSCH DMRS CDM group(s) without data | | 2 |
| | Frequency density (KPT-RS) | | 2 |
| PTRS | Time density (<i>L_{PT-RS}</i>) | | 1 |
| configuration | Resource Element Offset | | 2 |
| | First subcarrier index in the PRB | | 0 for CSI-RS |
| | | | |
| | used for CSI-RS (k ₀) | | resource 1,2,3,4 |
| | E: . OEDM | | 4 for CSI-RS |
| | First OFDM symbol in the PRB | | resource 1 and 3 |
| | used for CSI-RS (Io) | | 8 for CSI-RS |
| | | | resource 2 and 4 |
| | Number of CSL BS ports (V) | | 1 for CSI-RS |
| | Number of CSI-RS ports (X) | | resource 1,2,3,4 |
| | 00117 | | No CDM for CSI-RS |
| | CDM Type | | resource 1,2,3,4 |
| | | | 3 for CSI-RS |
| CSI-RS for | Density (ρ) | | resource 1,2,3,4 |
| | | | 120kHz SCS: 160 for |
| tracking | CCL DC mariadiaits | -1-4 | |
| | CSI-RS periodicity | slot | CSI-RS resource |
| | | | 1,2,3,4 |
| | | | 120 kHz SCS: |
| | | | 80 for CSI-RS |
| | CSI-RS offset | slot | resource 1 and 2 |
| | | | 81 for CSI-RS |
| | | | resource 3 and 4 |
| | | | Start PRB 0 |
| | Frequency Occupation | | Number of PRB = |
| | | | BWP size |
| | QCL info | | TCI state #0 |
| | QOL IIIIO | | |
| NZP CSI-RS | Francisco Occur ettera | | Start PRB 0 |
| for CSI | Frequency Occupation | | Number of PRB = |
| acquisition | | | BWP size |
| aoquionion | QCL info | | TCI state #1 |
| | | | - |

| | | | | Start PRB 0 | |
|--|------------------------------|--------------------------|--------------------------------|--|--|
| ZP CSI-RS for CSI acquisition | Frequency O | ccupation | | Number of PRB = BWP size | |
| | First subcarriused for CSI | er index in the PRB | | k ₀ =0 for CSI-RS resource 1,2 | |
| | | | | I ₀ = 8 for CSI-RS | |
| | First OFDM symbol in the PRB | | | resource 1 | |
| | used for CSI | -RS | | l ₀ = 9 for CSI-RS | |
| | | | | resource 2 1 for CSI-RS | |
| | Number of C | SI-RS ports (X) | | resource 1,2 | |
| CSI-RS for beam | CDM Type | | | 'No CDM' for CSI-RS resource 1,2 | |
| refinement | Density (ρ) | | | 3 for CSI-RS resource 1,2 | |
| | CSI-RS perio | odicity | Slots | 120 kHz SCS: 160 for CSI-RS resource | |
| | CCL DC affa | | Clata | 1,2 0 for CSI-RS | |
| | CSI-RS offse |) | Slots | resource 1,2 | |
| | Repetition | | | ON TOLL I III | |
| | QCL info Type 1 | SSB indov | | TCI state #1 SSB #0 | |
| | QCL | SSB index | | | |
| TCI state #0 | information | QCL Type | | Type C | |
| TOI State #0 | Type 2 | SSB index | | SSB #0 | |
| | QCL information | QCL Type | | Type D | |
| | | | | CSI-RS resource 1 | |
| | Type 1 QCL | CSI-RS resource | | from 'CSI-RS for tracking' | |
| | information | | | configuration | |
| TCI state #1 | | QCL Type | | Type A | |
| TCI state #1 | | | | CSI-RS resource 1 | |
| | Type 2 | CSI-RS resource | | from 'CSI-RS for | |
| | QCL information | | | tracking' configuration | |
| | Imormation | QCL Type | | Type D | |
| Number of HARO | | , , | | 8 | |
| HARQ ACK/NAC | | | | Multiplexed | |
| Redundancy ver | sion coding sed | quence | | {0,2,3,1} For FR2.120-1: | |
| | | | | 3 if mod (i.5) = 0, | |
| | | | | 6 if $mod(i,5) = 2$ | |
| | | | | For FR2.120-2: | |
| K1 value | O | | | 11 if $mod(i,8) = 0$, | |
| (PDSCH-to-HAR | Q-timing-indica | ator) | | 7]if $mod(i,8) = 4$, 6]if $mod(i,8) = 5$, | |
| | | | | where i is slot index | |
| | | | | per radio fame with | |
| | | | | values 0-79. | |
| | | | | OP.1 FDD as | |
| | | | | defined in Annex | |
| Symbols for unus | Symbols for unused REs | | | A.5.1.1 OP.1 TDD as | |
| | | | defined in Annex | | |
| | | | | A.5.2.1 | |
| Physical signals, channels manning and precoding. As specif | | | As specified in Annex B.4.1 | | |
| | | uled on slots containing | ng CSI-RS o | | |
| Note 2: UE as | | | | | |
| applied for the PDCCH transmission. Note 3: Point A coincides with minimum guard band as specified in Table 5.3.3-1 | | | | | |
| from TS 38.101-2 [7] for tested channel bandwidth and subcarrier spacing. Note 4: Additional PDCCH configuration for aperiodic reporting is only for test cases | | | | | |
| with aperiodic CSI reporting configured. | | | | | |

8.2 Reporting of Channel Quality Indicator (CQI)

8.2.1 1RX requirements

(Void)

8.2.2 2RX requirements

8.2.2.1 FDD

(Void)

8.2.2.2 TDD

8.2.2.2.1 CQI reporting under AWGN conditions

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

8.2.2.2.1.1 Minimum requirement for periodic CQI reporting

For the parameters specified in Table 8.2.2.2.1.1-1, and using the downlink physical channels specified in Annex C.5.1, the minimum requirements are specified by the following:

- a) the reported CQI value shall be in the range of ± 1 of the reported median more than 90% of the time;
- b) if the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, the BLER using the transport format indicated by the (median CQI + 1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, the BLER using transport format indicated by (median CQI 1) shall be less than or equal to 0.1.

Table 8.2.2.2.1.1-1 Test parameters

| | Parameter | Unit | Test 1 | Test 2 |
|-------------------|--|------|----------|------------------------------|
| Bandwidth | | MHz | | 00 |
| Subcarrier sp | | kHz | | 20 |
| Duplex Mode | | | | DD |
| TDD Slot Cor | nfiguration | | | Annex A.1.3 |
| SNR _{BB} | | dB | 8 9 | 14 15 |
| Propagation of | channel | | | VGN |
| Antenna conf | iguration | | | tatic channel n Annex B.1 |
| Beamforming | Model | | | ed in Annex .4.1 |
| | CSI-RS resource Type | | Pei | riodic |
| | Number of CSI-RS ports (X) | | | 4 |
| | CDM Type | | FD- | CDM2 |
| ZP CSI-RS | Density (ρ) | | | 1 |
| configuratio n | First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | | 8 |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁) | | | 13 |
| | CSI-RS periodicity and offset | slot | 8 | 3/1 |
| | CSI-RS resource Type | | Pei | riodic |
| | Number of CSI-RS ports (X) | | | 2 |
| | CDM Type | | fd-C | CDM2 |
| NZP CSI- | Density (ρ) | | | 1 |
| RS for CSI | First subcarrier index in the | | | |
| acquisition | PRB used for CSI-RS (k ₀ , k ₁) | | | 6 |
| acquiomen. | First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁) | | | 13 |
| | NZP CSI-RS-timeConfig | slot | , | 3/1 |
| | periodicity and offset | 3101 | | |
| | CSI-IM resource Type | | Pei | riodic |
| CSI-IM | CSI-IM RE pattern | | | 1 |
| configuratio | CSI-IM Resource Mapping | | (8. | , 13) |
| n | (KCSI-IM, ICSI-IM) | | (0, | , |
| | CSI-IM timeConfig | slot | 8 | 3/1 |
| | periodicity and offset | | | |
| ReportConfig | Туре | | | riodic |
| CQI-table | | | | ble 1 |
| reportQuantity | | | | PMI-CQI |
| | onForChannelMeasurements | | | nfigured |
| | nForInterferenceMeasurements | | | nfigured |
| cqi-FormatInd | | | | eband |
| pmi-FormatIn | | | Wid | eband |
| Sub-band Siz | | RB | | 8 |
| csi-Reporting | | | | 11111 |
| | eriodicity and offset | slot | | 3/3 |
| aperiodicTrigg | | | | nfigured |
| | Codebook Type | | typel-Si | nglePanel |
| | Codebook Mode | | | 1 |
| Codebook | (CodebookConfig- | 1 | Not co | nfigured |
| configuration | N1,CodebookConfig-N2) | 1 | | • |
| | CodebookSubsetRestriction | | | 0000 |
| <u></u> | RI Restriction | | | J/A |
| Physical char | nnel for CSI report | 1 | | CCH |
| ļ., . | CQI/RI/PMI delay | ms | 8. | 375 |
| Maximum nur | mber of HARQ transmission | | | 1 |
| Measurement | t channel | | | ed in Table TBS.1-2 |

8.2.2.2.2 CQI reporting under fading conditions

8.2.2.2.2.1 Minimum requirement for wideband CQI reporting

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

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

For the parameters specified in Table 8.2.2.2.2.1-1 and using the downlink physical channels specified in Annex C.5.1, the minimum requirements are specified by the following:

- a) a CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least α % of the time, where α % is specified in Table 8.2.2.2.2.1-2;
- b) the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be ≥ γ, where γ is specified in Table 8.2.2.2.2.1-2;
- c) when transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater or equal to 0.01.

Table 8.2.2.2.1-1 Test parameters

| Bandwidth | | Parameter | Unit | Test 1 Test 2 |
|---|-------------------|--|------|--------------------------|
| Duplex Mode | Bandwidth | | | |
| TDD Slot Configuration | | acing | | |
| SNRes | Duplex Mode | | | |
| Propagation channel | TDD Slot Cor | nfiguration | | |
| Antenna configuration Beamforming Model CSI-RS resource Type Number of CSI-RS ports (X) CDM Type Density (p) First subcarrier index in the PRB used for CSI-RS (ko, k1) First OFDM symbol in the PRB used for CSI-RS (ko, k1) NZP CSI-RS interval and offset CSI-RS resource Type Density (p) NZP CSI-RS (ko, k1) First Subcarrier index in the PRB used for CSI-RS (ko, k1) Density (p) NZP CSI-RS (ko, k1) NZP CSI-RS (ko, k1) NZP CSI-RS (ko, k1) NZP CSI-RS (ko, k1) First Subcarrier index in the PRB used for CSI-RS (ko, k1) PRB used for CSI-RS (ko, k1) NZP CSI-RS (ko, k1) Self-RS tor CSI-RS (ko, k1) NZP CSI-RS (ko, k1) NZP CSI-RS (ko, k1) NZP CSI-RS (ko, k1) NZP CSI-RS-timeConflig interval and offset aperiodic TriggeringOffset CSI-IM Resource Mapping (kosi-Ms.Lcsi-Ms) (kosi-Ms.Lcsi-Ms) CSI-Ms resource Mapping (kosi-Ms.Lcsi-Ms) (kosi-Ms.Lcsi-Ms) CSI-Ms resource Mapping (kosi-Ms.Lcsi-Ms) (kosi-Ms.Lcsi-Ms) CSI-Ms resource Mapping (kosi-Ms.Lcsi-Ms) (kosi-Ms.Lcsi-Ms) CSI-Ms resource Mapping (kosi-Ms.Lcsi-Ms) (kosi-Ms.Lcsi-Ms) (kosi-Ms.Lcsi-Ms) (kosi-Ms.Lcsi-Ms) CSI-Ms resource Aperiodic CSI-Ms resource CSI-Ms resource Aperiodic Col-Interval and offset Not configured Not configured Not configured CSI-Ms resource Not configured Not configured CSI-Ms resource Not configured CSI-Ms resource Not configured Not configured Codebook Mode Codebook Mode COdebook Mode COdebook Mode COGEROR Mode COGEROR MS COGEROR (ks) Associated Report Cod | | channel | dB | 1 1 |
| Beamforming Model CSI-RS resource Type Periodic | | | | 2×2 |
| CSI-RS resource Type Periodic Number of CSI-RS ports (X) | | - | | As specified in Annex |
| Number of CSI-RS ports (X) | | | | |
| ZP CSI-RS configuratio n PRB used for CSI-RS (ko, kt) First Subcarrier index in the PRB used for CSI-RS (ko, kt) First OFDM symbol in the PRB used for CSI-RS (ko, kt) CSI-RS interval and offset SIOT (SI-RS (ko, kt)) NZP CSI-RS RS for CSI acquisition NZP CSI-RS RS | | | | |
| Density (p) Tirst subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) First oFDM symbol in the PRB used for CSI-RS (k ₀ , k ₁) First oFDM symbol in the PRB used for CSI-RS (k ₀ , k ₁) First oFDM symbol in the PRB used for CSI-RS (k ₀ , k ₁) PRB used for CSI-RS ports (X) 2 CSI-RS resource Type Number of CSI-RS ports (X) 2 CDM Type Density (p) 1 First oFDM symbol in the PRB used for CSI-RS (k ₀ , k ₁) 6 PRB used for CSI-RS (k ₀ , k ₁) First oFDM symbol in the PRB used for CSI-RS (k ₀ , k ₁) First oFDM symbol in the PRB used for CSI-RS (k ₀ , k ₁) NZP CSI-RS-timeConfig interval and offset aperiodic TriggeringOffset O CSI-IM resource Type Aperiodic CSI-IM resource Type Aperiodic CSI-IM Resource Mapping (k _{CSI-IM-ICSI-IM}) (R _{CSI-IM-ICSI-IM}) CSI-IM timeConfig interval and offset Slot Not configured ReportConfigType Aperiodic CSI-IM resource Mapping (R _{CSI-IM-ICSI-IM}) CSI-IM timeConfig Slot Not configured Table 1 Table | | | | |
| configuration n | 7P CSI-RS | Density (o) | | |
| PRB used for CSI-RS (k₀, k1) | | First subcarrier index in the | | · |
| used for CSI-RS (lo, lr) CSI-RS interval and offset CSI-RS resource Type Number of CSI-RS ports (X) CDM Type Density (p) First subcarrier index in the PRB used for CSI-RS (ko, k1) First OFDM symbol in the PRB used for CSI-RS (lo, lr) NZP CSI-RS-timeConfig interval and offset aperiodicTriggeringOffset CSI-IM configuratio n CSI-IM RE pattern CSI-IM Resource Type CSI-IM Resource Mapping (KCSI-IM, ICSI-IM) CSI-IM timeConfig interval and offset slot Not configured (RCSI-IM, ICSI-IM) CSI-IM fire Config interval and offset speriodicTriggeringOffset CQI-table ReportConfigType CQI-table ReportConfigType CQI-table ReportConfigType CQI-table ReportConfigType CQI-table ReportConfigType CRI-RS-(IM, ICSI-IM) Table 1 Table 1 Table 1 Table 1 TeportQuantity timeRestrictionForChannelMeasurements Not configured timeRestrictionForChannelMeasurements Not configured timeRestrictionForInterferenceMeasurements Not configured timeRestrictionForTorhanelMeasurements Sub-band Size RB 8 8 8 8 8 8 11 111111111 CSI-Report periodicity and offset Aperiodic Report Slot Offset CSI request CSI-AperiodicTriggerStateList Codebook Codebook Mode Codebook Mode Codebook Mode Configuration (Codebook Mode Configuration COdebook Configuration CODED Aperiodic Codebook Configuration CODED Aperiodic Codebook Configuration CODED Aperiodic Codebook Configuration CODED Aperiodic Codebook Configuration CODED Aperiodic Codebook Configuration CODED Aperiodic Trigger Codebook Codebook Codebook Codebook Codebook Codebook C | _ | PRB used for CSI-RS (k ₀ , k ₁) | | 8 |
| interval and offset | | used for CSI-RS (l ₀ , l ₁) | | 13 |
| NZP CSI-RS for CSI acquisition NZP CSI-RS for CSI acquisition NZP CSI-RS for CSI acquisition NZP CSI-RS (For CSI acquisition) NZP CSI-RS (For CSI-RS) (For CS | | | slot | 8/1 |
| Number of CSI-RS ports (X) 2 CDM Type Incomplete | | CSI-RS resource Type | | Aperiodic |
| Density (p) 1 First subcarrier index in the PRB used for CSI-RS (ko, k1) 6 First subcarrier index in the PRB used for CSI-RS (ko, k1) First OFDM symbol in the PRB used for CSI-RS (lo, l1) NZP CSI-RS-timeConfig interval and offset aperiodicTriggeringOffset | | Number of CSI-RS ports (X) | | l <u>=</u> |
| RS for CSI acquisition First Subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) First OFDM symbol in the PRB used for CSI-RS (k ₀ , k ₁) NZP CSI-RS-timeConfig interval and offset aperiodic TriggeringOffset O CSI-IM resource Type Aperiodic CSI-IM resource Type Aperiodic CSI-IM Resource Mapping (k _{CSI-IM-LCSI-IM}) CSI-IM Resource Mapping (k _{CSI-IM-LCSI-IM}) (SSI-IM timeConfig interval and offset Aperiodic CQI-table Table 1 | | | | fd-CDM2 |
| RS for CSI acquisition PRB used for CSI-RS (k ₀ , k ₁) | NZP CSI- | | | 1 |
| First OF-DM symbol in the PRB used for CSI-RS (lo, l₁) NZP CSI-RS-timeConfig interval and offset aperiodic TriggeringOffset | RS for CSI | PRB used for CSI-RS (k ₀ , k ₁) | | 6 |
| NZP CSI-RS-timeConfig interval and offset aperiodicTriggeringOffset | acquisition | | | 13 |
| aperiodicTriggeringOffset 0 CSI-IM resource Type Aperiodic CSI-IM RE pattern 1 CSI-IM Resource Mapping (8, 13) CSI-IM Resource Mapping (8, 13) CSI-IM MimeConfig interval and offset Slot Not configured ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasurements Not configured timeRestrictionForInterferenceMeasurements Not configured cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 8 Sci-ReportingBand 111111111 CSI-Report periodicity and offset slot Not configured Aperiodic Report Slot Offset 5 CSI request Slot Offset 1 in slots i, where mod(i, 8) = 1, otherwise it is equal to 0 reportTriggerSize 1 CSI-AperiodicTriggerStateList Associated Report Configuration Configuration Codebook Configuration Codebook Codebook Mode 1 Codebook Configuration Codebook Configuration CSI-IM Aperiodic Vype State Codebook Configuration Aperiodic Vype State Codebook Configuration Alteroafiguration Aperiodic Vype State Codebook Configuration Aperiodic Codebook Configuration Aperiodic Codebook Configuration Aperiodic Codebook Configuration Aperiodic Codebook Configuration Aperiodic Codebook Configuration Aperiodic Codebook Configuration Aperiodic Codebook Configuration Aperiodic Codebook Configuration Aperiodic Codebook Configuration Aperiodic Codebook Configuration Aperiodic Codebook Configuration Aperiodic Codebook Configuration Aperiodic Codebook Codebook Configuration Aperiodic Codebook Cod | | | slot | Not configured |
| CSI-IM configuration n CSI-IM Resource Type | | | | 0 |
| CSI-IM Resource Mapping (RCSI-IM Resource Mapping) CSI-IM timeConfig interval and offset slot Not configured ReportConfigType Aperiodic CQI-table Table 1 reportQuantity Cri-RI-PMI-CQI timeRestrictionForChannelMeasurements Not configured timeRestrictionForInterferenceMeasurements Not configured cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 8 CSi-ReportingBand SII-Report periodicity and offset slot Not configured Aperiodic Report Slot Offset 6 CSI request SI In slots i, where mod(i, 8) = 1, otherwise it is equal to 0 reportTriggerSize 1 CSI-AperiodicTriggerStateList Associated Report Configuration Configuration Codebook Configuration Codebook Configuration Codebook Configuration Codebook Configuration (CodebookConfig- | | | | Aperiodic |
| configuration N | CSI-IM | | | 1 |
| ReportConfigType ReportConfigType ReportConfigType ReportConfigType ReportConfigType ReportConfigType ReportConfigType ReportConfigType ReportConfigType ReportConfigType ReportConfigType ReportConfigType ReportConfigUred ReportConfigUred ReportConfigUred ReportConfigUred ReportConfigUred ReportConfigUred ReportIndicator ReportIndica | configuratio | | | (8, 13) |
| ReportConfigType | n | CSI-IM timeConfig | slot | Not configured |
| CQI-table reportQuantity timeRestrictionForChannelMeasurements timeRestrictionForInterferenceMeasurements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-Report periodicity and offset Aperiodic Report Slot Offset CSI request CSI request CSI-AperiodicTriggerStateList Codebook Configuration Codebook Configuration Codebook Configuration Codebook Codebook Configuration Codebook Codebook Configuration Codebook Codebook Configuration Codebook Codebook CodebookConfig- Not configured Not configured And configured And configured And configured Codebook CodebookConfig- Not configured Not configured Associated Report Configuration Associated Report Configuration Codebook Type Codebook CodebookConfig- | ReportConfig | | | Aperiodic |
| reportQuantity timeRestrictionForChannelMeasurements timeRestrictionForInterferenceMeasurements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-Report periodicity and offset Aperiodic Report Slot Offset CSI request CSI request CSI-AperiodicTriggerStateList CSI-AperiodicTriggerStateList Codebook configuration Codebook Configuration Codebook Configuration Cir.RI-PMI-CQI Not configured Not configured Not configured Not configured Not configured Not configured Not configured Not configuration Cone State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI- RS and CSI-IM Not configured Not configured | CQI-table | -7 | | |
| timeRestrictionForChannelMeasurements timeRestrictionForInterferenceMeasurements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-Report periodicity and offset Aperiodic Report Slot Offset CSI request CSI request CSI-AperiodicTriggerStateList Codebook Codebo | | У | | |
| cqi-FormatIndicator Wideband pmi-FormatIndicator RB Sub-band Size RB csi-ReportingBand 111111111 CSI-Report periodicity and offset Slot Aperiodic Report Slot Offset 6 1 in slots i, where mod(i, 8) = 1, otherwise it is equal to 0 reportTriggerSize 1 One State with one Associated Report Configuration CSI-AperiodicTriggerStateList Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM Codebook Type typeI-SinglePanel Codebook Mode CodebookConfiguration 1 | timeRestriction | nForChannelMeasurements | | Not configured |
| pmi-FormatIndicator Sub-band Size Csi-ReportingBand CSI-Report periodicity and offset Aperiodic Report Slot Offset CSI request CSI request CSI request CSI-AperiodicTriggerStateList CSI-AperiodicTriggerStateList Codebook Configuration Codebook Configuration Codebook Configuration CSI-AperiodicTriggerStateList Codebook Configuration Codebook Configuration CSI-Substanting Report Configuration Codebook Codebook Mode Codebook Configuration CSI-Substanting Report Configuration Codebook Codebook Configuration Codebook Codebook Codebook Codebook Codebook Codebook Code | timeRestriction | nForInterferenceMeasurements | | |
| Sub-band Size csi-ReportingBand CSI-Report periodicity and offset Aperiodic Report Slot Offset CSI request CSI request reportTriggerSize CSI-AperiodicTriggerStateList CSI-AperiodicTriggerStateList Codebook | | | | |
| csi-ReportingBand 111111111 CSI-Report periodicity and offset slot Not configured Aperiodic Report Slot Offset 6 CSI request 1 in slots i, where mod(i, 8) = 1, otherwise it is equal to 0 reportTriggerSize 1 One State with one Associated Report Configuration CSI-AperiodicTriggerStateList Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM Codebook Type typeI-SinglePanel Codebook Configuration Codebook Mode Codebook Configuration 1 | _ | | | |
| CSI-Report periodicity and offset Aperiodic Report Slot Offset CSI request CSI request CSI request CSI request Totherwise it is equal to 0 TeportTriggerSize Tone State with one Associated Report Configuration CSI-AperiodicTriggerStateList Codebook Type Codebook Configuration CSI-SinglePanel Codebook Configuration CodebookConfig- CSI-Not configured Configuration CodebookConfig- CodebookConfig- Not configured | | | RB | |
| Aperiodic Report Slot Offset CSI request CSI request reportTriggerSize 1 One State with one Associated Report Configuration CSI-AperiodicTriggerStateList Codebook Type Codebook Configuration Codebook Configuration CSI-Siguration Codebook Type Codebook Configuration Codebook Configuration Codebook Configuration Codebook Configuration Codebook Mode Codebook Configuration | | | | |
| CSI request 1 in slots i, where mod(i, 8) = 1, otherwise it is equal to 0 reportTriggerSize 1 One State with one Associated Report Configuration CSI-AperiodicTriggerStateList Codebook Type Codebook Configuration Codebook CodebookConfig- Not configured | | | SIOT | • |
| configuration configuration configuration configuration configuration configuration configuration configuration configuration contains pointers to NZP CSI- RS and CSI-IM configuration configuration configuration configuration configuration configuration configuration configuration codebook configuration codebook configuration codebookConfig- | Aperiodic Rep | DORT SIDT OTISET | | 1 in slots i, where |
| reportTriggerSize 1 One State with one Associated Report Configuration Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI- RS and CSI-IM Codebook Codebook Mode Codebook Configuration CodebookConfig- | CSI request | | | otherwise it is equal to |
| CSI-AperiodicTriggerStateList CSI-AperiodicTriggerStateList Configuration Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI- RS and CSI-IM typeI-SinglePanel Codebook Codebook Mode CodebookConfig- Not configured | rone wT.: | and Tribute Oir | | 0 |
| Associated Report Configuration Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI- RS and CSI-IM Codebook Type Codebook Configuration CodebookConfig- Not configured | report riggerSize | | 1 | One State with and |
| CSI-AperiodicTriggerStateList Configuration Associated Report Configuration contains pointers to NZP CSI- RS and CSI-IM Codebook Type Codebook Codebook Mode configuration CodebookConfig- Not configured | | | | |
| CSI-AperiodicTriggerStateList Associated Report Configuration contains pointers to NZP CSI- RS and CSI-IM typel-SinglePanel Codebook Codebook Mode configuration (CodebookConfig- | | | | |
| Configuration contains pointers to NZP CSI- RS and CSI-IM Codebook Type typel-SinglePanel Codebook Codebook Mode 1 Codebook Configuration (CodebookConfig- | CSI-Aperiodic | cTriggerStateList | | |
| pointers to NZP CSI- RS and CSI-IM Codebook Type typeI-SinglePanel Codebook Codebook Mode 1 configuration (CodebookConfig- | oo, Aponoaid | 7 Higgor Ctate List | | |
| RS and CSI-IM | | | | |
| Codebook Type typel-SinglePanel Codebook Configuration (CodebookConfig- | | | | |
| Codebook Codebook Mode 1 configuration (CodebookConfig- | | Codebook Type | | |
| | Codebook | | | |
| N1,CodebookConfig-N2) | configuration | | | Not configured |
| | | N1,CodebookConfig-N2) | | rvot coringureu |

| | CodebookSubsetRestriction | | 000001 |
|---------------------------------|---------------------------|----|---|
| | RI Restriction | | N/A |
| Physical channel for CSI report | | | PUSCH |
| | CQI/RI/PMI delay | ms | 1.375 |
| Maximum num | nber of HARQ transmission | | 1 |
| Measurement | channel | | As specified in Table A.4-1, TBS.1-1 |

Table 8.2.2.2.1-2 Minimum requirements

| | Test 1 | Test 2 |
|------|--------|--------|
| α[%] | 2 | 2 |
| γ | 1.05 | 1.05 |

8.3 Reporting of Precoding Matrix Indicator (PMI)

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

The requirements for transmission mode 1 with 2TX and higher layer parameter *codebookType* set to 'typeI-SinglePanel' are specified in terms of the ratio

$$\gamma = \frac{t_{ue}}{t_{rnd}}$$

In the definition of γ , for 2TX PMI requirements, t_{ue} is 90 % of the maximum throughput obtained at SNR_{ue} using the precoders configured according to the UE reports, and t_{rnd} is the throughput measured at SNR_{ue} with random precoding.

8.3.1 1RX requirements

(Void)

8.3.2 2RX requirements

8.3.2.1 FDD

(Void)

8.3.2.2 TDD

8.3.2.2.1 Single PMI with 2TX Typel-SinglePanel Codebook

For the parameters specified in Table 8.3.2.2.1-1, and using the downlink physical channels specified in Annex C.5.1, the minimum requirements are specified in Table 8.3.2.2.1-2.

Table 8.3.2.2.1-1: Test parameters (single layer)

| Pa | rameter | Unit | Test 1 | Test 2 |
|--------------------------------------|--|------|--------------------------|--------------------------|
| Bandwidth | | MHz | 100 | 100 |
| Subcarrier spacing | ng | kHz | 120 | 120 |
| | | | FR2.120-2 as | FR2.120-1 as |
| TDD DL-UL conf | iguration | | specified in | specified in |
| Propagation char | nnel | | Annex A.1.3 TDLA30-35 | Annex A.1.3 TDLA30-35 |
| Antenna configur | | | 2 x 2 ULA Low | 2 x 2 ULA Low |
| Ţ. | | | As specified in | As specified in |
| Beamforming Mo | | | Annex B.4.1 | Annex B.4.1 |
| | CSI-RS resource Type | | Periodic | Periodic |
| | Number of CSI-RS ports (X) | | 4 | 4 |
| | CDM Type | | FD-CDM2 | FD-CDM2 |
| | Density (ρ) | | 1 | 1 |
| ZP CSI-RS configuration | First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | Row 4, (8,-) | Row 4, (8,-) |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁) | | (13,-) | (13,-) |
| | CSI-RS interval and offset | slot | 8/1 | 5/1 |
| | CSI-RS resource Type | | Aperiodic | Aperiodic |
| | Number of CSI-RS ports (X) | | 2 | 2 |
| | CDM Type | | FD-CDM2 | FD-CDM2 |
| | Density (ρ) | | 1 | 1 |
| NZP CSI-RS for CSI acquisition | First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | Row 3, (6,-) | Row 3, (6,-) |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁) | | (13,-) | (13,-) |
| | CSI-RS interval and offset | slot | Not configured | Not configured |
| | aperiodicTriggering Offset | | 0 | 0 |
| | CSI-IM resource Type | | Aperiodic | Aperiodic |
| | CSI-IM RE pattern | | Pattern 1 | Pattern 1 |
| CSI-IM configuration | CSI-IM Resource Mapping (kcsi-im,lcsi-im) | | (8,13) | (8,13) |
| | CSI-IM timeConfig interval and offset | slot | Not configured | Not configured |
| ReportConfigTyp | e | | Aperiodic | Aperiodic |
| CQI-table | | | Table 1 | Table 1 |
| reportQuantity | | | cri-RI-PMI-CQI | cri-RI-PMI-CQI |
| nts | orChannelMeasureme | | Not configured | Not configured |
| ements | orInterferenceMeasur | | Not configured | Not configured |
| cqi-FormatIndica | | | Wideband | Wideband |
| pmi-FormatIndica | ator | | Wideband | Wideband |

| Sub-band Size | | RB | 8 | 8 |
|-----------------------------|---|------|---|---|
| csi-ReportingBar | nd | | 111111111 | 111111111 |
| CSI-Report inter | val and offset | slot | Not configured | Not configured |
| Aperiodic Report | t Slot Offset | | 6 | 8 |
| CSI request | | | 1 in slots i, where mod(i, 8) = 1, otherwise it is equal to 0 | 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0 |
| reportTriggerSize | е | | 1 | 1 |
| CSI-AperiodicTri | | | One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM | One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM |
| | Codebook Type | | typel- SinglePanel | typel- SinglePanel |
| | Codebook Mode | | 1 | 1 |
| Codebook configuration | (CodebookConfig- N1,CodebookConfi g-N2) | | N/A | N/A |
| CodebookSubsetR estriction | | | 001111 | 001111 |
| | RI Restriction | | N/A | N/A |
| Physical channe | I for CSI report | | PUSCH | PUSCH |
| CQI/RI/PMI dela | | ms | 1.375 | 1.75 |
| Maximum number transmission | er of HARQ | | 4 | 4 |
| Measurement ch | annel | | R.PDSCH.5-8.1 TDD | R.PDSCH.5- 7.1 TDD |

Note 1: For random precoder selection, the precoder shall be updated in each slot (0.125 ms granularity).

Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-4)], this reported PMI cannot be applied at the gNB downlink before slot#(n+4)].

Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.

Table 8.3.2.2.1-2: Minimum requirement

| Parameter | Test 1 | Test 2 |
|-----------|--------|--------|
| γ | 1.05 | 1.05 |

8.4 Reporting of Rank Indicator (RI)

The purpose of this test is to verify that the reported rank indicator accurately represents the channel rank. The accuracy of RI reporting is determined by the relative increase of the throughput obtained when transmitting based on the reported rank compared to the case for which a fixed rank is used for transmission.

8.4.1 1RX requirements

(Void)

8.4.2 2RX requirements

8.4.2.1 FDD

(Void)

8.4.2.2 TDD

The minimum performance requirement in Table 8.4.2.2-2 is defined as

- a) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 1 shall be $\geq \gamma_1$;
- b) The ratio of the throughput obtained when transmitting based on UE reported RI and that obtained when transmitting with fixed rank 2 shall be $\geq \gamma_2$;

For the parameters specified in Table 8.4.2.2-1, and using the downlink physical channels specified in Annex C.5.1, the minimum requirements are specified in Table 8.4.2.2-2.

Table 8.4.2.2-1: RI Test (TDD)

| | Parameter | Unit | Test 1 | Test 2 | Test 3 |
|------------------------|--|------|--|--|--|
| Bandwidth | | MHz | 100 | 100 | 100 |
| Subcarrier sp | | kHz | 120 | 120 | 120 |
| Duplex Mode | | | TDD | TDD | TDD |
| TDD Slot Cor | nfiguration | | FR1.120-2 | FR1.120-2 | FR1.120-2 |
| SNR | | dB | 0 | 16 | 16 |
| Propagation (| | | TDLA30-35 | TDLA30-35 | TDLA30-35 |
| Antenna conf | iguration | | ULA Low 2x2 | ULA Low 2x2 | XP High 2x2 |
| Beamforming | Model | | As defined in Annex B.4.1 | As defined in Annex B.4.1 | As defined in Annex B.4.1 |
| | CSI-RS resource Type | | Periodic | Periodic | Periodic |
| | Number of CSI-RS ports (X) | | 4 | 4 | 4 |
| | CDM Type | | FD-CDM2 | FD-CDM2 | FD-CDM2 |
| ZP CSI-RS | Density (ρ) | | 1 | 1 | 1 |
| configuratio n | First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | Row 4, (8,-) | Row 4, (8,-) | Row 4, (8,-) |
| | First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁) | | (13,-) | (13,-) | (13,-) |
| | CSI-RS | 1. | 8/1 | 8/1 | 8/1 |
| | interval and offset | slot | 5 | <u>.</u> | 5 , 1 |
| | CSI-RS resource Type | | Aperiodic | Aperiodic | Aperiodic |
| | Number of CSI-RS ports (X) | | 2 | 2 | 2 |
| | CDM Type | | FD-CDM2 | FD-CDM2 | FD-CDM2 |
| NZP CSI- | Density (ρ) | | 1 | 1 | 1 |
| RS for CSI acquisition | First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) | | Row 3 (6,-) | Row 3 (6,-) | Row 3 (6,-) |
| aoquioition | First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁) | | (13,-) | (13,-) | (13,-) |
| | NZP CSI-RS-timeConfig | slot | Not configured | Not | Not |
| | interval and offset | 3101 | | configured | configured |
| | aperiodicTriggeringOffset | | 0 | 0 | 0 |
| | CSI-IM resource Type | | Periodic | Periodic | Periodic |
| CSI-IM | CSI-IM RE pattern | | Pattern 1 | Pattern 1 | Pattern 1 |
| configuratio n | CSI-IM Resource Mapping (kcsi-im,lcsi-im) | | (8,13) | (8,13) | (8,13) |
| | CSI-IM timeConfig interval and offset | slot | Not configured | Not configured | Not configured |
| ReportConfig | | | Aperiodic | Aperiodic | Aperiodic |
| CQI-table | туре | | Table 1 | Table 1 | Table 1 |
| reportQuantit | у | | cri-RI-PMI-CQI | cri-RI-PMI- CQI | cri-RI-PMI- CQI |
| timeRestriction | onForChannelMeasurements | | not configured | not configured | not configured |
| timeRestriction | onForInterferenceMeasurements | | not configured | not configured | not configured |
| cqi-FormatInd | dicator | | Wideband | Wideband | Wideband |
| pmi-FormatIn | | | Wideband | Wideband | Wideband |
| Sub-band Siz | ze | RB | 8 | 8 | 8 |
| csi-Reporting | Band | | 111111111 | 111111111 | 111111111 |
| CSI-Report in | nterval and offset | slot | Not configured | Not configured | Not configured |
| Aperiodic Re | port Slot Offset | | 7 | 7 | 7 |
| CSI request | | | 1 in slots i, where mod(i, 8) = 1, | 1 in slots i, where mod(i, 8) = 1, | 1 in slots i, where mod(i, 8) = 1, |
| | | | otherwise it is equal to 0 | otherwise it is equal to 0 | otherwise it is equal to 0 |
| reportTrigger | Size | | 1 | 1 | 1 |

| CSI-Aperiodic | TriggerStateList Codebook Type | | One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM | One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM | One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM |
|--|---|----|---|---|---|
| | Codebook Type | | typel- SinglePanel | typel- SinglePanel | typel- SinglePanel |
| | Codebook Mode | | 1 | 1 | 1 |
| Codebook | (CodebookConfig- N1,CodebookConfig-N2) | | N/A | N/A | N/A |
| configuration | CodebookSubsetRestriction | | 010000 for fixed rank 2, 010011 for following rank | 000011 for fixed rank 1, 010011 for following rank | 000011 for fixed rank 1, 010011 for following rank |
| | RI Restriction | | N/A | N/A | N/A |
| Physical channel for CSI report | | | PUSCH | PUSCH | PUSCH |
| CQI/RI/PMI delay | | ms | 1.375 | 1.375 | 1.375 |
| Maximum num | nber of HARQ transmission | | 1 | 1 | 1 |
| RI Configuration | | | Fixed RI = 2 and follow RI | Fixed RI = 1 and follow RI | Fixed RI = 1 and follow RI |
| NOTE 1: Massuraments channels are exceited in Table A 4.1 TRS 1.1 is used for Pank 1 case. TRS 1.2 | | | | | |

NOTE 1: Measurements channels are specified in Table A.4-1. TBS.1-1 is used for Rank 1 case. TBS.1-2 is used for Rank 2 case.

Table 8.4.2.2-2: Minimum requirement (TDD)

| | Test 1 | Test 2 | Test 3 |
|----|--------|--------|--------|
| 21 | N/A | 1.05 | 1.05 |
| 72 | 1.0 | N/A | N/A |

9 Demodulation performance requirements for interworking

9.1 General

This clause covers the UE demodulation performance requirements for EN-DC, NE-DC, inter-band NR-DC between FR1 and FR2, and inter-band NR CA between FR1 and FR2.

9.1.1 Applicability of requirements

The following applicability rules are specified for demodulation performance requirements for interworking:

- For UEs supporting both SA and NSA,
 - The performance requirements specified in Clause 5 will be verified only for SA except for the sustained downlink data rate test specified in Clause 5.5 and 5.5A.
 - The performance requirements specified in Clause 7 will be verified only for SA except for the sustained downlink data rate test specified in Clause 7.5 and 7.5A.
 - The sustained downlink data rate tests specified in Clauses 5.5, 5.5A and 7.5, 7.5A for SA and in Clause 9.4B for NSA are verified separately.

- The FR1 EN-DC test cases with the NR TDD DL-UL configurations which are not aligned with LTE's can be tested on the corresponding EN-DC band combinations where UE supports simultaneous transmission and reception.
- For UEs supporting NR FR1 CA and/or NR CA including FR1 and FR2, the requirements applicability is specified in Table 9.1.1-1.

Table 9.1.1-1: Requirements applicability for UEs supporting NR FR2 CA and NR CA including FR1 and FR2

| Supported scenarios | Requirements |
|--|---------------|
| NR FR2 CA | Clause 7.5A |
| NR CA including FR1 and FR2 | Clause 9.4A.1 |
| Both NR FR2 CA and NR CA including FR1 and FR2 | Clause 7.5A |

- For UEs supporting EN-DC including FR2 and/or EN-DC including FR1 and FR2, the requirements applicability is specified in Table 9.1.1-2.

Table 9.1.1-2: Requirements applicability for UEs supporting EN-DC including FR2 and EN-DC including FR1 and FR2

| Supported scenarios | SDR requirements | PDSCH requirements | PDCCH requirements |
|--|------------------|--------------------|--------------------|
| EN-DC including FR2 | Clause 9.4B.1.2 | Clause 9.2B.1.2 | Clause 9.3B.1.2 |
| EN-DC including FR1 and FR2 | Clause 9.4B.1.3 | Clause 9.2B.1.3 | Clause 9.3B.1.3 |
| Both EN-DC including FR2 and EN-DC including FR1 and FR2 | Clause 9.4B.1.2 | Clause 9.2B.1.2 | Clause 9.3B.1.2 |

- For UEs supporting NR-DC including FR1 and FR2, if the FR2 requirements in Clause 7.2 and Clause 7.3 are tested, the test coverage can be considered fulfilled without executing requirements in Clause 9.2B.2 and Clause 9.3B.2.
- For UEs supporting NR-DC between FR1 and FR2, if requirements in Clause 9.4A.1 are tested under same or higher data rate as in Clause 9.4B.2, the test coverage can be considered fulfilled without executing the requirements in Clause 9.4B.2.
- For UEs supporting NE-DC and EN-DC, the test coverage of demodulation performance requirements can be considered fulfilled, if the demodulation requirements in Clause 5 and Clause 9.4B.1 are executed for UE under test in the standalone mode.
- For UEs supporting NE-DC and not supporting EN-DC, the test coverage of demodulation performance requirements can be considered fulfilled, if the demodulation requirements in Clause 5 and Clause 9.4B.3 are executed for UE under test.
- For UEs supporting NGEN-DC, the test coverage of demodulation performance requirements can be considered fulfilled, if the demodulation requirements in Clause 5 and Clause 9.4B.1 are executed for UE under test.

9.1.1.1 Applicability of requirements for optional UE features

Table 9.1.1.1-1: Void

The applicability rule defined in Clause 5.1.1.3 shall be applied for performance requirements in Clauses 9.2B.1.1 and 9.4B.1.1.

The applicability rule defined in Clause 7.1.1.3 shall be applied for performance requirements in Clauses 9.2B.1.2, 9.4A.1, 9.4B.1.2 and 9.4B.1.3.

9.1.1.2 Applicability of requirements for mandatory UE features with capability signalling

The applicability rule defined in Clause 5.1.1.4 shall be applied for performance requirements in Clauses 9.2B.1.1 and 9.4B.1.1.

The applicability rule defined in Clause 7.1.1.4 shall be applied for performance requirements in Clauses 9.2B.1.2, 9.4A.1, 9.4B.1.2 and 9.4B.1.3.

9.1.2 E-UTRA Cell setup

This sub-clause provides the parameters for E-UTRA cell during the demodulation performance test for EN-DC unless otherwise stated. For EN-DC with multiple E-UTRA carriers or bands, randomly selected one carrier or band can be used as E-UTRA Pcell for the connection setup unless otherwise stated.

9.1.2.1 FDD

The parameters specified in Table 9.1.2.1-1 and Table 9.1.2.1-2 are used to setup E-UTRA cell. One of test setup in Table 9.1.2.1-2 will be selected for the E-UTRA Cell depending on the maximum bandwidth of an E-UTRA carrier for all the EN-DC band combinations supported by the UE.

The measurement channels in Table 9.1.2.1-2 and OCNG pattern OP.1 FDD are specified in TS 36.101 [4]. The physical channel setup with downlink power allocation is according to Annex C.3.2 of TS 36.101 [4].

Parameter Unit Value Cyclic prefix Normal Physical Cell ID 0 Number of PDCCH 1 symbols symbols PHICH Ng (Note 1) PHICH duration Normal Number of HARQ processes per **Processes** 8 component carrier Maximum number of 4 HARQ transmission Redundancy version {0,0,1,2} for 64QAM coding sequence Static propagation condition Propagation condition No external noise sources are applied Transmission mode Transmission time difference between E-0 μs UTRA cell and NR cell(s) All NR cells are in FR1: 1x2 Antenna configuration Any NR cell is in FR2: 1 TxNote 1 Codebook subset 10 restriction Symbols for all unused OCNG in Annex A.5 **REs**

Table 9.1.2.1-1: Common Test Parameters (FDD)

Note 1: As the link can be provided over the air, the UE Rx antenna configuration is not relevant for the test configuration and has no impact on the test implementation.

Table 9.1.2.1-2: Specific Test Parameters (FDD [64QAM])

| Test setup | Bandwidth (MHz) | Downlink power allocation (dB) | | • |
|---------------|--------------------|--------------------------------------|------------------------------|---|
| - | , , | $ ho_{\scriptscriptstyle A}$ | $ ho_{\scriptscriptstyle B}$ | σ |
| 1 | 5 | 0 | 0 | 0 |
| 2 | 10 | 0 | 0 | 0 |
| 3 | 15 | 0 | 0 | 0 |
| 4 | 20 | 0 | 0 | 0 |

9.1.2.2 TDD

The parameters specified in Table 9.1.2.2-1 and Table 9.1.2.2-2 are used to setup an E-UTRA cell. One of test setup in Table 9.1.2.2-2 will be selected for the E-UTRA Cell depending on the maximum bandwidth of an E-UTRA carrier for all the EN-DC band combinations supported by the UE.

The measurement channels in Table 9.1.2.2-2 and OCNG pattern OP.1 TDD are specified in TS 36.101 [4]. The physical channel setup with downlink power allocation is according to Annex C.3.2 of TS 36.101 [4].

Table 9.1.2.2-1: Common Test Parameters (TDD)

| Parameter | Unit | Value | |
|--------------------------|-----------|---|--|
| UL DL configuration | | 2 (Note1) | |
| Special subframe | | 7 | |
| configuration | | 1 | |
| Number of PDCCH | symbols | 1 | |
| symbols | 391110013 | ' | |
| PHICH Ng (Note 3) | | 1 | |
| PHICH duration | | Normal | |
| Cyclic prefix | | Normal | |
| Cell ID | | 0 | |
| Maximum number of | | 4 | |
| HARQ transmission | | 4 | |
| Redundancy version | | {0,0,1,2} for 64QAM | |
| coding sequence | | (0,0,1,2) 101 0+QAW | |
| Propagation condition | | Static propagation condition | |
| 1 Topagation condition | | No external noise sources are applied | |
| Transmission mode | | 1 | |
| Transmission time | | | |
| difference between E- | μs | 0 | |
| UTRA cell and NR | μο | Ŭ | |
| cell(s) | | | |
| Antenna configuration | | All NR cells are in FR1: 1x2 | |
| / internia configuration | | Any NR cell is in FR2: 1 Tx ^{Note 2} | |
| Codebook subset | | 10 | |
| restriction | | 10 | |
| Symbols for all unused | | OCNG in Annex A.5 | |
| REs | | OONS III AIIIIEX A.S | |

NOTE 1: The start of transmission of LTE frame is delayed by 2 LTE subframes with respect to the start of transmission of NR frame when TDD-TDD EN-DC configuration is configured during the test.

NOTE 2: As the link can be provided over the air, the UE Rx antenna configuration is not relevant for the test configuration and has no impact on the test implementation.

Table 9.1.2.2-2: Specific Test Parameters (FDD 64QAM)

| Test | Bandwidth | Downlink power allocation (dB | | |
|-------|-----------|-------------------------------|------------------------------|---|
| setup | (MHz) | $ ho_{\scriptscriptstyle A}$ | $ ho_{\scriptscriptstyle B}$ | σ |
| 1 | 10 | 0 | 0 | 0 |
| 2 | 15 | 0 | 0 | 0 |
| 3 | 20 | 0 | 0 | 0 |

9.2 PDSCH Demodulation

9.2A PDSCH demodulation for CA

9.2A.1 NR CA between FR1 and FR2

(Void)

9.2B PDSCH demodulation for DC

9.2B.1 EN-DC

9.2B.1.1 EN-DC within FR1

9.2B.1.1.1 PDSCH

The test setup for E-UTRA PCell is specified in Clause 9.1.2. The NR PDSCH demodulation performance requirements for NR are specified in Clause 5.2. During the test, only the PDSCH performance on the NR cell(s) shall be verified.

9.2B.1.2 EN-DC including FR2 NR carrier only

9.2B.1.2.1 PDSCH

The test setup for E-UTRA PCell is specified in Clause 9.1.2. The NR PDSCH demodulation performance requirements for NR are specified in Clause 7.2. During the test, only the PDSCH performance on the NR cell(s) on FR2 carriers shall be verified.

9.2B.1.3 EN-DC including FR1 and FR2 NR carriers

The test setup for E-UTRA PCell is specified in Clause 9.1.2. The NR PDSCH demodulation performance requirements for NR are specified in Clause 9.2B.1.1 and Clause 9.2B.1.2. During the test, only the PDSCH performance on the NR cell(s) on FR2 carriers shall be verified.

9.2B.2 NR DC between FR1 and FR2

The test setup for FR1 PCell is specified in Table 5.5A-1 with antenna configuration 1x2. The PDSCH demodulation performance requirements for NR FR2 cell(s) are specified in Clause 7.2. During the test, only the PDSCH performance on FR2 NR cell(s) shall be verified.

9.3 PDCCH demodulation

9.3A PDCCH demodulation for CA

9.3A.1 NR CA between FR1 and FR2

(Void)

9.3B PDCCH demodulation for DC

9.3B.1 EN-DC

9.3B.1.1 EN-DC within FR1

9.3B.1.1.1 PDCCH

The test setup for E-UTRA PCell is specified in Clause 9.1.2. The NR PDCCH demodulation performance requirements for NR are specified in Clause 5.3. During the test, only the PDCCH performance on the single NR cell shall be verified.

9.3B.1.2 EN-DC including FR2 NR carrier only

9.3B.1.2.1 PDCCH

The test setup for E-UTRA PCell is specified in Clause 9.1.2. The NR PDCCH demodulation performance requirements are specified in Clause 7.3. During the test, only the PDCCH performance on the single NR cell shall be verified.

9.3B.1.3 EN-DC including FR1 and FR2 NR carriers

The test setup for E-UTRA PCell is specified in Clause 9.1.2. The NR PDCCH demodulation performance requirements are specified in Clause 9.3B.1.1 and Clause 9.3B.1.2. During the test, only the PDCCH performance on the NR cell(s) on FR2 carriers shall be verified.

9.3B.2 NR DC between FR1 and FR2

The test setup for FR1 PCell is specified in Table 5.5A-1 with antenna configuration 1x2. The PDCCH demodulation performance requirements for NR FR2 cell are specified in Clause 7.3. During the test, only the PDCCH performance on FR2 NR cell shall be verified.

9.4 Void

9.4A SDR test for CA

9.4A.1 NR CA between FR1 and FR2

The Sustained Data Rate (SDR) requirements in this clause are applicable to the NR CA between FR1 and FR2 NR carriers.

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 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:

- Step 1: Calculate the NR FR1 data rate for CA bandwidth combinations, using a procedure from clause 4.1.2 of TS 38.306 [14], for all supported CA configurations and set of per NR component carrier (CC) UE capabilities among all supported UE capabilities:
 - Set of per NR CC UE capabilities includes a channel bandwidth, subcarrier spacing, number of PDSCH MIMO layers, modulation format and scaling factor as defined in clause 4.1.2 of TS 38.306 [14].
- Step 2: Calculate the NR FR2 data rate for CA bandwidth combinations, using a procedure from Clause 7.5A, for all supported CA configurations and set of per NR component carrier (CC) UE capabilities among all supported UE capabilities:
 - Set of per NR CC UE capabilities includes a channel bandwidth, subcarrier spacing, number of PDSCH MIMO layers, modulation format and scaling factor as defined in clause 4.1.2 of TS 38.306 [14].
- Step 3: Select the CA bandwidth combination among all supported CA configurations that achieves maximum total data rate in steps 1 and 2 among all UE capabilities:
 - When there are multiple sets of CA bandwidth combinations and UE capabilities with the same largest data rate, select a single set with the smallest aggregated channel bandwidth.
- Step 4: For each NR FR2 CC in the selected CA bandwidth combination, use MCS determined in step 2 for that CA bandwidth combination based on test parameters and indicated UE capabilities.

The test setup for NR FR1 PCell is specified in Clause 5.5A. The NR FR2 SDR tests setup is specified in Clause 7.5A. During the test, only the PDSCH performance on the NR cell(s) on FR2 carriers is verified and only NR FR1 PCell is activated from all FR1 CCs for the tested CA bandwidth combination.

The TB success rate shall be higher than 85% when NR FR2 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.

9.4B SDR test for DC

9.4B.1 EN-DC

< Editor note: which NR SDR test case(s) will be selected for EN-DC test need FFS.>

9.4B.1.1 EN-DC within FR1

9.4B.1.1.1 SDR test

The Sustained Data Rate (SDR) requirements in this clause are applicable to the EN-DC within FR1.

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 EN-DC bandwidth combination among all supported EN-DC 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 NR 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].
 - Set of per E-UTRA CC UE capabilities includes channel bandwidth, number of PDSCH MIMO layers and modulation format in accordance with clause 4.1.2 of TS 38.306 [14].
 - When there are multiple sets of EN-DC bandwidth combinations and UE capabilities with same largest data rate, select one among sets with the smallest aggregated channel bandwidth.

- For each NR FR1 CC in EN-DC bandwidth combination, use Table 5.5A-5 in Clause 5.5A to determine MCS based on test parameters and indicated UE capabilities.
- For each E-UTRA CC in EN-DC bandwidth combination, use Table 9.4B.1.1.1-2 and Table 9.4B.1.1.1-3 to determine FRC based on test parameters and indicated UE capabilities.

The test setup for E-UTRA Pcell is specified in Clause 9.1.2 and Table 9.4B.1.1.1-1. The NR SDR tests setup is specified in Clause 5.5A. During the test, the PDSCH performance on both the NR cell(s) and LTE cell(s) shall be verified.

The TB success rate shall be higher than 85% when NR PDSCH is scheduled with MCS defined for the selected EN-DC bandwidth combination and with the downlink physical channel setup according to Annex C.3.1 and when E-UTRA PDSCH is scheduled with FRC defined for the selected EN-DC bandwidth combination and with the downlink physical channel setup according to Annex C.3.2 from TS 36.101 [4]. The TB success rate of delivered PDCP SDU(s) by Layer2 is defined according to the different DRB type: Split bearer, MCG or SCG bearer.

- For the configuration of DRB type of Split bearer, the TB success rate across CGs is defined as TB success rate = 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. All the above numbers of transmitted, retransmitted or correctly received DL transport blocks are calculated as the sum of the numbers of DL transport blocks across all the CGs used for DC transmission or reception.
- For the configuration of DRB type of MCG or SCG bearer, the TB success rate across CGs is defined as TB success rate = 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 DL_correct_rx is the number of correctly received DL transport blocks. All the above numbers of transmitted, retransmitted or correctly received DL transport blocks are calculated as the sum of the numbers of DL transport blocks per CG used for DC.

Parameter Unit Value Inter-TTI Distance Number of OFDM symbols for PDCCH per OFDM symbols 1 component carrier Cross carrier scheduling Not configured Static propagation condition Propagation condition No external noise sources are applied dBm/15kHz at antenna port 2 layer CC 2x2 or 2x4 Antenna configuration 4 layer CC 4x4 Codebook subset 2 layer CC 10 restriction 4 layer CC 1000 2 layer CC $\rho_A = -3dB$. $\rho_B = -3dB$. $\sigma = 0dB$ Downlink power allocation 4 layer CC $\rho_A = -6$ dB, $\rho_B = -6$ dB, $\sigma = 3$ dB

Table 9.4B.1.1.1-1: Additional test setup for E-UTRA CC

Table 9.4B.1.1.1-2: E-UTRA FRC for SDR test (FDD)

| MIMO lavor | Bandwidth | Reference channel | | |
|----------------------|-----------|-------------------|-------------------|-------------------|
| MIMO layer Bandwidth | | 64QAM | 256QAM | 1024QAM |
| | 5 | R.PDSCH.4-1.1 FDD | R.PDSCH.4-3.1 FDD | R.PDSCH.4-5.1 FDD |
| 2 lover | 10 | R.PDSCH.4-1.2 FDD | R.PDSCH.4-3.2 FDD | R.PDSCH.4-5.2 FDD |
| 2 layer | 15 | R.PDSCH.4-1.3 FDD | R.PDSCH.4-3.3 FDD | R.PDSCH.4-5.3 FDD |
| | 20 | R.PDSCH.4-1.4 FDD | R.PDSCH.4-3.4 FDD | R.PDSCH.4-5.4 FDD |
| | 5 | R.PDSCH.4-2.1 FDD | R.PDSCH.4-4.1 FDD | R.PDSCH.4-6.1 FDD |
| 4 layer | 10 | R.PDSCH.4-2.2 FDD | R.PDSCH.4-4.2 FDD | R.PDSCH.4-6.2 FDD |
| | 15 | R.PDSCH.4-2.3 FDD | R.PDSCH.4-4.3 FDD | R.PDSCH.4-6.3 FDD |
| | 20 | R.PDSCH.4-2.4 FDD | R.PDSCH.4-4.4 FDD | R.PDSCH.4-6.4 FDD |

Table 9.4B.1.1.1-3: E-UTRA FRC for SDR test (TDD)

| MIMO lover | Bandwidth | Reference channel | | |
|-----------------|-----------|-------------------|-------------------|-------------------|
| MIMO layer Band | Danuwium | 64QAM | 256QAM | 1024QAM |
| | 10 | R.PDSCH.6-1.1 TDD | R.PDSCH.6-3.1 TDD | R.PDSCH.6-5.1 TDD |
| 2 layer | 15 | R.PDSCH.6-1.2 TDD | R.PDSCH.6-3.2 TDD | R.PDSCH.6-5.2 TDD |
| | 20 | R.PDSCH.6-1.3 TDD | R.PDSCH.6-3.3 TDD | R.PDSCH.6-5.3 TDD |
| | 10 | R.PDSCH.6-2.1 TDD | R.PDSCH.6-4.1 TDD | R.PDSCH.6-6.1 TDD |
| 4 layer | 15 | R.PDSCH.6-2.2 TDD | R.PDSCH.6-4.2 TDD | R.PDSCH.6-6.2 TDD |
| | 20 | R.PDSCH.6-2.3 TDD | R.PDSCH.6-4.3 TDD | R.PDSCH.6-6.3 TDD |

9.4B.1.2 EN-DC including FR2 NR carrier

9.4B.1.2.1 SDR test

The Sustained Data Rate (SDR) requirements in this clause are applicable to the EN-DC including FR2 NR carrier.

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 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:

- Step 1: Calculate the NR FR2 data rate for EN-DC bandwidth combinations, using a procedure from Clause 7.5A, for all supported EN-DC configurations and set of per NR component carrier (CC) UE capabilities among all supported UE capabilities:
 - Set of per NR CC UE capabilities includes a channel bandwidth, subcarrier spacing, number of PDSCH MIMO layers, modulation format and scaling factor as defined in clause 4.1.2 of TS 38.306 [14].
- Step 2: Calculate the E-UTRA data rate for EN-DC bandwidth combinations, using a procedure from clause 4.1.2 of TS 38.306 [14], for all supported EN-DC configurations and set of per E-UTRA component carrier (CC) UE capabilities among all supported UE capabilities:
 - Set of per E-UTRA CC UE capabilities includes a channel bandwidth, number of PDSCH MIMO layers and modulation format as defined in clause 4.1.2 of TS 38.306 [14].
- Step 3: Select the EN-DC bandwidth combination among all supported EN-DC configurations that achieves maximum total data rate in steps 1 and 2 among all UE capabilities:
 - When there are multiple sets of EN-DC bandwidth combinations and UE capabilities with the same largest data rate, select a single set with the smallest aggregated channel bandwidth.
- Step 4: For each NR FR2 CC in the selected EN-DC bandwidth combination, use MCS determined in step 1 for that EN-DC bandwidth combination based on test parameters and indicated UE capabilities.

The test setup for E-UTRA Pcell is specified in Clause 9.1.2 and Table 9.4B.1.1.1-1. The NR PDSCH SDR tests setup is specified in Clause 7.5A. During the test, only the PDSCH performance on the NR cell(s) on FR2 carriers is verified.

The TB success rate shall be higher than 85% when NR PDSCH is scheduled with MCS defined for the selected EN-DC bandwidth combination and with the downlink physical channel setup according to Annex C.3.1.

9.4B.1.3 EN-DC including FR1 and FR2 NR carriers

The Sustained Data Rate (SDR) requirements in this clause are applicable to the EN-DC including both FR1 and FR2 NR carriers.

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 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:

- Step 1: Calculate the NR FR1 data rate for EN-DC bandwidth combinations, using a procedure from clause 4.1.2 of TS 38.306 [14], for all supported EN-DC configurations and set of per NR component carrier (CC) UE capabilities among all supported UE capabilities:
 - Set of per NR CC UE capabilities includes a channel bandwidth, subcarrier spacing, number of PDSCH MIMO layers, modulation format and scaling factor as defined in clause 4.1.2 of TS 38.306 [14].
- Step 2: Calculate the NR FR2 data rate for EN-DC bandwidth combinations, using a procedure from Clause 7.5A, for all supported EN-DC configurations and set of per NR component carrier (CC) UE capabilities among all supported UE capabilities:
 - Set of per NR CC UE capabilities includes a channel bandwidth, subcarrier spacing, number of PDSCH MIMO layers, modulation format and scaling factor as defined in clause 4.1.2 of TS 38.306 [14].
- Step 3: Calculate the E-UTRA data rate for EN-DC bandwidth combinations, using a procedure from clause 4.1.2 of TS 38.306 [14], for all supported EN-DC configurations and set of per E-UTRA component carrier (CC) UE capabilities among all supported UE capabilities:
 - Set of per E-UTRA CC UE capabilities includes a channel bandwidth, number of PDSCH MIMO layers and modulation format as defined in clause 4.1.2 of TS 38.306 [14].
- Step 4: Select the EN-DC bandwidth combination among all supported EN-DC configurations that achieves the maximum total data rate in steps 1, 2 and 3 among all UE capabilities:
 - When there are multiple sets of EN-DC bandwidth combinations and UE capabilities with the same largest data rate, select a single set among sets with the smallest aggregated channel bandwidth.
- Step 5: For each NR FR2 CC in the selected EN-DC bandwidth combination, use MCS determined in step 2 for that EN-DC bandwidth combination based on test parameters and indicated UE capabilities.

The test setup for E-UTRA Pcell is specified in Clause 9.1.2 and Table 9.4B.1.1.1-1. The NR FR2 PDSCH SDR tests setup is specified in Clause 7.5A. During the test, only the PDSCH performance on the NR cell(s) on FR2 carriers is verified.

The TB success rate shall be higher than 85% when NR FR2 PDSCH is scheduled with MCS defined for the selected EN-DC bandwidth combination and with the downlink physical channel setup according to Annex C.3.1.

9.4B.2 NR DC between FR1 and FR2

The methodology for selection of tested NR DC bandwidth combination and the requirements are specified in Clause 9.4A.1.

9.4B.3 NE-DC

9.4B.3.1 NE-DC within FR1

The methodology for selection of tested NE-DC bandwidth combination and the requirements are specified in Clause 9.4B.1.1.

10 CSI reporting requirements for interworking

10.1 General

This clause specifies CSI performance requirements for EN-DC, NE-DC, inter-band NR-DC between FR1 and FR2, and inter-band NR CA between FR1 and FR2.

The definition of frequency ranges (FR1 and FR2) are specified in table 5.1-1 of TS 38.101-3 [8].

10.1.1 Applicability of requirements

The following applicability rules are specified for demodulation performance requirements for interworking:

- For UEs supporting both SA and NSA,
 - The performance requirements specified in Clause 6 will be verified only for SA.
 - The performance requirements specified in Clause 8 will be verified only for SA.
- The FR1 EN-DC test cases with the NR TDD DL-UL configurations which are not aligned with LTE's can be tested on the corresponding EN-DC band combinations where UE supports simultaneous transmission and reception.
- For UEs supporting NR-DC including FR1 and FR2, if the FR2 requirements in Clause 8.2, Clause 8.3 and Clause 8.4 are tested, the test coverage can be considered fulfilled without executing requirements in Clause 10.2B.2, Clause 10.3B.2 and Clause 10.4B.2.
- For UEs supporting NE-DC, the test coverage of CSI reporting requirements can be considered fulfilled, if the CSI reporting requirements in Clause 6 are executed for UE under test in the standalone mode.
- For UEs supporting NGEN-DC, the test coverage of CSI reporting requirements can be considered fulfilled, if the CSI reporting requirements in Clause 6 are executed for UE under test.
- For UEs supporting EN-DC including FR2 and/or EN-DC including FR1 and FR2, the requirements applicability is specified in Table 10.1.1-1.

Table 10.1.1-1: Requirements applicability for UEs supporting EN-DC including FR2 and/or EN-DC including FR1 and FR2

| Supported scenarios | CQI requirements | PMI requirements | RI requirements |
|--|------------------|------------------|------------------|
| EN-DC including FR2 | Clause 10.2B.1.2 | Clause 10.3B.1.2 | Clause 10.4B.1.2 |
| EN-DC including FR1 and FR2 | Clause 10.2B.1.3 | Clause 10.3B.1.3 | Clause 10.4B.1.3 |
| Both EN-DC including FR2 and EN-DC including FR1 and FR2 | Clause 10.2B.1.2 | Clause 10.3B.1.2 | Clause 10.4B.1.2 |

10.1.1.1 Applicability of requirements for optional UE features

Table 10.1.1.1-1: Void

10.1.1.2 Applicability of requirements for mandatory UE features with capability signalling

The applicability rule defined in Clause 6.1.1.4 shall be applied for performance requirements in Clauses 10.2B.1.1, 10.3B.1.1 and 10.4B.1.1.

The applicability rule defined in Clause 8.1.1.4 shall be applied for performance requirements in Clauses 10.2B.1.2, 10.3B.1.2 and 10.4B.1.2.

10.2 Reporting of Channel Quality Indicator (CQI)

10.2A Reporting of Channel Quality Indicator (CQI) for CA

(Void)

10.2B Reporting of Channel Quality Indicator (CQI) for DC

10.2B.1 EN-DC

10.2B.1.1 EN-DC within FR1

The test setup for E-UTRA PCell is specified in Clause 9.1.2. The NR CQI reporting requirements are specified in Clause 6.2. During the test, only the performance based on NR requirements on the NR cell(s) shall be verified.

10.2B.1.2 EN-DC including FR2 NR carrier

The test setup for E-UTRA PCell is specified in Clause 9.1.2. The NR CQI reporting requirements are specified in Clause 8.2. During the test, only the performance based on NR requirements on the NR cell(s) on FR2 carriers shall be verified.

10.2B.1.3 EN-DC including FR1 and FR2 NR carriers

The test setup for E-UTRA PCell is specified in Clause 9.1.2. The NR CQI reporting requirements are specified in Clause 10.2B.1.1 and Clause 10.2B.1.2. During the test, only the performance based on NR requirements on the NR cell(s) on FR2 carriers shall be verified.

10.2B.2 NR DC between FR1 and FR2

The test setup for FR1 PCell is specified in Table 5.5A-1 with antenna configuration 1x2. The test setup for FR2 cell is specified in Clause 8.1.2 and Clause 8.2. The NR CQI reporting requirements are specified in Clause 8.2. During the test, only the CQI performance based on NR requirements on the NR cell(s) on FR2 carriers shall be verified.

10.3 Reporting of Precoding Matrix Indicator (PMI)

10.3A Reporting of Precoding Matrix Indicator (PMI) for CA

(Void)

10.3B Reporting of Precoding Matrix Indicator (PMI) for DC

10.3B.1 EN-DC

10.3B.1.1 EN-DC within FR1

The test setup for E-UTRA PCell is specified in Clause 9.1.2. The NR PMI reporting requirements are specified in Clause 6.3. During the test, only the performance based on NR requirements on the NR cell(s) shall be verified.

10.3B.1.2 EN-DC including NR FR2 carrier

The test setup for E-UTRA PCell is specified in Clause 9.1.2. The NR PMI reporting requirements are specified in Clause 8.3. During the test, only the performance based on NR requirements on the NR cell(s) on FR2 carriers shall be verified.

10.3B.1.3 EN-DC including FR1 and FR2 NR carriers

The test setup for E-UTRA PCell is specified in Clause 9.1.2. The NR PMI reporting requirements are specified in Clause 10.3B.1.1 and Clause 10.3B.1.2. During the test, only the performance based on NR requirements on the NR cell(s) on FR2 carriers shall be verified.

10.3B.2 NR DC between FR1 and FR2

The test setup for FR1 PCell is specified in Table 5.5A-1 with antenna configuration 1x2. The test setup for FR2 cell is specified in Clause 8.1.2 and Clause 8.3. The PMI reporting requirements are specified in Clause 8.3. During the test, only the PMI performance based on NR requirements on the NR cell(s) on FR2 carriers shall be verified.

10.4 Reporting of Rank Indicator (RI)

10.4A Reporting of Rank Indicator (RI) for CA

10.4B Reporting of Rank Indicator (RI) for DC

10.4B.1 EN-DC

10.4B.1.1 EN-DC within FR1

The test setup for E-UTRA PCell is specified in Clause 9.1.2. The NR RI reporting requirements are specified in Clause 6.4. During the test, only the performance based on NR requirements on the NR cell(s) shall be verified.

10.4B.1.2 EN-DC including NR FR2 carrier

The test setup for E-UTRA PCell is specified in Clause 9.1.2. The NR RI reporting requirements are specified in Clause 8.4. During the test, only the performance based on NR requirements on the NR cell(s) on FR2 carriers shall be verified.

10.4B.1.3 EN-DC including FR1 and FR2 NR carriers

The test setup for E-UTRA PCell is specified in Clause 9.1.2. The NR PMI reporting requirements are specified in Clause 10.4B.1.1 and Clause 10.4B.1.2. During the test, only the performance based on the NR requirements on the NR cell(s) on FR2 carriers shall be verified.

10.4B.2 NR DC between FR1 and FR2

The test setup for FR1 PCell is specified in Table 5.5A-1 with antenna configuration 1x2. The test setup for FR2 cell is specified in Clause 8.1.2 and Clause 8.4. The NR RI reporting requirements for NR FR2 cell are specified in Clause 8.4. During the test, only the RI performance based on NR requirements on the NR cell(s) on FR2 carriers shall be verified.

Annex A (normative): Measurement channels

A.1 General

A.1.1 Throughput definition

The throughput values defined in the measurement channels specified in Annex A, are calculated and are valid per codeword. For multi-codeword transmissions, the throughput referenced in the minimum requirements is the sum of throughputs of all codewords.

A.1.2 TDD UL-DL configurations for FR1

TDD UL-DL configurations for performance requirements are provided in Tables A.1.2-1, A.1.2-2, and A.1.2-3.

Table A.1.2-1: TDD UL-DL configuration for SCS 15 kHz

| | Parameter | Unit | UL-DL pattern |
|------------------------------|---------------------------------|------|---------------------|
| | Parameter | Unit | FR1.15-1 |
| TDD Slot Configuration | on pattern (Note 1) | | DDDSU |
| Special Slot Configur | ation (Note 2) | | 10D+2G+2U |
| referenceSubcarrierSpacing , | | | 15 |
| pattern1 | dl-UL-TransmissionPeriodicity | ms | 5 |
| | nrofDownlinkSlots | | 3 |
| | nrofDownlinkSymbols | | 10 |
| | nrofUplinkSlot | | 1 |
| | nrofUplinkSymbols | | 2 |
| The number of slots b | petween PDSCH and corresponding | | 4 if $mod(i,5) = 0$ |
| HARQ-ACK informati | ion (Note 3) | | 3 if $mod(i,5) = 1$ |
| | | | 2 if $mod(i,5) = 2$ |
| | | | 6 if $mod(i,5) = 3$ |

Note 1: D denotes a slot with all DL symbols; S denotes a slot with a mix of DL, UL and guard symbols; U denotes a slot with all UL symbols. The field is for information.

Note 2: D, G, U denote DL, guard and UL symbols, respectively. The field is for information.

Note 3: i is the slot index per frame; $i = \{0,...,9\}$.

Table A.1.2-2: TDD UL-DL configuration for SCS 30 kHz

| | | T | | | | | | |
|--|-----------------------------------|------|---|--|--|--|--|--|
| Parar | neter | Unit | FR1.30-1 | FR1.30-2 | FR1.30-3 | UL-DL pattern FR1.30-4 | FR1.30-5 | FR1.30-6 |
| TDD Slot Configuration pattern | (Note 1) | | 7DS2U | DDDSU | DDDSUDDSUU | DDDSUUDDDD | DSUU | DS₁S₂U |
| Special Slot Configuration (Not | te 2) | | 6D+4G+4U | 10D+2G+2U | 10D+2G+2U | 6D+4G+4U | 12D+2G | S1: 10D+2G+2U S2: 12D+2G+0U |
| referenceSubcarrierSpacing | | kHz | 30 | 30 | 30 | 30 | 30 | 30 |
| pattern1 | | | | | | | | |
| | dl-UL- TransmissionPeriodicity | ms | 5 | 2.5 | 2.5 | 3 | 2 | 1 |
| | nrofDownlinkSlots | | 7 | 3 | 3 | 3 | 1 | 1 |
| | nrofDownlinkSymbols | | 6 | 10 | 10 | 6 | 12 | 10 |
| | nrofUplinkSlot | | 2 | 1 | 1 | 2 | 2 | 0 |
| | nrofUplinkSymbols | | 4 | 2 | 2 | 4 | 0 | 2 |
| pattern2 | dl-UL- TransmissionPeriodicity | ms | N/A | N/A | 2.5 | 2 | N/A | 1 |
| | nrofDownlinkSlots | | N/A | N/A | 2 | 4 | N/A | 0 |
| | nrofDownlinkSymbols | | N/A | N/A | 10 | 0 | N/A | 12 |
| | nrofUplinkSlot | | N/A | N/A | 2 | 0 | N/A | 1 |
| | nrofUplinkSymbols | | N/A | N/A | 2 | 0 | N/A | 0 |
| The number of slots between F HARQ-ACK information (Note | | | 8 if mod(i,10) = 0 7 if mod(i,10) = 1 6 if mod(i,10) = 2 5 if mod(i,10) = 3 5 if mod(i,10) = 4 4 if mod(i,10) = 5 3 if mod(i,10) = 6 2 if mod(i,10) = 7 | 4 if mod(i,5) = 0 3 if mod(i,5) = 1 2 if mod(i,5) = 2 6 if mod(i,5) = 3 | 4 if $mod(i,10) = 0$ 3 if $mod(i,10) = 1$ 2 if $mod(i,10) = 2$ 5 if $mod(i,10) = 3$ 3 if $mod(i,10) = 5$ 3 if $mod(i,10) = 6$ 2 if $mod(i,10) = 7$ | 5 if mod(i,10) = 0 4 if mod(i,10) = 1 3 if mod(i,10) = 2 2 if mod(i,10) = 6 7 if mod(i,10) = 7 6 if mod(i,10) = 8 5 if mod(i,10) = 9 | 3 if mod(i,4) = 0 2 if mod(i,4) = 1 | 3 if mod(i,4) = 0 2 if mod(i,4) = 1 3 if mod(i,4) = 2 |

- Note 1: D denotes a slot with all DL symbols; S denotes a slot with a mix of DL, UL and guard symbols; U denotes a slot with all UL symbols. The field is for information.
- Note 2: D, G, U denote DL, guard and UL symbols, respectively. The field is for information. Note 3: i is the slot index per frame; $i = \{0,...,19\}$

Table A.1.2-2a: TDD UL-DL configuration for SCS 30 kHz for DCI-based dynamic UL/DL detection

| Parameter | | Unit | UL-DL pattern | | | |
|---|--|----------|----------------------|--|--|--|
| | | | | | | |
| TDD Slot Configuration pattern (N | Note 1) | | 7DS2U | | | |
| Special Slot Configuration (Note 2 | 2) | | 6D+4G+4U | | | |
| referenceSubcarrierSpacing | | kHz | N/A | | | |
| pattern1 (Note 4) | | | | | | |
| | dl-UL- TransmissionPeriodicity | ms | N/A | | | |
| | nrofDownlinkSlots | | N/A | | | |
| | nrofDownlinkSymbols | | N/A | | | |
| | nrofUplinkSlot | | N/A | | | |
| | nrofUplinkSymbols | | N/A | | | |
| PDCCH DCI Configuration | DCI Format | | 1-1 for slot | | | |
| | | | indices with | | | |
| | | | mod(i,10) = | | | |
| | | | 0,1,2,3,4,5,6,7 | | | |
| | Scheduled Grant | | Symbol 2-13 for | | | |
| | | | slot indices with | | | |
| | | | mod(i,10) = | | | |
| | | | 0,1,2,3,4,5,6 and | | | |
| | | | Symbol 2-5 for | | | |
| | | | slot indices with | | | |
| | | | mod(i,10) = 7 | | | |
| The number of slots between PD | SCH and corresponding | | 8 if $mod(i,10) = 0$ | | | |
| HARQ-ACK information (Note 3) | | | 7 if $mod(i,10) = 1$ | | | |
| (PDSCH-to-HARQ-timing-indicate | or) | | 6 if $mod(i,10) = 2$ | | | |
| | | | 5 if $mod(i,10) = 3$ | | | |
| | | | 5 if $mod(i,10) = 4$ | | | |
| | | | 4 if $mod(i,10) = 5$ | | | |
| | | | 3 if $mod(i,10) = 6$ | | | |
| | | | 2 if mod(i,10) = 7 | | | |
| | all DL symbols; S denotes a slo | | | | | |
| information. | guard symbols; U denotes a slot with all UL symbols. The field is for information. | | | | | |
| Note 2: D, G and U denote DL information. | | | | | | |
| Note 3: i is the slot index per fr | rame; $i = \{0,, 19\}$ | | | | | |
| Note 4: Do not configure tdd-U | <i>IL-DL-ConfigurationCommon</i> ւ | ising RF | RC configuration | | | |

A.1.3 TDD UL-DL configurations for FR2

TDD UL-DL patterns configurations for performance requirements are provided in Tables A.1.3-1, A.1.3-2.

Table A.1.3-1: TDD UL-DL pattern for SCS 60 kHz

| Parar | notor | Unit | UL-DL pattern |
|---------------------------------|---|-------|---------------------|
| Farai | neter | Ollit | FR2.60-1 |
| TDD Slot Configuration pattern | (Note 1) | | DDSU |
| Special Slot Configuration (Not | e 2) | | 11D+3G+0U |
| referenceSubcarrierSpacing | | kHz | 60 |
| pattern1 | dI-UL- | ms | 1 |
| | TransmissionPeriodicity | | 1 |
| | nrofDownlinkSlots | | 2 |
| | nrofDownlinkSymbols | | 11 |
| | nrofUplinkSlot | | 1 |
| | nrofUplinkSymbols | | 0 |
| The number of slots between P | The number of slots between PDSCH and corresponding | | 3 if $mod(i,4) = 0$ |
| HARQ-ACK information (Note: | HARQ-ACK information (Note 3) | | 2 if $mod(i,4) = 1$ |
| | | | 5 if $mod(i,4) = 2$ |

Note 1: D denotes a slot with all DL symbols; S denotes a slot with a mix of DL, UL and guard symbols; U

denotes a slot with all UL symbols. The field is for information.

Note 2: D, G, U denote DL, guard and UL symbols, respectively. The field is for information.

Note 3: i is the slot index per frame; $i = \{0,...,39\}$

Table A.1.3-2: TDD UL-DL configuration for SCS 120 kHz

| Parar | motor | Unit | UL-DL | pattern |
|---|-----------------------------------|----------|---------------------|---------------------|
| Parai | neter | Unit | FR2.120-1 | FR2.120-2 |
| TDD Slot Configuration pattern (Note 1) | | | DDDSU | DDSU |
| Special Slot Configuration (Not | e 2) | | 10D+2G+2U | 11D+3G+0U |
| referenceSubcarrierSpacing | | kHz | 120 | 120 |
| pattern1 | dl-UL- TransmissionPeriodicity | ms 0.625 | | 0.5 |
| | nrofDownlinkSlots | | 3 | 2 |
| | nrofDownlinkSymbols | | 10 | 11 |
| | nrofUplinkSlot | | 1 | 1 |
| | nrofUplinkSymbols | | 2 | 0 |
| The number of slots between P | DSCH and corresponding | | 4 if $mod(i,5) = 0$ | 3 if $mod(i,4) = 0$ |
| HARQ-ACK information(Note 3) | | | 3 if $mod(i,5) = 1$ | 2 if $mod(i,4) = 1$ |
| | | | 2 if mod(i,5) = 2 | 5 if $mod(i,4) = 2$ |
| | | | 6 if $mod(i,5) = 3$ | |

Note 1: D denotes a slot with all DL symbols; S denotes a slot with a mix of DL, UL and guard symbols; U denotes a slot with all UL symbols. The field is for information.

Note 2: D, G, U denote DL, guard and UL symbols, respectively. The field is for information.

Note 3: i is the slot index per frame; $i = \{0, ..., 79\}$

Table A.1.3-2a: TDD UL-DL configuration for SCS 120 kHz for DCI-based dynamic UL/DL detection

| Parameter | | Unit | UL-DL pattern | | |
|---|------------------|--|---------------|--|--|
| | Faraille | stei | Oill | FR2.120-1A | |
| TDD Slot Configura | ation pattern (N | Note 1) | | DDDSU | |
| Special Slot Config | juration (Note 2 | 2) | | 10D+2G+2U | |
| referenceSubcarrie | erSpacing | | kHz | N/A | |
| pattern1 (Note 4) | | dl-UL- TransmissionPeriodicity | ms | N/A | |
| | | nrofDownlinkSlots | | N/A | |
| | | nrofDownlinkSymbols | | N/A | |
| | | nrofUplinkSlot | | N/A | |
| | | nrofUplinkSymbols | | N/A | |
| PDCCH DCI Confi | guration | DCI Format | | 1-1 for slot indices with mod(i,5) = 0,1,2,3 | |
| | | Scheduled Grant | | Symbol 1-13 for slot indices with mod(i,5) = 0,1,2 and Symbol 1-9 for slot indices with mod(i,5) = 3 | |
| The number of slots between PDSCH and corresponding HARQ-ACK information(Note 3) | | | | 4 if mod(i,5) = 0 3 if mod(i,5) = 1 2 if mod(i,5) = 2 6 if mod(i,5) = 3 | |
| Note 1: D denotes a slot with all DL symbols; S denotes a slot with a mix of DL, UL and guard symbols; U denotes a slot with all UL symbols. The field is for information. Note 2: D, G and U denote DL, guard and UL symbols, respectively. The field is for information. | | | | | |
| | | rame; i = {0,,79} /L-DL-ConfigurationCommon \ | using R | RC configuration. | |

A.2 Void

< Editor's note: Clause A.2 is a placeholder for UL Measurement channels>

A.3 DL reference measurement channels

A.3.1 General

The transport block size (TBS) determination procedure is described in clause 5.1.3.2 of TS 38.214 [12].

Unless otherwise stated, no user data is scheduled on slot #0 within 20 ms in order to avoid SSB and PDSCH transmissions in one slot and simplify test configuration.

A.3.2 Reference measurement channels for PDSCH performance requirements

For PDSCH reference channels if more than one Code Block is present, an additional CRC sequence of L=24 Bits is attached to each Code Block (otherwise L=0 Bit).

A.3.2.1 FDD

A.3.2.1.1 Reference measurement channels for SCS 15 kHz FR1

Table A.3.2.1.1-1: PDSCH Reference Channel for FDD (QPSK)

| Parameter | Unit | | | Value | |
|--|-------|------------------|-------------|------------|--|
| Deference channel | | R.PDSCH.1- | R.PDSCH.1- | R.PDSCH.1- | |
| Reference channel | | 1.1 FDD | 1.2 FDD | 1.3 FDD | |
| Channel bandwidth | MHz | 10 | 10 | 10 | |
| Subcarrier spacing | kHz | 15 | 15 | 15 | |
| Number of allocated resource blocks | PRBs | 52 | 6 | 52 | |
| Number of consecutive PDSCH symbols | | 12 | 12 | 7 | |
| Allocated slots per 2 frames | Slots | 19 | 19 | 19 | |
| MCS table | | 64QAM | 64QAM | 64QAM | |
| MCS index | | 4 | 4 | 4 | |
| Modulation | | QPSK | QPSK | QPSK | |
| Target Coding Rate | | 0.30 | 0.30 | 0.30 | |
| Number of MIMO layers | | 1 | 1 | 1 | |
| Number of DMRS REs | | 18 | 12 | 12 | |
| Overhead for TBS determination | | 0 | 0 | 0 | |
| Information Bit Payload per Slot | | | | | |
| For Slot i = 0 | Bits | N/A | N/A | N/A | |
| For Slots i = 1,, 19 | Bits | 3904 | 480 | 2280 | |
| Transport block CRC per Slot | | | | | |
| For Slot i = 0 | Bits | N/A | N/A | N/A | |
| For Slots i = 1,, 19 | Bits | 24 | 16 | 16 | |
| Number of Code Blocks per Slot | | | | | |
| For Slot i = 0 | CBs | N/A | N/A | N/A | |
| For Slots i = 1,, 19 | CBs | 1 | 1 | 1 | |
| Binary Channel Bits Per Slot | | | | | |
| For Slot i = 0 | Bits | N/A | N/A | N/A | |
| For Slots i = 10, 11 | Bits | 12480 | 1512 | 6864 | |
| For Slots i =1,, 9, 12,, 19 | Bits | 13104 | 1584 | 7488 | |
| Max. Throughput averaged over 2 frames | Mbps | 3.709 | 0.456 | 2.166 | |
| Note 1: SS/PBCH block is transmit | | t #0 with period | icity 20 ms | | |

Table A.3.2.1.1-2: PDSCH Reference Channel for FDD (16QAM)

| Parameter | Unit | | | Value | | |
|--|-------|------------|------------|------------|------------|--|
| Deference channel | | R.PDSCH.1- | R.PDSCH.1- | R.PDSCH.1- | R.PDSCH.1- | |
| Reference channel | | 2.1 FDD | 2.2 FDD | 2.3 FDD | 2.4 FDD | |
| Channel bandwidth | MHz | 10 | 10 | 10 | 10 | |
| Subcarrier spacing | kHz | 15 | 15 | 15 | 15 | |
| Number of allocated resource blocks | PRBs | 52 | 52 | 52 | 52 | |
| Number of consecutive PDSCH symbols | | 12 | 12 | 12 | 12 | |
| Allocated slots per 2 frames | Slots | 19 | 19 | 19 | 19 | |
| MCS table | | 64QAM | 64QAM | 64QAM | 64QAM | |
| MCS index | | 13 | 13 | 13 | 13 | |
| Modulation | | 16QAM | 16QAM | 16QAM | 16QAM | |
| Target Coding Rate | | 0.48 | 0.48 | 0.48 | 0.48 | |
| Number of MIMO layers | | 1 | 2 | 3 | 4 | |
| Number of DMRS REs | | 12 | 12 | 24 | 24 | |
| Overhead for TBS determination | | 0 | 0 | 0 | 0 | |
| Information Bit Payload per Slot | | | | | | |
| For Slot i = 0 | Bits | N/A | N/A | N/A | N/A | |
| For Slots i = 1,, 19 | Bits | 13064 | 26120 | 35856 | 48168 | |
| Transport block CRC per Slot | | | | | | |
| For Slot i = 0 | Bits | N/A | N/A | N/A | N/A | |
| For Slots i = 1,, 19 | Bits | 24 | 24 | 24 | 24 | |
| Number of Code Blocks per Slot | | | | | | |
| For Slot i = 0 | CBs | N/A | N/A | N/A | N/A | |
| For Slots i = 1,, 19 | CBs | 2 | 4 | 5 | 6 | |
| Binary Channel Bits Per Slot | | | | | | |
| For Slot i = 0 | Bits | N/A | N/A | N/A | N/A | |
| For Slots i = 10, 11 | Bits | 26208 | 52416 | 71136 | 94848 | |
| For Slots i = 1,, 9, 12,, 19 | Bits | 27456 | 54912 | 74880 | 99840 | |
| Max. Throughput averaged over 2 frames | Mbps | 12.411 | 24.814 | 34.063 | 45.760 | |

Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms

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

| Parameter | Unit | | Value |
|--|-------|------------|-------|
| Reference channel | | R.PDSCH.1- | |
| Reference channel | | 3.1 FDD | |
| Channel bandwidth | MHz | 10 | |
| Subcarrier spacing | kHz | 15 | |
| Number of allocated resource blocks | PRBs | 52 | |
| Number of consecutive PDSCH | | 12 | |
| symbols | | 12 | |
| Allocated slots per 2 frames | Slots | 19 | |
| MCS table | | 64QAM | |
| MCS index | | 19 | |
| Modulation | | 64QAM | |
| Target Coding Rate | | 0.51 | |
| Number of MIMO layers | | 2 | |
| Number of DMRS REs | | 12 | |
| Overhead for TBS determination | | 0 | |
| Information Bit Payload per Slot | | | |
| For Slot $i = 0$ | Bits | N/A | |
| For Slots i = 1,, 19 | Bits | 42016 | |
| Transport block CRC per Slot | | | |
| For Slot $i = 0$ | Bits | N/A | |
| For Slots i = 1,, 19 | Bits | 24 | |
| Number of Code Blocks per Slot | | | |
| For Slot $i = 0$ | CBs | N/A | |
| For Slots i = 1,, 19 | CBs | 5 | |
| Binary Channel Bits Per Slot | | | |
| For Slot $i = 0$ | Bits | N/A | |
| For Slots i = 10, 11 | Bits | 78624 | |
| For Slots i = 1,, 9, 12,, 19 | Bits | 82368 | |
| Max. Throughput averaged over 2 | Mbps | 39.915 | |
| frames Note 1: SS/PBCH block is transmitt | • | | |

Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms Note 2: Slot i is slot index per 2 frames

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

| Parameter | Unit | | Value |
|-------------------------------------|--------|------------|-------|
| Reference channel | | R.PDSCH.1- | |
| Reference channel | | 4.1 FDD | |
| Channel bandwidth | MHz | 10 | |
| Subcarrier spacing | kHz | 15 | |
| Number of allocated resource blocks | PRBs | 52 | |
| Number of consecutive PDSCH | | 12 | |
| symbols | | 12 | |
| Allocated slots per 2 frames | Slots | 19 | |
| MCS table | | 256QAM | |
| MCS index | | 24 | |
| Modulation | | 256QAM | |
| Target Coding Rate | | 0.82 | |
| Number of MIMO layers | | 1 | |
| Number of DMRS REs | | 12 | |
| Overhead for TBS determination | | 0 | |
| Information Bit Payload per Slot | | | |
| For Slot $i = 0$ | Bits | N/A | |
| For Slots i = 1,, 19 | Bits | 45096 | |
| Transport block CRC per Slot | | | |
| For Slot $i = 0$ | Bits | N/A | |
| For Slots i = 1,, 19 | Bits | 24 | |
| Number of Code Blocks per Slot | | | |
| For Slot $i = 0$ | CBs | N/A | |
| For Slots i = 1,, 19 | CBs | 6 | |
| Binary Channel Bits Per Slot | | | |
| For Slot $i = 0$ | Bits | N/A | |
| For Slots i = 10, 11 | Bits | 52416 | |
| For Slots i = 1,, 9, 12,, 19 | Bits | 54912 | |
| Max. Throughput averaged over 2 | Mbps | 42.841 | |
| frames | IVIDPS | 42.041 | |

Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms Note 2: Slot i is slot index per 2 frames

Table A.3.2.1.1-5: PDSCH Reference Channel for FDD and CSI-RS overlapped with PDSCH

| Parameter | Unit | | Value |
|-------------------------------------|--------|------------|-------|
| Deference channel | | R.PDSCH.1- | |
| Reference channel | | 5.1 FDD | |
| Channel bandwidth | MHz | 10 | |
| Subcarrier spacing | kHz | 15 | |
| Number of allocated resource blocks | PRBs | 52 | |
| Number of consecutive PDSCH | | 12 | |
| symbols | | 12 | |
| Allocated slots per 2 frames | Slots | 19 | |
| MCS table | | 64QAM | |
| MCS index | | 13 | |
| Modulation | | 16QAM | |
| Target Coding Rate | | 0.48 | |
| Number of MIMO layers | | 2 | |
| Number of DMRS REs | | 12 | |
| Overhead for TBS determination | | 0 | |
| Information Bit Payload per Slot | | | |
| For Slot i = 0 | Bits | N/A | |
| For Slots i = 1,, 19 | Bits | 26120 | |
| Transport block CRC per Slot | | | |
| For Slot i = 0 | Bits | N/A | |
| For Slots i = 1,, 19 | Bits | 24 | |
| Number of Code Blocks per Slot | | | |
| For Slot i = 0 | CBs | N/A | |
| For Slots i = 1,, 19 | CBs | 4 | |
| Binary Channel Bits Per Slot | | | |
| For Slot i = 0 | Bits | N/A | |
| For Slots i = 5, 15 | Bits | 50752 | |
| For Slots i = 10 | Bits | 48256 | |
| For Slots i = 11 | Bits | 52416 | |
| For Slots $i = 1,,4,6,,$ | Bits | 54912 | |
| 9,12,14,16,,19 | טונס | J4312 | |
| Max. Throughput averaged over 2 | Mbps | 24.814 | |
| frames | 1110ps | _ | |

SS/PBCH block is transmitted in slot #0 with periodicity 20 ms Slot i is slot index per 2 frames

Table A.3.2.1.1-6: PDSCH Reference Channel for FDD PMI reporting requirements

| Parameter | Unit | | | Value | |
|---------------------------------------|-------|------------|------------|-------|--|
| Reference channel | | R.PDSCH.1- | R.PDSCH.1- | | |
| | | 6.1 FDD | 6.2 FDD | | |
| Channel bandwidth | MHz | 10 | 10 | | |
| Subcarrier spacing | kHz | 15 | 15 | | |
| Number of allocated resource blocks | PRBs | 52 | 52 | | |
| Number of consecutive PDSCH | | 12 | 12 | | |
| symbols | | 12 | | | |
| Allocated slots per 2 frames | Slots | 15 | 15 | | |
| MCS table | | 64QAM | 64QAM | | |
| MCS index | | 13 | 13 | | |
| Modulation | | 16QAM | 16QAM | | |
| Target Coding Rate | | 0.48 | 0.48 | | |
| Number of MIMO layer | | 1 | 2 | | |
| Number of DMRS REs (Note 3) | | 24 | 24 | | |
| Overhead for TBS determination | | 0 | 0 | | |
| Information Bit Payload per Slot | | | | | |
| For Slot i = 0 | Bits | N/A | N/A | | |
| For CSI Slots i, if mod (i,5) =1, | | N/A | N/A | | |
| i={0,,19} | | IN/A | IN/A | | |
| For Non CSI-RS Slot i, if mod (i,5) | Bits | 12040 | 24072 | | |
| ={0,2,3,4}, i={1,19} | סונס | 12040 | 24072 | | |
| Transport block CRC per Slot | | | | | |
| For Slot i = 0 | Bits | N/A | N/A | | |
| For CSI Slots i, if mod (i,5) =1, | | N/A | N/A | | |
| i={0,,19} | | IN/A | IN/A | | |
| For Non CSI-RS Slot i, if mod (i,5) | Bits | 24 | 24 | | |
| $=\{0,2,3,4\}, i=\{1,19\}$ | סונס | 24 | 24 | | |
| Number of Code Blocks per Slot | | | | | |
| For Slot i = 0 | CBs | N/A | N/A | | |
| For CSI Slots i, if mod $(i,5) = 1$, | | N/A | N/A | | |
| i={0,,19} | | IN//A | IN//A | | |
| For Non CSI-RS Slot i, if mod (i,5) | CBs | 2 | 3 | | |
| ={0,2,3,4}, i={1,,19} | 003 | | ŭ | | |
| Binary Channel Bits Per Slot | | | | | |
| For Slot i = 0 | Bits | N/A | N/A | | |
| For CSI Slots i, if mod (i,5) =1, | | N/A | N/A | | |
| i={0,,19} | | | · | | |
| For Slots i = 10 | Bits | 23712 | 47424 | | |
| For Non CSI-RS Slot i, if mod (i,5) | Bits | 24960 | 49920 | | |
| ={0,2,3,4}, i={1,9,11,,19} | טוט | 2-300 | 70020 | | |
| Max. Throughput averaged over 2 | Mbps | 9.030 | 18.054 | | |
| frames | · | | 10.004 | | |

SS/PBCH block is transmitted in slot #0 with periodicity 20 ms Note 1:

Note 2:

Slot i is slot index per 2 frames
Number of DMRS REs includes the overhead of the DM-RS CDM groups without data Note 3:

Table A.3.2.1.1-7: PDSCH Reference Channel for FDD LTE-NR coexistence scenario

| Parameter | Unit | Value | | | | | |
|---|-------|-----------------------|-----------------------|--|--|--|--|
| Reference channel | | R.PDSCH.1- 7.1 FDD | R.PDSCH.1- 7.2 FDD | | | | |
| Channel bandwidth | MHz | 10 | 10 | | | | |
| Subcarrier spacing | kHz | 15 | 15 | | | | |
| Number of allocated resource blocks | PRBs | 52 | 52 | | | | |
| Number of consecutive PDSCH symbols | TREG | 9 | 11 | | | | |
| Allocated slots per 2 frames | Slots | 16 | 16 | | | | |
| MCS table | | 64QAM | 64QAM | | | | |
| MCS index | | 4 | 4 | | | | |
| Modulation | | QPSK | QPSK | | | | |
| Target Coding Rate | | 0.30 | 0.30 | | | | |
| Number of MIMO layers | | 1 | 1 | | | | |
| Number of DMRS REs | | 12 | 12 | | | | |
| Overhead for TBS determination | | 18 | 18 | | | | |
| Information Bit Payload per Slot | | | | | | | |
| For Slots i = 0,5,10,15 | Bits | N/A | N/A | | | | |
| For Slots i, if $mod(i, 5) = \{1,2,3,4\}$ for i from $\{0,,19\}$ | Bits | 2472 | 3240 | | | | |
| Transport block CRC per Slot | | | | | | | |
| For Slots i = 0,5,10,15 | Bits | N/A | N/A | | | | |
| For Slots i, if $mod(i, 5) = \{1,2,3,4\}$ for i from $\{0,,19\}$ | Bits | 16 | 16 | | | | |
| Number of Code Blocks per Slot | | | | | | | |
| For Slots i = 0,5,10,15 | CBs | N/A | N/A | | | | |
| For Slots i, if $mod(i, 5) = \{1,2,3,4\}$ for i from $\{0,,19\}$ | CBs | 1 | 1 | | | | |
| Binary Channel Bits Per Slot | | | | | | | |
| For Slots i = 0,5,10,15 | Bits | N/A | N/A | | | | |
| For Slots i = 11 | Bits | 7760 | 10256 | | | | |
| For Slots i, if $mod(i, 5) = \{1,2,3,4\}$ for i from $\{1,, 9, 12,, 19\}$ | Bits | 8384 | 10880 | | | | |
| Max. Throughput averaged over 2 frames | Mbps | 1.978 | 2.592 | | | | |

SS/PBCH block is transmitted in slot #0 with periodicity 20 ms Note 1:

Note 2:

Slot i is slot index per 2 frames
No user data is scheduled on slots with LTE PBCH/PSS/SSS Note 3:

Table A.3.2.1.1-8: PDSCH Reference Channel for FDD HST scenario

| Parameter | Unit | | Value |
|--|-------|------------|-------|
| Reference channel | | R.PDSCH.1- | |
| Reference channel | | 8.1 FDD | |
| Channel bandwidth | MHz | 10 | |
| Subcarrier spacing | kHz | 15 | |
| Number of allocated resource blocks | PRBs | 52 | |
| Number of consecutive PDSCH | | 12 | |
| symbols | | 12 | |
| Allocated slots per 2 frames | Slots | 19 | |
| MCS table | | 64QAM | |
| MCS index | | 13 | |
| Modulation | | 16QAM | |
| Target Coding Rate | | 0.48 | |
| Number of MIMO layers | | 1 | |
| Number of DMRS REs | | 18 | |
| Overhead for TBS determination | | 0 | |
| Information Bit Payload per Slot | | | |
| For Slot i = 0 | Bits | N/A | |
| For Slots i = 1,, 19 | Bits | 12552 | |
| Transport block CRC per Slot | | | |
| For Slot i = 0 | Bits | N/A | |
| For Slots i = 1,, 19 | Bits | 24 | |
| Number of Code Blocks per Slot | | | |
| For Slot i = 0 | CBs | N/A | |
| For Slots i = 1,, 19 | CBs | 2 | |
| Binary Channel Bits Per Slot | | | |
| For Slot i = 0 | Bits | N/A | |
| For Slots i = 1,2,11,12 | Bits | 24960 | |
| For Slots i = 3,, 10, 13,, 19 | Bits | 26208 | |
| Max. Throughput averaged over 2 | Mbps | 11.924 | |
| frames Note 1: SS/PBCH block is transmitt | • | | |

Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms Note 2: Slot i is slot index per 2 frames

Reference measurement channels for SCS 30 kHz FR1 A.3.2.1.2

Table A.3.2.1.2-1: PDSCH Reference Channel for FDD (64QAM)

| Parameter | Unit | | Value |
|--|------------|-------------------|----------|
| Deference showned | | R.PDSCH.2- | |
| Reference channel | | 1.1 FDD | |
| Channel bandwidth | MHz | 20 | |
| Subcarrier spacing | kHz | 30 | |
| Number of allocated resource blocks | PRBs | 51 | |
| Number of consecutive PDSCH symbols | | 12 | |
| Allocated slots per 2 frames | Slots | 39 | |
| MCS table | | 64QAM | |
| MCS index | | 19 | |
| Modulation | | 64QAM | |
| Target Coding Rate | | 0.51 | |
| Number of MIMO layers | | 2 | |
| Number of DMRS REs | | 12 | |
| Overhead for TBS determination | | 0 | |
| Information Bit Payload per Slot | | | |
| For Slot i = 0 | Bits | N/A | |
| For Slots i = 1,, 39 | Bits | 40976 | |
| Transport block CRC per Slot | | | |
| For Slot i = 0 | Bits | N/A | |
| For Slots i = 1,, 39 | Bits | 24 | |
| Number of Code Blocks per Slot | | | |
| For Slot i = 0 | CBs | N/A | |
| For Slots i = 1,, 39 | CBs | 5 | |
| Binary Channel Bits Per Slot | | | |
| For Slot i = 0 | Bits | N/A | |
| For Slots i = 20, 21 | Bits | 77112 | |
| For Slots i = 1,, 19, 22,, 39 | Bits | 80784 | |
| Max. Throughput averaged over 2 frames | Mbps | 79.903 | |
| Note 1: SS/PBCH block is transmitted | ed in slot | #0 with periodici | ty 20 ms |

Note 1: SS/PBCH block is transmitted in Note 2: Slot i is slot index per 2 frames

A.3.2.1.3 Reference measurement channels for SCS 60 kHz FR1

A.3.2.1.4 Reference measurement channels for E-UTRA

Table A.3.2.1.4-1: PDSCH Reference Channel for sustained data-rate test (64QAM, 2 MIMO layers)

| Parameter | Unit | | | | |
|--|------|------------|------------|------------|------------|
| Reference channel | | R.PDSCH.4- | R.PDSCH.4- | R.PDSCH.4- | R.PDSCH.4- |
| | | 1.1 FDD | 1.2 FDD | 1.3 FDD | 1.4 FDD |
| Channel bandwidth | MHz | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | Note 6 | Note 7 | Note 8 | Note 9 |
| Allocated subframes per Radio Frame | | 9 | 10 | 10 | 10 |
| Modulation | | 64QAM | 64QAM | 64QAM | 64QAM |
| Coding Rate | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9, | | 0.85 | 0.85 | 0.85 | 0.88 |
| For Sub-Frame 5 | | N/A | 0.89 | 0.91 | 0.87 |
| For Sub-Frame 0 | | 0.83 | 0.90 | 0.88 | 0.90 |
| Information Bit Payload (Note 3) | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 18336 | 36696 | 55056 | 75376 |
| For Sub-Frame 5 | Bits | N/A | 35160 | 52752 | 71112 |
| For Sub-Frame 0 | Bits | 15840 | 36696 | 55056 | 75376 |
| Number of Code Blocks | | | | | |
| (Notes 3 and 4) | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | CBs | 3 | 6 | 9 | 13 |
| For Sub-Frame 5 | CBs | N/A | 6 | 9 | 12 |
| For Sub-Frame 0 | CBs | 3 | 6 | 9 | 13 |
| Binary Channel Bits (Note 3) | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 21600 | 43200 | 64800 | 86400 |
| For Sub-Frame 5 | Bits | N/A | 39744 | 60480 | 82080 |
| For Sub-Frame 0 | Bits | 19152 | 40752 | 62352 | 83952 |
| Number of layers | | 2 | 2 | 2 | 2 |
| Max. Throughput averaged over 1 frame (Note 3) | Mbps | 16.253 | 36.542 | 54.826 | 74.950 |

Note 1: 1 symbol allocated to PDCCH for all tests.

Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [15].

Note 3: Given per component carrier per codeword.

Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).

Note 5: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.

Note 6: Resource blocks $n_{PRB} = 0..24$ in sub-frames 0,1,2,3,4,6,7,8,9.

Note 7: Resource blocks $n_{PRB} = 3..49$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..49$ in sub-frames 0,1,2,3,4,6,7,8,9.

Note 8: Resource blocks nPRB = 4..74 are allocated for the user data in sub-frame 5, and resource blocks nPRB = 0..74 in sub-frames 0,1,2,3,4,6,7,8,9.

Note 9: Resource blocks $n_{PRB} = 4..99$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..99$ in sub-frames 0,1,2,3,4,6,7,8,9.

Table A.3.2.1.4-2: PDSCH Reference Channel for sustained data-rate test (64QAM, 4 MIMO layers)

| Parameter | Unit | | Va | lue | |
|--|------|------------|------------|------------|------------|
| Reference channel | | R.PDSCH.4- | R.PDSCH.4- | R.PDSCH.4- | R.PDSCH.4- |
| | | 2.1 FDD | 2.2 FDD | 2.3 FDD | 2.4 FDD |
| Channel bandwidth | MHz | 5 | 10 | 15 | 20 |
| Allocated resource blocks | | Note 6 | Note 7 | Note 8 | Note 9 |
| Allocated subframes per Radio Frame | | 9 | 10 | 10 | 10 |
| Modulation | | 64QAM | 64QAM | 64QAM | 64QAM |
| Coding Rate | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9, | | 0.78 | 0.78 | 0.77 | 0.79 |
| For Sub-Frame 5 | | N/A | 0.80 | 0.79 | 0.81 |
| For Sub-Frame 0 | | 0.85 | 0.83 | 0.8 | 0.81 |
| Information Bit Payload (Note 3) | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 31704 | 63776 | 93800 | 128496 |
| For Sub-Frame 5 | Bits | N/A | 59256 | 90816 | 124464 |
| For Sub-Frame 0 | Bits | 30576 | 63776 | 93800 | 128496 |
| Number of Code Blocks | | | | | |
| (Notes 3 and 4) | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | CBs | 6 | 11 | 16 | 21 |
| For Sub-Frame 5 | CBs | N/A | 10 | 15 | 21 |
| For Sub-Frame 0 | CBs | 5 | 11 | 16 | 21 |
| Binary Channel Bits (Note 3) | | | | | |
| For Sub-Frames 1,2,3,4,6,7,8,9 | Bits | 40800 | 81600 | 122400 | 163200 |
| For Sub-Frame 5 | Bits | N/A | 74976 | 114144 | 154944 |
| For Sub-Frame 0 | Bits | 36192 | 76992 | 117792 | 158592 |
| Number of layers | | 4 | 4 | 4 | 4 |
| Max. Throughput averaged over 1 frame (Note 3) | Mbps | 28.421 | 63.324 | 93.502 | 128.093 |

- Note 1: 1 symbol allocated to PDCCH for all tests.
- Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [15].
- Note 3: Given per component carrier per codeword.
- Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
- Note 5: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 6: Resource blocks $n_{PRB} = 0..24$ in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 7: Resource blocks $n_{PRB} = 3..49$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..49$ in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 8: Resource blocks nPRB = 4..74 are allocated for the user data in sub-frame 5, and resource blocks nPRB = 0..74 in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0,1,2,3,4,6,7,8,9.

Table A.3.2.1.4-3: PDSCH Reference Channel for sustained data-rate test (256QAM, 2 MIMO layers)

| Parameter | Unit | Value | | | | |
|--|------|------------|------------|------------|------------|--|
| Reference channel | | R.PDSCH.4- | R.PDSCH.4- | R.PDSCH.4- | R.PDSCH.4- | |
| | | 3.1 FDD | 3.2 FDD | 3.3 FDD | 3.4 FDD | |
| Channel bandwidth | MHz | 5 | 10 | 15 | 20 | |
| Allocated resource blocks | | Note 6 | Note 7 | Note 8 | Note 9 | |
| Allocated subframes per Radio Frame | | 10 | 10 | 10 | 10 | |
| Modulation | | 256QAM | 256QAM | 256QAM | 256QAM | |
| Coding Rate | | | | | | |
| For Sub-Frames 3,4,8,9 | | 0.85 | 0.85 | 0.88 | 0.85 | |
| For Sub-Frames 1,2,6,7 | | 0.77 | 0.74 | 0.74 | 0.74 | |
| For Sub-Frame 5 | | 0.79 | 0.77 | 0.77 | 0.75 | |
| For Sub-Frame 0 | | 0.84 | 0.78 | 0.77 | 0.76 | |
| Information Bit Payload (Note 3) | | | | | | |
| For Sub-Frames 3,4,8,9 | Bits | 24496 | 48936 | 75376 | 97896 | |
| For Sub-Frames 1,2,6,7 | Bits | 21384 | 42368 | 63776 | 84760 | |
| For Sub-Frame 5 | Bits | 19848 | 40576 | 61664 | 81176 | |
| For Sub-Frame 0 | Bits | 21384 | 42368 | 63776 | 84760 | |
| Number of Code Blocks | | | | | | |
| (Notes 3 and 4) | | | | | | |
| For Sub-Frames 3,4,8,9 | CBs | 4 | 8 | 13 | 16 | |
| For Sub-Frames 1,2,6,7 | CBs | 4 | 7 | 11 | 14 | |
| For Sub-Frame 5 | CBs | 4 | 7 | 11 | 14 | |
| For Sub-Frame 0 | CBs | 4 | 7 | 11 | 14 | |
| Binary Channel Bits (Note 3) | | | | | | |
| For Sub-Frames 3,4,8,9 | Bits | 28800 | 57600 | 86400 | 115200 | |
| For Sub-Frames 1,2,6,7 | Bits | 28800 | 57600 | 86400 | 115200 | |
| For Sub-Frame 5 | Bits | 25344 | 52992 | 80640 | 109440 | |
| For Sub-Frame 0 | Bits | 25536 | 54336 | 83136 | 111936 | |
| Number of layers | | 2 | 2 | 2 | 2 | |
| Max. Throughput averaged over 1 frame (Note 3) | Mbps | 22.475 | 44.816 | 68.205 | 89.656 | |

- Note 1: 1 symbol allocated to PDCCH for all tests.
- Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [15].
- Note 3: Given per component carrier per codeword.
- Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
- Note 5: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 6: Resource blocks $n_{PRB} = 2..24$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..24$ in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 8: Resource blocks nPRB = 4..74 are allocated for the user data in sub-frame 5, and resource blocks nPRB = 0..74 in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0,1,2,3,4,6,7,8,9.

Table A.3.2.1.4-4: PDSCH Reference Channel for sustained data-rate test (256QAM, 4 MIMO layers)

| Parameter | Unit | Value | | | | |
|--|------|------------|------------|------------|------------|--|
| Reference channel | | R.PDSCH.4- | R.PDSCH.4- | R.PDSCH.4- | R.PDSCH.4- | |
| | | 4.1 FDD | 4.2 FDD | 4.3 FDD | 4.4 FDD | |
| Channel bandwidth | MHz | 5 | 10 | 15 | 20 | |
| Allocated resource blocks | | Note 6 | Note 7 | Note 8 | Note 9 | |
| Allocated subframes per Radio Frame | | 10 | 10 | 10 | 10 | |
| Modulation | | 256QAM | 256QAM | 256QAM | 256QAM | |
| Coding Rate | | | | | | |
| For Sub-Frames 3,4,8,9 | | 0.85 | 0.78 | 0.79 | 0.78 | |
| For Sub-Frames 1,2,6,7 | | 0.77 | 0.78 | 0.79 | 0.78 | |
| For Sub-Frame 5 | | 0.79 | 0.82 | 0.82 | 0.786 | |
| For Sub-Frame 0 | | 0.84 | 0.83 | 0.82 | 0.80 | |
| Information Bit Payload (Note 3) | | | | | | |
| For Sub-Frames 3,4,8,9 | Bits | 42368 | 84760 | 128496 | 169544 | |
| For Sub-Frames 1,2,6,7 | Bits | 42368 | 84760 | 128496 | 169544 | |
| For Sub-Frame 5 | Bits | 39232 | 81176 | 124464 | 161760 | |
| For Sub-Frame 0 | Bits | 39232 | 84760 | 128496 | 169544 | |
| Number of Code Blocks | | | | | | |
| (Notes 3 and 4) | | | | | | |
| For Sub-Frames 3,4,8,9 | CBs | 7 | 14 | 21 | 28 | |
| For Sub-Frames 1,2,6,7 | CBs | 7 | 14 | 21 | 28 | |
| For Sub-Frame 5 | CBs | 7 | 14 | 21 | 27 | |
| For Sub-Frame 0 | CBs | 7 | 14 | 21 | 28 | |
| Binary Channel Bits (Note 3) | | | | | | |
| For Sub-Frames 3,4,8,9 | Bits | 54400 | 108800 | 163200 | 217600 | |
| For Sub-Frames 1,2,6,7 | Bits | 54400 | 108800 | 163200 | 217600 | |
| For Sub-Frame 5 | Bits | 47744 | 99968 | 152192 | 206592 | |
| For Sub-Frame 0 | Bits | 48256 | 102656 | 157056 | 211456 | |
| Number of layers | | 4 | 4 | 4 | 4 | |
| Max. Throughput averaged over 1 frame (Note 3) | Mbps | 41.741 | 84.4016 | 128.093 | 168.766 | |

- Note 1: 1 symbol allocated to PDCCH for all tests.
- Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [15].
- Note 3: Given per component carrier per codeword.
- Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
- Note 5: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 6: Resource blocks $n_{PRB} = 2..24$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..24$ in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 8: Resource blocks nPRB = 4..74 are allocated for the user data in sub-frame 5, and resource blocks nPRB = 0..74 in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0,1,2,3,4,6,7,8,9.

Table A.3.2.1.4-5: PDSCH Reference Channel for sustained data-rate test (1024QAM, 2 MIMO layers)

| Parameter | Unit | Value | | | | |
|--|------|------------|------------|------------|------------|--|
| Reference channel | | R.PDSCH.4- | R.PDSCH.4- | R.PDSCH.4- | R.PDSCH.4- | |
| | | 5.1 FDD | 5.2 FDD | 5.3 FDD | 5.4 FDD | |
| Channel bandwidth | MHz | 5 | 10 | 15 | 20 | |
| Allocated resource blocks | | Note 6 | Note 7 | Note 8 | Note 9 | |
| Allocated subframes per Radio Frame | | 10 | 10 | 10 | 10 | |
| Modulation | | 1024QAM | 1024QAM | 1024QAM | 1024QAM | |
| Coding Rate | | | | | | |
| For Sub-Frames 3,4,8,9 | | 0.76 | 0.73 | 0.75 | 0.76 | |
| For Sub-Frames 1,2,6,7 | | 0.76 | 0.73 | 0.75 | 0.76 | |
| For Sub-Frame 5 | | 0.80 | 0.77 | 0.78 | 0.77 | |
| For Sub-Frame 0 | | 0.86 | 0.78 | 0.78 | 0.79 | |
| Information Bit Payload (Note 3) | | | | | | |
| For Sub-Frames 3,4,8,9 | Bits | 27376 | 52752 | 81176 | 110136 | |
| For Sub-Frames 1,2,6,7 | Bits | 27376 | 52752 | 81176 | 110136 | |
| For Sub-Frame 5 | Bits | 25456 | 51024 | 78704 | 105528 | |
| For Sub-Frame 0 | Bits | 27376 | 52752 | 81176 | 110136 | |
| Number of Code Blocks | | | | | | |
| (Notes 3 and 4) | | | | | | |
| For Sub-Frames 3,4,8,9 | CBs | 5 | 9 | 14 | 18 | |
| For Sub-Frames 1,2,6,7 | CBs | 5 | 9 | 14 | 18 | |
| For Sub-Frame 5 | CBs | 5 | 9 | 13 | 18 | |
| For Sub-Frame 0 | CBs | 5 | 9 | 14 | 18 | |
| Binary Channel Bits (Note 3) | | | | | | |
| For Sub-Frames 3,4,8,9 | Bits | 36000 | 72000 | 108000 | 144000 | |
| For Sub-Frames 1,2,6,7 | Bits | 36000 | 72000 | 108000 | 144000 | |
| For Sub-Frame 5 | Bits | 31680 | 66240 | 100800 | 136800 | |
| For Sub-Frame 0 | Bits | 31920 | 67920 | 103920 | 139920 | |
| Number of layers | | 2 | 2 | 2 | 2 | |
| Max. Throughput averaged over 1 frame (Note 3) | Mbps | 27.18 | 52.58 | 80.93 | 109.68 | |

- Note 1: 1 symbol allocated to PDCCH for all tests.
- Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [15].
- Note 3: Given per component carrier per codeword.
- Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
- Note 5: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 6: Resource blocks $n_{PRB} = 2..24$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..24$ in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 8: Resource blocks nPRB = 4..74 are allocated for the user data in sub-frame 5, and resource blocks nPRB = 0..74 in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0,1,2,3,4,6,7,8,9.

Table A.3.2.1.4-6: PDSCH Reference Channel for sustained data-rate test (1024QAM, 4 MIMO layers)

| Parameter | Unit | Value | | | | |
|--|------|------------|------------|------------|------------|--|
| Reference channel | | R.PDSCH.4- | R.PDSCH.4- | R.PDSCH.4- | R.PDSCH.4- | |
| | | 6.1 FDD | 6.2 FDD | 6.3 FDD | 6.4 FDD | |
| Channel bandwidth | MHz | 5 | 10 | 15 | 20 | |
| Allocated resource blocks | | Note 6 | Note 7 | Note 8 | Note 9 | |
| Allocated subframes per Radio Frame | | 10 | 10 | 10 | 10 | |
| Modulation | | 1024QAM | 1024QAM | 1024QAM | 1024QAM | |
| Coding Rate | | | | | | |
| For Sub-Frames 3,4,8,9 | | 0.78 | 0.81 | 0.79 | 0.81 | |
| For Sub-Frames 1,2,6,7 | | 0.78 | 0.81 | 0.79 | 0.81 | |
| For Sub-Frame 5 | | 0.82 | 0.81 | 0.83 | 0.82 | |
| For Sub-Frame 0 | | 0.87 | 0.86 | 0.82 | 0.83 | |
| Information Bit Payload (Note 3) | | | | | | |
| For Sub-Frames 3,4,8,9 | Bits | 52752 | 110136 | 161760 | 220296 | |
| For Sub-Frames 1,2,6,7 | Bits | 52752 | 110136 | 161760 | 220296 | |
| For Sub-Frame 5 | Bits | 48936 | 101840 | 157432 | 211936 | |
| For Sub-Frame 0 | Bits | 52752 | 110136 | 161760 | 220296 | |
| Number of Code Blocks | | | | | | |
| (Notes 3 and 4) | | | | | | |
| For Sub-Frames 3,4,8,9 | CBs | 9 | 18 | 27 | 36 | |
| For Sub-Frames 1,2,6,7 | CBs | 9 | 18 | 27 | 36 | |
| For Sub-Frame 5 | CBs | 8 | 17 | 26 | 35 | |
| For Sub-Frame 0 | CBs | 9 | 18 | 27 | 36 | |
| Binary Channel Bits (Note 3) | | | | | | |
| For Sub-Frames 3,4,8,9 | Bits | 68000 | 136000 | 204000 | 272000 | |
| For Sub-Frames 1,2,6,7 | Bits | 68000 | 136000 | 204000 | 272000 | |
| For Sub-Frame 5 | Bits | 59680 | 124960 | 190240 | 258240 | |
| For Sub-Frame 0 | Bits | 60320 | 128320 | 196320 | 264320 | |
| Number of layers | | 4 | 4 | 4 | 4 | |
| Max. Throughput averaged over 1 frame (Note 3) | Mbps | 52.37 | 109.31 | 161.33 | 219.46 | |

- Note 1: 1 symbol allocated to PDCCH for all tests.
- Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [15].
- Note 3: Given per component carrier per codeword.
- Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
- Note 5: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 6: Resource blocks $n_{PRB} = 2..24$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..24$ in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 8: Resource blocks nPRB = 4..74 are allocated for the user data in sub-frame 5, and resource blocks nPRB = 0..74 in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0,1,2,3,4,6,7,8,9.

A.3.2.2 TDD

- A.3.2.2.1 Reference measurement channels for SCS 15 kHz FR1
- A.3.2.2.2 Reference measurement channels for SCS 30 kHz FR1

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

| Parameter | Unit | | | Value | | |
|--|------|------------------|------------|------------|---|--|
| Reference channel | | R.PDSCH.2- | R.PDSCH.2- | R.PDSCH.2- | | |
| | | 1.1 TDD | 1.2 TDD | 1.3 TDD | | |
| Channel bandwidth | MHz | 40 | 40 | 40 | | |
| Subcarrier spacing | kHz | 30 | 30 | 30 | | |
| Allocated resource blocks | PRBs | 106 | 6 | 106 | | |
| Number of consecutive PDSCH | | | | | | |
| symbols | | | | | | |
| For Slot i, if $mod(i, 10) = 7$ for i from | | 4 | 4 | NI/A | | |
| {0,,39} | | 4 | 4 | N/A | | |
| For Slot i, if mod(i, 10) = | | 40 | 40 | 7 | | |
| {0,1,2,3,4,5,6} for i from {1,,39} | | 12 | 12 | 7 | | |
| Allocated slots per 2 frames | | 31 | 31 | 27 | | |
| MCS table | | 64QAM | 64QAM | 64QAM | | |
| MCS index | | 4 | 4 | 4 | | |
| Modulation | | QPSK | QPSK | QPSK | | |
| Target Coding Rate | | 0.30 | 0.30 | 0.30 | | |
| Number of MIMO layers | | 1 | 1 | 1 | | |
| Number of DMRS REs | | 1 | 1 | 1 | | |
| For Slot i, if mod(i, 10) = 7 for i from | | | | + | | |
| | | 6 | 6 | N/A | | |
| {0,,39} | | | | | | |
| For Slot i, if mod(i, 10) = | | 18 | 12 | 12 | | |
| {0,1,2,3,4,5,6} for i from {1,,39} | | | | | | |
| Overhead for TBS determination | | 0 | 0 | 0 | | |
| Information Bit Payload per Slot | | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | Bits | N/A | N/A | N/A | | |
| (8,9) for i from (0,,39) | Dito | 14// (| 14// (| 14/71 | | |
| For Slot i, if $mod(i, 10) = 7$ for i from | Bits | 2664 | 144 | N/A | | |
| {0,,39} | Dita | 2004 | 144 | IN/ A | | |
| For Slot i, if mod(i, 10) = | Bits | 8064 | 480 | 4608 | | |
| {0,1,2,3,4,5,6} for i from {1,,39} | Dita | 0004 | 400 | 4000 | | |
| Transport block CRC per Slot | | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | D:4- | NI/A | NI/A | NI/A | | |
| {8,9} for i from {0,,39} | Bits | N/A | N/A | N/A | | |
| For Slot i, if mod(i, 10) = 7 for i from | D:: | 4.0 | 4.0 | N1/A | | |
| {0,,39} | Bits | 16 | 16 | N/A | | |
| For Slot i, if mod(i, 10) = | | | | | | |
| {0,1,2,3,4,5,6} for i from {1,,39} | Bits | 24 | 16 | 24 | | |
| Number of Code Blocks per Slot | | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | | | | | | |
| {8,9} for i from {0,,39} | CBs | N/A | N/A | N/A | | |
| For Slot i, if $mod(i, 10) = 7$ for i from | | | | | | |
| {0,,39} | CBs | 1 | 1 | N/A | | |
| For Slot i, if mod(i, 10) = | | | | | | |
| {0,1,2,3,4,5,6} for i from {1,,39} | CBs | 1 | 1 | 1 | | |
| Binary Channel Bits Per Slot | + | | | + | | |
| For Slots 0 and Slot i, if mod(i, 10) = | | | | | | |
| {8,9} for i from {0,,39} | Bits | N/A | N/A | N/A | | |
| | Dito | 25440 | 1510 | 12002 | | |
| For Slots i = 20, 21 | Bits | 25440 | 1512 | 13992 | | |
| For Slot i, if $mod(i, 10) = 7$ for i from | Bits | 8904 | 504 | N/A | | |
| (0,,39) | | | | | | |
| For Slot i, if mod(i, 10) = | D.: | 00710 | 4504 | 45004 | | |
| (0,1,2,3,4,5,6) for i from | Bits | 26712 | 1584 | 15264 | | |
| {1,,19,22,,39} | 1 | | | | | |
| Max. Throughput averaged over 2 | Mbps | 11.419 | 0.677 | 6.221 | | |
| rames | · | | | 0.221 | | |
| Note 1: SS/PBCH block is transmitted | | with periodicity | / 20 ms | - | • | |

Table A.3.2.2.2-2: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-1 (16QAM)

| Parameter | Unit | | | Value | | | |
|---|------|------------------|------------|------------|------------|--|--|
| Reference channel | | R.PDSCH.2- | R.PDSCH.2- | R.PDSCH.2- | R.PDSCH.2- | | |
| | | 2.1 TDD | 2.2 TDD | 2.3 TDD | 2.4 TDD | | |
| Channel bandwidth | MHz | 40 | 40 | 40 | 40 | | |
| Subcarrier spacing | kHz | 30 | 30 | 30 | 30 | | |
| Allocated resource blocks | PRBs | 106 | 106 | 106 | 106 | | |
| Number of consecutive PDSCH | | | | | | | |
| symbols For Slot i, if mod(i, 10) = 7 for i from | | | | | | | |
| {0,,39} | | 4 | 4 | 4 | 4 | | |
| For Slot i, if mod(i, 10) = | | 12 | 12 | 12 | 12 | | |
| {0,1,2,3,4,5,6} for i from {1,,39} | | | | | | | |
| Allocated slots per 2 frames | | 31 | 31 | 31 | 31 | | |
| MCS table | | 64QAM | 64QAM | 64QAM | 64QAM | | |
| MCS index | | 13 | 13 | 13 | 13 | | |
| Modulation | | 16QAM | 16QAM | 16QAM | 16QAM | | |
| Target Coding Rate | | 0.48 | 0.48 | 0.48 | 0.48 | | |
| Number of MIMO layers | | 1 | 2 | 3 | 4 | | |
| Number of DMRS REs | | | | | | | |
| For Slot i, if $mod(i, 10) = 7$ for i from $\{0,,39\}$ | | 6 | 6 | 12 | 12 | | |
| For Slot i, if mod(i, 10) = | | 12 | 12 | 24 | 24 | | |
| {0,1,2,3,4,5,6} for i from {1,,39} Overhead for TBS determination | | 0 | 0 | 0 | 0 | | |
| Information Bit Payload per Slot | | 0 | 0 | U | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | | | | | | | |
| $\{8,9\}$ for i from $\{0,,39\}$ | Bits | N/A | N/A | N/A | N/A | | |
| For Slot i, if mod(i, 10) = 7 for i from | | | | | | | |
| {0,,39} | Bits | 8456 | 16896 | 22032 | 29192 | | |
| For Slot i, if mod(i, 10) = | Dita | 20022 | 52200 | 70770 | 00070 | | |
| {0,1,2,3,4,5,6} for i from {1,,39} | Bits | 26632 | 53288 | 73776 | 98376 | | |
| Transport block CRC per Slot | | | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39} | Bits | N/A | N/A | N/A | N/A | | |
| For Slot i, if $mod(i, 10) = 7$ for i from | Bits | 24 | 24 | 24 | 24 | | |
| {0,,39} | Dita | 24 | 24 | 24 | 24 | | |
| For Slot i, if mod(i, 10) = | Bits | 24 | 24 | 24 | 24 | | |
| {0,1,2,3,4,5,6}for i from {1,,39} Number of Code Blocks per Slot | | | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | | | | | | | |
| $\{8,9\}$ for i from $\{0,,39\}$ | CBs | N/A | N/A | N/A | N/A | | |
| For Slot i, if mod(i, 10) = 7 for i from | CBs | 2 | 3 | 3 | 4 | | |
| {0,,39} | CDS | 2 | 3 | 3 | 4 | | |
| For Slot i, if mod(i, 10) = | CBs | 4 | 7 | 9 | 12 | | |
| {0,1,2,3,4,5,6} for i from {1,,39} | ODS | 7 | ' | 3 | 12 | | |
| Binary Channel Bits Per Slot | | | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | Bits | N/A | N/A | N/A | N/A | | |
| {8,9} for i from {0,,39} | | | | | | | |
| For Slots i = 20, 21 | Bits | 53424 | 106848 | 144008 | 193344 | | |
| For Slot i, if $mod(i, 10) = 7$ for i from $\{0,,39\}$ | Bits | 17808 | 35616 | 45792 | 61056 | | |
| For Slot i, if mod(i, 10) = | | | | | | | |
| {0,1,2,3,4,5,6} for i from | Bits | 55968 | 111936 | 152640 | 203520 | | |
| {1,,19,22,,39} | | | | | | | |
| Max. Throughput averaged over 2 | Mbps | 37.644 | 75.318 | 104.004 | 138.646 | | |
| frames | | | | | | | |
| Note 1: SS/PBCH block is transmitte | | #U with periodic | City 20 ms | | | | |
| Note 2: Slot i is slot index per 2 frames | | | | | | | |

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

| Parameter | Unit | | Value | | | | |
|--|--------------|-----------------------|-------|--|--|--|--|
| Reference channel | | R.PDSCH.2- 3.1 TDD | | | | | |
| Channel bandwidth | MHz | 40 | | | | | |
| Subcarrier spacing | kHz | 30 | | | | | |
| Allocated resource blocks | PRBs | 106 | | | | | |
| Number of consecutive PDSCH | | | | | | | |
| symbols | | | | | | | |
| For Slot i, if $mod(i, 10) = 7$ for i from $\{0,,39\}$ | | 4 | | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ for i from $\{1,,39\}$ | | 12 | | | | | |
| Allocated slots per 2 frames | | 31 | | | | | |
| MCS table | | 64QAM | | | | | |
| MCS index | | 19 | | | | | |
| Modulation | | 64QAM | | | | | |
| Target Coding Rate | | 0.51 | | | | | |
| Number of MIMO layers | | 2 | | | | | |
| Number of DMRS REs | | | | | | | |
| For Slot i, if mod(i, 10) = 7 for i from $\{0,,39\}$ | | 6 | | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ for i from $\{1,,39\}$ | | 12 | | | | | |
| Overhead for TBS determination | | 0 | | | | | |
| Information Bit Payload per Slot | | | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39} | Bits | N/A | | | | | |
| For Slot i, if $mod(i, 10) = 7$ for i from $\{0,,39\}$ | Bits | 27144 | | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ | Bits | 83976 | | | | | |
| for i from {1,,39} Transport block CRC per Slot | | | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | | | | | | | |
| {8,9} for i from {0,,39} | Bits | N/A | | | | | |
| For Slot i, if mod(i, 10) = 7 for i from $\{0,,39\}$ | Bits | 24 | | | | | |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39} | Bits | 24 | | | | | |
| Number of Code Blocks per Slot | | | | | | | |
| For Slots 0 and Slot i, if $mod(i, 10) = \{8,9\}$ for i from $\{0,,39\}$ | CBs | N/A | | | | | |
| For Slot i, if $mod(i, 10) = 7$ for i from $\{0,,39\}$ | CBs | 4 | | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ for i from $\{1,,39\}$ | CBs | 10 | | | | | |
| Binary Channel Bits Per Slot | | | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39} | Bits | N/A | | | | | |
| For Slots i = 20, 21 | Bits | 160272 | | | | | |
| For Slot i, if mod(i, 10) = 7 for i from {0,,39} | Bits | 53424 | | | | | |
| For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,6\}$ for i from $\{1,,19,22,,39\}$ | Bits | 167904 | | | | | |
| Max. Throughput averaged over 2 frames | Mbps | 118.796 | | | | | |
| | n slot #0 14 | ith periodicity 20 |) me | | | | |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms Note 2: Slot i is slot index per 2 frames | | | | | | | |

Table A.3.2.2.4: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-1 (256QAM)

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

Table A.3.2.2.5: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-2

| Parameter | Unit | | Value | | |
|---|--------------|--------------------|--|--|--|
| Reference channel | | R.PDSCH.2- | | | |
| | | 5.1 TDD | | | |
| Channel bandwidth | MHz | 40 | | | |
| Subcarrier spacing | kHz | 30 | | | |
| Allocated resource blocks | PRBs | 106 | | | |
| Number of consecutive PDSCH | | | | | |
| symbols | | | | | |
| For Slot i, if $mod(i, 5) = 3$ for i from | | 8 | | | |
| {0,,39} | | | | | |
| For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i | | 12 | | | |
| from {1,,39} | | 0.4 | | | |
| Allocated slots per 2 frames | | 31 | | | |
| MCS table | | 64QAM | | | |
| MCS index | | 4 | | | |
| Modulation | | QPSK | | | |
| Target Coding Rate | | 0.30 | | | |
| Number of MIMO layers | | 1 | | | |
| Number of DMRS REs | | | | | |
| For Slot i, if $mod(i, 5) = 3$ for i from | | 12 | | | |
| {0,,39} | | | | | |
| For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i | | 12 | | | |
| from {1,,39} Overhead for TBS determination | | 0 | | | |
| Information Bit Payload per Slot | | 0 | | | |
| For Slot 0 and Slot i, if $mod(i, 5) = 4$ for | | | | | |
| i from $\{0,,39\}$ | Bits | N/A | | | |
| For Slot i, if $mod(i, 5) = 3$ for i from | | | | | |
| $\{0,,39\}$ | Bits | 5376 | | | |
| For Slot i, if $mod(i, 5) = \{0, 1, 2\}$ for i | | | | | |
| from {1,,39} | Bits | 8456 | | | |
| Transport block CRC per Slot | | | | | |
| For Slot 0 and Slot i, if $mod(i, 5) = 4$ for | | | | | |
| i from {0,,39} | Bits | N/A | | | |
| For Slot i, if $mod(i, 5) = 3$ for i from | 5 | 0.4 | | | |
| {0,,39} | Bits | 24 | | | |
| For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i | D:4- | 0.4 | | | |
| from {1,,39} | Bits | 24 | | | |
| Number of Code Blocks per Slot | | | | | |
| For Slot 0 and Slot i, if mod(i, 5) = 4 for | CD- | NI/A | | | |
| i from {0,,39} | CBs | N/A | | | |
| For Slot i, if $mod(i, 5) = 3$ for i from | CBs | 1 | | | |
| {0,,39} | CDS | 1 | | | |
| For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i | CBs | 2 | | | |
| from {1,,39} | ODS | | | | |
| Binary Channel Bits Per Slot | | | | | |
| For Slot 0 and Slot i, if $mod(i, 5) = 4$ for | Bits | N/A | | | |
| i from {0,,39} | | | | | |
| For Slot i = 20, 21 | Bits | 26712 | | | |
| For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ | Bits | 17808 | | | |
| For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i | | 1 | + + + + | | |
| For Slot 1, if $mod(1, 5) = \{0, 1, 2\}$ for 1 from $\{1,, 19, 22,, 39\}$ | Bits | 27984 | | | |
| Max. Throughput averaged over 2 | | 1 | | | |
| frames | Mbps | 11.875 | | | |
| Note 1: SS/PBCH block is transmitted | in slot #0 w | ith periodicity 20 | 20 ms | | |
| Note 2: Slot i is slot index per 2 frames | | | | | |

Table A.3.2.2.6: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-3

| Parameter | Unit | | Value | | | |
|--|------|------------|-------|--|--|--|
| Reference channel | | R.PDSCH.2- | | | | |
| Neierence channel | | 6.1 TDD | | | | |
| Channel bandwidth | MHz | 40 | | | | |
| Subcarrier spacing | kHz | 30 | | | | |
| Allocated resource blocks | PRBs | 106 | | | | |
| Number of consecutive PDSCH | | | | | | |
| symbols | | | | | | |
| For Slot i, if $mod(i, 10) = \{3,7\}$ for i from | | 8 | | | | |
| {0,,39} | | - | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,5,6\}$ for | | 12 | | | | |
| i from {1,,39} | | 0.7 | | | | |
| Allocated slots per 2 frames | | 27 | | | | |
| MCS table | | 64QAM | | | | |
| MCS index | | 4 | | | | |
| Modulation | | QPSK | | | | |
| Target Coding Rate | | 0.30 | | | | |
| Number of MIMO layers | | 1 | | | | |
| Number of DMRS REs | | | | | | |
| For Slot i, if $mod(i, 10) = \{3,7\}$ for i from | | 12 | | | | |
| {0,,39} | | | | | | |
| For Slot i, if mod(i, 10) = $\{0,1,2,5,6\}$ for | | 12 | | | | |
| i from {1,,39} Overhead for TBS determination | | 0 | | | | |
| Information Bit Payload per Slot | | U | | | | |
| For Slot 0 and Slot i, if mod(i, 10) = | | | | | | |
| $\{4,8,9\}$ for i from $\{0,,39\}$ | Bits | N/A | | | | |
| For Slot i, if $mod(i, 10) = \{3,7\}$ for i from | | | | | | |
| $\{0,,39\}$ | Bits | 5376 | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,5,6\}$ for | | | | | | |
| i from {1,,39} | Bits | 8456 | | | | |
| Transport block CRC per Slot | | | | | | |
| For Slot 0 and Slot i, if mod(i, 10) = | | | | | | |
| {4,8,9} for i from {0,,39} | Bits | N/A | | | | |
| For Slot i, if $mod(i, 10) = \{3,7\}$ for i from | D., | 0.4 | | | | |
| {0,,39} | Bits | 24 | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,5,6\}$ for | D:1- | 0.4 | | | | |
| i from {1,,39} | Bits | 24 | | | | |
| Number of Code Blocks per Slot | | | | | | |
| For Slot 0 and Slot i, if mod(i, 10) = | CBs | N/A | | | | |
| {4,8,9} for i from {0,,39} | CDS | IN/A | | | | |
| For Slot i, if $mod(i, 10) = \{3,7\}$ for i from | CBs | 1 | | | | |
| {0,,39} | CDS | ' | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,5,6\}$ for | CBs | 2 | | | | |
| i from {1,,39} | 003 | | | | | |
| Binary Channel Bits Per Slot | | | | | | |
| For Slot 0 and Slot i, if mod(i, 10) = | Bits | N/A | | | | |
| {4,8,9} for i from {0,,39} | | | | | | |
| For Slot i = 20, 21 | Bits | 26712 | | | | |
| For Slot i, if $mod(i, 10) = \{3,7\}$ for i from | Bits | 17808 | | | | |
| {0,,39} | | | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,5,6\}$ for | Bits | 27984 | | | | |
| i from {1,,19,22,,39} | | | | | | |
| Max. Throughput averaged over 2 | Mbps | 10.184 | | | | |
| frames | • | | 00 | | | |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms | | | | | | |
| Note 2: Slot i is slot index per 2 frames | | | | | | |

Table A.3.2.2.7: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-1 and CSI-RS overlapped with PDSCH

| Parameter | Unit | | Value | | |
|--|------|--------------------|-------|--|--|
| Reference channel | | R.PDSCH.2- | | | |
| Reference charmer | | 7.1 TDD | | | |
| Channel bandwidth | MHz | 40 | | | |
| Subcarrier spacing | kHz | 30 | | | |
| Allocated resource blocks | PRBs | 106 | | | |
| Number of consecutive PDSCH | | | | | |
| symbols For Slot i, if mod(i, 10) = 7 for i from | | | | | |
| {0,,39} | | 4 | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ | | 40 | | | |
| for i from {1,,39} | | 12 | | | |
| Allocated slots per 2 frames | | 31 | | | |
| MCS table | | 64QAM | | | |
| MCS index | | 13 | | | |
| Modulation | | 16QAM | | | |
| Target Coding Rate | | 0.48 | | | |
| Number of MIMO layers | | 2 | | | |
| Number of DMRS REs For Slot i, if mod(i, 10) = 7 for i from | | | | | |
| $\{0,,39\}$ | | 6 | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ | | | | | |
| for i from {1,,39} | | 12 | | | |
| Overhead for TBS determination | | 0 | | | |
| Information Bit Payload per Slot | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | Bits | N/A | | | |
| {8,9} for i from {0,,39} | Dito | 14/71 | | | |
| For Slot i, if $mod(i, 10) = 7$ for i from | Bits | 16896 | | | |
| $\{0,,39\}$ For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,6\}$ | | | | | |
| For Slot 1, 11 mod(1, 10) = $\{0, 1, 2, 3, 4, 5, 6\}$ for i from $\{1,, 39\}$ | Bits | 53288 | | | |
| Transport block CRC per Slot | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | D., | . | | | |
| {8,9} for i from {0,,39} | Bits | N/A | | | |
| For Slot i, if mod(i, 10) = 7 for i from | Bits | 24 | | | |
| {0,,39} | סונס | 24 | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ | Bits | 24 | | | |
| for i from {1,,39} | | | | | |
| Number of Code Blocks per Slot | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39} | CBs | N/A | | | |
| For Slot i, if $mod(i, 10) = 7$ for i from | | _ | | | |
| {0,,39} | CBs | 3 | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ | CDa | 7 | | | |
| for i from {1,,39} | CBs | 1 | | | |
| Binary Channel Bits Per Slot | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | Bits | N/A | | | |
| {8,9} for i from {0,,39} | | | | | |
| For Slot i, if $mod(i, 10) = \{0,5\}$ for i from | Bits | 103456 | | | |
| {1,,19,22,,39} For Slots i = 20 | Bits | 98368 | | | |
| For Slots i = 20 | Bits | 106848 | | | |
| For Slot i, if $mod(i, 10) = 7$ for i from | | | | | |
| {0,,39} | Bits | 35616 | | | |
| For Slot i, if $mod(i, 10) = \{1,2,3,4,6\}$ for | D:+- | 111000 | | | |
| i from {1,,19,22,,39} | Bits | 111936 | | | |
| Max. Throughput averaged over 2 | Mbps | 75.318 | | | |
| frames | - | | | | |
| Note 1: SS/PBCH block is transmitted i | | ith periodicity 20 |) ms | | |
| Note 2: Slot i is slot index per 2 frames | | | | | |

Table A.3.2.2.2-8: PDSCH Reference Channel for TDD PMI reporting requirements with UL-DL pattern FR1.30-1 (16QAM)

| Parameter | Unit | | | Value |
|--|--------------|------------------|-------------------|-------|
| Reference channel | | R.PDSCH.2- | R.PDSCH.2- | |
| Reference channel | | 8.1 TDD | 8.2 TDD | |
| Channel bandwidth | MHz | 40 | 40 | |
| Subcarrier spacing | kHz | 30 | 30 | |
| Allocated resource blocks | PRBs | 106 | 106 | |
| Number of consecutive PDSCH | | 12 | 12 | |
| symbols | | 12 | 12 | |
| Allocated slots per 2 frames | | 23 | 23 | |
| MCS table | | 64QAM | 64QAM | |
| MCS index | | 13 | 13 | |
| Modulation | | 16QAM | 16QAM | |
| Target Coding Rate | | 0.48 | 0.48 | |
| Number of MIMO layers | | 1 | 2 | |
| Number of DMRS REs (Note 3) | | 24 | 24 | |
| Overhead for TBS determination | | 0 | 0 | |
| Information Bit Payload per Slot | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | D:+- | NI/A | NI/A | |
| {7,8,9} for i from {0,,39} | Bits | N/A | N/A | |
| For CSI-RS Slot i, if mod(i,10) =1 for i | D:1- | N1/A | NI/A | |
| from {0,,39} | Bits | N/A | N/A | |
| For Slot i = 20 | Bits | 24576 | 49176 | |
| For Slot i, if $mod(i, 10) = \{0,2,3,4,5,6\}$ | Dito | 24576 | 40476 | |
| for i from {1,,19,22,,39} | Bits | 24576 | 49176 | |
| Transport block CRC per Slot | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | Bits | N/A | N/A | |
| {7,8,9} for i from {0,,39} | DIIS | IN/A | IN/A | |
| For CSI-RS Slot i, if mod(i,10) =1 for i | Bits | N/A | N/A | |
| from {0,,39} | | IN/A | IN/A | |
| For Slot i = 20 | Bits | 24 | 24 | |
| For Slot i, if $mod(i, 10) = \{0,2,3,4,5,6\}$ | Bits | 24 | 24 | |
| for i from {1,,19,22,,39} | DIIS | 24 | 24 | |
| Number of Code Blocks per Slot | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | CBs | N/A | N/A | |
| {7,8,9} for i from {0,,39} | CDS | IN/A | IN/A | |
| For CSI-RS Slot i, if mod(i,10) =1 for i | CBs | N/A | N/A | |
| from {0,,39} | | - | · | |
| For Slot i = 20 | CBs | 3 | 6 | |
| For Slot i, if $mod(i, 10) = \{0,2,3,4,5,6\}$ | CBs | 3 | 6 | |
| for i from {1,,19,22,,39} | CD3 | 3 | U | |
| Binary Channel Bits Per Slot | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | Bits | N/A | N/A | |
| {7,8,9} for i from {0,,39} | סווט | IN/A | IN/A | |
| For CSI-RS Slot i, if mod(i,10) =1 for i | Rite | N/A | N/A | |
| from {0,,39} | | | | |
| | Bits | 48336 | 96672 | |
| | Rite | 50880 | 101760 | |
| for i from {1,,19,22,,39} | טונס | 30000 | 101700 | |
| | Mhns | 28 2624 | 56 5524 | |
| frames | - | | | |
| from {0,,39} For Slot i = 20 For Slot i, if mod(i, 10) = {0,2,3,4,5,6} for i from {1,,19,22,,39} Max. Throughput averaged over 2 | Bits Mbps | 50880 28.2624 | 101760 56.5524 | |

Note 1:

Note 2:

SS/PBCH block is transmitted in slot #0 with periodicity 20 ms
Slot i is slot index per 2 frames
Number of DMRS REs includes the overhead of the DM-RS CDM groups without data Note 3:

Table A.3.2.2.2-9: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-4 (64QAM)

| Parameter | Unit | | Value | | | |
|---|------|------------|-------|--|--|--|
| Reference channel | | R.PDSCH.2- | | | | |
| | | 9.1 TDD | | | | |
| Channel bandwidth | MHz | 20 | | | | |
| Subcarrier spacing | kHz | 30 | | | | |
| Allocated resource blocks | PRBs | 51 | | | | |
| Number of consecutive PDSCH | | | | | | |
| symbols | | | | | | |
| For Slot i, if $mod(i, 10) = 3$ for i from | | 4 | | | | |
| $\{0,,39\}$ For Slot i, if mod(i, 10) = $\{0,1,2,6,7,8,9\}$ | | | | | | |
| For Slot 1, if find(1, 10) = $\{0, 1, 2, 6, 7, 8, 9\}$ for i from $\{1,, 39\}$ | | 12 | | | | |
| Allocated slots per 2 frames | | 31 | | | | |
| MCS table | | 64QAM | | | | |
| MCS index | | 19 | | | | |
| Modulation | | 64QAM | | | | |
| Target Coding Rate | | 0.51 | | | | |
| Number of MIMO layers | | 2 | | | | |
| Number of DMRS REs | | | | | | |
| For Slot i, if mod(i, 10) = 3 for i from | | | | | | |
| {0,,39} | | 6 | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,6,7,8,9\}$ | | 40 | | | | |
| for i from {1,,39} | | 12 | | | | |
| Overhead for TBS determination | | 0 | | | | |
| Information Bit Payload per Slot | | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | D:1- | NI/A | | | | |
| {4,5} for i from {0,,39} | Bits | N/A | | | | |
| For Slot i, if $mod(i, 10) = 3$ for i from | Bits | 13064 | | | | |
| {0,,39} | סונס | 13004 | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,6,7,8,9\}$ | Bits | 40976 | | | | |
| for i from {1,,39} | סונס | 40370 | | | | |
| Transport block CRC per Slot | | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | Bits | N/A | | | | |
| {4,5} for i from {0,,39} | | | | | | |
| For Slot i, if $mod(i, 10) = 3$ for i from | Bits | 24 | | | | |
| $\{0,,39\}$ For Slot i, if mod(i, 10) = $\{0,1,2,6,7,8,9\}$ | | | | | | |
| For Slot 1, if $mod(1, 10) = \{0, 1, 2, 6, 7, 8, 9\}$ for i from $\{1,, 39\}$ | Bits | 24 | | | | |
| Number of Code Blocks per Slot | | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | | | | | | |
| {4,5} for i from {0,,39} | CBs | N/A | | | | |
| For Slot i, if $mod(i, 10) = 3$ for i from | | _ | | | | |
| {0,,39} | CBs | 2 | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,6,7,8,9\}$ | | _ | | | | |
| for i from {1,,39} | CBs | 5 | | | | |
| Binary Channel Bits Per Slot | | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | D:4- | NI/A | | | | |
| {4,5} for i from {0,,39} | Bits | N/A | | | | |
| For Slots i = 20, 21 | Bits | 77112 | | | | |
| For Slot i, if mod(i, 10) = 3 for i from | Bits | 25704 | | | | |
| {0,,39} | סווס | 23104 | | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,6,7,8,9\}$ | Bits | 80784 | | | | |
| for i from {1,,19,22,,39} | טונס | 00704 | | | | |
| Max. Throughput averaged over 2 | Mbps | 57.930 | | | | |
| frames | | | | | | |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms | | | | | | |
| Note 2: Slot i is slot index per 2 frames | | | | | | |

Table A.3.2.2.2-10: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-1 and HST scenario

| Parameter | Unit | | Valu | е | |
|--|-------------|-------------------|------|---|--|
| Reference channel | | R.PDSCH.2- | | | |
| | | 10.1 TDD | | | |
| Channel bandwidth | MHz | 40 | | | |
| Subcarrier spacing | kHz | 30 | | | |
| Allocated resource blocks | PRBs | 106 | | | |
| Number of consecutive PDSCH | | | | | |
| symbols | | | | | |
| For Slot i, if $mod(i, 10) = 7$ for i from | | 4 | | | |
| $\{0,,39\}$ For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,6\}$ | | | | | |
| | | 12 | | | |
| for i from {1,,39} Allocated slots per 2 frames | | 31 | | | |
| MCS table | | 64QAM | | | |
| MCS table | | 13 | | | |
| Modulation | | 16QAM | | | |
| Target Coding Rate | | 0.48 | | | |
| Number of MIMO layers | | 1 | | | |
| Number of DMRS REs | | | | | |
| For Slot i, if mod(i, 10) = 7 for i from | | | | | |
| {0,,39} | | 6 | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ | | | | | |
| for i from $\{1,,39\}$ | | 18 | | | |
| Overhead for TBS determination | | 0 | | | |
| Information Bit Payload per Slot | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | | | | | |
| {8,9} for i from {0,,39} | Bits | N/A | | | |
| For Slot i, if $mod(i, 10) = 7$ for i from | D., | 0.450 | | | |
| {0,,39} | Bits | 8456 | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ | D:to | 25000 | | | |
| for i from {1,,39} | Bits | 25608 | | | |
| Transport block CRC per Slot | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | Bits | N/A | | | |
| {8,9} for i from {0,,39} | Dita | IN/A | | | |
| For Slot i, if mod(i, 10) = 7 for i from | Bits | 24 | | | |
| {0,,39} | Dito | 2-7 | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ | Bits | 24 | | | |
| for i from {1,,39} | 2.10 | | | | |
| Number of Code Blocks per Slot | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | CBs | N/A | | | |
| {8,9} for i from {0,,39} | | | | | |
| For Slot i, if $mod(i, 10) = 7$ for i from | CBs | 2 | | | |
| $\{0,,39\}$ For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,6\}$ | | | | | |
| For Slot 1, if flod(1, 10) = $\{0,1,2,3,4,5,6\}$ for i from $\{1,,39\}$ | CBs | 4 | | | |
| Binary Channel Bits Per Slot | | | | | |
| For Slots 0 and Slot i, if mod(i, 10) = | | | | | |
| {8,9} for i from {0,,39} | Bits | N/A | | | |
| | | 52176 | | | |
| For Slots i = 1,2,21,22 | Bits | (Note 3) | | | |
| For Slot i, if mod(i, 10) = 7 for i from | | | | | |
| {0,,39} | Bits | 17808 | | | |
| For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ | D:+- | F0.40.4 | | | |
| for i from {3,,20,23,,39} | Bits | 53424 | | | |
| Max. Throughput averaged over 2 | Mhna | 26.262 | | | |
| frames | Mbps | 36.262 | | | |
| Note 1: SS/PBCH block is transmitted in | n clot #0 w | ith pariadiaity 2 | 0 mc | | |

Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms

Note 2: Slot i is slot index per 2 frames

Note 3: Binary Channel Bits are calculated under assumption of 52 PRBs TRS allocation.

Table A.3.2.2.2-11: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-5

| Parameter | Unit | | Value | |
|--|--------------|------------------------|-------|--|
| Reference channel | | R.PDSCH.2- 11.1 TDD | | |
| Channel bandwidth | MHz | 40 | | |
| Subcarrier spacing | kHz | 30 | | |
| Allocated resource blocks | PRBs | 106 | | |
| Number of consecutive PDSCH | | | | |
| symbols | | | | |
| For Slot i, if $mod(i, 4) = 0$ for i from $\{1,,39\}$ | | 12 | | |
| For Slot i, if $mod(i, 4) = 1$ for i from $\{0,,39\}$ | | 10 | | |
| Allocated slots per 2 frames | | 31 | | |
| MCS table | | 64QAM | | |
| MCS index | | 4 | | |
| Modulation | | QPSK | | |
| Target Coding Rate | | 0.30 | | |
| Number of MIMO layers | | 1 | | |
| Number of DMRS REs | | | | |
| For Slot i, if $mod(i, 4) = 0$ for i from $\{1,,39\}$ | | 18 | | |
| For Slot i, if $mod(i, 4) = 1$ for i from $\{0,,39\}$ | | 18 | | |
| Overhead for TBS determination | | 0 | | |
| Information Bit Payload per Slot | | | | |
| For Slot 0 and Slot i, if $mod(i, 4) = \{2,3\}$ for i from $\{0,,39\}$ | Bits | N/A | | |
| For Slot i, if $mod(i, 4) = 0$ for i from $\{1,,39\}$ | Bits | 8064 | | |
| For Slot i, if $mod(i, 4) = 1$ for i from $\{0,,39\}$ | Bits | 6528 | | |
| Transport block CRC per Slot | | | | |
| For Slot 0 and Slot i, if $mod(i, 4) = \{2,3\}$ for i from $\{0,,39\}$ | Bits | N/A | | |
| For Slot i, if $mod(i, 4) = 0$ for i from $\{1,,39\}$ | Bits | 24 | | |
| For Slot i, if mod(i, 4) = 1 for i from $\{0,,39\}$ | Bits | 24 | | |
| Number of Code Blocks per Slot | | | | |
| For Slot 0 and Slot i, if $mod(i, 4) = \{2,3\}$ for i from $\{0,,39\}$ | CBs | N/A | | |
| For Slot i, if $mod(i, 4) = 0$ for i from $\{1,,39\}$ | CBs | 1 | | |
| For Slot i, if mod(i, 4) = 1 for i from | CBs | 1 | | |
| {0,,39} Binary Channel Bits Per Slot | | | | |
| For Slot 0 and Slot i, if $mod(i, 4) = \{2,3\}$ | | | | |
| for i from {0,,39} | Bits | N/A | | |
| For Slot i = 20 | Bits | 25440 20352 | | |
| For Slot i = 21 For Slot i, if $mod(i, 4) = 0$ for i from | Bits Bits | 20352 | | |
| $\{1,,19,22,,39\}$ For Slot i, if mod(i, 4) = 1 for i from | Bits | 21624 | | |
| {0,,19,22,,39} Max. Throughput averaged over 2 | Mbps | 6.893 | | |
| frames | | | | |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms Note 2: Slot i is slot index per 2 frames | | | | |

Table A.3.2.2.2-12: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-6

| Parameter | Unit | | Value | |
|--|------|------------------------|-------|------|
| Reference channel | | R.PDSCH.2- 12.1 TDD | | |
| Channel bandwidth | MHz | 40 | | |
| Subcarrier spacing | kHz | 30 | | |
| Allocated resource blocks | PRBs | 106 | | |
| Number of consecutive PDSCH | | | | |
| symbols | | | | |
| For Slot i, if mod(i, 4) = 0 for i from | | 12 | | |
| {1,,39} For Slot i, if mod(i, 4) = 1 for i from | | 12 | | |
| For Slot i, if $mod(i, 4) = 1$ for i from | | 8 | | |
| {0,,39} | | 0 | | |
| For Slot i, if $mod(i, 4) = 2$ for i from | | 10 | | |
| {0,,39} | | | | |
| Allocated slots per 2 frames | | 31 | | |
| MCS table MCS index | | 64QAM 4 | | |
| Modulation | | QPSK | | |
| Target Coding Rate | | 0.30 | | |
| Number of MIMO layers | | 0.30 | | |
| Number of DMRS REs | | <u>'</u> | | |
| For Slot i, if mod(i, 4) = 0 for i from | | 1 | | |
| {1,,39} | | 18 | | |
| For Slot i, if $mod(i, 4) = 1$ for i from | | 40 | | |
| {0,,39} | | 18 | | |
| For Slot i, if $mod(i, 4) = 2$ for i from | | 18 | | |
| {0,,39} | | | | |
| Overhead for TBS determination | | 0 | | |
| Information Bit Payload per Slot | | | | |
| For Slot 0 and Slot i, if $mod(i, 4) = 3$ for | Bits | N/A | | |
| i from {0,,39} | | | | |
| For Slot i, if $mod(i, 4) = 0$ for i from | Bits | 8064 | | |
| $\{1,,39\}$ For Slot i, if mod(i, 4) = 1 for i from | | | | |
| {0,,39} | Bits | 4992 | | |
| For Slot i, if $mod(i, 4) = 2$ for i from | | | | |
| {0,,39} | Bits | 6528 | | |
| Transport block CRC per Slot | | | | |
| For Slot 0 and Slot i, if $mod(i, 4) = 3$ for | Bits | N/A | | |
| i from {0,,39} | DIIS | IN/A | | |
| For Slot i, if $mod(i, 4) = 0$ for i from | Bits | 24 | | |
| {1,,39} | Bito | | | |
| For Slot i, if $mod(i, 4) = 1$ for i from | Bits | 24 | | |
| $\{0,,39\}$ For Slot i, if mod(i, 4) = 2 for i from | | | | |
| For Slot i, if $mod(i, 4) = 2$ for i from $\{0,,39\}$ | Bits | 24 | | |
| Number of Code Blocks per Slot | | | | |
| For Slot 0 and Slot i, if $mod(i, 4) = 3$ for | | | | |
| i from {0,,39} | CBs | N/A | | |
| For Slot i, if $mod(i, 4) = 0$ for i from | CD- | 4 | | |
| {1,,39} | CBs | 1 | | |
| For Slot i, if $mod(i, 4) = 1$ for i from | CBs | 1 | | |
| {0,,39} | CDS | ' | | |
| For Slot i, if mod(i, 4) = 2 for i from | CBs | 1 | | |
| {0,,39} | | · . | | |
| Binary Channel Bits Per Slot | | | | |
| For Slot 0 and Slot i, if $mod(i, 4) = 3$ for i from $(0, 30)$ | Bits | N/A | | |
| i from {0,,39} For Slot i = 20 | Bits | 25440 | | |
| For Slot i = 20 | Bits | 15264 | | |
| For Slot i, if $mod(i, 4) = 0$ for i from | | | | |
| {1,,19,22,,39} | Bits | 26712 | | |
| For Slot i, if $mod(i, 4) = 1$ for i from | D., | 40500 | | |
| {1,,19,22,,39} | Bits | 16536 | | |
| For Slot i, if $mod(i, 4) = 2$ for i from | Bits | 21624 | | |
| {0,,39} | סוום | 21024 | | |

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| Max. Thre | oughput averaged over 2 | Mbps | 9.389 | | | | |
|--|-----------------------------------|------|-------|--|--|--|--|
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms | | | | | | | |
| Note 2: | Slot i is slot index per 2 frames | | | | | | |

A.3.2.2.3 Reference measurement channels for SCS 60 kHz FR1

A.3.2.2.4 Reference measurement channels for SCS 60 kHz FR2

Table A.3.2.2.4-1: PDSCH Reference Channel for TDD UL-DL pattern FR2.60-1 (16QAM)

| Reference channel | | R.PDSCH.4- | | |
|---|-------|---------------|-------|--|
| Channel bandwidth | MHz | 1.1 TDD 50 | | |
| Subcarrier spacing | kHz | 60 | | |
| Allocated resource blocks | PRBs | 66 | | |
| Number of consecutive PDSCH | TINDS | 00 | | |
| symbols | | | | |
| For Slot i, if mod(i, 4) = 2 for i from | 1 | | + | |
| * * * | | 10 | | |
| $\{1,, 79\}$ For Slot i, if mod(i, 4) = $\{0,1\}$ for i from | | | | |
| | | 13 | | |
| {1,,79} Allocated slots per 2 frames | 1 | 50 | | |
| | | 59 | | |
| MCS table | | 64QAM | | |
| MCS index | 1 | 13 | | |
| Modulation | | 16QAM | | |
| Target Coding Rate | | 0.48 | | |
| Number of MIMO layers | | 2 | | |
| Number of DMRS REs | | | | |
| For Slot i, if $mod(i, 4) = 2$ for i from | | 12 | | |
| {1,, 79} | | 12 | | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from | | 10 | | |
| {1,,79} | | 12 | | |
| Overhead for TBS determination | | 6 | | |
| Information Bit Payload per Slot | | | | |
| For Slots 0 and Slot i, if mod(i, 4) = 3 | D.: | 11/0 | | |
| for i from {0,,79} | Bits | N/A | | |
| For Slot i, if $mod(i, 4) = 2$ for i from | 5 | 05000 | | |
| {1,, 79} | Bits | 25608 | | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from | | | | |
| {1,,79} | Bits | 34816 | | |
| Transport block CRC per Slot | | | | |
| For Slots 0 and Slot i, if $mod(i, 4) = 3$ | | | | |
| for i from {0,,79} | Bits | N/A | | |
| For Slot i, if $mod(i, 4) = 2$ for i from | | | | |
| {1,, 79} | Bits | 24 | | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from | | | | |
| {1,,79} | Bits | 24 | | |
| Number of Code Blocks per Slot | | | | |
| For Slots 0 and Slot i, if $mod(i, 4) = 3$ | | | | |
| | CBs | N/A | | |
| for i from $\{0,,79\}$ For Slot i, if mod(i, 4) = 2 for i from | 1 | | + | |
| * * * | CBs | 4 | | |
| $\{1,, 79\}$ For Slot i, if mod(i, 4) = $\{0,1\}$ for i from | 1 | | + | |
| | CBs | 5 | | |
| {1,,79} Binary Channel Bits Per Slot | 1 | | + | |
| | - | | | |
| For Slots 0 and Slot i, if $mod(i, 4) = 3$ | Bits | N/A | | |
| for i from {0,,79} | D:1- | | | |
| For Slot $i = 40, 41$ | Bits | 69960 | | |
| For Slot i, if $mod(i, 4) = 2$ for i from | Bits | 54912 | | |
| {4,, 79} | | | | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from | Bits | 73128 | | |
| {1,,39,42,,79} | | 12.20 | | |
| Max. Throughput averaged over 2 | Mbps | 93.499 | | |
| frames | | | | |
| Note 1: SS/PBCH block is transmitted | | | | |

A.3.2.2.5 Reference measurement channels for SCS 120 kHz FR2

Table A.3.2.2.5-1: PDSCH Reference Channel for TDD UL-DL pattern FR2.120-1 and FR2.120-1A (QPSK)

| Parameter | Unit | | Value |
|---|------|------------|-------|
| Deference channel | | R.PDSCH.5- | |
| Reference channel | | 1.1 TDD | |
| Channel bandwidth | MHz | 100 | |
| Subcarrier spacing | kHz | 120 | |
| Allocated resource blocks | PRBs | 66 | |
| Number of consecutive PDSCH | | | |
| symbols | | | |
| For Slot i, if mod(i, 5) = 3 for i from | | 9 | |
| {0,, 159} | | 9 | |
| For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i | | 13 | |
| from {1,,159} | | 13 | |
| Allocated slots per 2 frames | | 127 | |
| MCS table | | 64QAM | |
| MCS index | | 4 | |
| Modulation | | QPSK | |
| Target Coding Rate | | 0.30 | |
| Number of MIMO layers | | 1 | |
| Number of DMRS REs | | | |
| For Slot i, if $mod(i, 5) = 3$ for i from | | 12 | |
| {0,, 159} | | 12 | |
| For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i | | 12 | |
| from {1,,159} | | 12 | |
| Overhead for TBS determination | | 6 | |
| Information Bit Payload per Slot | | | |
| For Slots 0 and Slot i, if $mod(i, 5) = 4$ | Bits | N/A | |
| for i from {0,,159} | Dita | IN/A | |
| For Slot i, if $mod(i, 5) = 3$ for i from | Bits | 3624 | |
| {0,, 159} | Dita | 3024 | |
| For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i | Bits | 5504 | |
| from {1,,159} | Dito | 000+ | |
| Transport block CRC per Slot | | | |
| For Slots 0 and Slot i, if $mod(i, 5) = 4$ | Bits | N/A | |
| for i from {0,,159} | Dito | 14/71 | |
| For Slot i, if $mod(i, 5) = 3$ for i from | Bits | 16 | |
| {0,, 159} | D.KO | | |
| For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i | Bits | 24 | |
| from {1,,159} | | | |
| Number of Code Blocks per Slot | | | |
| For Slots 0 and Slot i, if $mod(i, 5) = 4$ | CBs | N/A | |
| for i from {0,,159} | | • | |
| For Slot i, if $mod(i, 5) = 3$ for i from | CBs | 1 | |
| {0,, 159} | | | |
| For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i | CBs | 1 | |
| from {1,,159} | | | |
| Binary Channel Bits Per Slot | | | |
| For Slots 0 and Slot i, if $mod(i, 5) = 4$ | Bits | N/A | |
| for i from {0,,159} | Dito | 17400 | |
| For Slots i = 80, 81 | Bits | 17490 | |
| For Slot i, if mod(i, 5) = 3 for i from $(0, 150)$ | Bits | 12210 | |
| $\{0,, 159\}$ For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i | | | |
| | Bits | 18282 | |
| from {1,,79,82,,159} | | | |
| Max. Throughput averaged over 2 frames | Mbps | 31.942 | |
| Note 1: SS/PBCH block is transmitted | | | |

Note 2: Slot i is slot index per 2 frames

Table A.3.2.2.5-2: PDSCH Reference Channel for TDD UL-DL pattern FR2.120-1 (16QAM)

| Parameter | Unit | | | Value | |
|---|------|-------------------------|-----------------------|-----------------------|--|
| Reference channel | | R.PDSCH.5- 2.1 TDD | R.PDSCH.5- 2.2 TDD | R.PDSCH.5- 2.3 TDD | |
| Channel bandwidth | MHz | 100 | 100 | 200 | |
| Subcarrier spacing | kHz | 120 | 120 | 120 | |
| Allocated resource blocks | PRBs | 66 | 66 | 132 | |
| Number of consecutive PDSCH | | | | | |
| symbols | | | | | |
| For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 159\}$ | | 9 | 9 | 9 | |
| For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,159\}$ | | 13 | 13 | 13 | |
| Allocated slots per 2 frames | | 127 | 127 | 127 | |
| MCS table | | 64QAM | 64QAM | 64QAM | |
| MCS index | | 13 | 13 | 13 | |
| Modulation | | 16QAM | 16QAM | 16QAM | |
| Target Coding Rate | | 0.48 | 0.48 | 0.48 | |
| Number of MIMO layers | | 1 | 2 | 2 | |
| Number of DMRS REs | | | | | |
| For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 159\}$ | | 12 | 12 | 12 | |
| For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,159\}$ | | 12 | 12 | 12 | |
| Overhead for TBS determination | | 6 | 6 | 6 | |
| Information Bit Payload per Slot | | - | - | | |
| For Slots 0 and Slot i, if $mod(i, 5) = 4$ for i from $(0, 159)$ | Bits | N/A | N/A | N/A | |
| For Slot i, if mod(i, 5) = 3 for i from $\{0,, 159\}$ | Bits | 11272 | 22536 | 45096 | |
| For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,159\}$ | Bits | 17424 | 34816 | 69672 | |
| Transport block CRC per Slot | | | | | |
| For Slots 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,159\}$ | Bits | N/A | N/A | N/A | |
| For Slot i, if mod(i, 5) = 3 for i from $\{0,, 159\}$ | Bits | 24 | 24 | 24 | |
| For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i from $\{1,,159\}$ | Bits | 24 | 24 | 24 | |
| Number of Code Blocks per Slot | | | | | |
| For Slots 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,159\}$ | CBs | N/A | N/A | N/A | |
| For Slot i, if mod(i, 5) = 3 for i from $\{0,, 159\}$ | CBs | 2 | 3 | 6 | |
| For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i from $\{1,,159\}$ | CBs | 3 | 5 | 9 | |
| Binary Channel Bits Per Slot | | | | | |
| For Slots 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,159\}$ | Bits | N/A | N/A | N/A | |
| For Slots i = 80, 81 | Bits | 36564 | 69960 | 139920 | |
| For Slots i = 82, 83 | Bits | 34980 | 73128 | 146256 | |
| For Slot i, if mod(i, 5) = 3 for i from {0,, 159} | Bits | 24420 | 48840 | 97680 | |
| For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i from $\{1,,79,84,,159\}$ | Bits | 36564 | 73128 | 146256 | |
| Max. Throughput averaged over 2 | Mbps | 100.799 | 201.434 | 403.096 | |
| frames Note 1: SS/PBCH block is transmitted | | l D with periodicity | | | |

Note 2: Slot i is slot index per 2 frames

Table A.3.2.2.5-3: PDSCH Reference Channel for TDD UL-DL pattern FR2.120-1 (64QAM)

| Parameter | Unit | | Va | lue | |
|--|--|---------------------|------|-----|--|
| Defenses showed | | R.PDSCH.5- | | | |
| Reference channel | | 3.1 TDD | | | |
| Channel bandwidth | MHz | 100 | | | |
| Subcarrier spacing | kHz | 120 | | | |
| Allocated resource blocks | PRBs | 66 | | | |
| Number of consecutive PDSCH | | | | | |
| symbols | | | | | |
| For Slot i, if mod(i, 5) = 3 for i from | | _ | | | |
| {0,, 159} | | 9 | | | |
| For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i | | | | | |
| from {1,,159} | | 13 | | | |
| Allocated slots per 2 frames | | 127 | | | |
| MCS table | | 64QAM | | | |
| MCS index | | 18 | | | |
| Modulation | | 64QAM | | | |
| Target Coding Rate | | 0.46 | | | |
| Number of MIMO layers | | 1 | | | |
| Number of DMRS REs | | ' | | | |
| For Slot i, if mod(i, 5) = 3 for i from | 1 | 1 | | + | |
| {0,, 159} | | 12 | | | |
| For Slot i, if $mod(i, 5) = \{0, 1, 2\}$ for i | | | | | |
| from $\{1,,159\}$ | | 12 | | | |
| Overhead for TBS determination | + | 6 | | | |
| | | O | | | |
| Information Bit Payload per Slot | | N/A | | | |
| For Slots 0 and Slot i, if $mod(i, 5) = 4$ | Bits | IN/A | | | |
| for i from $\{0,,159\}$ For Slot i, if mod(i, 5) = 3 for i from | | | | | |
| | Bits | 16136 | | | |
| {0,, 159} | | | | | |
| For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i | Bits | 25104 | | | |
| from {1,,159} | | | | | |
| Transport block CRC per Slot | | NI/A | | | |
| For Slots 0 and Slot i, if $mod(i, 5) = 4$ | Bits | N/A | | | |
| for i from $\{0,,159\}$ For Slot i, if mod(i, 5) = 3 for i from | | | | | |
| | Bits | 24 | | | |
| {0,, 159} | | | | | |
| For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i | Bits | 24 | | | |
| from {1,,159} | | | | | |
| Number of Code Blocks per Slot | | | | | |
| For Slots 0 and Slot i, if $mod(i, 5) = 4$ | CBs | N/A | | | |
| for i from {0,,159} | | | | | |
| For Slot i, if $mod(i, 5) = 3$ for i from | CBs | 2 | | | |
| $\{0,, 159\}$ For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i | | | | | |
| | CBs | 3 | | | |
| from {1,,159} | | | | | |
| Binary Channel Bits Per Slot | | NI/A | | | |
| For Slots 0 and Slot i, if $mod(i, 5) = 4$ | Bits | N/A | | | |
| for i from {0,,159} | | E0.470 | | | |
| For Slots i = 80, 81 | Bits | 52470 | | | |
| For Slot i, if $mod(i, 5) = 3$ for i from | Bits | 36630 | | | |
| {0,, 159} | | | | | |
| For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i | Bits | 54846 | | | |
| from {1,,79,82,,159} | | | | | |
| Max. Throughput averaged over 2 | Mbps | 145.062 | | | |
| frames | • | dela manda P. M. O. | 0 | | |
| Note 1: SS/PBCH block is transmitted | | vith periodicity 2 | u ms | | |
| Note 2: Slot i is slot index per 2 frames | i | | | | |

Table A.3.2.2.5-4: PDSCH Reference Channel for TDD UL-DL pattern FR2.120-2 (QPSK)

| Parameter | Unit | | Value |
|---|------|--------------------|--|
| Reference channel | | R.PDSCH.5- | |
| | | 4.1 TDD | |
| Channel bandwidth | MHz | 100 | |
| Subcarrier spacing | kHz | 120 | |
| Allocated resource blocks | PRBs | 6 | |
| Number of consecutive PDSCH | | | |
| symbols | | | |
| For Slot i, if $mod(i, 4) = 2$ for i from | | 10 | |
| {1,, 159} | | | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from | | 13 | |
| {1,,159} | | 110 | |
| Allocated slots per 2 frames | | 119 | |
| MCS table | | 64QAM | |
| MCS index | | 4 | |
| Modulation Date | | QPSK | |
| Target Coding Rate | | 0.30 | |
| Number of MIMO layers | | 2 | |
| Number of DMRS REs | | | |
| For Slot i, if $mod(i, 4) = 2$ for i from | | 12 | |
| {1,, 159} | | | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from | | 12 | |
| {1,,159} Overhead for TBS determination | | 6 | |
| Information Bit Payload per Slot | | 0 | |
| For Slots 0 and Slot i, if $mod(i, 4) = 3$ | | | |
| for i from $\{0,,159\}$ | Bits | N/A | |
| For Slot i, if mod(i, 4) = 2 for i from | | | |
| {1,, 159} | Bits | 736 | |
| For Slot i, if $mod(i, 4) = \{0, 1\}$ for i from | | | |
| {1,,159} | Bits | 1032 | |
| Transport block CRC per Slot | | | |
| For Slots 0 and Slot i, if $mod(i, 4) = 3$ | D., | 21/2 | |
| for i from {0,,159} | Bits | N/A | |
| For Slot i, if $mod(i, 4) = 2$ for i from | D:: | 40 | |
| {1,, 159} | Bits | 16 | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from | Dito | 16 | |
| {1,,159} | Bits | 16 | |
| Number of Code Blocks per Slot | | | |
| For Slots 0 and Slot i, if $mod(i, 4) = 3$ | CBs | N/A | |
| for i from {0,,159} | CDS | IN/A | |
| For Slot i, if $mod(i, 4) = 2$ for i from | CBs | 1 | |
| {1,, 159} | ODS | ' | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from | CBs | 1 | |
| {1,,159} | OBO | | |
| Binary Channel Bits Per Slot | | | |
| For Slots 0 and Slot i, if $mod(i, 4) = 3$ | Bits | N/A | |
| for i from {0,,159} | | | |
| For Slot i = 80, 81 | Bits | 3180 | |
| For Slot i, if $mod(i, 4) = 2$ for i from | Bits | 2496 | |
| {4,, 159} | | 1 | |
| For Slot i, if mod(i, 4) = $\{0,1\}$ for i from | Bits | 3324 | |
| {1,,79,82,,159} | | | |
| Max. Throughput averaged over 2 | Mbps | 5.548 | |
| frames Note 1: SS/PBCH block is transmitted | · | ith poriodicity Of | 20 mg |
| Note 1: SS/PBCH block is transmitted in Note 2: Slot i is slot index per 2 frames | | nur periodicity 20 | 201110 |
| Trote 2. Sign is sign index per 2 maines | | | |

Table A.3.2.2.5-5: PDSCH Reference Channel for TDD UL-DL pattern FR2.120-2 (16QAM)

| Parameter | Unit | | | Value | | |
|---|------------|------------------|------------|-------|---|--|
| Reference channel | | R.PDSCH.5- | R.PDSCH.5- | | | |
| Reference charmer | | 5.1 TDD | 5.2 TDD | | | |
| Channel bandwidth | MHz | 100 | 50 | | | |
| Subcarrier spacing | kHz | 120 | 120 | | | |
| Allocated resource blocks | PRBs | 66 | 32 | | | |
| Number of consecutive PDSCH | | | | | | |
| symbols | | | | | | |
| For Slot i, if $mod(i, 4) = 2$ for i from | | 10 | 10 | | | |
| {1,, 159} | | | | | | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from | | 13 | 13 | | | |
| {1,,159} | | | | + | | |
| Allocated slots per 2 frames | | 119 | 119 | | | |
| MCS table | | 64QAM | 64QAM | | | |
| MCS index | | 13 | 13 | | | |
| Modulation | | 16QAM | 16QAM | | | |
| Target Coding Rate | | 0.48 | 0.48 | + | | |
| Number of MIMO layers | | 2 | 2 | + | | |
| Number of DMRS REs | | | | + | | |
| For Slot i, if $mod(i, 4) = 2$ for i from | | 12 | 12 | | | |
| $\{1,, 159\}$ For Slot i, if mod(i, 4) = $\{0,1\}$ for i from | | | | + | + | |
| | | 12 | 12 | | | |
| {1,,159} Overhead for TBS determination | | 6 | 6 | + | | |
| Information Bit Payload per Slot | | 0 | 0 | + | | |
| For Slots 0 and Slot i, if $mod(i, 4) = 3$ | | | | | | |
| for i from $\{0,,159\}$ | Bits | N/A | N/A | | | |
| For Slot i, if $mod(i, 4) = 2$ for i from | | | | | | |
| {1,, 159} | Bits | 25608 | 12552 | | | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from | | | | † | + | |
| {1,,159} | Bits | 34816 | 16896 | | | |
| Transport block CRC per Slot | | | | | | |
| For Slots 0 and Slot i, if $mod(i, 4) = 3$ | D., | 21/2 | 21/0 | | | |
| for i from {0,,159} | Bits | N/A | N/A | | | |
| For Slot i, if $mod(i, 4) = 2$ for i from | Dita | 0.4 | 24 | | | |
| {1,, 159} | Bits | 24 | 24 | | | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from | Dito | 24 | 24 | | | |
| {1,,159} | Bits | 24 | 24 | | | |
| Number of Code Blocks per Slot | | | | | | |
| For Slots 0 and Slot i, if $mod(i, 4) = 3$ | CBs | N/A | N/A | | | |
| for i from {0,,159} | CDS | IN/A | IN/A | | | |
| For Slot i, if mod(i, 4) = 2 for i from | CBs | 4 | 2 | | | |
| {1,, 159} | 020 | ' | _ | | | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from | CBs | 5 | 3 | | | |
| {1,,159} | 050 | Ŭ | Ŭ | | | |
| Binary Channel Bits Per Slot | | | | 1 | | |
| For Slots 0 and Slot i, if $mod(i, 4) = 3$ | Bits | N/A | N/A | | | |
| for i from {0,,159} | | | | + | | |
| For Slot i = 80, 81 | Bits | 69960 | 33920 | 1 | | |
| For Slot i, if $mod(i, 4) = 2$ for i from | Bits | 54912 | 26624 | | | |
| $\{4,, 159\}$ For Slot i, if mod(i, 4) = $\{0,1\}$ for i from | - | | | + | | |
| | Bits | 73128 | 35456 | | | |
| {1,,79,82,,159} Max. Throughput averaged over 2 | | | | + | + | |
| frames | Mbps | 188.739 | 91.843 | | | |
| Note 1: SS/PBCH block is transmitted | in slot #0 | with periodicity | 20 ms | 1 | | |
| Note 2: Slot i is slot index per 2 frames | | portodioity / | | | | |

Table A.3.2.2.5-6: PDSCH Reference Channel for TDD UL-DL pattern FR2.120-2 (64QAM)

| Parameter | Unit | | Value | | | | |
|---|--------------|-----------------------|-------|---|--|--|--|
| Reference channel | | R.PDSCH.5- 6.1 TDD | | | | | |
| Channel bandwidth | MHz | 100 | | | | | |
| Subcarrier spacing | kHz | 120 | | | | | |
| Allocated resource blocks | PRBs | 66 | | | | | |
| Number of consecutive PDSCH | | | | | | | |
| symbols | | | | | | | |
| For Slot i, if mod(i, 4) = 2 for i from $\{1,, 159\}$ | | 10 | | | | | |
| For Slot i, if mod(i, 4) = $\{0,1\}$ for i from $\{1,,159\}$ | | 13 | | | | | |
| Allocated slots per 2 frames | | 119 | | | | | |
| MCS table | | 64QAM | | | | | |
| MCS index | | 17 | | | | | |
| Modulation | | 64QAM | | | | | |
| Target Coding Rate | | 0.43 | | | | | |
| Number of MIMO layers | | 2 | | | | | |
| Number of DMRS REs | | | | | | | |
| For Slot i, if mod(i, 4) = 2 for i from $\{1,, 159\}$ | | 12 | | | | | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from $\{1,,159\}$ | | 12 | | | | | |
| Overhead for TBS determination | | 6 | | | | | |
| Information Bit Payload per Slot | | | | | | | |
| For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$ | Bits | N/A | | | | | |
| For Slot i, if mod(i, 4) = 2 for i from {1,, 159} | Bits | 34816 | | | | | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from $\{1,,159\}$ | Bits | 47112 | | | | | |
| Transport block CRC per Slot | | | | | | | |
| For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$ | Bits | N/A | | | | | |
| For Slot i, if mod(i, 4) = 2 for i from {1,, 159} | Bits | 24 | | | | | |
| For Slot i, if mod(i, 4) = $\{0,1\}$ for i from $\{1,,159\}$ | Bits | 24 | | | | | |
| Number of Code Blocks per Slot | | | | | | | |
| For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$ | CBs | N/A | | | | | |
| For Slot i, if mod(i, 4) = 2 for i from {1,, 159} | CBs | 5 | | | | | |
| For Slot i, if $mod(i, 4) = \{0,1\}$ for i from $\{1,,159\}$ | CBs | 6 | | | | | |
| Binary Channel Bits Per Slot | | | | | | | |
| For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$ | Bits | N/A | | | | | |
| For Slot i = 80, 81 | Bits | 114940 | | | | | |
| For Slot i, if $mod(i, 4) = 2$ for i from $\{4,, 159\}$ | Bits | 82368 | | | | | |
| For Slot i, if mod(i, 4) = $\{0,1\}$ for i from $\{1,,79,82,,159\}$ | Bits | 109692 | | | | | |
| Max. Throughput averaged over 2 frames | Mbps | 255.724 | | | | | |
| Note 1: SS/PBCH block is transmitted | in slot #0 w | vith periodicity 20 | 0 ms | L | | | |
| Note 2: Slot i is slot index per 2 frames | | | | | | | |

Table A.3.2.2.5-7: PDSCH Reference Channel for TDD PMI reporting requirements with UL-DL pattern FR2.120-1 (16QAM)

| Parameter | Unit | | Value |
|---|--------|------------------------------|-------|
| Reference channel | | R.PDSCH.5- | |
| Reference channel | | 7.1 TDD | |
| Channel bandwidth | MHz | 100 | |
| Subcarrier spacing | kHz | 120 | |
| Allocated resource blocks | PRBs | 66 | |
| Number of consecutive PDSCH symbols | | 12 | |
| Allocated slots per 2 frames | | 63 | |
| MCS table | | 64QAM | |
| MCS index | | 13 | |
| Modulation | | 16QAM | |
| Target Coding Rate | | 0.48 | |
| Number of MIMO layers | | 1 | |
| Number of DMRS REs (Note 3) | | 24 | |
| Overhead for TBS determination | | 6 | |
| Information Bit Payload per Slot | | | |
| For Slots 0 and Slot i, if mod(i, 5) = | D:4- | NI/A | |
| {3,4} for i from {0,,159} | Bits | N/A | |
| For CSI-RS Slot i, if mod(i,5) =1 for i | D:4- | NI/A | |
| from {0,,159} | Bits | N/A | |
| For Slot i = 80 | Bits | 14344 | |
| For Slot i, if $mod(i, 5) = \{0,2\}$ for i from | D:4- | 44044 | |
| {1,,79,82,,159} | Bits | 14344 | |
| Transport block CRC per Slot | | | |
| For Slots 0 and Slot i, if mod(i, 5) = | D:4- | NI/A | |
| {3,4} for i from {0,,159} | Bits | N/A | |
| For CSI-RS Slot i, if mod(i,5) =1 for i | D:4- | NI/A | |
| from {0,,159} | Bits | N/A | |
| For Slot i = 80 | Bits | 24 | |
| For Slot i, if $mod(i, 5) = \{0,2\}$ for i from | Dito | 24 | |
| {1,,79,82,,159} | Bits | 24 | |
| Number of Code Blocks per Slot | | | |
| For Slots 0 and Slot i, if mod(i, 5) = | CBs | N/A | |
| {3,4} for i from {0,,159} | CBS | IN/A | |
| For CSI-RS Slot i, if $mod(i,5) = 1$ for i | CBs | N/A | |
| from {0,,159} | | | |
| For Slot i = 80 | CBs | 2 | |
| For Slot i, if $mod(i, 5) = \{0,2\}$ for i from | CBs | 2 | |
| {1,,79,82,,159} | CDS | 2 | |
| Binary Channel Bits Per Slot | | | |
| For Slots 0 and Slot i, if mod(i, 5) = | Bits | N/A | |
| {3,4} for i from {0,,159} | סווס | 11/71 | |
| For CSI-RS Slot i, if mod(i,5) =1 for i | Bits | N/A | |
| from {0,,159} | | | |
| For Slot i = 80 | Bits | 28776 | |
| For Slot i, if $mod(i, 5) = \{0,2\}$ for i from | Bits | 30360 | |
| {1,,79,82,,159} | טונס | 30300 | |
| Max. Throughput averaged over 2 | Mbps | 45.1836 | |
| frames | • | | |
| Note 1: CC/DDCH block is transmitted in | 1-4 // | date in a mile all altern Of | 0 |

SS/PBCH block is transmitted in slot #0 with periodicity 20 ms Note 1:

Note 2:

Slot i is slot index per 2 frames
Number of DMRS REs includes the overhead of the DM-RS CDM groups without data Note 3:

Table A.3.2.2.5-8: PDSCH Reference Channel for TDD PMI reporting requirements with UL-DL pattern FR2.120-2 (16QAM)

| Parameter | Unit | | Value |
|---|------|-----------------------|-------|
| Reference channel | | R.PDSCH.5- 8.1 TDD | |
| Channel bandwidth | MHz | 100 | |
| Subcarrier spacing | kHz | 120 | |
| Allocated resource blocks | PRBs | 66 | |
| Number of consecutive PDSCH symbols | | 12 | |
| Allocated slots per 2 frames | | 59 | |
| MCS table | | 64QAM | |
| MCS index | | 13 | |
| Modulation | | 16QAM | |
| Target Coding Rate | | 0.48 | |
| Number of MIMO layers | | 1 | |
| Number of DMRS REs (Note 3) | | 24 | |
| Overhead for TBS determination | | 6 | |
| Information Bit Payload per Slot | | | |
| For Slots 0 and Slot i, if $mod(i, 4) = \{2,3\}$ for i from $\{0,,159\}$ | Bits | N/A | |
| For CSI-RS Slot i, if mod(i,8) =1 for i from {0,,159} | Bits | N/A | |
| For Slot i = 80 | Bits | 14344 | |
| For Slot i, if $mod(i, 8) = \{0,4,5\}$ for i from $\{1,,79,82,,159\}$ | Bits | 14344 | |
| Transport block CRC per Slot | | | |
| For Slots 0 and Slot i, if mod(i, 4) = {2,3} for i from {0,,159} | Bits | N/A | |
| For CSI-RS Slot i, if $mod(i,8) = 1$ for i from $\{0,,159\}$ | Bits | N/A | |
| For Slot i = 80 | Bits | 24 | |
| For Slot i, if $mod(i, 8) = \{0,4,5\}$ for i from $\{1,,79,82,,159\}$ | Bits | 24 | |
| Number of Code Blocks per Slot | | | |
| For Slots 0 and Slot i, if $mod(i, 4) = \{2,3\}$ for i from $\{0,,159\}$ | CBs | N/A | |
| For CSI-RS Slot i, if $mod(i,8) = 1$ for i from $\{0,,159\}$ | CBs | N/A | |
| For Slot i = 80 | CBs | 2 | |
| For Slot i, if $mod(i, 8) = \{0,4,5\}$ for i from $\{1,,79,82,,159\}$ | CBs | 2 | |
| Binary Channel Bits Per Slot | | | |
| For Slots 0 and Slot i, if $mod(i, 4) = \{2,3\}$ for i from $\{0,,159\}$ | Bits | N/A | |
| For CSI-RS Slot i, if mod(i,8) =1 for i from {0,,159} | Bits | N/A | |
| For Slot i = 80 | Bits | 28776 | |
| For Slot i, if $mod(i, 8) = \{0,4,5\}$ for i from $\{1,,79,82,,159\}$ | Bits | 30360 | |
| Max. Throughput averaged over 2 frames Note 1: SS/PBCH block is transmitted in | Mbps | 42.3148 | |

SS/PBCH block is transmitted in slot #0 with periodicity 20 ms Note 1:

Note 2:

Slot i is slot index per 2 frames
Number of DMRS REs includes the overhead of the DM-RS CDM groups without data Note 3:

A.3.2.2.6 Reference measurement channels for E-UTRA

Table A.3.2.2.6-1: PDSCH Reference Channel for sustained data-rate test (64QAM, 2 MIMO layers)

| Parameter | Unit | Value | | | | |
|--|------|------------|------------|------------|--|--|
| Reference channel | | R.PDSCH.6- | R.PDSCH.6- | R.PDSCH.6- | | |
| | | 1.1 TDD | 1.2 TDD | 1.3 TDD | | |
| Channel bandwidth | MHz | 10 | 15 | 20 | | |
| Allocated resource blocks | | Note 7 | Note 8 | Note 9 | | |
| Uplink-Downlink Configuration (Note 3) | | 2 | 2 | 2 | | |
| Number of HARQ Processes per component | | 10 | 10 | 10 | | |
| carrier | | | | | | |
| Allocated subframes per Radio Frame (D+S) | | 6 | 6 | 6 | | |
| Modulation | | 64QAM | 64QAM | 64QAM | | |
| Coding Rate | | | | | | |
| For Sub-Frames 1,2,6,7 | | N/A | N/A | N/A | | |
| For Sub-Frames 3,4,8,9 | | 0.85 | 0.85 | 0.88 | | |
| For Sub-Frame 5 | | 0.88 | 0.87 | 0.87 | | |
| For Sub-Frame 0 | | 0.90 | 0.88 | 0.90 | | |
| Information Bit Payload (Note 4) | | | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A | | |
| For Sub-Frames 3,4,8,9 | Bits | 36696 | 55056 | 75376 | | |
| For Sub-Frame 5 | Bits | 35160 | 52752 | 71112 | | |
| For Sub-Frame 0 | Bits | 36696 | 55056 | 75376 | | |
| Number of Code Blocks | | | | | | |
| (Notes 4 and 5) | | | | | | |
| For Sub-Frames 1,2,6,7 | CBs | N/A | N/A | N/A | | |
| For Sub-Frames 3,4,8,9 | CBs | 6 | 9 | 13 | | |
| For Sub-Frame 5 | CBs | 6 | 9 | 12 | | |
| For Sub-Frame 0 | CBs | 6 | 9 | 13 | | |
| Binary Channel Bits (Note 4) | | | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A | | |
| For Sub-Frames 3,4,8,9 | Bits | 43200 | 64800 | 86400 | | |
| For Sub-Frame 5 | Bits | 40176 | 60912 | 82512 | | |
| For Sub-Frame 0 | Bits | 41184 | 62784 | 84384 | | |
| Number of layers | | 2 | 2 | 2 | | |
| Max. Throughput averaged over 1 frame (Note 4) | Mbps | 21.864 | 32.803 | 44.799 | | |

- Note 1: 1 symbol allocated to PDCCH for all tests.
- Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [15].
- Note 3: As per Table 4.2-2 in TS 36.211 [15].
- Note 4: Given per component carrier per codeword.
- Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
- Note 6: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,3,4,8,9.
- Note 8: Resource blocks n_{PRB} = 4..74 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..74 in sub-frames 0,3,4,8,9.
- Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0.3,4.8,9.

Table A.3.2.2.6-2: PDSCH Reference Channel for sustained data-rate test (64QAM, 4 MIMO layers)

| Parameter | Unit | Value | | | |
|--|------|------------|------------|------------|---------------------------------------|
| Reference channel | | R.PDSCH.6- | R.PDSCH.6- | R.PDSCH.6- | |
| | | 2.1 TDD | 2.2 TDD | 2.3 TDD | |
| Channel bandwidth | MHz | 10 | 15 | 20 | |
| Allocated resource blocks | | Note 7 | Note 8 | Note 9 | |
| Uplink-Downlink Configuration (Note 3) | | 2 | 2 | 2 | |
| Number of HARQ Processes per component | | 10 | 10 | 10 | |
| carrier | | | | | |
| Allocated subframes per Radio Frame (D+S) | | 6 | 6 | 6 | |
| Modulation | | 64QAM | 64QAM | 64QAM | |
| Coding Rate | | | | | |
| For Sub-Frames 1,2,6,7 | | N/A | N/A | N/A | |
| For Sub-Frames 3,4,8,9 | | 0.78 | 0.77 | 0.79 | |
| For Sub-Frame 5 | | 0.79 | 0.79 | 0.80 | |
| For Sub-Frame 0 | | 0.82 | 0.79 | 0.81 | |
| Information Bit Payload (Note 4) | | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A | |
| For Sub-Frames 3,4,8,9 | Bits | 63776 | 93800 | 128496 | |
| For Sub-Frame 5 | Bits | 59256 | 90816 | 124464 | |
| For Sub-Frame 0 | Bits | 63776 | 93800 | 128496 | |
| Number of Code Blocks | | | | | |
| (Notes 4 and 5) | | | | | |
| For Sub-Frames 1,2,6,7 | CBs | N/A | N/A | N/A | |
| For Sub-Frames 3,4,8,9 | CBs | 11 | 16 | 21 | |
| For Sub-Frame 5 | CBs | 10 | 15 | 21 | |
| For Sub-Frame 0 | CBs | 11 | 16 | 21 | |
| Binary Channel Bits (Note 4) | | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A | |
| For Sub-Frames 3,4,8,9 | Bits | 81600 | 122400 | 163200 | · · · · · · · · · · · · · · · · · · · |
| For Sub-Frame 5 | Bits | 75840 | 115008 | 155808 | • |
| For Sub-Frame 0 | Bits | 77856 | 118656 | 159456 | |
| Number of layers | | 4 | 4 | 4 | |
| Max. Throughput averaged over 1 frame (Note 4) | Mbps | 37.813 | 55.981 | 76.694 | |

- Note 1: 1 symbol allocated to PDCCH for all tests.
- Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [15].
- Note 3: As per Table 4.2-2 in TS 36.211 [15].
- Note 4: Given per component carrier per codeword.
- Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
- Note 6: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,3,4,8,9.
- Note 8: Resource blocks n_{PRB} = 4..74 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..74 in sub-frames 0,3,4,8,9.
- Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0,3,4,8,9.

Table A.3.2.2.6-3: PDSCH Reference Channel for sustained data-rate test (256QAM, 2 MIMO layers)

| Parameter | Unit | Value | | | |
|--|--------------|------------|------------|------------|--|
| Reference channel | | R.PDSCH.6- | R.PDSCH.6- | R.PDSCH.6- | |
| | | 3.1 TDD | 3.2 TDD | 3.3 TDD | |
| Channel bandwidth | MHz | 10 | 15 | 20 | |
| Allocated resource blocks | | Note 7 | Note 8 | Note 9 | |
| Uplink-Downlink Configuration (Note 3) | | 2 | 2 | 2 | |
| Number of HARQ Processes per component | | 10 | 10 | 10 | |
| carrier | | | | | |
| Allocated subframes per Radio Frame (D+S) | | 6 | 6 | 6 | |
| Modulation | | 256QAM | 256QAM | 256QAM | |
| Coding Rate | | | | | |
| For Sub-Frames 1,2,6,7 | | N/A | N/A | N/A | |
| For Sub-Frames 3,4 | | 0.74 | 0.79 | 0.74 | |
| For Sub-Frames 8,9 | | 0.85 | 0.88 | 0.85 | |
| For Sub-Frame 5 | | 0.76 | 0.76 | 0.74 | |
| For Sub-Frame 0 | | 0.78 | 0.77 | 0.76 | |
| Information Bit Payload (Note 4) | | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A | |
| For Sub-Frames 3,4 | Bits | 42368 | 63776 | 84760 | |
| For Sub-Frames 8,9 | Bits | 48936 | 75376 | 97896 | |
| For Sub-Frame 5 | Bits | 40576 | 61664 | 81176 | |
| For Sub-Frame 0 | Bits | 42368 | 63776 | 84760 | |
| Number of Code Blocks | | | | | |
| (Notes 4 and 5) | | | | | |
| For Sub-Frames 1,2,6,7 | CBs | N/A | N/A | N/A | |
| For Sub-Frames 3,4 | CBs | 7 | 11 | 14 | |
| For Sub-Frames 8,9 | CBs | 8 | 13 | 16 | |
| For Sub-Frame 5 | CBs | 7 | 11 | 14 | |
| For Sub-Frame 0 | CBs | 7 | 11 | 14 | |
| Binary Channel Bits (Note 4) | | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A | |
| For Sub-Frames 3,4 | Bits Bits | 57600 | 86400 | 115200 | |
| For Sub-Frames 8,9 | | 57600 | 86400 | 115200 | |
| For Sub-Frame 5 | Bits | 53568 | 81216 | 110016 | |
| For Sub-Frame 0 | Bits | 54912 | 83712 | 112512 | |
| Number of layers | | 2 | 2 | 2 | |
| Max. Throughput averaged over 1 frame (Note 4) | Mbps | 26.555 | 40.374 | 53.125 | |

- Note 1: 1 symbol allocated to PDCCH for all tests.
- Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [15].
- Note 3: As per Table 4.2-2 in TS 36.211 [15].
- Note 4: Given per component carrier per codeword.
- Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
- Note 6: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 7: Resource blocks $n_{PRB} = 3..49$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..49$ in sub-frames 0,3,4,8,9.
- Note 8: Resource blocks n_{PRB} = 4..74 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..74 in sub-frames 0,3,4,8,9.
- Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0,3,4,8,9.

Table A.3.2.2.6-4: PDSCH Reference Channel for sustained data-rate test (256QAM, 4 MIMO layers)

| Parameter | Unit | Value | | | |
|--|------|------------|------------|------------|---|
| Reference channel | | R.PDSCH.6- | R.PDSCH.6- | R.PDSCH.6- | |
| | | 4.1 TDD | 4.2 TDD | 4.3 TDD | |
| Channel bandwidth | MHz | 10 | 15 | 20 | |
| Allocated resource blocks | | Note 7 | Note 8 | Note 9 | |
| Uplink-Downlink Configuration (Note 3) | | 2 | 2 | 2 | |
| Number of HARQ Processes per component | | 10 | 10 | 10 | |
| carrier | | | | | |
| Allocated subframes per Radio Frame (D+S) | | 6 | 6 | 6 | |
| Modulation | | 256QAM | 256QAM | 256QAM | |
| Coding Rate | | | | | |
| For Sub-Frames 1,2,6,7 | | N/A | N/A | N/A | |
| For Sub-Frames 3,4 | | 0.78 | 0.79 | 0.78 | |
| For Sub-Frames 8,9 | | 0.78 | 0.79 | 0.78 | |
| For Sub-Frame 5 | | 0.81 | 0.82 | 0.78 | |
| For Sub-Frame 0 | | 0.82 | 0.82 | 0.80 | |
| Information Bit Payload (Note 4) | | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A | |
| For Sub-Frames 3,4 | Bits | 84760 | 128496 | 169544 | |
| For Sub-Frames 8,9 | Bits | 84760 | 128496 | 169544 | |
| For Sub-Frame 5 | Bits | 81176 | 124464 | 161760 | |
| For Sub-Frame 0 | Bits | 84760 | 128496 | 169544 | |
| Number of Code Blocks | | | | | |
| (Notes 4 and 5) | | | | | |
| For Sub-Frames 1,2,6,7 | CBs | N/A | N/A | N/A | |
| For Sub-Frames 3,4 | CBs | 14 | 21 | 28 | |
| For Sub-Frames 8,9 | CBs | 14 | 21 | 28 | |
| For Sub-Frame 5 | CBs | 14 | 21 | 27 | |
| For Sub-Frame 0 | CBs | 14 | 21 | 28 | |
| Binary Channel Bits (Note 4) | | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A | |
| For Sub-Frames 3,4 | Bits | 108800 | 163200 | 217600 | |
| For Sub-Frames 8,9 | Bits | 108800 | 163200 | 217600 | |
| For Sub-Frame 5 | Bits | 101120 | 153344 | 207744 | |
| For Sub-Frame 0 | Bits | 103808 | 158208 | 212608 | |
| Number of layers | | 4 | 4 | 4 | |
| Max. Throughput averaged over 1 frame (Note 4) | Mbps | 50.498 | 76.694 | 100.948 | _ |

- Note 1: 1 symbol allocated to PDCCH for all tests.
- Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [15].
- Note 3: As per Table 4.2-2 in TS 36.211 [15].
- Note 4: Given per component carrier per codeword.
- Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
- Note 6: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 7: Resource blocks $n_{PRB} = 3..49$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..49$ in sub-frames 0,3,4,8,9.
- Note 8: Resource blocks n_{PRB} = 4..74 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..74 in sub-frames 0,3,4,8,9.
- Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0,3,4,8,9.

Table A.3.2.2.6-5: PDSCH Reference Channel for sustained data-rate test (1024QAM, 2 MIMO layers)

| Parameter | Unit | Value | | | |
|--|------|------------|------------|------------|--|
| Reference channel | | R.PDSCH.6- | R.PDSCH.6- | R.PDSCH.6- | |
| | | 5.1 TDD | 5.2 TDD | 5.3 TDD | |
| Channel bandwidth | MHz | 10 | 15 | 20 | |
| Allocated resource blocks | | Note 7 | Note 8 | Note 9 | |
| Uplink-Downlink Configuration (Note 3) | | 2 | 2 | 2 | |
| Number of HARQ Processes per component | | 10 | 10 | 10 | |
| carrier | | | | | |
| Allocated subframes per Radio Frame (D+S) | | 6 | 6 | 6 | |
| Modulation | | 1024QAM | 1024QAM | 1024QAM | |
| Coding Rate | | | | | |
| For Sub-Frames 1,2,6,7 | | N/A | N/A | N/A | |
| For Sub-Frames 3,4 | | 0.76 | 0.75 | 0.76 | |
| For Sub-Frames 8,9 | | 0.76 | 0.75 | 0.76 | |
| For Sub-Frame 5 | | 0.76 | 0.78 | 0.77 | |
| For Sub-Frame 0 | | 0.80 | 0.78 | 0.78 | |
| Information Bit Payload (Note 4) | | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A | |
| For Sub-Frames 3,4 | Bits | 55056 | 81176 | 110136 | |
| For Sub-Frames 8,9 | Bits | 55056 | 81176 | 110136 | |
| For Sub-Frame 5 | Bits | 51024 | 78704 | 105528 | |
| For Sub-Frame 0 | Bits | 55056 | 81176 | 110136 | |
| Number of Code Blocks | | | | | |
| (Notes 4 and 5) | | | | | |
| For Sub-Frames 1,2,6,7 | CBs | N/A | N/A | N/A | |
| For Sub-Frames 3,4 | CBs | 9 | 14 | 18 | |
| For Sub-Frames 8,9 | CBs | 9 | 14 | 18 | |
| For Sub-Frame 5 | CBs | 9 | 13 | 18 | |
| For Sub-Frame 0 | CBs | 9 | 14 | 18 | |
| Binary Channel Bits (Note 4) | | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A | |
| For Sub-Frames 3,4 | Bits | 72000 | 108000 | 144000 | |
| For Sub-Frames 8,9 | Bits | 72000 | 108000 | 144000 | |
| For Sub-Frame 5 | | 66960 | 101520 | 137520 | |
| For Sub-Frame 0 | Bits | 68640 | 104640 | 140640 | |
| Number of layers | | 2 | 2 | 2 | |
| Max. Throughput averaged over 1 frame (Note 4) | Mbps | 32.630 | 48.458 | 65.621 | |

- Note 1: 1 symbol allocated to PDCCH for all tests.
- Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [15].
- Note 3: As per Table 4.2-2 in TS 36.211 [15].
- Note 4: Given per component carrier per codeword.
- Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
- Note 6: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,3,4,8,9.
- Note 8: Resource blocks n_{PRB} = 4..74 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..74 in sub-frames 0,3,4,8,9.
- Note 9: Resource blocks $n_{PRB} = 4..99$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..99$ in sub-frames 0,3,4,8,9.

Table A.3.2.2.6-6: PDSCH Reference Channel for sustained data-rate test (1024QAM, 4 MIMO layers)

| Parameter | Unit | | Valu | e | |
|--|------|------------|------------|------------|--|
| Reference channel | | R.PDSCH.6- | R.PDSCH.6- | R.PDSCH.6- | |
| | | 6.1 TDD | 6.2 TDD | 6.3 TDD | |
| Channel bandwidth | MHz | 10 | 15 | 20 | |
| Allocated resource blocks | | Note 7 | Note 8 | Note 9 | |
| Uplink-Downlink Configuration (Note 3) | | 2 | 2 | 2 | |
| Number of HARQ Processes per component | | 10 | 10 | 10 | |
| carrier | | | | | |
| Allocated subframes per Radio Frame (D+S) | | 6 | 6 | 6 | |
| Modulation | | 1024QAM | 1024QAM | 1024QAM | |
| Coding Rate | | | | | |
| For Sub-Frames 1,2,6,7 | | N/A | N/A | N/A | |
| For Sub-Frames 3,4 | | 0.81 | 0.79 | 0.81 | |
| For Sub-Frames 8,9 | | 0.81 | 0.79 | 0.81 | |
| For Sub-Frame 5 | | 0.81 | 0.82 | 0.82 | |
| For Sub-Frame 0 | | 0.85 | 0.82 | 0.83 | |
| Information Bit Payload (Note 4) | | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A | |
| For Sub-Frames 3,4 | Bits | 110136 | 161760 | 220296 | |
| For Sub-Frames 8,9 | Bits | 110136 | 161760 | 220296 | |
| For Sub-Frame 5 | Bits | 101840 | 157432 | 211936 | |
| For Sub-Frame 0 | Bits | 110136 | 161760 | 220296 | |
| Number of Code Blocks | | | | | |
| (Notes 4 and 5) | | | | | |
| For Sub-Frames 1,2,6,7 | CBs | N/A | N/A | N/A | |
| For Sub-Frames 3,4 | CBs | 18 | 27 | 36 | |
| For Sub-Frames 8,9 | CBs | 18 | 27 | 36 | |
| For Sub-Frame 5 | CBs | 17 | 26 | 35 | |
| For Sub-Frame 0 | CBs | 18 | 27 | 36 | |
| Binary Channel Bits (Note 4) | | | | | |
| For Sub-Frames 1,2,6,7 | Bits | N/A | N/A | N/A | |
| For Sub-Frames 3,4 | Bits | 136000 | 204000 | 272000 | |
| For Sub-Frames 8,9 | Bits | 136000 | 204000 | 272000 | |
| For Sub-Frame 5 | Bits | 126400 | 191680 | 259680 | |
| For Sub-Frame 0 | Bits | 129760 | 197760 | 265760 | |
| Number of layers | | 2 | 2 | 2 | |
| Max. Throughput averaged over 1 frame (Note 4) | Mbps | 65.252 | 96.623 | 131.342 | |

- Note 1: 1 symbol allocated to PDCCH for all tests.
- Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [15].
- Note 3: As per Table 4.2-2 in TS 36.211 [15].
- Note 4: Given per component carrier per codeword.
- Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
- Note 6: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,3,4,8,9.
- Note 8: Resource blocks n_{PRB} = 4..74 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..74 in sub-frames 0,3,4,8,9.
- Note 9: Resource blocks $n_{PRB} = 4..99$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..99$ in sub-frames 0,3,4,8,9.

A.3.3 Reference measurement channels for PDCCH performance requirements

A.3.3.1 FDD

A.3.3.1.1 Reference measurement channels for SCS 15 kHz FR1

Table A.3.3.1.1-1: PDCCH Reference Channels (Time domain allocation 1 symbol)

| Parameter | Unit | | Value | | | | | | |
|-------------------|------|------------|------------|------------|--|--|--|--|--|
| Reference | | R.PDCCH.1- | R.PDCCH.1- | R.PDCCH.1- | | | | | |
| channel | | 1.1 FDD | 1.2 FDD | 1.3 FDD | | | | | |
| Subcarrier | kHz | 15 | 15 | 15 | | | | | |
| spacing | | | | | | | | | |
| CORESET | | 48 | 48 | 48 | | | | | |
| frequency domain | | | | | | | | | |
| allocation | | | | | | | | | |
| CORESET time | | 1 | 1 | 1 | | | | | |
| domain allocation | | | | | | | | | |
| Aggregation level | | 4 | 4 | 8 | | | | | |
| DCI Format | | 1_0 | 1_1 | 1_1 | | | | | |
| Payload (without | Bits | 39 | 52 | 52 | | | | | |
| CRC) | | | | | | | | | |

Table A.3.3.1.1-2: PDCCH Reference Channel (Time domain allocation 2 symbols)

| Parameter | Unit | | | Va | lue | | |
|-----------------------|------|------------|------------|------------|------------|------------|------------|
| Reference | | R.PDCCH.1- | R.PDCCH.1- | R.PDCCH.1- | R.PDCCH.1- | R.PDCCH.1- | R.PDCCH.1- |
| channel | | 2.1 FDD | 2.2 FDD | 2.3 FDD | 2.4 FDD | 2.5 FDD | 2.6 FDD |
| Subcarrier | kHz | 15 | 15 | 15 | 15 | 15 | 15 |
| spacing | | | | | | | |
| CORESET | | 24 | 24 | 24 | 48 | 48 | 48 |
| frequency | | | | | | | |
| domain | | | | | | | |
| allocation | | | | | | | |
| CORESET time | | 2 | 2 | 2 | 2 | 2 | 2 |
| domain | | | | | | | |
| allocation | | | | | | | |
| Aggregation | | 2 | 4 | 2 | 4 | 8 | 16 |
| level | | | | | | | |
| DCI Format | | 1_0 | 1_0 | 1_1 | 1_1 | 1_1 | 1_0 |
| Payload (without CRC) | Bits | 39 | 39 | 52 | 52 | 52 | 39 |

A.3.3.1.2 Reference measurement channels for SCS 30 kHz FR1

Table A.3.3.1.2-1: PDCCH Reference Channels (Time domain allocation 1 symbol)

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

Table A.3.3.1.2-2: PDCCH Reference Channel (Time domain allocation 2 symbols)

| Parameter | Unit | | Value |
|-------------------|------|------------|-------|
| Reference | | R.PDCCH.2- | |
| channel | | 2.1 FDD | |
| Subcarrier | kHz | 30 | |
| spacing | | | |
| CORESET | | 48 | |
| frequency domain | | | |
| allocation | | | |
| CORESET time | | 2 | |
| domain allocation | | | |
| Aggregation level | | 16 | |
| DCI Format | | 1_0 | |
| Payload (without | Bits | 41 | |
| CRC) | | | |

A.3.3.2 TDD

A.3.3.2.1 Reference measurement channels for SCS 15 kHz FR1

Table A.3.3.2.1-1: PDCCH Reference Channels (Time domain allocation 1 symbol)

| Parameter | Unit | | | Valu | ne | |
|-------------------|------|------------|------------|------------|----|--|
| Reference | | R.PDCCH.1- | R.PDCCH.1- | R.PDCCH.1- | | |
| channel | | 1.1 TDD | 1.2 TDD | 1.3 TDD | | |
| Subcarrier | kHz | 15 | 15 | 15 | | |
| spacing | | | | | | |
| CORESET | | 48 | 48 | 48 | | |
| frequency domain | | | | | | |
| allocation | | | | | | |
| CORESET time | | 1 | 1 | 1 | | |
| domain allocation | | | | | | |
| Aggregation level | | 4 | 4 | 8 | | |
| DCI Format | | 1_0 | 1_1 | 1_1 | | |
| Payload (without | Bits | 39 | 52 | 52 | | |
| CRC) | | | | | | |

Table A.3.3.2.1-2: PDCCH Reference Channel (Time domain allocation 2 symbols)

| Parameter | Unit | | | Va | lue | | |
|-----------------------|------|------------|------------|------------|------------|------------|------------|
| Reference | | R.PDCCH.1- | R.PDCCH.1- | R.PDCCH.1- | R.PDCCH.1- | R.PDCCH.1- | R.PDCCH.1- |
| channel | | 2.1 TDD | 2.2 TDD | 2.3 TDD | 2.4 TDD | 2.5 TDD | 2.6 TDD |
| Subcarrier | kHz | 15 | 15 | 15 | 15 | 15 | 15 |
| spacing | | | | | | | |
| CORESET | | 24 | 24 | 24 | 48 | 48 | 48 |
| frequency | | | | | | | |
| domain | | | | | | | |
| allocation | | | | | | | |
| CORESET time | | 2 | 2 | 2 | 2 | 2 | 2 |
| domain | | | | | | | |
| allocation | | | | | | | |
| Aggregation | | 2 | 4 | 2 | 4 | 8 | 16 |
| level | | | | | | | |
| DCI Format | | 1_0 | 1_0 | 1_1 | 1_1 | 1_1 | 1_0 |
| Payload (without CRC) | Bits | 39 | 39 | 52 | 52 | 52 | 39 |

A.3.3.2.2 Reference measurement channels for SCS 30 kHz FR1

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

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

Table A.3.3.2.2-2: PDCCH Reference Channel (Time domain allocation 2 symbols)

| Parameter | Unit | | Value |
|-------------------|------|------------|-------|
| Reference | | R.PDCCH.2- | |
| channel | | 2.1 TDD | |
| Subcarrier | kHz | 30 | |
| spacing | | | |
| CORESET | | 48 | |
| frequency domain | | | |
| allocation | | | |
| CORESET time | | 2 | |
| domain allocation | | | |
| Aggregation level | | 16 | |
| DCI Format | | 1_0 | |
| Payload (without | Bits | 41 | |
| CRC) | | | |

A.3.3.2.3 Reference measurement channels for SCS 60 kHz FR1

A.3.3.2.4 Reference measurement channels for SCS 60 kHz FR2

A.3.3.2.5 Reference measurement channels for SCS 120 kHz FR2

Table A.3.3.2.5-1: PDCCH Reference Channels (Time domain allocation 1 symbol)

| Parameter | Unit | | | Valu | lue |
|-------------------|------|------------|------------|------------|-----|
| Reference | | R.PDCCH.5- | R.PDCCH.5- | R.PDCCH.5- | |
| channel | | 1.1 TDD | 1.2 TDD | 1.3 TDD | |
| Subcarrier | kHz | 120 | 120 | 120 | |
| spacing | | | | | |
| CORESET | | 60 | 60 | 60 | |
| frequency domain | | | | | |
| allocation | | | | | |
| CORESET time | | 1 | 1 | 1 | |
| domain allocation | | | | | |
| Aggregation level | | 2 | 4 | 8 | |
| DCI Format | | 1_0 | 1_1 | 1_1 | |
| Payload (without | Bits | 40 | 56 | 56 | |
| CRC) | | | | | |

Table A.3.3.2.5-2: PDCCH Reference Channel (Time domain allocation 2 symbols)

| Parameter | Unit | | Value | | | | |
|-------------------|------|------------|-------|---|--|--|--|
| Reference | | R.PDCCH.5- | | | | | |
| channel | | 2.1 TDD | | | | | |
| Subcarrier | kHz | 120 | | | | | |
| spacing | | | | | | | |
| CORESET | | 60 | | | | | |
| frequency domain | | | | | | | |
| allocation | | | | | | | |
| CORESET time | | 2 | | | | | |
| domain allocation | | | | | | | |
| Aggregation level | | 16 | | | | | |
| DCI Format | | 1_0 | | | | | |
| Payload (without | Bits | 40 | | _ | | | |
| CRC) | | | | | | | |

A.3.4 Reference measurement channels for PBCH demodulation requirements

A.3.4.1 Reference measurement channels for FR1

Table A.3.4.1-1: PBCH Reference Channel

| Parameter | Unit | Va | lue |
|--|------|----------|----------|
| Reference channel | | R.PBCH.1 | R.PBCH.2 |
| SS/PBCH block subcarrier spacing | kHz | 15 | 30 |
| Modulation | | QPSK | QPSK |
| Target coding rate | | 56/864 | 56/864 |
| Payload (without CRC and timing related PBCH payload bits) | bits | 24 | 24 |

A.3.4.2 Reference measurement channels for FR2

Table A.3.4.2-1: PBCH Reference Channel

| Parameter | Unit | Va | lue |
|--|------|----------|----------|
| Reference channels | | R.PBCH.5 | R.PBCH.6 |
| SS/PBCH block subcarrier spacing | kHz | 120 | 240 |
| Modulation | | QPSK | QPSK |
| Target coding rate | | 56/864 | 56/864 |
| Payload (without CRC and timing related PBCH payload bits) | bits | 24 | 24 |

A.4 CSI reference measurement channels

This clause defines the DL signal applicable to the reporting of channel status information (Clause X).

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

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

| TBS Scheme | | | TBS.1-1 | TBS.1-2 | | | | | |
|---|---------------|------------|-----------|---------|-------|------------|-----------|---------|--|
| MCS table | | | | | | 640 | QAM | | |
| Number of allocated PDSCH resource blocks | | | 66 | 66 | | | | | |
| Number of c | onsecutive PI | DSCH symbo | ls | 12 | 12 | | | | |
| Number of F | PDSCH MIMO | layers | | 1 | 2 | | | | |
| Number of D | OMRS REs (N | ote 1) | | 24 | 24 | | | | |
| Overhead for | r TBS determ | ination | | 6 | 6 | | | | |
| Available RE | E-s | | | 7590 | 7590 | | | | |
| CQI index | Spectral | MCS | Modulatio | | Infor | mation Bit | Payload p | er Slot | |
| | efficiency | index | n | | | | | | |
| 0 | OOR | OOR | OOR | N/A | N/A | | | | |
| 1 | 0.1523 | 0 | | 1800 | 3624 | | | | |
| 2 | 0.2344 | 0 | QPSK | 1800 | 3624 | | | | |
| 3 | 0.3770 | 2 | | 2856 | 5640 | | | | |
| 4 | 0.6016 | 4 | | 4480 | 8968 | | | | |
| 5 | 0.8770 | 6 | | 6528 | 13064 | | | | |
| 6 | 1.1758 | 8 | | 8712 | 17928 | | | | |
| 7 | 1.4766 | 11 | | 11016 | 22032 | | | | |
| 8 | 1.9141 | 13 | 16QAM | 14343 | 28680 | | | | |
| 9 | 2.4063 | 15 | | 17928 | 35856 | | | | |
| 10 | 2.7305 | 18 | | 20496 | 40976 | | | | |
| 11 | 3.3223 | 20 |] | 25104 | 50184 | | | | |
| 12 | 3.9023 | 22 | 64QAM | 29192 | 58384 | | | | |
| 13 | 4.5234 | 24 | | 33816 | 67584 | | | | |
| 14 | 5.1152 | 26 | | 38936 | 77896 | | | | |
| 15 | 5.5547 | 28 | | 42016 | 83976 | | | | |
| Note 1: N | | | | | | | | | |

Note 1: Number of DMRS REs includes the overhead of the DM-RS CDM groups without data Note 2: PDSCH is not scheduled on slots containing CSI-RS or slots which are not full DL Note 3: PDSCH is not scheduled on slots containing PBCH, i.e. slot#0 per 20ms periodicity

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

| TBS Scheme TBS.2-1 TBS.2-2 TBS.2-3 T | | | | | | | TBS.2-4 | TBS.2-5 | TBS.2-6 |
|---|----------------|---------------|-----------------|-----------|--------------|--------------|-------------|---------|---------|
| MCS table | 256QAM | | | | | | | | |
| Number of a | allocated PDS | CH resource l | olocks | 52 | 52 | 106 | 106 | 8 | 16 |
| Number of c | consecutive PI | DSCH symbol | s | 12 | 12 | 12 | 12 | 12 | 12 |
| Number of F | PDSCH MIMO | layers | | 1 | 2 | 1 | 2 | 1 | 1 |
| Number of E | OMRS REs (N | ote 1) | | 24 | 24 | 24 | 24 | 24 | 24 |
| Overhead for | or TBS determ | ination | | 0 | 0 | 0 | 0 | 0 | 0 |
| Available R | E-s for PDSCH | 1 | | 6240 | 6240 | 12720 | 12720 | 960 | 1920 |
| CQI index | Spectral | MCS | Modulatio | | Infor | mation Bit F | Payload per | r Slot | |
| | efficiency | index | n | | | | | | |
| 0 | OOR | OOR | OOR | N/A | N/A | N/A | N/A | N/A | N/A |
| 1 | 0.1523 | 0 | | 1480 | 2976 | 2976 | 5896 | 224 | 456 |
| 2 | 0.3770 | 1 | QPSK | 2408 | 4744 | 4744 | 9480 | 368 | 736 |
| 3 | 0.8770 | 3 | | 5504 | 11016 | 11016 | 22536 | 848 | 1736 |
| 4 | 1.4766 | 5 | | 9224 | 18432 | 18960 | 37896 | 1416 | 2856 |
| 5 | 1.9141 | 7 | 16QAM | 12040 | 24072 | 24576 | 49176 | 1864 | 3752 |
| 6 2.4063 9 | | 15112 | 30216 | 30728 | 61480 | 2408 | 4608 | | |
| 7 | 2.7305 | 11 | | 16896 | 33816 | 34816 | 69672 | 2600 | 5248 |
| 8 | 3.3223 | 13 | | 20496 | 40976 | 42016 | 83976 | 3240 | 6400 |
| 9 | 3.9023 | 15 | 64QAM | 24576 | 49176 | 49176 | 98376 | 3752 | 7424 |
| 10 | 4.5234 | 17 | | 28168 | 56368 | 57376 | 114776 | 4352 | 8712 |
| 11 | 5.1152 | 19 | | 31752 | 63528 | 65576 | 131176 | 4864 | 9736 |
| 12 | 5.5547 | 21 | | 34816 | 69672 | 69672 | 139376 | 5248 | 10760 |
| 13 | 6.2266 | 23 | 2560 4 14 | 38936 | 77896 | 79896 | 159880 | 6016 | 12040 |
| 14 | 6.9141 | 25 | 256QAM | 43032 | 86040 | 88064 | 176208 | 6656 | 13320 |
| 15 | 7.4063 | 27 | | 46104 | 92200 | 94248 | 188576 | 7040 | 14088 |
| Note 1: Number of DMRS REs includes the overhead of the DM-RS CDM groups without data | | | | | | | | | |
| Note 2: P | DSCH is not s | scheduled on | slots containii | ng CSI-RS | or slots whi | ch are not f | ull DL | | |
| Note 3: P | | | | | | | | | |

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

| Number of allocated PDSCH resource blocks 52 52 106 106 | | | | | | |
|--|--|--|--|--|--|--|
| Number of consecutive PDSCH symbols | | | | | | |
| Number of PDSCH MIMO layers 3 4 3 4 Number of DMRS REs (Note 1) 24 24 24 24 Overhead for TBS determination 0 0 0 0 Available RE-s for PDSCH 6240 6240 12720 12720 CQI index Spectral efficiency index MCS index Modulation Information Bit Payload per Slot 0 OOR OOR N/A N/A N/A N/A 1 0.1523 0 A360 5896 8976 11784 2 0.3770 1 QPSK 7048 9480 14344 18976 3 0.8770 3 16392 22032 33816 45096 4 1.4766 5 27656 36896 56368 75792 5 1.9141 7 16QAM 35856 48168 73776 98376 6 2.4063 9 45096 60456 92200 122976 7 | | | | | | |
| Number of DMRS REs (Note 1) 24 24 24 24 24 24 24 2 | | | | | | |
| Overhead for TBS determination 0 0 0 0 Available RE-s for PDSCH 6240 6240 12720 12720 CQI index Spectral efficiency index MCS index Modulation index Information Bit Payload per Slot 0 OOR OOR N/A N/A N/A N/A 1 0.1523 0 4360 5896 8976 11784 2 0.3770 1 QPSK 7048 9480 14344 18976 3 0.8770 3 16392 22032 33816 45096 4 1.4766 5 27656 36896 56368 75792 5 1.9141 7 16QAM 35856 48168 73776 98376 6 2.4063 9 45096 60456 92200 122976 7 2.7305 11 51216 67584 104496 139376 8 3.3223 13 64QAM 73776 9 | | | | | | |
| Available RE-s for PDSCH 6240 6240 12720 12720 CQI index Spectral efficiency MCS index Modulation index Information Bit Payload per Slot 0 OOR OOR N/A N/A N/A N/A 1 0.1523 0 4360 5896 8976 11784 2 0.3770 1 QPSK 7048 9480 14344 18976 3 0.8770 3 16392 22032 33816 45096 4 1.4766 5 27656 36896 56368 75792 5 1.9141 7 16QAM 35856 48168 73776 98376 6 2.4063 9 45096 60456 92200 122976 7 2.7305 11 51216 67584 104496 139376 8 3.3223 13 64QAM 73776 98376 147576 196776 9 3.9023 15 < | | | | | | |
| CQI index Spectral efficiency index MCS index Modulation efficiency index Information Bit Payload per Slot 0 OOR OOR N/A N/A N/A N/A 1 0.1523 0 4360 5896 8976 11784 2 0.3770 1 QPSK 7048 9480 14344 18976 3 0.8770 3 16392 22032 33816 45096 4 1.4766 5 27656 36896 56368 75792 5 1.9141 7 16QAM 35856 48168 73776 98376 6 2.4063 9 45096 60456 92200 122976 7 2.7305 11 51216 67584 104496 139376 8 3.3223 13 64QAM 73776 98376 147576 196776 9 3.9023 15 64QAM 73776 98376 147576 196776 | | | | | | |
| efficiency index 0 OOR OOR N/A N/A N/A N/A 1 0.1523 0 4360 5896 8976 11784 2 0.3770 1 QPSK 7048 9480 14344 18976 3 0.8770 3 16392 22032 33816 45096 4 1.4766 5 27656 36896 56368 75792 5 1.9141 7 16QAM 35856 48168 73776 98376 6 2.4063 9 45096 60456 92200 122976 7 2.7305 11 51216 67584 104496 139376 8 3.3223 13 62504 81976 127080 167976 9 3.9023 15 64QAM 73776 98376 147576 196776 10 4.5234 17 96264 127080 196776 262376 </td <td></td> | | | | | | |
| 0 OOR OOR OOR N/A N/A N/A N/A 1 0.1523 0 4360 5896 8976 11784 2 0.3770 1 QPSK 7048 9480 14344 18976 3 0.8770 3 16392 22032 33816 45096 4 1.4766 5 27656 36896 56368 75792 5 1.9141 7 16QAM 35856 48168 73776 98376 6 2.4063 9 45096 60456 92200 122976 7 2.7305 11 51216 67584 104496 139376 8 3.3223 13 62504 81976 127080 167976 9 3.9023 15 64QAM 73776 98376 147576 196776 10 4.5234 17 96264 127080 196776 262376 | | | | | | |
| 1 0.1523 0 4360 5896 8976 11784 2 0.3770 1 QPSK 7048 9480 14344 18976 3 0.8770 3 16392 22032 33816 45096 4 1.4766 5 27656 36896 56368 75792 5 1.9141 7 16QAM 35856 48168 73776 98376 6 2.4063 9 45096 60456 92200 122976 7 2.7305 11 51216 67584 104496 139376 8 3.3223 13 62504 81976 127080 167976 9 3.9023 15 64QAM 73776 98376 147576 196776 10 4.5234 17 83976 112648 172176 229576 11 5.1152 19 96264 127080 196776 262376 | | | | | | |
| 2 0.3770 1 QPSK 7048 9480 14344 18976 3 0.8770 3 16392 22032 33816 45096 4 1.4766 5 27656 36896 56368 75792 5 1.9141 7 16QAM 35856 48168 73776 98376 6 2.4063 9 45096 60456 92200 122976 7 2.7305 11 51216 67584 104496 139376 8 3.3223 13 62504 81976 127080 167976 9 3.9023 15 64QAM 73776 98376 147576 196776 10 4.5234 17 83976 112648 172176 229576 11 5.1152 19 96264 127080 196776 262376 | | | | | | |
| 3 0.8770 3 16392 22032 33816 45096 4 1.4766 5 27656 36896 56368 75792 5 1.9141 7 16QAM 35856 48168 73776 98376 6 2.4063 9 45096 60456 92200 122976 7 2.7305 11 51216 67584 104496 139376 8 3.3223 13 62504 81976 127080 167976 9 3.9023 15 64QAM 73776 98376 147576 196776 10 4.5234 17 83976 112648 172176 229576 11 5.1152 19 96264 127080 196776 262376 | | | | | | |
| 4 1.4766 5 5 1.9141 7 6 2.4063 9 7 2.7305 11 8 3.3223 13 9 3.9023 15 10 4.5234 17 11 5.1152 19 27656 36896 56368 75792 36896 56368 75792 35856 48168 73776 98200 122976 51216 67584 104496 139376 62504 81976 127080 167976 83976 112648 172176 229576 96264 127080 196776 262376 | | | | | | |
| 5 1.9141 7 16QAM 35856 48168 73776 98376 6 2.4063 9 45096 60456 92200 122976 7 2.7305 11 51216 67584 104496 139376 8 3.3223 13 62504 81976 127080 167976 9 3.9023 15 64QAM 73776 98376 147576 196776 10 4.5234 17 83976 112648 172176 229576 11 5.1152 19 96264 127080 196776 262376 | | | | | | |
| 6 2.4063 9 45096 60456 92200 122976 7 2.7305 11 51216 67584 104496 139376 8 3.3223 13 62504 81976 127080 167976 9 3.9023 15 64QAM 73776 98376 147576 196776 10 4.5234 17 83976 112648 172176 229576 11 5.1152 19 96264 127080 196776 262376 | | | | | | |
| 7 2.7305 11 8 3.3223 13 9 3.9023 15 10 4.5234 17 11 5.1152 19 51216 67584 104496 139376 62504 81976 127080 167976 73776 98376 147576 196776 83976 112648 172176 229576 96264 127080 196776 262376 | | | | | | |
| 8 3.3223 13 9 3.9023 15 10 4.5234 17 11 5.1152 19 62504 81976 127080 167976 98376 147576 196776 83976 112648 172176 229576 96264 127080 196776 262376 | | | | | | |
| 9 3.9023 15 64QAM 73776 98376 147576 196776 10 4.5234 17 83976 112648 172176 229576 11 5.1152 19 96264 127080 196776 262376 | | | | | | |
| 10 4.5234 17 83976 112648 172176 229576 11 5.1152 19 96264 127080 196776 262376 | | | | | | |
| 11 5.1152 19 96264 127080 196776 262376 | | | | | | |
| | | | | | | |
| 12 5 5547 21 104406 120276 212476 279776 | | | | | | |
| 12 3.3347 21 104430 133370 213170 276770 | | | | | | |
| 13 6.2266 23 _{25600M} 116792 155776 237776 319784 | | | | | | |
| 14 6.9141 25 256QAM 110732 133776 257776 313764 129128 172176 262376 352440 | | | | | | |
| 15 7.4063 27 139376 184424 278776 376896 | | | | | | |
| Note 1: Number of DMRS REs includes the overhead of the DM-RS CDM groups without data Note 2: PDSCH is not scheduled on slots containing CSI-RS or slots which are not full DL Note 3: PDSCH is not scheduled on slots containing PBCH, i.e. slot#0 per 20ms periodicity | | | | | | |

OFDMA Channel Noise Generator (OCNG) **A.5**

A.5.1OCNG Patterns for FDD

A.5.1.1 OCNG FDD pattern 1: Generic OCNG FDD Pattern for all unused **REs**

Table A.5.1.1-1: OP.1 FDD: Generic OCNG FDD Pattern for all unused REs

| OCNG Appliance | Control Region | Data Region | | | | |
|--|---|---|--|--|--|--|
| OCNG Parameters | (CORESET) | | | | | |
| Resources allocated | All unused REs (Note 1) | All unused REs (Note 2) | | | | |
| Structure | PDCCH | PDSCH | | | | |
| Content | Uncorrelated pseudo random QPSK modulated data | Uncorrelated pseudo random QPSK modulated data | | | | |
| Transmission scheme for multiple antennas ports transmission | Single Tx port transmission | Spatial multiplexing using any precoding matrix with dimensions same as the precoding matrix for PDSCH | | | | |
| Subcarrier Spacing | Same as for RMC PDCCH in the active BWP | Same as for RMC PDSCH in the active BWP | | | | |
| Power Level | Same as for RMC PDCCH | Same as for RMC PDSCH | | | | |
| Note 1: All unused REs in the active CORESETS appointed by the search spaces in use. | | | | | | |

Unused available REs refer to REs in PRBs not allocated for any physical channels, CORESETs, Note 2: synchronization signals or reference signals, and excluding REs in all the available PDSCH DMRS CDM groups, in channel bandwidth.

A.5.2 OCNG Patterns for TDD

OCNG TDD pattern 1: Generic OCNG TDD Pattern for all unused A.5.2.1 **REs**

Table A.5.2.1-1: OP.1 TDD: Generic OCNG TDD Pattern for all unused REs

| OCNG Appliance OCNG Parameters | Control Region (CORESET) | Data Region |
|--|---|---|
| Resources allocated | All unused REs (Note 1) | All unused REs (Note 2) |
| Structure | PDCCH | PDSCH |
| Content | Uncorrelated pseudo random QPSK modulated data | Uncorrelated pseudo random QPSK modulated data |
| Transmission scheme for multiple antennas ports transmission | Single Tx port transmission | Spatial multiplexing using any precoding matrix with dimensions same as the precoding matrix for PDSCH |
| Subcarrier Spacing | Same as for RMC PDCCH in the active BWP | Same as for RMC PDSCH in the active BWP |
| Power Level | Same as for RMC PDCCH | Same as for RMC PDSCH |

All unused REs in the active CORESETS appointed by the search spaces in use. Note 1:

Unused available REs refer to REs in PRBs not allocated for any physical channels, CORESETs, Note 2: synchronization signals or reference signals, and excluding REs in all the available PDSCH DMRS CDM groups, in channel bandwidth.

Annex B (normative): Propagation conditions

B.1 Static propagation condition

B.1.1 UE Receiver with 2Rx

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

$$\mathbf{H} = \begin{pmatrix} 1 \\ 1 \end{pmatrix}$$
.

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

$$\mathbf{H} = \begin{pmatrix} 1 & j \\ 1 & -j \end{pmatrix}.$$

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

$$\mathbf{H} = \begin{bmatrix} 1 & 1 & j & j \\ 1 & 1 - j & -j \end{bmatrix}$$

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

$$\mathbf{H} = \begin{bmatrix} 1 & 1 & 1 & 1 & j & j & j \\ 1 & 1 & 1 & 1 - j - j - j - j \end{bmatrix}$$

B.1.2 UE Receiver with 4Rx

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

$$\mathbf{H} = \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$$

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

$$\mathbf{H} = \begin{bmatrix} 1 & j \\ 1 & -j \\ 1 & j \\ 1 & -j \end{bmatrix}.$$

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

$$\mathbf{H} = \begin{bmatrix} 1 & 1 & j & j \\ 1 & 1 & -j & -j \\ 1 & -1 & j & -j \\ 1 & -1 & -j & j \end{bmatrix}.$$

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

$$\mathbf{H} = \begin{bmatrix} 1 & 1 & 1 & 1 & j & j & j & j \\ 1 & 1 & 1 & 1 & -j & -j & -j & -j \\ 1 & 1 & -1 & -1 & j & j & -j & -j \\ 1 & 1 & -1 & -1 & -j & -j & j & j \end{bmatrix}$$

B.2 Multi-path fading propagation conditions

The multipath propagation conditions consist of several parts:

- A delay profile in the form of a "tapped delay-lin", characterized by a number of taps at fixed positions on a sampling grid. The profile can be further characterized by the r.m.s. delay spread and the maximum delay spanned by the taps.
- A combination of channel model parameters that include the Delay profile and the Doppler spectrum that is characterized by a classical spectrum shape and a maximum Doppler frequency.
- Different models are used for FR1 (below 6 GHz) and FR2 (above 6 GHz).

B.2.1 Delay profiles

The delay profiles are simplified from the TR 38.901 [5] TDL models. The simplification steps are shown below for information. These steps are only used when new delay profiles are created. Otherwise, the delay profiles specified in B.2.1.1 and B.2.1.2 can be used as such.

- Step 1: Use the original TDL model from TR 38.901[5].
- Step 2: Re-order the taps in ascending delays
- Step 3: Perform delay scaling according to the procedure described in clause 7.7.3 in TR 38.901 [5].
- Step 4: Apply the quantization to the delay resolution 5 ns. This is done simply by rounding the tap delays to the nearest multiple of the delay resolution.
- Step 5: If multiple taps are rounded to the same delay bin, merge them by calculating their linear power sum.
- Step 6: If there are more than 12 taps in the quantized model, merge the taps as follows
- Find the weakest tap from all taps (both merged and unmerged taps are considered)
 - If there are two or more taps having the same value and are the weakest, select the tap with the smallest delay as the weakest tap.
- When the weakest tap is the first delay tap, merge taps as follows
 - Update the power of the first delay tap as the linear power sum of the weakest tap and the second delay tap.
 - Remove the second delay tap.
- When the weakest tap is the last delay tap, merge taps as follows
 - Update the power of the last delay tap as the linear power sum of the second-to-last tap and the last tap.
 - Remove the second-to-last tap.
- Otherwise
 - For each side of the weakest tap, identify the neighbour tap that has the smaller delay difference to the weakest tap.

- When the delay difference between the weakest tap and the identified neighbour tap on one side equals the delay difference between the weakest tap and the identified neighbour tap on the other side.
 - Select the neighbour tap that is weaker in power for merging.
- Otherwise, select the neighbour tap that has smaller delay difference for merging.
- To merge, the power of the merged tap is the linear sum of the power of the weakest tap and the selected tap.
- When the selected tap is the first tap, the location of the merged tap is the location of the first tap. The weakest tap is removed.
- When the selected tap is the last tap, the location of the merged tap is the location of the last tap. The weakest tap is removed.
- Otherwise, the location of the merged tap is based on the average delay of the weakest tap and selected tap. If the average delay is on the sampling grid, the location of the merged tap is the average delay. Merge two parallel taps with different delays (average delay, sum power) starting from the weakest ones. Otherwise, the location of the merged tap is rounded towards the direction of the selected tap (e.g. 10 ns & 20 ns → 15 ns, 10 ns & 25 ns → 20 ns, if 25 ns had higher or equal power; 15 ns, if 10 ns had higher power). The weakest tap and the selected tap are removed.
- Repeat step 6 until the final number of taps is 12.
- Step 7: Round the amplitudes of taps to one decimal (e.g. $-8.78 \text{ dB} \rightarrow -8.8 \text{ dB}$)
- Step 8: If the delay spread has slightly changed due to the tap merge, adjust the final delay spread by increasing or decreasing the power of the last tap so that the delay spread is corrected.
- Step 9: Re-normalize tap powers such that the strongest tap is at 0dB.
- Note: Some values of the delay profile created by the simplification steps may differ from the values in tables B.2.1.1-2, B.2.1.1-3, B.2.1.1-4, B.2.1.2-2, and B.2.1.1-3 for the corresponding model.
- Note: For Step 5 and Step 6, the power values are expressed in the linear domain using 6 digits of precision. The operations are in the linear domain.

B.2.1.1 Delay profiles for FR1

The delay profiles for FR1 are selected to be representative of low, medium and high delay spread environment. The resulting model parameters are specified in B.2.1.1-1 and the tapped delay line models are specified in Tables B.2.1.1-2 ~ Table B.2.1.1-4.

Table B.2.1.1-1: Delay profiles for NR channel models

| Model | Number of channel taps | Delay spread (r.m.s.) | Maximum excess tap delay (span) | Delay resolution |
|----------|------------------------|--------------------------|---------------------------------|------------------|
| TDLA30 | 12 | 30 ns | 290 ns | 5 ns |
| TDLB100 | 12 | 100 ns | 480 ns | 5 ns |
| TDI C300 | 12 | 300 ns | 2595 ns | 5 ns |

Table B.2.1.1-2 TDLA30 (DS = 30 ns)

| Tap # | Delay [ns] | Power [dB] | Fading distribution |
|-------|------------|------------|---------------------|
| 1 | 0 | -15.5 | Rayleigh |
| 2 | 10 | 0 | Rayleigh |
| 3 | 15 | -5.1 | Rayleigh |
| 4 | 20 | -5.1 | Rayleigh |
| 5 | 25 | -9.6 | Rayleigh |
| 6 | 50 | -8.2 | Rayleigh |
| 7 | 65 | -13.1 | Rayleigh |
| 8 | 75 | -11.5 | Rayleigh |
| 9 | 105 | -11.0 | Rayleigh |
| 10 | 135 | -16.2 | Rayleigh |
| 11 | 150 | -16.6 | Rayleigh |
| 12 | 290 | -26.2 | Rayleigh |

Table B.2.1.1-3 TDLB100 (DS = 100ns)

| Tap# | Delay [ns] | Power [dB] | Fading distribution |
|------|------------|------------|---------------------|
| 1 | 0 | 0 | Rayleigh |
| 2 | 10 | -2.2 | Rayleigh |
| 3 | 20 | -0.6 | Rayleigh |
| 4 | 30 | -0.6 | Rayleigh |
| 5 | 35 | -0.3 | Rayleigh |
| 6 | 45 | -1.2 | Rayleigh |
| 7 | 55 | -5.9 | Rayleigh |
| 8 | 120 | -2.2 | Rayleigh |
| 9 | 170 | -0.8 | Rayleigh |
| 10 | 245 | -6.3 | Rayleigh |
| 11 | 330 | -7.5 | Rayleigh |
| 12 | 480 | -7.1 | Rayleigh |

Table B.2.1.1-4 TDLC300 (DS = 300 ns)

| Tap# | Delay [ns] | Power [dB] | Fading distribution |
|------|------------|------------|---------------------|
| 1 | 0 | -6.9 | Rayleigh |
| 2 | 65 | 0 | Rayleigh |
| 3 | 70 | -7.7 | Rayleigh |
| 4 | 190 | -2.5 | Rayleigh |
| 5 | 195 | -2.4 | Rayleigh |
| 6 | 200 | -9.9 | Rayleigh |
| 7 | 240 | -8.0 | Rayleigh |
| 8 | 325 | -6.6 | Rayleigh |
| 9 | 520 | -7.1 | Rayleigh |
| 10 | 1045 | -13.0 | Rayleigh |
| 11 | 1510 | -14.2 | Rayleigh |
| 12 | 2595 | -16.0 | Rayleigh |

B.2.1.2 Delay profiles for FR2

The delay profiles for FR2 are specified in B.2.1.2-1 and the tapped delay line models are specified in Tables B.2.1.2-2 and table B.2.1.2-3.

Table B.2.1.2-1: Delay profiles for NR channel models

| Model | Number of channel taps | Delay spread (r.m.s.) | Maximum excess tap delay (span) | Delay resolution |
|--------|------------------------|--------------------------|---------------------------------|------------------|
| TDLA30 | 12 | 30 ns | 290 ns | 5 ns |
| TDLC60 | 12 | 60 ns | 520 ns | 5 ns |

Table B.2.1.2-2 TDLA30 (DS = 30 ns)

| Tap# | Delay [ns] | Power [dB] | Fading distribution |
|------|------------|------------|---------------------|
| 1 | 0 | -15.5 | Rayleigh |
| 2 | 10 | 0 | Rayleigh |
| 3 | 15 | -5.1 | Rayleigh |
| 4 | 20 | -5.1 | Rayleigh |
| 5 | 25 | -9.6 | Rayleigh |
| 6 | 50 | -8.2 | Rayleigh |
| 7 | 65 | -13.1 | Rayleigh |
| 8 | 75 | -11.5 | Rayleigh |
| 9 | 105 | -11.0 | Rayleigh |
| 10 | 135 | -16.2 | Rayleigh |
| 11 | 150 | -16.6 | Rayleigh |
| 12 | 290 | -26.2 | Rayleigh |

Table B.2.1.2-3 TDLC60 (DS = 60 ns)

| Tap# | Delay [ns] | Power [dB] | Fading distribution |
|------|------------|------------|---------------------|
| 1 | 0 | -7.8 | Rayleigh |
| 2 | 15 | -0.3 | Rayleigh |
| 3 | 40 | 0 | Rayleigh |
| 4 | 50 | -8.9 | Rayleigh |
| 5 | 55 | -14.5 | Rayleigh |
| 6 | 75 | -8.5 | Rayleigh |
| 7 | 80 | -10.2 | Rayleigh |
| 8 | 130 | -12.1 | Rayleigh |
| 9 | 210 | -13.9 | Rayleigh |
| 10 | 300 | -15.2 | Rayleigh |
| 11 | 360 | -16.9 | Rayleigh |
| 12 | 520 | -19.4 | Rayleigh |

B.2.2 Combinations of channel model parameters

The propagation conditions used for the performance measurements in multi-path fading environment are indicated as a combination of a channel model name and a maximum Doppler frequency, i.e., TDLA<DS>-<Doppler>, TDLB<DS>-<Doppler> or TDLC<DS>-<Doppler> where '<DS>' indicates the desired delay spread and '<Doppler>' indicates the maximum Doppler frequency (Hz).

Table B.2.2-1 and Table B.2.2-2 show the propagation conditions that are used for the performance measurements in multi-path fading environment for low, medium and high Doppler frequencies for FR1 and FR2, respectively.

Table B.2.2-1 Channel model parameters for FR1

| Combination name | Model | Maximum Doppler frequency |
|------------------|---------|---------------------------|
| TDLA30-5 | TDLA30 | 5 Hz |
| TDLA30-10 | TDLA30 | 10 Hz |
| TDLB100-400 | TDLB100 | 400 Hz |
| TDLC300-100 | TDLC300 | 100 Hz |

Table B.2.2-2 Channel model parameters for FR2

| Combination name | Model | Maximum Doppler frequency |
|------------------|--------|---------------------------|
| TDLA30-35 | TDLA30 | 35 Hz |
| TDLA30-75 | TDLA30 | 75 Hz |
| TDLA30-300 | TDLA30 | 300 Hz |
| TDLC60-300 | TDLC60 | 300 Hz |

B.2.3 MIMO Channel Correlation Matrices

The MIMO channel correlation matrices defined in B.2.3 apply for the antenna configuration using uniform linear arrays at both gNB and UE and for the antenna configuration using cross polarized antennas.

B.2.3.1 MIMO Correlation Matrices using Uniform Linear Array (ULA)

The MIMO channel correlation matrices defined in B.2.3.1 apply for the antenna configuration using uniform linear array (ULA) at both gNB and UE.

B.2.3.1.1 Definition of MIMO Correlation Matrices

Table B.2.3.1.1-1 defines the correlation matrix for the gNB.

Table B.2.3.1.1-1 gNB correlation matrix

| | One antenna | Two antennas | Four antennas |
|-----------------|---------------|--|---|
| gNB Correlation | $R_{gNB} = 1$ | $R_{gNB} = \begin{pmatrix} 1 & \alpha \\ \alpha^* & 1 \end{pmatrix}$ | $R_{gNB} = \begin{pmatrix} 1 & \alpha^{1/9} & \alpha^{4/9} & \alpha \\ \alpha^{1/9*} & 1 & \alpha^{1/9} & \alpha^{4/9} \\ \alpha^{4/9*} & \alpha^{1/9*} & 1 & \alpha^{1/9} \\ \alpha^* & \alpha^{4/9*} & \alpha^{1/9*} & 1 \end{pmatrix}$ |

Table B.2.3.1.1-2 defines the correlation matrix for the UE:

Table B.2.3.1.1-2 UE correlation matrix

| | One antenna | Two antennas | Four antennas |
|----------------|-------------|---|---|
| UE Correlation | R_{UE} =1 | $R_{UE} = \begin{pmatrix} 1 & \beta \\ \beta^* & 1 \end{pmatrix}$ | $R_{UE} = \begin{pmatrix} 1 & \beta^{\frac{1}{9}} & \beta^{\frac{4}{9}} & \beta \\ \beta^{\frac{1}{9}^*} & 1 & \beta^{\frac{1}{9}} & \beta^{\frac{4}{9}} \\ \beta^{\frac{4}{9}^*} & \beta^{\frac{1}{9}^*} & 1 & \beta^{\frac{1}{9}} \\ \beta^* & \beta^{\frac{4}{9}^*} & \beta^{\frac{1}{9}^*} & 1 \end{pmatrix}$ |

Table B.2.3.1.1-3 defines the channel spatial correlation matrix R_{spat} . The parameters, α and β in Table B.2.3.1-3 defines the spatial correlation between the antennas at the gNB and UE.

Table B.2.3.1.1-3: R_{spat} correlation matrices

| 1x2 case | $R_{spat} = R_{UE} = \begin{bmatrix} 1 & \beta \\ \beta^* & 1 \end{bmatrix}$ |
|----------|--|
| 1x4 case | $R_{spat} = R_{UE} = \begin{pmatrix} 1 & \beta^{1/9} & \beta^{4/9} & \beta \\ \beta^{1/9} & 1 & \beta^{1/9} & \beta^{4/9} \\ \beta^{4/9} & \beta^{1/9} & 1 & \beta^{1/9} \\ \beta^* & \beta^{4/9} & \beta^{1/9} & 1 \end{pmatrix}$ $R_{spat} = R_{gNB} = \begin{bmatrix} 1 & \alpha \\ \alpha^* & 1 \end{bmatrix}$ |
| 2x1 case | $R_{spat} = R_{gNB} = \begin{bmatrix} 1 & \alpha \\ \alpha^* & 1 \end{bmatrix}$ |
| 2x2 case | $R_{spat} = R_{gNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha \\ \alpha^* & 1 \end{bmatrix} \otimes \begin{bmatrix} 1 & \beta \end{bmatrix} = \begin{bmatrix} 1 & \beta & \alpha & \alpha\beta \\ \beta^* & 1 & \alpha\beta^* & \alpha \\ \alpha^* & \alpha^*\beta & 1 & \beta \\ \alpha^*\beta^* & \alpha^* & \beta^* & 1 \end{bmatrix}$ |
| 2x4 case | $R_{spat} = R_{gNB} \otimes R_{UE} = egin{bmatrix} 1 & lpha \ lpha^* & 1 \end{bmatrix} \otimes egin{bmatrix} 1 & eta^{1/9} & eta^{4/9} & eta \ eta^{1/9^*} & 1 & eta^{1/9} & eta^{4/9} \ eta^{4/9^*} & eta^{1/9^*} & 1 & eta^{1/9} \ eta^* & eta^{4/9^*} & eta^{1/9^*} & 1 \end{bmatrix}$ |
| 4x1 case | $R_{spat} = R_{gNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha \\ \alpha^* & 1 \end{bmatrix} \otimes \begin{bmatrix} 1 & \beta \\ \beta^* & 1 \end{bmatrix} = \begin{bmatrix} 1 & \beta & \alpha & \alpha\beta \\ \beta^* & 1 & \alpha\beta^* & \alpha \\ \alpha^* & \alpha^*\beta & 1 & \beta \\ \alpha^*\beta^* & \alpha^* & \beta^* & 1 \end{bmatrix}$ $R_{spat} = R_{gNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha \\ \alpha^* & 1 \end{bmatrix} \otimes \begin{bmatrix} 1 & \beta^{1/9} & \beta^{4/9} & \beta \\ \beta^{1/9*} & 1 & \beta^{1/9} & \beta^{4/9} \\ \beta^{1/9*} & \beta^{1/9*} & 1 & \beta^{1/9} \\ \beta^* & \beta^{4/9*} & \beta^{1/9*} & 1 \end{bmatrix}$ $R_{spat} = R_{gNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha^{1/9} & \alpha^{4/9} & \alpha \\ \alpha^{1/9} & 1 & \alpha^{1/9} & \alpha^{4/9} \\ \alpha^{1/9} & \alpha^{1/9} & 1 & \alpha^{1/9} \\ \alpha^* & \alpha^{4/9} & \alpha^{1/9} & 1 \end{bmatrix}$ $R_{spat} = R_{gNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha^{1/9} & \alpha^{4/9} & \alpha \\ \alpha^{1/9} & 1 & \alpha^{1/9} & \alpha^{4/9} \\ \alpha^{4/9} & \alpha^{1/9} & 1 & \alpha^{1/9} \\ \alpha^{4/9} & \alpha^{1/9} & 1 & \alpha^{1/9} \end{bmatrix} \otimes \begin{bmatrix} 1 & \beta \\ \beta^* & 1 \end{bmatrix}$ |
| 4x2 case | $R_{spat} = R_{gNB} \otimes R_{UE} = egin{bmatrix} 1 & lpha^{1/9} & lpha^{4/9} & lpha \ lpha^{1/9} & 1 & lpha^{1/9} & lpha^{4/9} \ lpha^{4/9} & lpha^{1/9} & 1 & lpha^{1/9} \ lpha^* & lpha^{4/9} & lpha^{1/9} & 1 \end{bmatrix} egin{bmatrix} 1 & eta \ eta^* & 1 \end{bmatrix}$ |
| 4x4 case | $R_{spat} = R_{gNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha^{1/9} & \alpha^{4/9} & \alpha \\ \alpha^{1/9} & 1 & \alpha^{1/9} & \alpha^{4/9} \\ \alpha^{4/9} & \alpha^{1/9} & 1 & \alpha^{1/9} \end{bmatrix} \otimes \begin{bmatrix} 1 & \beta^{1/9} & \beta^{4/9} & \beta \\ \beta^{1/9*} & 1 & \beta^{1/9} & \beta^{4/9} \\ \beta^{4/9*} & \beta^{1/9*} & 1 & \beta^{1/9} \\ \beta^{*} & \beta^{4/9*} & \beta^{1/9*} & 1 \end{bmatrix}$ |

For cases with more antennas at either gNB or UE or both, the channel spatial correlation matrix can still be expressed as the Kronecker product of R_{gNB} and R_{UE} according to $R_{spat} = R_{gNB} \otimes R_{UE}$.

B.2.3.1.2 MIMO Correlation Matrices at High, Medium and Low Level

The α and β for different correlation types are given in Table B.2.3.1.2-1.

Table B.2.3.1.2-1: The α and β parameters for ULA MIMO correlation matrices

| Correlation Model | α | β |
|-------------------|-----|--------|
| Low correlation | 0 | 0 |
| Medium | 0.3 | 0.9 |
| Correlation | | |
| Medium | 0.3 | 0.3874 |
| Correlation A | | |
| High Correlation | 0.9 | 0.9 |

The correlation matrices for high, medium, medium A and low correlation are defined in Table B.2.3.1.2-2, B.2.3.1.2-3, B.2.3.1.2-4 and B.2.3.1.2-5 as below.

The values in Table B.2.3.1.2-2 have been adjusted for the 4x2 and 4x4 high correlation cases to insure the correlation matrix is positive semi-definite after round-off to 4 digit precision. This is done using the equation:

$$R_{high} = [R_{spat} + aI_n]/(1+a)$$

Where the value "a" is a scaling factor such that the smallest value is used to obtain a positive semi-definite result. For the 4x2 high correlation case, a=0.00010. For the 4x4 high correlation case, a=0.00012.

The same method is used to adjust the 2x4 and 4x4 medium correlation matrix in Table B.2.3.1.2-3 to insure the correlation matrix is positive semi-definite after round-off to 4 digit precision with a = 0.00010 and a = 0.00012.

Table B.2.3.1.2-2: MIMO correlation matrices for high correlation

| 1x2 case | $R_{high} = \begin{pmatrix} 1 & 0.9 \\ 0.9 & 1 \end{pmatrix}$ | |
|-------------|--|--|
| 2x1 case | $R_{high} = \begin{pmatrix} 1 & 0.9 \\ 0.9 & 1 \end{pmatrix}$ | |
| 2x2 case | $R_{high} = \begin{pmatrix} 1 & 0.9 & 0.9 & 0.81 \\ 0.9 & 1 & 0.81 & 0.9 \\ 0.9 & 0.81 & 1 & 0.9 \\ 0.81 & 0.9 & 0.9 & 1 \end{pmatrix}$ | |
| 4x2 case | $R_{high} = \begin{bmatrix} 1.0000 & 0.8999 & 0.9883 & 0.8894 & 0.9542 & 0.8587 & 0.8999 & 0.8099 \\ 0.8999 & 1.0000 & 0.8894 & 0.9883 & 0.8587 & 0.9542 & 0.8099 & 0.8999 \\ 0.9883 & 0.8894 & 1.0000 & 0.8999 & 0.9883 & 0.8894 & 0.9542 & 0.8587 \\ 0.8894 & 0.9883 & 0.8999 & 1.0000 & 0.8894 & 0.9883 & 0.8587 & 0.9542 \\ 0.9542 & 0.8587 & 0.9883 & 0.8894 & 1.0000 & 0.8999 & 0.9883 & 0.8894 \\ 0.8587 & 0.9542 & 0.8894 & 0.9883 & 0.8999 & 1.0000 & 0.8894 & 0.9883 \\ 0.8999 & 0.8099 & 0.9542 & 0.8587 & 0.9883 & 0.8894 & 1.0000 & 0.8999 \\ 0.8099 & 0.8999 & 0.8587 & 0.9542 & 0.8894 & 0.9883 & 0.8999 & 1.0000 \end{bmatrix}$ | |
| 4x4 case | $R_{high} = \begin{bmatrix} 1.0000 \ 0.9882 \ 0.9541 \ 0.8999 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.8894 \ 0.9541 \ 0.9430 \ 0.9105 \ 0.8587 \ 0.8999 \ 0.8894 \ 0.8587 \ 0.8999 \ 0.8894 \ 0.8587 \ 0.8999 \ 0.8894 \ 0.8587 \ 0.8999 \ 0.8894 \ 0.8999 \ 0.8894 \ 0.9430 \ 0.9767 \ 0.9430 \ 0.9541 \ 0.9430 \ 0.9541 \ 0.9430 \ 0.9541 \ 0.9430 \ 0.8587 \ 0.8894 \ 0.8999 \ 0.8894 \ 0.8999 \ 0.8894 \ 0.9430 \ 0.9767 \ 0.9882 \ 0.9767 \ 0.9105 \ 0.9430 \ 0.9541 \ 0.9430 \ 0.9541 \ 0.8099 \ 0.8587 \ 0.8894 \ 0.8999 \ 0.8894 \ 0.9430 \ 0.9767 \ 0.9430 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.9541 \ 0.9430 \ 0.9541 \ 0.9430 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.9541 \ 0.9430 \ 0.9541 \ 0.9430 \ 0.9767 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.9767 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.9767 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.9767 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.9767 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.9882 \ 0.9767 \ 0.9882$ | 0.8587 0.8894 0.8999 0.8587 0.9105 0.9541 0.8894 0.9430 0.9767 0.9882 0.8999 0.9541 |

Table B.2.3.1.2-3: MIMO correlation matrices for medium correlation

| 1x2 case | N/A | | | | | | | | |
|-------------|---|--|--|--|--|--|--|--|--|
| 2x1 | NI/A | | | | | | | | |
| case | N/A | | | | | | | | |
| 2x2 case | $R_{medium} = \begin{pmatrix} 1 & 0.9 & 0.3 & 0.27 \\ 0.9 & 1 & 0.27 & 0.3 \\ 0.3 & 0.27 & 1 & 0.9 \\ 0.27 & 0.3 & 0.9 & 1 \end{pmatrix}$ | | | | | | | | |
| 2x4 case | $R_{medium} = \begin{pmatrix} 1.0000 & 0.9882 & 0.9541 & 0.8999 & 0.3000 & 0.2965 & 0.2862 & 0.2700 \\ 0.9882 & 1.0000 & 0.9882 & 0.9541 & 0.2965 & 0.3000 & 0.2965 & 0.2862 \\ 0.9541 & 0.9882 & 1.0000 & 0.9882 & 0.2862 & 0.2965 & 0.3000 & 0.2965 \\ 0.8999 & 0.9541 & 0.9882 & 1.0000 & 0.2700 & 0.2862 & 0.2965 & 0.3000 \\ 0.3000 & 0.2965 & 0.2862 & 0.2700 & 1.0000 & 0.9882 & 0.9541 & 0.8999 \\ 0.2965 & 0.3000 & 0.2965 & 0.2862 & 0.9882 & 1.0000 & 0.9882 & 0.9541 \\ 0.2862 & 0.2965 & 0.3000 & 0.2965 & 0.9541 & 0.9882 & 1.0000 & 0.9882 \\ 0.2700 & 0.2862 & 0.2965 & 0.3000 & 0.8999 & 0.9541 & 0.9882 & 1.0000 \end{pmatrix}$ | | | | | | | | |
| 4x2 case | $R_{medium} = \left(\begin{array}{cccccccccccccccccccccccccccccccccccc$ | | | | | | | | |
| 4x4 case | 1.0000 0.9882 0.9541 0.8999 0.8747 0.8645 0.8347 0.7872 0.5855 0.5787 0.5588 0.5270 0.3000 0.2965 0.2862 0.2700 | | | | | | | | |

Table B.2.3.1.2-4: MIMO correlation matrices for medium correlation A

| 1x4 case | | | | | | R _{mediu} | n = | 1 0.9000 0.6561 0.3874 | 0.9000 1 0.9000 0.6561 | 0.90) 1 | 0.0 0.9 | 3874 _] 5561 9000 1 | | | | | |
|-------------|------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| 2x4 case | | | | $_{lium A} =$ | 1.0000 0.9000 0.6561 0.3874 0.3000 0.2700 0.1968 0.1162 | 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 | 000 0 000 1 561 0 700 0 700 0 700 0 | .9000 .0000 .9000 .1968 .2700 .3000 | 0.3874 0.6561 0.9000 1.0000 0.1162 0.1968 0.2700 0.3000 | 1.000 0.900 0.656 0.387 | 00 0.3 68 0.2 62 0.1 60 0.9 60 1.0 61 0.9 64 0.6 | 3000 2700 968 9000 9000 9000 | 0.1968 0.2700 0.3000 0.2700 0.6561 0.9000 1.0000 0.9000 | 0.1162 0.1963 0.2700 0.3000 0.3874 0.656 0.9000 1.0000 | 3 0 0 4 1 1 0 | | |
| 4x4 case | $R_{medium A} =$ | 0.9000 0.6561 0.3874 0.8748 0.7873 0.5739 0.3389 0.5856 0.5270 0.3842 0.2269 0.3000 0.2700 0.1968 | 1.0000 0.9000 0.6561 0.7873 0.8748 0.7873 0.5270 0.5856 0.5270 0.3842 0.2700 0.3000 0.2700 | 0.9000 1.0000 0.9000 0.5739 0.7873 0.8748 0.7873 0.3842 0.5270 0.5856 0.5270 0.1968 0.2700 0.3000 | 0.6561 0.9000 1.0000 0.3389 0.5739 0.7873 0.8748 0.2269 0.3842 0.5270 0.5856 0.1162 0.1968 0.2700 | 0.7873 0.5739 0.3389 1.0000 0.9000 0.6561 0.3874 0.7873 0.5739 0.3389 0.5856 0.5270 0.3842 | 0.8748 0.7873 0.5739 0.9000 1.0000 0.9000 0.6561 0.7873 0.5739 0.5270 0.5856 | 0.7873 0.8748 0.7873 0.6561 0.9000 1.0000 0.9000 6 0.5739 6 0.7873 6 0.7873 0 0.3842 6 0.5270 0 0.5856 | 0.5739 0.7873 0.8748 0.3874 0.6561 0.9000 1.0000 0.3389 0.5739 0.7873 0.8748 0.2269 0.3842 0.5270 | 0.5270 0.3842 0.2269 0.8748 0.7873 0.5739 0.3389 1.0000 0.9000 0.6561 0.3874 0.8748 0.7873 0.5739 | 0.5856 0.5270 0.3842 0.7873 0.8748 0.7873 0.5739 0.9000 1.0000 0.9000 0.6561 0.7873 0.8748 0.7873 | 0.5270 0.5856 0.5270 0.5739 0.7873 0.8748 0.7873 0.6560 0.9000 0.9000 0.5733 0.8748 | 2 0.2269 0.3842 0.5270 0.5856 0.3389 0.5739 0.7873 0.8748 0.3874 0.9000 0 1.0000 0 0.3389 3 0.5739 3 0.7873 3 0.8748 | 0.2700 0.1968 0.1162 0.5856 0.5270 0.3842 0.2269 0.8748 0.7873 0.5739 0.3389 1.0000 0.9000 0.6561 | 0.3000 0.2700 0.1968 0.5270 0.5856 0.5270 0.3842 0.7873 0.8748 0.7873 0.5739 0.9000 1.0000 | 0.2700 0.3000 0.2700 0.3842 0.5270 0.5856 0.5270 0.5739 0.7873 0.8748 0.7873 0.6561 0.9000 | 0.1968 0.2700 0.3000 0.2269 0.3842 0.5270 0.5856 0.3389 0.5739 0.7873 0.8748 0.3874 0.6561 0.9000 |

Table B.2.3.1.2-5: MIMO correlation matrices for low correlation

| 1x2 case | $R_{low} = \mathbf{I}_2$ |
|----------|-----------------------------|
| 1x4 case | $R_{low} = \mathbf{I}_4$ |
| 2x1 case | $R_{low} = \mathbf{I}_2$ |
| 2x2 case | $R_{low} = \mathbf{I}_4$ |
| 2x4 case | $R_{low} = \mathbf{I}_8$ |
| 4x1 case | $R_{low} = \mathbf{I}_4$ |
| 4x2 case | $R_{low} = \mathbf{I}_8$ |
| 4x4 case | $R_{low} = \mathbf{I}_{16}$ |

In Table B.2.3.1.2-5, \mathbf{I}_d is the $d \times d$ identity matrix.

B.2.3.2 MIMO Correlation Matrices using Cross Polarized Antennas (X-pol)

The MIMO channel correlation matrices defined in B.2.3.2 apply for the antenna configuration using cross polarized (XP/X-pol) antennas at both gNB and UE. The cross-polarized antenna elements with ± 1.45 degrees polarization slant angles are deployed at gNB and cross-polarized antenna elements with ± 1.45 degrees polarization slant angles are deployed at UE.

For the 2D cross-polarized antenna array at eNodeB, the *N* antennas are indexed by (N_1, N_2, P) , and total number of antennas is $N = P \cdot N_1 \cdot N_2$, where

- N_1 is the number of antenna elements in first dimension with same polarization,
- N_2 is the number of antenna elements in second dimension with same polarization, and
- *P* is the number of polarization groups.

For the 2D cross-polarized antennas at gNB, the N antennas are labelled such that antennas shall be in increasing order of the second dimension firstly, then the first dimension, and finally the polarization group. For a specific antenna element at p-th polarization, n_1 -th row, and n_2 -th column within the 2D antenna array, the following index number is used for antenna labelling:

$$Inde(p, n_1, n_2) = p \cdot N_1 \cdot N_2 + n_1 \cdot N_2 + n_2 + 1; \qquad p = 0, 1; \quad n_1 = 0, \dots, N_1 - 1; \quad n_2 = 0, \dots, N_2 - 1.$$

where N is the number of transmit antennas, p is the polarization group index, n_1 is the row index, and n_2 is the column index of the antenna element.

For the linear (single dimension, 1D) cross-polarized antenna, the N antennas are labelled following the above equations with $N_2=1$.

B.2.3.2.1 Definition of MIMO Correlation Matrices using cross polarized antennas

For the channel spatial correlation matrix, the following is used:

$$R_{spat} = P(R_{gNB} \otimes \Gamma \otimes R_{UE})P^{T}$$

where

- $R_{\!\scriptscriptstyle U\!E}$ is the spatial correlation matrix at the UE with same polarization,
- R_{gNB} is the spatial correlation matrix at the gNB with same polarization,
- Γ is a polarization correlation matrix, and
- $(\bullet)^T$ denotes transpose.

The matrix Γ is defined as

$$\Gamma = \begin{bmatrix} 1 & 0 & -\gamma & 0 \\ 0 & 1 & 0 & \gamma \\ -\gamma & 0 & 1 & 0 \\ 0 & \gamma & 0 & 1 \end{bmatrix}$$

A permutation matrix P elements are defined as

$$P(a,b) = \begin{cases} 1 & \text{for } a = (j-1)Nr + i & \text{and } b = 2(j-1)Nr + i, & i = 1, \dots, Nr, j = 1, \dots Nt/2 \\ 1 & \text{for } a = (j-1)Nr + i & \text{and } b = 2(j-Nt/2)Nr - Nr + i, & i = 1, \dots, Nr, j = Nt/2 + 1, \dots, Nt + i, \\ 0 & \text{otherwise} \end{cases}$$

where Nt and Nr is the number of transmitter and receiver respectively. This is used to map the spatial correlation coefficients in accordance with the antenna element labelling system described in B.2.3.2.

For the 2D cross-polarized antenna array at gNB, the spatial correlation matrix at the gNB is further expressed as following for 2D cross-polarized antenna array at gNB:

$$R_{gNB} = R_{gNB \ Dim1} \otimes R_{gNB \ Dim2}$$

where

- - R_{gNB_Diml} is the correlation matrix of antenna elements in first dimension with same polarization, and
- - R_{gNB_Dim2} is the correlation matrix of antenna elements in second dimension with same polarization.

For the 2D cross polarized antenna array at gNB side, the spatial correlation matrices in one direction of antenna array are as follows:

- For 1 antenna element with the same polarization in one direction,

$$R_{eNB Dim.i} = 1$$
.

- For 2 antenna elements with the same polarization in one direction,

$$R_{gNB_Dim,i} = \begin{pmatrix} 1 & \alpha_i \\ \alpha_i^* & 1 \end{pmatrix}.$$

- For 3 antenna elements with the same polarization in one direction,

$$R_{gNB_Dim,i} = egin{pmatrix} 1 & lpha_i^{1/4} & lpha_i \ lpha_i^{1/4*} & 1 & lpha_i^{1/4} \ lpha_i^* & lpha_i^{1/4*} & 1 \end{pmatrix} \cdot egin{pmatrix} lpha_i^{1/4} & lpha_i^{1/4} & lpha_i^{1/4} \end{bmatrix}$$

- For 4 antenna elements with the same polarization in one direction,

$$R_{gNB_Dim,i} = egin{pmatrix} 1 & lpha_i^{1/9} & lpha_i^{4/9} & lpha_i \ lpha_i^{1/9^*} & 1 & lpha_i^{1/9} & lpha_i^{4/9} \ lpha_i^{4/9^*} & lpha_i^{1/9^*} & 1 & lpha_i^{1/9} \ lpha_i^{*} & lpha_i^{4/9^*} & lpha_i^{1/9^*} & 1 \end{pmatrix}.$$

where the index i = 1,2 stands for first dimension and second dimension respectively.

For the 1D cross-polarized antenna array at gNB, the matrix of R_{gNB} is determined by follow the equations for 2D cross-polarized antenna array and letting $R_{gNB,Dim2} = 1$, i.e.,

$$R_{gNB} = R_{gNB_Dim,1}$$

The spatial correlation matrices at UE side are as follows:

- For 1 antenna element with the same polarization,

$$R_{UE}=1$$
.

- For 2 antenna elements with the same polarization,

$$R_{UE} = \begin{pmatrix} 1 & \beta \\ \beta^* & 1 \end{pmatrix}.$$

B.2.3.2.2 MIMO Correlation Matrices using cross polarized antennas

The values for parameters α_1 , α_2 , β and γ for the cross polarized antenna models are given in Table B.2.3.2.2-1.

Table B.2.3.2.2-1: The α and β parameters for cross-polarized MIMO correlation matrices

| Corr | relation Model | α_1 | 02 | β | γ | | |
|---|---|------------|-----|-----|-----|--|--|
| Medi | um Correlation | 0.3 | 0.3 | 0.6 | 0.2 | | |
| High Correlation 0.9 0.9 0.9 | | | | | | | |
| Note 1: | Note 1: Value of α₁ applies when more than one pair of cross-polarized antenna elements in first dimension at gNB side. Note 2: Value of α₂ applies when more than one pair of cross-polarized | | | | | | |
| antenna elements in second dimension at gNB side. Note 3: Value of β applies when more than one pair of cross-polarized antenna elements at UE side. | | | | | | | |

For the 1D cross polarized antenna array at gNB side, the correlation matrices for high spatial correlation and medium correlation are defined in Table B.2.3.2.2-2 and Table B.2.3.2.2-3 as below.

The values in Table B.2.3.2.2-2 have been adjusted to ensure the correlation matrix is positive semi-definite after round-off to 4 digit precision. This is done using the equation:

$$R_{high} = [R_{spat} + aI_n]/(1+a)$$
 or $R_{medium} = [R_{spat} + aI_n]/(1+a)$

Where the value "a" is a scaling factor such that the smallest value is used to obtain a positive semi-definite result. For the $8(4,1,2)x^2$ high spatial correlation case, a=0.00010.

Table B.2.3.2.2-2: MIMO correlation matrices for high spatial correlation

| | | | | T 1 | 0000 | 0.0000 | 0.90 | 200 (| 0.0000 | -0.30 | 000 0 | 0.0000 | -0.27 | 700 0 | .0000 | | |
|--------------------|-------------------|-------------------|--------------|------------------|------------------|-----------------------|-------------------|------------------|------------------|-------------------|-------------------|------------------|------------------|-------------------|-------------------|------------------|--------|
| | | | | | | | | | | | | | | | | | |
| | | | | | | 1.0000 | 0.00 | |).9000 | 0.00 | | 0.3000 | 0.00 | | 0.2700 | | |
| | | | | 0. | 9000 | 0.0000 | 1.00 | 000 (| 0.0000 | -0.27 | 700 0 | 0.0000 | -0.30 | 000 0 | .0000 | | |
| 4(2,1,2)x2 | | | D _ | 0. | 0000 | 0.9000 | 0.0 | 000 | 0000.1 | 0.00 | 000 0 | .2700 | 0.00 | 00 0 | .3000 | | |
| case | | | $R_{high} =$ | -0. | 3000 | 0.0000 | -0.2 | 700 (| 0.0000 | 1.00 | 00 0 | .0000 | 0.90 | 00 0 | .0000 | | |
| | | | | 0. | 0000 | 0.3000 | 0.0 | 0000 | 0.2700 | 0.00 | 00 1 | .0000 | 0.00 | 00 0 | .9000 | | |
| | | | | | | 0.0000 | | | 0.0000 | 0.90 | | .0000 | 1.00 | | .0000 | | |
| | | | | | | | | | | | | | | | | | |
| | | | | 0. | 0000 | 0.2700 | 0.0 | 0000 (| 0.3000 | 0.00 | | .9000 | 0.00 | 000 1. | .0000 | | |
| | | | | 1. | 0000 | 0.9000 | 0.0 | 000 | 0.0000 | -0.30 | 000 -(| 0.2700 | 0.00 | 00 0. | 0000 | | |
| | | | | 0. | 9000 | 1.0000 | 0.0 | 000 | 0.0000 | -0.27 | '00 -0 | 0.3000 | 0.00 | 00 0. | 0000 | | |
| | | | | 0. | 0000 | 0.0000 | 1.0 | 000 | 0.9000 | 0.00 | 000 0 | .0000 | 0.300 | 0 0.2 | 700 | | |
| 2/1 1 2)×4 | | | | 0. | 0000 | 0.0000 | 0.9 | 000 | 1.0000 | 0.00 | 00 0 | .0000 | 0.270 | 0 0.3 | 000 | | |
| 2(1,1,2)x4 case | | | R_{high} | = | 3000 | -0.270 | | 000 | 0.0000 | | | .9000 | 0.000 | | 000 | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | .2700 | -0.300 | | 000 | 0.0000 | | | .0000 | 0.000 | | 000 | | |
| | | | | | 0000 | 0.0000 | | 000 | 0.2700 | | | .0000 | 1.000 | | 000 | | |
| | | | | L 0. | 0000 | 0.0000 | 0.2 | 700 | 0.3000 | 0.00 | 000 0 | .0000 | 0.900 | 0 1.0 | 000 | | |
| | | 1.0000 | | | 0.0000 | 0.9000 | 0.8100 | 0.0000 | | -0.3000 | -0.2700 | 0.0000 | 0.0000 | -0.2700 | -0.2430 | | 0.0000 |
| | | 0.9000 | | 0.0000 | 0.0000 | 0.8100 0.0000 | 0.9000 | 0.0000 | 0.0000 0.8100 | -0.2700 0.0000 | -0.3000 0.0000 | 0.0000 | 0.0000 0.2700 | -0.2430 0.0000 | -0.2700 0.0000 | 0.0000 0.2700 | 0.0000 |
| | | 0.0000 | | 0.9000 | 1.0000 | 0.0000 | 0.0000 | 0.9000 0.8100 | 0.9000 | 0.0000 | 0.0000 | 0.3000 | 0.2700 | 0.0000 | 0.0000 | 0.2700 | 0.2430 |
| | | 0.9000 | | 0.0000 | 0.0000 | 1.0000 | 0.9000 | 0.0000 | 0.0000 | -0.2700 | -0.2430 | 0.0000 | 0.0000 | -0.3000 | -0.2700 | 0.0000 | 0.0000 |
| | | 0.8100 | | 0.0000 | 0.0000 | 0.9000 | 1.0000 | 0.0000 | 0.0000 | -0.2430 | -0.2700 | 0.0000 | 0.0000 | -0.2700 | -0.3000 | 0.0000 | 0.0000 |
| 4/2 1 2\v4 | | 0.0000 | | | 0.8100 | 0.0000 | 0.0000 | 1.0000 | 0.9000 | 0.0000 | 0.0000 | 0.2700 | 0.2430 | 0.0000 | 0.0000 | 0.3000 | 0.2700 |
| 4(2,1,2)x4 case | $R_{ m high}$ $=$ | 0.0000 -0.3000 | | 0.8100 | 0.9000 0.0000 | 0.0000 -0.2700 | 0.0000 -0.2430 | 0.9000 | 1.0000 0.0000 | 0.0000 1.0000 | 0.0000 | 0.2430 0.0000 | 0.2700 0.0000 | 0.0000 | 0.0000 0.8100 | 0.2700 0.0000 | 0.3000 |
| 0000 | | | | 0.0000 | 0.0000 | -0.2430 | -0.2700 | 0.0000 | 0.0000 | 0.9000 | 1.0000 | 0.0000 | 0.0000 | 0.8100 | 0.9000 | 0.0000 | 0.0000 |
| | | 0.0000 | | 0.3000 | 0.2700 | 0.0000 | 0.0000 | 0.2700 | 0.2430 | 0.0000 | 0.0000 | 1.0000 | 0.9000 | 0.0000 | 0.0000 | 0.9000 | 0.8100 |
| | | 0.0000 -0.2700 | | 0.2700 0.0000 | 0.3000 | 0.0000 -0.3000 | 0.0000 -0.2700 | 0.2430 | 0.2700 0.0000 | 0.0000 0.9000 | 0.0000 0.8100 | 0.9000 0.0000 | 1.0000 0.0000 | 0.0000 1.0000 | 0.0000 | 0.8100 0.0000 | 0.9000 |
| | | | | 0.0000 | 0.0000 | | -0.2700 | 0.0000 | 0.0000 | 0.8100 | 0.9000 | 0.0000 | 0.0000 | 0.9000 | 1.0000 | 0.0000 | 0.0000 |
| | | 0.0000 | | 0.2700 | 0.2430 | 0.0000 | 0.0000 | 0.3000 | 0.2700 | 0.0000 | 0.0000 | 0.9000 | 0.8100 | 0.0000 | 0.0000 | 1.0000 | 0.9000 |
| | | 0.0000 | 0.0000 | 0.2430 | 0.2700 | 0.0000 | 0.0000 | 0.2700 | 0.3000 | 0.0000 | 0.0000 | 0.8100 | 0.9000 | 0.0000 | 0.0000 | 0.9000 | 1.0000 |
| | | 1.0000 | 0.0000 | 0.988 | 3 0.0000 | 0.9542 | 0.0000 | 0.8999 | 0.0000 | -0.3000 | 0.0000 | -0.2965 | 0.0000 | -0.2862 | 0.0000 | -0.2700 | 0.0000 |
| | | 0.0000 | 1.0000 | 0.000 | 0.9883 | 3 0.0000 | 0.9542 | | | | | 0.0000 | | 0.0000 | | 0.0000 | 0.2700 |
| | | 0.9883 | 0.0000 | | | 0.9883 | | | 0.0000 | | | -0.3000 | | -0.2965 | | | 0.0000 |
| | | 0.0000 | | | | 0.0000 | | | | | | | | | | | |
| | | 0.9542 | | | | | 0.0000 | | 0.0000 | | | | | | | | |
| | | 0.0000 | | | | 3 0.0000 | | | | | | | | | | | |
| | | 0.8999 | | | | 0.9883 | | | 0.0000 | | | | | | | | |
| 8(4,1,2)x2 | $R_{high} =$ | 0.0000 | | | | 2 0.0000 | | | | | | | | | | | |
| case | | -0.3000 | | | | 0 -0.2862 | | | | | | | | | | | |
| | | 0.0000 -0.2965 | | | | 5 0.0000 0 -0.2965 | | | | | | | | | | 0.0000 | |
| | | 0.0000 | | | |) -0.2903) 0.0000 | | | | | | | | 0.0000 | | 0.9342 | |
| | | -0.2862 | | | | 0.0000 | | | | | | | | 1.0000 | | 0.9883 | |
| | | 0.0000 | | | | 5 0.0000 | | | | | | | | 0.0000 | 1.0000 | | |
| | | -0.2700 | | | | 0.000 | | | | | 0.9342 | | 0.0000 | | 0.0000 | | |
| | | | | | | 2 0.0000 | | | | | | | | | | | 1.0000 |
| | | L 0.0000 | 0.2700 | 0.000 | 0.2002 | 2 0.0000 | 0.2700 | 0.000 | . 0.3000 | 0.000 | 0.0777 | 0.0000 | 0.7574 | 0.0000 | 0.7003 | 0.000 | 1.0000 |

Table B.2.3.2.2-3: MIMO correlation matrices for medium spatial correlation

| | [1.0 | 0000 | 0.0000 | -0.2000 | 0.0000 | |
|------------|-----------------------------|-------|--------|---------|--------|--|
| 2(1,1,2)x2 | | .0000 | 1.0000 | 0.0000 | 0.2000 | |
| case | $\Lambda_{medium} - _{-0}$ | .2000 | 0.0000 | 1.0000 | 0.0000 | |
| | [0. | 0000 | 0.2000 | 0.0000 | 1.0000 | |

B.2.3.2.3 Beam steering approach

For the 2D cross-polarized antenna array at gNB, given the channel spatial correlation matrix in B.2.3.2.1 and B.2.3.2.2, the corresponding random channel matrix *H* can be calculated. The signal model for the *k*-th slot is denoted as

$$y = HD_{\theta_{k,1},\theta_{k,2}}Wx + n$$

And the steering matrix is further expressed as following:

$$D_{\theta_{k,1},\theta_{k,2}} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \otimes \left(D_{\theta_{k,1}} (N_1) \otimes D_{\theta_{k,2}} (N_2) \right)$$

where

- H is the $Nr \times Nt$ channel matrix per subcarrier.
- $D_{\theta_{k,1},\theta_{k,2}}$ is the steering matrix,
- $D_{\theta_{i,1}}(N_1)$ is the steering matrix in first dimension with same polarization,
- $D_{\theta_{i,2}}(N_2)$ is the steering matrix in second dimension with same polarization,
- N_1 is the number of antenna elements in first dimension with same polarization,
- N_2 is the number of antenna elements in second dimension with same polarization,
- For antenna array with only one direction, number of antenna element in second direction N_2 equals 1.

For 1 antenna element with the same polarization in one direction,

$$D_{\theta_{i,i}}(1) = 1.$$

For 2 antenna elements with the same polarization in one direction,

$$D_{\theta_{k,i}}(2) = \begin{bmatrix} 1 & 0 \\ 0 & e^{j3\theta_{k,i}} \end{bmatrix}.$$

For 3 antenna elements with the same polarization in one direction,

$$D_{\theta_{k,i}}(3) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & e^{j1.5\theta_{k,i}} & 0 \\ 0 & 0 & e^{j3\theta_{k,i}} \end{bmatrix}.$$

For 4 antenna elements with the same polarization in one direction,

$$D_{\theta_{k,i}}(4) = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & e^{j\theta_{k,i}} & 0 & 0 \\ 0 & 0 & e^{j2\theta_{k,i}} & 0 \\ 0 & 0 & 0 & e^{j3\theta_{k,i}} \end{bmatrix}.$$

where the index i=1,2 stands for first dimension and second dimension respectively.

- $\theta_{k,i}$ controls the phase variation in first dimension and second dimension respectively, and the phase for k-th subframe is denoted by $\theta_{k,i} = \theta_{0,i} + \Delta\theta \cdot k$, where $\theta_{0,i}$ is the random start value with the uniform distribution, i.e., $\theta_{0,i} \in [0,2\pi]$, $\Delta\theta$ is the step of phase variation, which is defined in Table B.2.3B.4-1, and k is the linear increment of $2^{-\mu}$ for every slot throughout the simulation, the index i=1,2 stands for first dimension and second dimension respectively.
- W is the precoding matrix for Nt transmission antennas,
- y is the received signal, x is the transmitted signal, and n is AWGN.
- μ corresponds to subcarrier spacing configuration, $\Delta f = 2^{\mu} \cdot 15 \text{[kHz]}$

For the 1D cross-polarized antenna array at gNB, the corresponding random channel matrix H can be calculated by letting N_2 =1, i.e.,

$$D_{\theta_{k,1}} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \otimes D_{\theta_{k,1}}(N_1)$$

Table B.2.3B.4-1: The step of phase variation

| Variation Step | Value (rad/ms) |
|-----------------|-------------------------|
| $\Delta \theta$ | 1.2566×10 ⁻³ |

B.2.4 Two-tap propagation conditions for CQI tests

For Channel Quality Indication (CQI) tests, the following additional multi-path profile is used:

$$h(t,\tau) = \delta(\tau) + a \exp(-i2\pi f_D t)\delta(\tau - \tau_d)$$

in continuous time (t,τ) representation, with \mathcal{T}_d the delay, a constant value of a and f_D the Doppler frequency. The same $h(t,\tau)$ is used to describe the fading channel between every pair of Tx and Rx.

B.3 High Speed Train Scenario

B.3.1 Single Tap Channel Profile

The high speed train condition for the test of the baseband performance is a non fading propagation channel with one tap. Doppler shift is given by

$$f_s(t) = f_d \cos \theta(t) \tag{B.3.1.1}$$

where $f_s(t)$ is the Doppler shift and f_d is the maximum Doppler frequency. The cosine of angle $\theta(t)$ is given by

$$\cos \theta(t) = \frac{D_s/2 - vt}{\sqrt{D_{\min}^2 + (D_s/2 - vt)^2}}, \ 0 \le t \le D_s/v$$
(B.3.1.2)

$$\cos \theta(t) = \frac{-1.5D_s + vt}{\sqrt{D_{\min}^2 + (-1.5D_s + vt)^2}}, \ D_s/v < t \le 2D_s/v$$
(B.3.1.3)

$$\cos\theta(t) = \cos\theta(t) \mod(2D_s/v), t > 2D_s/v$$
(B.3.1.4)

where $D_s/2$ is the initial distance of the train from gNB, and D_{\min} is gNB Railway track distance, both in meters; v is the velocity of the train in m/s, t is time in seconds.

Doppler shift and cosine angle are given by equation B.3.1.1 and B.3.1.2-B.3.1.4 respectively, where the required input parameters listed in table B.3.1-1 and the resulting Doppler shift shown in Figure B.3.1-1 are applied for all frequency bands.

Value Parameter HST-1000 HST-750 D_{s} 300 m 300 m $D_{ ext{min}}$ 2 m 2 m ν 300 km/h 300 km/h f_d 750 Hz for 15 kHz SCS test 1000 Hz for 30 kHz SCS test

Table B.3.1-1: High speed train scenario

NOTE 1: Parameters for HST conditions in table B.3.1-1 including f_d and Doppler shift trajectories presented on figure B.3.1-1 for 750 Hz for 15 kHz SCS and figure B.3.1-2 for 1000 Hz for 30 kHz SCS are applied for performance verification in all frequency bands.

NOTE 2: The propagation conditions used for the performance requirements under high speed train condition are indicated as a combination of "HST" and Doppler shift f_d , i.e. HST-<Doppler shift>, where '<Doppler shift>' indicates the maximum Doppler shift (Hz) .

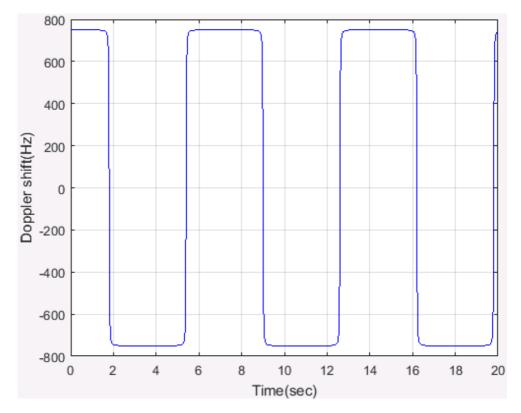


Figure B.3.1-1: Doppler shift trajectory ($f_{\scriptscriptstyle d}$ = 750 Hz)

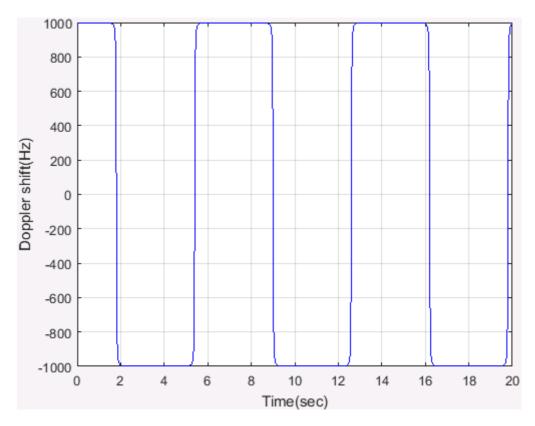


Figure B.3.1-2: Doppler shift trajectory ($f_{\scriptscriptstyle d}$ = 1000 Hz)

For 1x2 antenna configuration, the same $h(t,\tau)$ is used to describe the channel between every pair of Tx and Rx. For 1x4 antenna configuration, the same $h(t,\tau)$ is used to describe the channel between every pair of Tx and Rx. Static channel matrix will be used as defined in Annex B.1.

B.4 Physical signals, channels mapping and precoding

B.4.1 General

Unless otherwise stated, the transmission on antenna port(s) $p = p_0, p_0 + 1, ..., p_0 + N_p - 1$ is defined by using a precoder matrix W(i) of size $N_{ANT} \times N_p$, where N_{ANT} is the number of physical transmit antenna elements configured per test, N_p is the number of ports for a reference signal or physical channel configured per test, and p_0 is the first port for that reference signal or physical channel as defined in clauses 7.3 and 7.4 in TS 38.211 [9]. This precoder takes as an input a block of signals for antenna port(s) $p = p_0, p_0 + 1, ..., p_0 + N_p - 1, y^{(p)}(i) = \frac{1}{2} \sum_{i=1}^{n} \frac{1}$

 $\begin{bmatrix} y^{(p_0)}(i) \ y^{(p_0+1)}(i) \ \dots \ y^{(p_0+N_p-1)}(i) \end{bmatrix}^T, \ i=0,1,\dots, M_{\text{symb}}^{\text{ap}}-1, \text{ with } M_{\text{symb}}^{\text{ap}} \text{ being the number of modulation}$ symbols per antenna port including the reference signal symbols, and generates a block of signals $y_{bf}^{(q)}(i)=\begin{bmatrix} y_{bf}^{(0)}(i) \ y_{bf}^{(1)}(i) \ \dots \ y_{bf}^{(N_{ANT}-1)}(i) \end{bmatrix}^T$ the elements of which are to be mapped onto the frequency-time index pair (k,l) as per the test configuration but transmitted on different physical antenna elements:

$$y_{bf}^{(q)}(i) = W(i)y^{(p)}(i)$$

For Clause 6 and 8, the transmission of PDCCH and PDCCH DMRS on antenna port $p = p_0$ is defined by using a precoder matrix W(i) of size 2x1. This precoder takes as an input a block of signals for antenna port(s) $p = p_0$,

$$y^{(p)}(i) = y^{(p_0)}(i)$$
 and generates a block of signals $y_{bf}^{(q)}(i) = \left[y_{bf}^{(0)}(i) \ y_{bf}^{\left(\frac{N_{ANT}}{2}\right)}(i)\right]^T$ the elements of which are to be

mapped onto the frequency-time index pair (k, l) as per the test configuration but transmitted on different physical antenna elements:

$$y_{bf}^{(q)}(i) = W(i)y^{(p)}(i)$$

The precoder matrix W(i) is specific to the test case configuration. W(i) is defined in Clause 5.2.2.2 of TS 38.214 [12].

The transimison on PT-RS antenna port is associated (using same precoder) with the lowest indexed DM-RS antenna port among the DM-RS antenna ports assigned for the PDSCH.

The physical antenna elements are identified by indices $j = 0,1,...,N_{ANT}-1$, where N_{ANT} is the number of physical antenna elements configured per test.

Modulation symbols $y^{(p)}(i)$ with $p \in \{4000\}$ (i.e. PSS, SSS, PBCH and DM-RS for PBCH) are directly mapped to first physical antenna element.

Modulation symbols $a_{k,l}$ for CSI-RS resources which configured for tracking with one port are directly mapped to first physical antenna element.

Modulation symbols $a_{k,l}$ for CSI-RS resources which configured for beam refinement with one port are directly mapped to first physical antenna element.

Modulation symbols $a_{k,l}^{(p)}$ for NZP CSI-RS which configured for CSI acquisition with

 $p \in \{p_0, p_0 + 1, ..., p_0 + N_{CSI} - 1\}$ are mapped to the physical antenna index $j = p - p_0$ where N_{CSI} is the number of NZP CSI-RS ports configured per test.

Annex C (normative): Downlink physical channels

C.1 General

This annex specifies the downlink physical channels that are needed for setting a connection and channels that are needed during a connection.

C.2 Setup (Conducted)

Table C.2-1 describes the downlink Physical Channels that are required for connection set up.

Table C.2-1: Downlink Physical Channels required for connection set-up

| Physical Channel |
|------------------|
| PBCH |
| SSS |
| PSS |
| PDCCH |
| PDSCH |
| PBCH DMRS |
| PDCCH DMRS |
| PDSCH DMRS |
| CSI-RS |

C.3 Connection (Conducted)

The following clauses, describes the downlink Physical Channels that are transmitted during a connection i.e., when measurements are done.

C.3.1 Measurement of Performance requirements

Table C.3.1-1 is applicable for measurements in which uniform RS-to-EPRE boosting for all downlink physical channels, unless otherwise stated.

Table C.3.1-1: Downlink Physical Channels transmitted during a connection (FDD and TDD)

| Parameter | Unit | Value (Note 2) | | | | |
|---|------|------------------------|--|--|--|--|
| SSS transmit power | W | Test specific | | | | |
| EPRE ratio of PSS to SSS | dB | 0 | | | | |
| EPRE ratio of PBCH to SSS | dB | 0 | | | | |
| EPRE ratio of PBCH to PBCH DMRS | dB | 0 | | | | |
| EPRE ratio of PDCCH to SSS | dB | 0 | | | | |
| EPRE ratio of PDCCH to PDCCH DMRS | dB | 0 | | | | |
| EPRE ratio of PDSCH to SSS | | 0 | | | | |
| EPRE ratio of PDSCH to PDSCH DMRS | | Test specific (Note 1) | | | | |
| EPRE ratio of NZP CSI-RS to SSS | | -10*log10(L) (Note 3) | | | | |
| EPRE ratio of PDSCH OCNG to SSS | dB | 0 | | | | |
| EPRE ratio of PDCCH OCNG to SSS | dB | 0 | | | | |
| EPRE ratio of LTE CRS to NR SSS | dB | 0 (Note 4) | | | | |
| Note 1: Value is derived from Table 4.1-1 in TS 38.214 [12] based on "Number of DM-RS CDM | | | | | | |
| groups without data" and "DMRS Type" parameters specified for each test | | | | | | |
| Note 2: The value is the energy of per RE for a single antenna port before pre-coding. | | | | | | |
| Note 3: $L \in \{1,2,4,8\}$ is the CDM group size of NZP CSI-RS specified for each test. | | | | | | |

Note 4: It is only applicable to LTE-NR coexistence tests.

C.4 Setup (Radiated)

Table C.4-1 describes the downlink Physical Channels that are required for connection set up.

Table C.4-1: Downlink Physical Channels required for connection set-up

| Physical Channel | | | | | | | |
|------------------|--|--|--|--|--|--|--|
| PBCH | | | | | | | |
| SSS | | | | | | | |
| PSS | | | | | | | |
| PDCCH | | | | | | | |
| PDSCH | | | | | | | |
| PBCH DMRS | | | | | | | |
| PDCCH DMRS | | | | | | | |
| PDSCH DMRS | | | | | | | |
| CSI-RS | | | | | | | |
| PTRS | | | | | | | |

C.5 Connection (Radiated)

The following clauses, describes the downlink Physical Channels that are transmitted during a connection i.e., when measurements are done.

C.5.1 Measurement of Receiver Characteristics

Table C.5.1-1 is applicable for measurements in which uniform RS-to-EPRE boosting for all downlink physical channels, unless otherwise stated.

Table C.5.1-1: Downlink Physical Channels transmitted during a connection (TDD)

| Parameter | Unit | Value (Note 2) |
|-----------------------------------|------|------------------------|
| SSS transmit power | W | Test specific |
| EPRE ratio of PSS to SSS | dB | 0 |
| EPRE ratio of PBCH to SSS | dB | 0 |
| EPRE ratio of PBCH to PBCH DMRS | dB | 0 |
| EPRE ratio of PDCCH to SSS | dB | 0 |
| EPRE ratio of PDCCH to PDCCH DMRS | dB | 0 |
| EPRE ratio of PDSCH to SSS | dB | 0 |
| EPRE ratio of PDSCH to PDSCH DMRS | dB | Test specific (Note 1) |
| EPRE ratio of NZP CSI-RS to SSS | dB | -10*log10(L) (Note 3) |
| EPRE ratio of PTRS to PDSCH | dB | Test specific (Note 4) |
| EPRE ratio of PDSCH OCNG to SSS | dB | 0 |
| EPRE ratio of PDCCH OCNG to SSS | dB | 0 |

- Note 1: Value is derived from Table 4.1-1 in TS 38.214 [12] based on "Number of DM-RS CDM groups without data" and "DMRS Type" parameters specified for each test
- Note 2: The value is the energy of per RE for a single antenna port before pre-coding.
- Note 3: $L \in \{1,2,4,8\}$ is the CDM group size of NZP CSI-RS specified for each test.
- Note 4: Value is derived from Table 4.1-2 in TS 38.214 [12] based on "The number of PDSCH layers" and "epre-Ratio" parameters specified for each test.

Annex D (informative): Void

Annex E (normative): Environmental conditions

E.1 General

This annex specifies the environmental requirements of the UE. Within these limits the requirements of the present documents shall be fulfilled.

E.2 Environmental (Conducted)

The requirements in this clause apply to all types of UE(s).

E.2.1 Temperature

The UE shall fulfil all the requirements in the temperature range defined in Table E.2.1-1.

Table E.2.1-1: Temperature conditions

| +15°C to +35°C | For normal conditions (with relative humidity of 25 % to 75 %) |
|----------------|--|
|----------------|--|

Outside this temperature range the UE, if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in clause 6.2 of TS 38.101-1 [6] for extreme operation.

E.2.2 Voltage

The UE shall fulfil all the requirements in the voltage range defined in Table E.2.2-1.

Table E.2.2-1: Voltage conditions

| Power source | Normal conditions voltage |
|-----------------------------|---------------------------|
| AC mains | nominal |
| Regulated lead acid battery | 1,1 * nominal |
| Non regulated batteries: | |
| Leclanché | Nominal |
| Lithium | 1,1 * Nominal |
| Mercury/nickel & cadmium | Nominal |

Outside this voltage range the UE if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in TS 38.101-1[6, Clause 6.2] for extreme operation. In particular, the UE shall inhibit all RF transmissions when the power supply voltage is below the manufacturer declared shutdown voltage.

E.2.3 Vibration

The UE shall fulfil all the requirements when vibrated at the following frequency/amplitudes.

Table E.2.3-1: Vibration conditions

| Frequency | ASD (Acceleration Spectral Density) random vibration |
|-----------------|---|
| 5 Hz to 20 Hz | $0.96 \mathrm{m}^2/\mathrm{s}^3$ |
| 20 Hz to 500 Hz | 0,96 m ² /s ³ at 20 Hz, thereafter –3 dB/Octave |

Outside the specified frequency range the UE, if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in TS 38.101-1[6] for extreme operation.

E.3 Environmental (Radiated)

The requirements in this clause apply to all types of UE(s).

E.3.1 Temperature

All requirements for UEs operating in FR2 are defined over the air and can only be tested in an OTA chamber.

The UE shall fulfil all the requirements in the temperature range defined in Table E.3.1-1.

Table E.3.1-1: Temperature conditions

| + 25 °C ± 10 °C | For normal (room temperature) conditions with relative |
|-----------------|--|
| | humidity of 25% to 75% |

Outside this temperature range the UE, if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in clause 6.2 of TS 38.101-2 [7] for extreme operation.

E.3.2 Voltage

< Editor's note: This requirement is incomplete. The following aspects are either missing or not yet determined:

Methodology to control the voltage in a case which a power cable is not connected to DUT is FFS since it is not agreed whether we can connect the power cable to DUT at the OTA measurement situation yet.

>

The UE shall fulfil all the requirements in the voltage range defined in Table E.3.2-1.

Table E.3.2-1: Voltage conditions

| Power source | Normal conditions voltage |
|-----------------------------|---------------------------|
| AC mains | nominal |
| Regulated lead acid battery | 1,1 * nominal |
| Non regulated batteries: | |
| Leclanché | Nominal |
| Lithium | 1,1 * Nominal |
| Mercury/nickel & cadmium | Nominal |

Outside this voltage range the UE if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in clause 6.2 of TS 38.101-2 [7] for extreme operation. In particular, the UE shall inhibit all RF transmissions when the power supply voltage is below the manufacturer declared shutdown voltage.

E.3.3 Void

| Annex G (informative): Void | |
|-----------------------------|--|
| Annex H (informative): Void | |
| Annex I (informative): Void | |
| Annex J (informative): Void | |
| Annex K (informative): Void | |

Annex L (informative): Change history

| Date | Meeting | tDoc | CR | Rev | Cat | Change history Subject/Comment | New |
|--------------------|------------------|------------------------|-----|------|-----|--|---------|
| Date | Meeting | iboc | O.K | 1100 | Oat | oubject/outment | version |
| 2018-07 | RAN4 AH18-07 | R4- 1809554 | | | | Draft skeleton | 0.0.1 |
| 2018-08 | RAN4#88 | R4- 1811357 | | | | Skeleton update | 0.0.2 |
| 2018-10 | RAN4#88 bis | R4- 1814237 | | | | Approved Text Proposal in RAN4#88bis: R4-1814053, "TP on performance specification 38.101-4 Chapter 4 | 0.1.0 |
| | DIS | 1014237 | | | | general part" | |
| | | | | | | R4-1814054, "TP to TS 38.101-4: FR1 PDSCH demodulation requirements (5.2)" | |
| | | | | | | R4-1813924, "TP for introducing FR1 PDCCH requirements in TS 38.101-4 clause 5.3" | |
| | | | | | | R4-1814058, "TP for 38.101-4 section 6.3 FR1 PMI test cases" R4-1814060, "Draft TP on FR1 Rank Indication Reporting | |
| | | | | | | Performance Requirements" R4-1814055, "Draft TP on FR2 PDSCH Demodulation Performance | |
| | | | | | | Requirements" R4-1814022, "TP to TS38.101-4 Section 7.3: PDCCH demodulation | |
| | | | | | | requirements" R4-1814059, "TP for 38.101-4 section 8.3 FR2 PMI test cases" | |
| | | | | | | R4-1814061, "Draft TP on FR2 Rank Indication Reporting Performance Requirements" | |
| | | | | | | R4-1813925, "TP for introducing demodulation performance requirements for interworking TS 38.101-4 section 9" | |
| | | | | | | R4-1814052, "TP for 38.101-4 section 10 CSI test cases of interworking" | |
| | | | | | | R4-1814066, "TP on channel models for TS38.101-4" R4-1814023, "TP to TS38.101-4 Annex C: Downlink physical | |
| | | | | | | channels" R4-1814024, "TP to TS38.101-4 Annex E: Environmental | |
| 2018-11 | RAN4#89 | R4- | | | | conditions" | 0.2.0 |
| 2018-11 | KAN4#89 | 1816559 | | | | Approved Text Proposal in RAN4#89: R4-1814053, "TP on performance specification 38.101-4 Chapter 4 | 0.2.0 |
| | | | | | | general part" R4-1814487, "TP for TS38.101-4 section 2 (Reference)" | |
| | | | | | | R4-1814488, "TP for TS38.101-4 section 3 (Definitions, symbols and abbreviations)" | |
| | | | | | | R4-1814579, "TP to TS 38.101-4: Annex A Measurement channels – PDSCH" | |
| | | | | | | R4-1814580, "TP to TS 38.101-4: Annex A Measurement channels - DL Control" | |
| | | | | | | R4-1814581, "TP to TS 38.101-4: Annex A Measurement channels – CSI" | |
| | | | | | | R4-1816395, "FR2 demod: Noc, Band groups and Ref point - TP for TS 38.101-4" | |
| | | | | | | R4-1816692, "TP to TS 38.101-4: Requirements applicability" R4-1816693, "TP for performance requirements for interworking (9)" | |
| | | | | | | R4-1816694, "TP to TS 38.101-4: FR1 PDSCH demodulation requirements (5.2)" | |
| | | | | | | R4-1816695, "Draft TP on FR2 PDSCH Demodulation Performance Requirements" | |
| | | | | | | R4-1816697, "TP for updating FR1 PDCCH requirements in TS 38.101-4 section 5.3" | |
| | | | | | | R4-1816699, "TP to TS 38.101-4: 5.4 FR1 PBCH demodulation requirements" | |
| | | | | | | R4-1816700, "TP to TS 38.101-4: 7.4 FR2 PBCH demodulation requirements" | |
| | | | | | | R4-1816701, "TP of introduction of FR1 CQI requirement (6.2)" R4-1816702, "TP to TS 38.101-4: FR2 CQI requirements (8.2)" | |
| | | | | | | R4-1816703, "Draft TP on FR1 Rank Indication Reporting Performance Requirements" | |
| | | | | | | R4-1816704, "Draft TP on FR2 Rank Indication Reporting Performance Requirements" | |
| | | | | | | R4-1816705, "TP for TS 38.101-4 FR1 PMI test requirement" | |
| | | | | | | R4-1816706, "TP to TS 38.101-4 FR2 PMI requirements" R4-1816712, "TP to TS 38.101-4: FR1 SDR requirements (5.5) " | |
| | | | | | | R4-1816713, "TP to TS38.101-4 Section 7.3: PDCCH demodulation requirements" | |
| | | | | | | R4-1816714, "TP for propagation conditions in TS 38.104-4(Annex B)" | |
| 2018-12 2018-12 | RAN#82 RAN#82 | RP-182408 RP-182704 | | | | V1.0.0 is submitted to RAN for 1-step approval V1.0.1 with editorial changes | 1.0.0 |
| 2018-12 | RAN#82 | 02,04 | 1 | 1 | | Approved by plenary – Rel-15 spec under change control | 15.0.0 |

| 2019-03 | RAN#83 | RP-190403 | 0001 | В | CR on UE demodulation and CSI requirements for 38.101-4 | 15.1.0 |
|---------|--------|-----------|------|---|--|--------|
| | | | | | This CR comboines all the endorsed draft CRs as list below: General sections | |
| | | | | | R4-1902427, Draft CR on NR UE demodulation requirements | |
| | | | | | applicability (Intel Corporation) | |
| | | | | | R4-1902576, Draft CR on General Applicability of Requirements (Qualcomm Incorporated) | |
| | | | | | R4-1902412, Editorial cleanup of FR2 Radiated Requirements | |
| | | | | | General section (ANRITSU) | |
| | | | | | PDSCH | |
| | | | | | R4-1902414, Draft CR on FR1 normal PDSCH demodulation requirements (Intel Corporation) | |
| | | | | | R4-1902415, Draft CR on FR2 PDSCH Requirements (Qualcomm | |
| | | | | | Incorporated) | |
| | | | | | R4-1902411, Draft CR on FR1 SDR requirements (Intel Corporation) | |
| | | | | | PDCCH | |
| | | | | | R4-1902416 Draft CR for updating FR1 PDCCH performance requirements in TS38.101-4Huawei, HiSilicon | |
| | | | | | R4-1902423 Draft CR for updating FR2 PDCCH performance | |
| | | | | | requirements in TS38.101-4 section 7.3 CATT | |
| | | | | | PBCH PA 1002420 Droft CB on 2By PBCH demodulation requirement for | |
| | | | | | R4-1902420, Draft CR on 2Rx PBCH demodulation requirement for FR1 (CMCC) | |
| | | | | | R4-1902421, Draft CR on 4Rx PBCH demodulation requirements for | |
| | | | | | FR1 (CMCC) | |
| | | | | | R4-1902422, Draft CR on 2Rx PBCH demodulation requirement for | |
| | | | | | FR2 (CMCC) CSI | |
| | | | | | R4-1902418, Draft CR on FR2 CSI Reporting Tests (Qualcomm | |
| | | | | | Incorporated) | |
| | | | | | R4-1902419, Draft CR on FR1 CSI Reporting Tests (Qualcomm | |
| | | | | | Incorporated) R4-1900105, Draft CR on NR CSI reporting (Intel Corporation) | |
| | | | | | R4-1902058, Draft CR for update of FR1 CQI reporting test (Huawei, | |
| | | | | | HiSilicon) | |
| | | | | | R4-1902059, Draft CR for update of FR2 CQI reporting test (Intel) | |
| | | | | | R4-1902426, Draft CR for PMI test cases: 6.2, 8.2, A.3.2.2.2, A.3.2.2.5 (Samsung) | |
| | | | | | R4-1902425, Draft CR for FR1 and FR2 RI test cases (Qualcomm) | |
| | | | | | Annex | |
| | | | | | R4-1900369, Draft CR on PDSCH FRC (Intel Corporation) | |
| | | | | | R4-1900370, Draft CR on PDCCH FRC (Intel Corporation) R4-1902424, Corrections to 38.101-4 clause B.2.1 Delay profile | |
| | | | | | calculation (Huawei, HiSilicon) | |
| | | | | | R4-1902575, Draft CR on Beamforming Model (Qualcomm) | |
| | | | | | Additional modifications: | |
| | | | | | - Compared to endorsed CR R4-1902414, requirements for several | |
| | | | | | FR1 PDSCH test cases were modified to correct stat error | |
| | | | | | - Correct the format for Annex A.x | |
| | | | | | - Correct table number under PDSCH section 5.2.3.1.3 - Some minor editorial changes | |
| | | | | | | |
| | | | | | Editorial changes after RAN#83 | |
| | | | | | To align the annex numbering with other specifications (TS 38.101-x series), annexes J and K were added and Change history was | |
| | | | | | numbered as annex L. | |

| endorsed draft CRs from RAN4#90bis R4-1902885, Draft CR on DL power allocation for TS 38.101-4 R4-1902387, Draft CR or adding applicable rules on CSI test cases: 6, 8, 10 R4-1903471, Draft CR on PBCH requirements R4-1904750, draftCR on RNC for demod requirement for 38.101-4 R4-1904750, Carlicia on on step 5 and step 6 for delay profiles calculation in B 2.1 R4-1904750, Draft CR on FR1 normal PDSCH demodulation sequence of the control of | 2019-06 | RAN#84 | RP-191240 | 0002 | | to TS 38.101-4: Implementation of endorsed draft CRs from N4#90bis and RAN4#91 | 15.2.0 |
|--|---------|--------|-----------|------|-----|--|--------|
| R4-1902885, Draft CR on DL power allocation for TS 38.101-4 R4-1903377, Draft CR on Adding applicable rules on CSI test cases: 6, 8, 10 R4-1903471, Draft CR on PBCH requirements R4-1904750, draftCR on RMC for demod requirement for 38.101-4 R4-1904756, Draft CR on FR1 normal PDSCH demodulation requirements R4-1904755, Draft CR on FR1 normal PDSCH demodulation requirements R4-1904755, Draft CR on FR2 PDSCH Demodulation Performance Tests R4-1904756, Draft CR on EN-DC SDR requirements R4-1904756, Draft CR on EN-DC SDR requirements R4-1904756, Draft CR on FR2 PDCCH demodulation requirements R4-1904756, Draft CR on FR2 PDCCH demodulation requirements R4-1904766, Draft CR on FR2 PDCCH demodulation requirements R4-1904766, Draft CR for Beamforming model: Annex B.4.1 R4-1904766, Draft CR for Beamforming model: Annex B.4.1 R4-1904776, Draft CR for RF2 PDC Endemodulation requirements R4-1904776, Draft CR for RF2 SDR equirements R4-1904778, Draft CR on FR2 SDR equirements R4-1904778, Draft CR for SB8.101-4 con Explication R4-1904778, Draft CR for TS38.101-4 con Explication R4-1904778, Draft CR for TS38.101-4 con Explication R4-1904796, Draft CR for TS38.101-4 on Spplicable SNR level for RF2 R4-1904796, Draft CR for TS38.101-4 on Spplicable SNR level for RF2 R4-1904796, Draft CR for TS38.101-4 on Spplicable SNR level for RF2 R4-1904796, Draft CR for TS38.101-4 on Spplicable SNR level for RF2 R4-1904796, Draft CR for TS38.101-4 on Spplicable SNR level for RF2 R4-1904796, Draft CR for TS38.101-4 on Spplicable SNR level for RF2 R4-190790, Editional corrections for 38.101-4 or SNR, Es and Noc setup endorsed draft CRs from RAN4#91 R4-190790, Draft CR for TS38.101-4 or SNR, Es setup R4-190790, Draft CR for TS38.101-4 or SNR, Es setup R4-190790, Draft CR for SSSR for SRC PSC PSCH test parameters R4-190729, draftCR: updates to FR PSC PSCH test parameters R4-1907290, draftCR: updates to FR PSC PSCH t | | | | | | | |
| R4-1903387, Draft CR for adding applicable rules on CSI test cases: 6, 8, 10 R4-1903471, Draft CR on PBCH requirements R4-1904750, draftCR on RNC for demod requirement for 38.101-4 R4-1904751, Clarification on step 5 and step 6 for delay profiles calculation in B.2.1 R4-1904756, Draft CR on FR1 normal PDSCH demodulation requirements R4-1904757, Draft CR on FR2 PDSCH Demodulation Performance Tests R4-1904757, Draft CR on EN-DC SDR requirements R4-1904759, Addition of alternative TDD configuration for UE demodulation requirements R4-1904766, Draft CR on FR2 PDSCH demodulation requirements R4-1904766, Draft CR on FR2 PDCCH demodulation requirements R4-1904766, Draft CR on FR2 PDCCH demodulation requirements R4-1904766, Draft CR on FR2 PDC CH demodulation requirements R4-1904767, Draft CR for Beamforming model: Annex B.4.1 R4-1904767, Draft CR for for modification on CSI test cases: 6, 8, 10 R4-1904777, Draft CR on FR2 SDR Requirements R4-1904777, Draft CR on FR2 SDR Requirements R4-1904778, Draft CR on FR2 SDR Requirements R4-1904778, Draft CR on FR2 SDR Requirements R4-1904778, Draft CR on TS38.101-4: Correction to FR1 CSI test cases R4-1904780, Draft CR to TS38.101-4: Correction to FR2 CSI test cases R4-1904780, Draft CR to TS38.101-4 on applicable SNR level for FR2 R4-1904830, Draft CR to TS38.101-4 on SNR, Es and Noc setup endorsed draft CRs from RAN4991 R4-1906069, Draft CR to no PBCH requirements R4-190779, Carlot CR to TS38.101-4 on Applicable SNR level for FR2 R4-190799, Draft CR to No cand Es setup R4-1907998, draftCR: updates to FR2 CDSCH test parameters R4-190799, draftCR: updates to FR2 CDSCH test parameters R4-1907998, draftCR: updates to FR2 CDSCH test parameters R4-1907998, draftCR: updates to FR2 CDSCH test parameters R4-1907998, draftCR: updates to FR2 CDSCH test parameters R4-1907300, Draft CR to 38.101-4 on Applicability of requirements for intervoxing R4-1907300, Draft CR to 38.101-4 on Applicability of requirements R4-1907300, Draft CR to TS38.101-4 on CSI requirements R4-1907300, Draft CR to | | | | | | | |
| 6, 8, 10 R4-1903471, Draft CR on PBCH requirements R4-1904750, draftCR on RMC for demod requirement for 38.101-4 R4-1904750, Clarification on step 5 and step 6 for delay profiles calculation in B.2.1 R4-1904756, Draft CR on FR1 normal PDSCH demodulation requirements R4-1904755, Draft CR on FR2 PDSCH Demodulation Performance Tests R4-1904759, Addition of alternative TDD configuration for UE demodulation requirements R4-1904759, Draft CR on FR2 PDCCH demodulation requirements R4-1904760, draftCR updates to FR1 PDCCH demodulation requirements R4-1904760, draftCR updates to FR1 PDCCH demodulation requirements R4-1904760, draftCR updates to FR1 PDCCH demodulation requirements R4-1904760, draftCR updates to FR1 PDCCH demodulation requirements R4-1904760, draftCR updates to FR1 PDCCH demodulation requirements R4-1904760, draft CR for modification on CS1 test cases: 6, 8, 10 R8-1904760, Draft CR for FR2 SDR requirements R4-1904776, Draft CR on FR2 SDR requirements R4-1904776, Draft CR on FR2 SDR requirements R4-1904776, Draft CR on FR2 SDR requirements R4-1904776, Draft CR to TS38, 101-4.2 Correction to FR1 CS1 test cases R4-1904780, Draft CR to TS38, 101-4 as popilicable SNR level for FR2 R4-1904833, Draft CR to TS38, 101-4 on applicable SNR level for FR2 R4-1904983, Draft CR to TS38, 101-4 on SNR, Es and Noc setup endorsed draft CRs from RAN4#91 R4-1906806, Draft CR on Noc and Es setup R4-1907906, Editional corrections for 38, 101-4 PBCH tables R4-1907793, draftCR introduce single-lap HST channel model in TS 38, 101-4 R4-1907290, draftCR: updates to FR2 PDSCH test parameters R4-1907290, draftCR: updates to FR2 CPDSCH demodulation requirements R4-1907390, Draft CR to TS38, 101-4 on Applicability of requirements R4-1907390, Draft CR to TS38, 101-4 on Applicability of requirements R4-1907 | | | | | | | |
| R4-1904750, draftCR on PBCH requirements R4-1904750, draftCR on RMC for demod requirement for 38.101-4 R4-1904750, floating on RMC for demod requirement for 38.101-4 R4-1904750, Foraft CR on FR1 normal PDSCH demodulation requirements R4-1904756, Draft CR on FR2 PDSCH Demodulation Performance Tosts R4-1904758, Addition of alternative TDD configuration for UE demodulation requirements R4-1904758, Draft CR on FR2 PDSCH demodulation requirements R4-1904756, Draft CR on FR2 PDCCH demodulation requirements R4-1904766, Draft CR on FR2 SDR Requirements R4-19047678, Draft CR for modification on CSI test cases: 6, 8, 10 R4-1904778, Draft CR for modification on CSI test cases: 6, 8, 10 R4-1904778, Draft CR on FR2 SDR Requirements R4-1904778, Draft CR on FR2 SDR Requirements R4-1904778, Draft CR to TS38.101-4: Correction to FR1 CSI test cases R4-1904778, Draft CR to TS38.101-4: Correction to FR2 CSI test cases R4-1904780, Draft CR to TS38.101-4: Correction to FR2 CSI test cases R4-1904780, Draft CR to TS38.101-4 on SNR, Es and Noc setup endorsed draft CRs from RAN4#91 R4-1906089, Draft CR to TS38.101-4 on SNR, Es and Noc setup endorsed draft CRs from RAN4#91 R4-190709, Editorial corrections for 38.101-4 PBCH tables R4-190779, Draft CR to Noc and Es setup R4-1907293, Draft CR to TS38.101-4 on FR2 SDR test cases R4-190779, Draft CR to Noc and Es setup R4-1907293, Draft CR to TS38.101-4 on PBCH requirements R4-1907290, Draft CR to TS38.101-4 on FR2 SDR test cases R4-1907290, Draft CR to SR SDR SDR SDR SDR SDR SDR SDR SDR SDR | | | | | | , 5 11 | |
| R4-1904750, draftCR on RMC for demod requirement for 38.101-4 R4-1904756, Draft CR on FR1 normal PDSCH demodulation requirements R4-1904756, Draft CR on FR1 normal PDSCH demodulation requirements R4-1904757, Draft CR on FR2 PDSCH Demodulation Performance Tests R4-1904758, Draft CR on EN-DC SDR requirements R4-1904758, Draft CR on EN-DC SDR requirements R4-1904758, Draft CR on EN-DC SDR requirements R4-1904765, Draft CR on FR2 PDCCH demodulation for UE demodulation requirements R4-1904766, draftCR: Updates to FR1 PDCCH demodulation requirements R4-1904766, draftCR: Updates to FR1 PDCCH demodulation requirements R4-19047676, Draft CR for Beamforming model: Annex B.4.1 R4-1904767, Draft CR for Beamforming model: Annex B.4.1 R4-1904767, Draft CR on FR1 SDR requirements R4-1904776, Draft CR on FR1 SDR requirements R4-1904777, Draft CR on FR2 SDR Requirements R4-1904777, Draft CR on FR2 SDR Requirements R4-1904778, Draft CR on PDSCH DL RMC R4-1904779, Draft CR on PDSCH DL RMC R4-1904780, Draft CR to TS38, 101-4: Correction to FR1 CSI test cases R4-1904780, Draft CR to TS38, 101-4: Correction to FR2 CSI test cases R4-1904780, Draft CR to TS38, 101-4: Correction to FR2 CSI test cases R4-1904796, Draft CR to TS38, 101-4: Correction to FR2 R4-190433, Draft CR to TS38, 101-4 on applicable SNR level for FR2 R4-1904933, Draft CR to TS38, 101-4 for FR2 SDR test cases R4-190799, Draft CR on PBCH requirements R4-190790, Traft CR on Noc and Es setup R4-1907990, Traft CR to TS38, 101-4 for FR2 SDR test cases R4-1907990, Traft CR to TS38, 101-4 for FR2 SDR test cases R4-1907290, Traft CR to TS38, 101-4 for FR2 SDR test cases R4-1907290, Traft CR to TS38, 101-4 for FR2 SDR test cases R4-1907290, Traft CR to TS38, 101-4 for FR2 SDR test cases R4-1907290, Traft CR to TS38, 101-4 for FR2 SDR test cases in section 6.2 R4-1907290, Traft CR to TS38, 101-4 on Applicability of requirements R4-1907290, Traft CR to TS38, 101-4 on Applicability of requirements for interworking R4-1907300, Traft CR to TS38, 101-4 on Applicability of requireme | | | | | | | |
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| 2019-09 | RAN#85 | RP-192022 | 8000 | | F | CR to TS 38.101-4: Implementation of endorsed draft CRs from RAN4#92 (Rel-15) | 15.3.0 |
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| | | | | | | R4-1910021, DraftCR to 38.101-4: Corrections to Interworking requirements | |
| | | | | | | R4-1910023, Draft CR to TS 38.101-4: Enhanced SU-MIMO receiver definition | |
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| 2019-12 | RAN#86 | RP-192998 | 0009 | 2 | F | CR to TS 38.101-4: Corrections for applicability rules (R15) | 15.4.0 |
| 2019-12 | RAN#86 | RP-192998 | 0010 | | F | CR to TS 38.101-4: Editorial corrections for PDSCH RMC (R15) | 15.4.0 |
| 2019-12 | RAN#86 | RP-192998 | 0011 | | В | CR to TS 38.101-4: Introduction of NE-DC and NR-DC SDR requirements (R15) | 15.4.0 |
| | | RP-192998 | | 1 | F | CR on corrections for MIMO Correlation Matrices | 15.4.0 |
| 2019-12 2019-12 | RAN#86 RAN#86 | RP-192998 RP-192998 | 0015 0016 | 1 | F | CR on corrections for FR1 PDSCH demodulation performance tests CR on corrections for FR2 PDSCH demodulation performance tests | 15.4.0 15.4.0 |
| 2019-12 | RAN#86 | RP-192998 | 0017 | 1 | F | CR on corrections for FR1 CSI Reporting performance tests | 15.4.0 |
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| 2019-12 2019-12 | RAN#86 RAN#86 | RP-192998 RP-192998 | 0019 0021 | 1 | F | Editorial change on reference PDCCH payload size Editorial CR to correct PMI test cases | 15.4.0 15.4.0 |
| 2019-12 | RAN#86 | RP-192998 | 0023 | 1 | F | CR for TS38.101-4: Angle of arrival for radiated UE demodulation testing | 15.4.0 |
| 2019-12 | RAN#86 | RP-192998 | 0024 | | F | CR on demodulation performance requirements for EN-DC including FR1 and FR2 CCs | 15.4.0 |
| 2019-12 | RAN#86 | RP-192998 | 0025 | | F | CR: Correction on NR PDCCH demodulation performance requirements | 15.4.0 |
| 2019-12 | RAN#86 | RP-192998 | 0026 | | F | CR on CSI reporting requirements for EN-DC including FR1 and FR2 CCs | 15.4.0 |
| 2019-12 | RAN#86 | RP-192998 | 0027 | 1 | В | CR on NE-DC and NGEN-DC performance requirements | 15.4.0 |
| 2019-12 | RAN#86 | RP-192998 | 0028 | 1 | В | CR on NR-DC performance requirements | 15.4.0 |
| 2019-12 2019-12 | RAN#86 RAN#86 | RP-192998 RP-192998 | 0029 0030 | 1 | F | CR: Updates to NR RMC for UE performance requirements CR: Updates to NR EN-DC SDR tests | 15.4.0 15.4.0 |
| 2020-03 | RAN#87 | RP-200397 | 0031 | 1 | F | Clarification of Random PMI when testing | 15.5.0 |
| 2020-03 | RAN#87 | RP-200397 | 0032 | 1 | F | Correction to 5.3.3 4Rx PDCCH Demod Requirements | 15.5.0 |
| 2020-03 2020-03 | | RP-200397 RP-200397 | 0033 0034 | 1 | F | CR on corrections for FR1 PDSCH demodulation performance tests CR to TS 38.101-4: Editorial corrections (R15) | 15.5.0 15.5.0 |
| 2020-03 | RAN#87 | RP-200397 | 0034 | 1 | F | CR on number of NZP CSI-RS ports for RI reporting test in a TDD | 15.5.0 |
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| 2020-03 2020-06 | RAN#87 RAN#88 | RP-200397 RP-200985 | 0038 0039 | | F | CR: Updates to NR PDSCH test parameters (Rel-15) CR to Aperiodic Report Slot Offset for CQI report | 15.5.0 15.6.0 |
| 2020-00 | 17/11/#00 | 111-200900 | 0038 | | | ON to Apendule Nepolt old Oliset for Oki Tepolt | 13.0.0 |

| 2020-06 | RAN#88 | RP-200985 | 0048 | | F | CR for correction of Angle of Arrival for Radiated Requirements in section 4 | 15.6.0 |
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| 2020-06 | RAN#88 | RP-200985 | 0050 | | F | CR: updates to NR CSI test | 15.6.0 |
| 2020-06 | RAN#88 | RP-200985 | 0043 | 1 | F | CR to TS 38.101-4: Beamforming clarification (R15) | 15.6.0 |
| 2020-06 | RAN#88 | RP-200985 | 0049 | 1 | F | Update of DL physical channels definitions | 15.6.0 |
| 2020-06 | RAN#88 | RP-200985 | 0051 | 1 | F | CR: clarification on EPRE ratio definition | 15.6.0 |
| 2020-06 | RAN#88 | RP-200985 | 0046 | 1 | F | CR to TS 38.101-4: MIMO correlation matrices definition (R15) | 15.6.0 |
| 2020-09 | RAN#89 | RP-201512 | 0060 | | F | CR to 2Rx PDSCH mapping type B | 15.7.0 |
| 2020-09 | RAN#89 | RP-201512 | 0077 | 1 | F | CR on Corrections in 38.101-4 | 15.7.0 |
| 2020-09 | RAN#89 | RP-201512 | 0058 | 1 | F | CR to ZP-CSI-RS configuration | 15.7.0 |
| 2020-12 | RAN#90 | RP-202489 | 0079 | | F | Update of Noc for NR operating bands in FR2 | 15.8.0 |
| 2020-12 | RAN#90 | RP-202489 | 0081 | | F | Correction to FR1 Aperiodic CSI Reporting | 15.8.0 |
| 2020-12 | RAN#90 | RP-202489 | 0083 | | F | Correction to FR2 PMI Aperiodic CSI Reporting | 15.8.0 |
| 2020-12 | RAN#90 | RP-202489 | 0116 | 1 | F | CR: Updates to OCNG pattern reference | 15.8.0 |
| 2020-12 | RAN#90 | RP-202489 | 0118 | 1 | F | CR: Correction on OCNG pattern | 15.8.0 |
| 2021-03 | RAN#91 | RP-210116 | 0157 | 1 | F | Correction of CQI test parameters and FRC for UE demodulation test | 15.9.0 |
| 2021-03 | RAN#91 | RP-210116 | 0161 | 1 | F | CR on FRC for NR RI requirements (Rel-15) | 15.9.0 |
| 2021-03 | RAN#91 | RP-210116 | 0167 | 1 | F | CR on corrections for LTE-NR Co-existence tests and OCNG pattern | 15.9.0 |
| 2021-03 | RAN#91 | RP-210116 | 0169 | 1 | F | CR to 38.101-4 on update to CSI reporting test parameters for Aperiodic reporting (R15) | 15.9.0 |

History

| | Document history | | | | | | | |
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| V15.0.0 | April 2019 | Publication | | | | | | |
| V15.1.0 | May 2019 | Publication | | | | | | |
| V15.2.0 | July 2019 | Publication | | | | | | |
| V15.3.0 | October 2019 | Publication | | | | | | |
| V15.4.0 | January 2020 | Publication | | | | | | |
| V15.5.0 | April 2020 | Publication | | | | | | |
| V15.6.0 | July 2020 | Publication | | | | | | |
| V15.7.0 | November 2020 | Publication | | | | | | |
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| V15.9.0 | May 2021 | Publication | | | | | | |