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### **Foreword**

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

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

Version x.y.z

where:

- x the first digit:
  - 1 presented to TSG for information;
  - 2 presented to TSG for approval;
  - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

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

shall indicates a mandatory requirement to do somethingshall not indicates an interdiction (prohibition) to do something

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

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

**should** indicates a recommendation to do something

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

**may** indicates permission to do something

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

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

can indicates that something is possiblecannot indicates that something is impossible

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

will indicates that something is certain or expected to happen as a result of action taken by an agency

the behaviour of which is outside the scope of the present document

will not indicates that something is certain or expected not to happen as a result of action taken by an

agency the behaviour of which is outside the scope of the present document

might indicates a likelihood that something will happen as a result of action taken by some agency the

behaviour of which is outside the scope of the present document

might not indicates a likelihood that something will not happen as a result of action taken by some agency

the behaviour of which is outside the scope of the present document

In addition:

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

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

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

# 1 Scope

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

# 2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.
- 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". 3GPP TS 38.211: "NR; Physical channels and modulation". [9]
- [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"
- [17] 3GPP TS 38.331: "Radio Resource Control (RRC) protocol specification".

# 3 Definitions, symbols and abbreviations

#### 3.1 Definitions

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

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

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

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

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

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

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

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

## 3.2 Symbols

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

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

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

 $N_{\rm ac}$  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
DPS Dynamic Point Selection
EPRE Energy Per Resource Element
EN-DC E-UTRA-NR Dual Connectivity

FR Frequency Range

FRC Fixed Reference Channel

HARQ Hybrid Automatic Repeat Request

HST High Speed Train

HST-SFN High Speed Train Single Frequency Network

LI Layer Indicator

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

NR New Radio

NSA Non-Standalone Operation Mode 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 2<sup>nd</sup> level clause, shown in table 4.3-1.

Table 4.3-1: Definition of suffixes

Clause suffix	Variant	
None	Single Carrier	
Α	Carrier Aggregation (CA)	
В	Dual-Connectivity (DC)	
С	Supplement Uplink (SUL)	

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

# 4.4 Conducted requirements

#### 4.4.0 Introduction

The requirements are defined for the following modes:

- Mode 1: Conditions with external noise source
  - Wanted signal with power level Es is transmitted.
  - External white noise source with power spectral density Noc is used.
  - Es and Noc levels are selected to achieve target SNR as described in Clause 4.4.2.
- Mode 2: Noise free conditions
  - Wanted signal with power level Es is transmitted.
  - No external noise transmitted.

#### 4.4.1 Reference point

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

#### 4.4.2 SNR definition

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

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

#### Where

- N<sub>RX</sub> 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<sub>Band\_X, SCS\_Y, CBW\_Z</sub> 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<sub>REFSENS</sub> = -1 dB is the SNR used for simulation of REFSENS
- $\Delta_{\text{thermal}}$  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<sub>Band\_X, SCS\_Y, CBW\_Z</sub> 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<sub>REFSENS</sub> = -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.

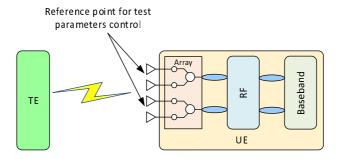


Figure 4.5.1-1: Reference point for radiated Demodulation and CSI requirements

#### 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<sub>BB</sub>. The SNR at the reference point is defined as

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

where  $\Delta_{BB}$  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<sub>RX</sub> 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  $\Delta_{BB}$  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 Power class			
	1	2	3	4
n257	-166.8	-161.3	-157.6	-166.3
n258	-166.8	-161.3	-157.6	-166.3
n259			-154.0	
n260	-163.8		-155.0	-164.3
n261	-166.8	-161.3	-157.6	-166.3
Note 1: Noc levels 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<sub>SB</sub> is the Noc defined in Table 4.5.3.2-1
- $\Delta MB_{P,n}$  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<sub>SC</sub> is derived by assuming UE supports single carrier.
- $\Delta R_{IB}$  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<sub>PC3, n260, 50MHz</sub> 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<sub>REFSENS</sub> is a subcarrier spacing associated with N<sub>RB</sub> for 50MHz in Table 5.3.2-1 of TS 38.101-2 [7], chosen as 120 kHz.
- PRB<sub>REFSENS</sub> is N<sub>RB</sub> 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<sub>REFSENS</sub> = -1 dB is the SNR used for simulation of REFSENS
- $\Delta_{thermal}$  is the amount of dB that the wanted noise is set above UE thermal noise, giving a rise in total noise of  $\Delta_{BB}$ .  $\Delta_{thermal} = 6dB$ , 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<sub>PC\_X</sub>, Band\_Y, 50MHz - REFSENS<sub>PC3</sub>, 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 2RX	PDSCH	All tests in Clause 5.2.2	
	PDCCH	All tests in Clause 5.3.2	
	PBCH	All tests in Clause 5.4.2	
UE supports only 4RX or both 2RX and 4RX	PDSCH	All tests in Clause 5.2.3 (Note 2)	
	PDCCH	All tests in Clause 5.3.3 (Note 2)	
	PBCH	All tests in Clause 5.4.2 or 5.4.3 (Note)	
Note 1: Requirements for PBCH with 4Rx is up to UE declaration  Note 2:  'maxMIMO-Layers-r16' is not configured during the performance requirements testing for UE supporting Release 16 per-BWP MIMO layer adaptation.			

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

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

Table 5.1.1.3-1: Requirements applicability for optional UE features

UE feature/capability [14]	Test	type	Test list	Applicability notes
SU-MIMO Interference Mitigation	FR1 FDD	PDSCH	Clause 5.2.2.1.1 (Test 3-1)	
advanced receiver				
	FR1 TDD	PDSCH	Clause 5.2.3.1.1 (Test 5-1) Clause 5.2.2.2.1 (Test 3-1)	-
	FRITUU	РОЗСП	Clause 5.2.2.1 (Test 3-1)	
			Clause 5.2.3.2.1 (Test 5-1)	
Alternative additional DMRS	FR1 FDD	PDSCH	Clause 5.2.2.1.4 (Test 1-2)	
position for co-existence with LTE CRS (additionalDMRS-DL-Alt)			Clause 5.2.3.1.4 (Test 1-2)	
	FR1 TDD	PDSCH	Clause 5.2.2.2.4 (Test 1-2)	
			OL 50004/T (40)	
Basic DL NR-NR CA operation	NR CA	SDR	Clause 5.2.3.2.4 (Test 1-2) Clause 5.5A.1	1)Up to 16 DL
(supportedBandCombinationList)				carriers 2)Same numerology across carrier for data/control channel at a given time
Enhanced demodulation	FR1 FDD	PDSCH	Clause 5.2.2.1.9 (Test 1-1)	
processing for HST-SFN joint transmission scheme with velocity up to 500km/h			Clause 5.2.3.1.9 (Test 1-1)	
	FR1 TDD	PDSCH	Clause 5.2.2.2.9 (Test 1-1)	
			Clause F 2 2 2 0 (Test 1 1)	
Alternative 64QAM MCS table	FR1 FDD	PDSCH	Clause 5.2.3.2.9 (Test 1-1) Clause 5.2.2.1.5	
for PDSCHNew 64QAM MCS			Clause 5.2.3.1.5	
table for PDSCH (dl-64QAM-			Clause 5.2.2.1.6	
MCS-TableAlt)	FR1 TDD	PDSCH	Clause 5.2.3.1.6 Clause 5.2.2.2.5	_
	FRITUU	РОЗСП	Clause 5.2.3.2.5	
			Clause 5.2.2.2.6	
			Clause 5.2.3.2.6	
CQI table with target BLER of	FR1 FDD	PDSCH	Clause 5.2.2.1.5	
10^-5New CQI table (cqi- TableAlt)			Clause 5.2.3.1.5	
TableAlty	FR1 TDD	PDSCH	Clause 5.2.2.2.5	1
			Clause 5.2.3.2.5	
PDSCH repetitions over multiple	FR1 FDD	PDSCH	Clause 5.2.2.1.6	
slots (pdsch-			Clause 5.2.3.1.6	
RepetitionMultiSlots)	FR1 TDD	PDSCH	Clause 5.2.2.2.6	1
		1 20011	Clause 5.2.3.2.6	
UE PDSCH processing capability #2 (pdsch-ProcessingType2)	FR1 FDD	PDSCH	Clause 5.2.2.1.7 Clause 5.2.3.1.7	
	FR1 TDD	PDSCH	Clause 5.2.2.2.7	]
		DDC 0::	Clause 5.2.3.2.7	
Pre-emption indication for DL (pre-EmptIndication-DL)	FR1 FDD	PDSCH	Clause 5.2.2.1.8	
(pre-empanaication-de)	FR1 TDD	PDSCH	Clause 5.2.3.1.8 Clause 5.2.2.2.8	1
		. 200	Clause 5.2.3.2.8	

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

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

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

UE feature/capability [14]	Test	type	Test list	Applicability notes
256QAM modulation scheme for PDSCH for FR1 (pdsch- 256QAM-FR1)	FR1 FDD	PDSCH	Clause 5.2.2.1.1 (Test 1-3) Clause 5.2.3.1.1 (Test 1-3)	
,	FR1 TDD	PDSCH	Clause 5.2.2.2.1 (Test 1-3) Clause 5.2.3.2.1 (Test 1-3)	
PDSCH mapping type B (pdsch-MappingTypeB)	FR1 FDD	PDSCH	Clause 5.2.2.1.3 Clause 5.2.3.1.3 Clause 5.2.2.1.7 Clause 5.2.3.1.7	
	FR1 TDD	PDSCH	Clause 5.2.2.2.3 Clause 5.2.3.2.3 Clause 5.2.2.2.7 Clause 5.2.3.2.7	
Rate-matching around LTE CRS (rateMatchingLTE-CRS)	FR1 FDD	PDSCH	Clause 5.2.2.1.4 Clause 5.2.3.1.4	For UEs supporting "Alternative additional DMRS position for co- existence with LTE CRS", if Test 1-2 is tested, the test coverage can be considered fulfilled without executing Test 1-1. Otherwise, only Test 1-1 is tested.
	FR1 TDD	PDSCH	Clause 5.2.2.2.4 Clause 5.2.3.2.4	
Supported maximum number of ports across all configured NZP-CSI-RS resources per CC (maxConfigNumberPortsAcros sNZP-CSI-RS-PerCC)	FR1 FDD	PDSCH	Clause 5.2.2.1.4 (Tests 1-1, 1-2) Clause 5.2.3.1.1 (Tests 3-1, 4-1, 5-1) Clause 5.2.3.1.4 (Tests 1-1, 1-2)	The requirements apply only in case the number of NZP-CSI-RS ports in the test case satisfies UE capability on maximum number of NZP-CSI-RS ports
	FR1 TDD	PDSCH	Clause 5.2.3.2.1 (Test 3-1, 4-1, 5-1)	
Supported maximum number of PDSCH MIMO layers (maxNumberMIMO-LayersPDSCH)	FR1 FDD	PDSCH	Clause 5.2.2.1.1 (Tests 2-1, 2-2, 3-1) Clause 5.2.2.1.2 Clause 5.2.3.1.1 (Tests 2-1, 2-2, 3-1, 4-1, 5-1) Clause 5.2.3.1.2	The requirements apply only in case the PDSCH MIMO rank in the test case does not exceed UE PDSCH MIMO layers capability
	FR1 TDD	PDSCH	Clause 5.2.2.2.1 (Tests 2-1, 2-2, 3-1) Clause 5.2.2.2.2 Clause 5.2.3.2.1 (Tests 2-1, 2-2, 3-1, 4-1, 5-1) Clause 5.2.3.2.2	

Support number of active TCI states per BWP per CC, including control and data (maxNumberActiveTCI-PerBWP)	FR1 FDD	PDSCH	Clause 5.2.2.1.10 Clause 5.2.3.1.10	For the value of "maxNumberActiveT CI-PerBWP" other than n1, if Test 1-2 is tested, the test coverage can be considered fulfilled without executing Test 1-1. Otherwise, only Test 1-1 is tested.
	FR1 TDD	PDSCH	Clause 5.2.2.2.10 Clause 5.2.3.2.10	

Table 5.1.1.5-1: Applicability of requirements for HST

#### 5.1.1.5 Applicability of different requirements for HST

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

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

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

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

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

- First select the bandwidth combinations with the same bandwidth in each carrier.
  - If there is no such bandwidth combination, select the bandwidth combinations with smallest bandwidth difference between the two carriers, and the carrier with smaller bandwidth will be used for test.
- Among the bandwidth combinations selected, select the CA combination with largest aggregated bandwidth combination.

#### 5.1.1.7 Applicability of CA requirements

#### 5.1.1.7.1 Definition of CA capability

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

Table 5.1.1.7.1-1: Definition of CA capability

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

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

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

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

Tests	CA capability where the tests apply	CA configuration from the selected CA capability where the tests apply	CA Bandwidth combination to be tested in priority order	PCell CC configuration
Test 1 in Clause 5.2A.2.1 and 5.2A.3.1	CA_C, CA_N, CA_AX	Table 5.1.1.7.2-2	Largest aggregated CA bandwidth combination	Any of CCs
Test 2 in Clause 5.2A.2.1 and 5.2A.3.1	CA_C, CA_N, CA_AX	Table 5.1.1.7.2-2	Largest aggregated CA bandwidth combination	Any of CCs
Test 3 in Clause 5.2A.2.1 and 5.2A.3.1	CA_AX	Table 5.1.1.7.2-2	Largest aggregated CA bandwidth combination	TDD CC if supported, otherwise FDD CC
Test 4 in Clause 5.2A.2.1 and 5.2A.3.1 (NOTE 2)	CA_AX	Table 5.1.1.7.2-2	Largest aggregated CA bandwidth combination	Any of CCs
Test 5 in Clause 5.2A.2.1 and 5.2A.3.1 (NOTE 3)	CA_AX	Table 5.1.1.7.2-2	Largest aggregated CA bandwidth combination	15 kHz CC if supported, otherwise 30 kHz CC

NOTE 1: In case CA\_AX with different number of X is supported then one or two CA configurations are selected based on procedure from Table 5.1.1.7.2-2.

NOTE 2: These scenarios are only tested for UEs which are not verified with Test 3 in Clause 5.2A.2.1 and 5.2A.3.1. NOTE 3: These scenarios are only tested for UEs which are not verified with Test 2 in Clause 5.2A.2.1 and 5.2A.3.1.

Table 5.1.1.7.2-2: Selection of CA configurations

CA capability	Step 1	Step 2	Step 3	Step 4
CA_C or CA_N	Select the CA configurations with the maximum number of CCs, for which the supported maximum number of MIMO layers is not lower than 2.	Select any one of CA configurations, which contain CA bandwidth combination with the largest aggregated channel bandwidth and supported maximum data rate is not lower than the tested date rate, among all the selected CA configurations from Step 1.	N/A	N/A
CA_AX	Select the CA configurations with the maximum number of CCs, for which the supported maximum number of MIMO layers is not lower than 2.	Select any one of CA configurations, which contain CA bandwidth combination with the largest aggregated channel bandwidth and supported maximum data rate is not lower than the tested date rate, among all the selected CA configurations from Step 1.	Select the CA configurations with the largest number of bands and with the maximum number of CCs, for which the supported maximum number of MIMO layers is not lower than 2.	Select any one of CA configurations, which contain CA bandwidth combination with the largest aggregated channel bandwidth and supported maximum data rate is not lower than the tested date rate, among all the selected CA configurations from Step 3.
	_AX capability, if CA confi ep 3 and Step 4 are skipp			
1	-1	,	•	

are used for testing.

NOTE 2: Maximum supported data rate for Step 2 and Step 4 is calculated based clause 4.1.2 of TS 38.306 [14].

NOTE 3: Tested data rate for Step 2 and Step 4 is calculated based on the equation  $DataRate = 10^{-3} \sum_{j=1}^{J} TBS_j 2^{\mu_j}$ and FRCs used in the test.

#### 5.1.1.7.3 Antenna connection for CA tests with 4 RX

**TBD** 

#### 5.2 PDSCH demodulation requirements

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

**Table 5.2-1: Common test parameters** 

	Parameter	Unit	Value
PDSCH transmission			Transmission scheme 1
Carrier	Offset between Point A and the lowest	RBs	0
configuration	usable subcarrier on this carrier (Note 2)		45 00
DL BWP	Subcarrier spacing Cyclic prefix	kHz	15 or 30 Normal
configuration #1	Cyclic prefix		Normai
John garation // 1	RB offset	RBs	0
	Number of contiguous PRB	PRBs	Maximum transmission bandwidth
	-		configuration as specified in clause
			5.3.2 of TS 38.101-1 [6] for tested
			channel bandwidth and subcarrier spacing
Common serving	Physical Cell ID		0 0
cell parameters	1 Hydrodi Coll 12		· ·
	SSB position in burst		First SSB in Slot #0
	SSB periodicity	ms	20
PDCCH	Slots for PDCCH monitoring		Each slot
configuration	Symbolo with DDCCLI	Cymholo	0.1
	Symbols with PDCCH Number of PRBs in CORESET	Symbols	0, 1 Table 5.2-2 for tested channel
	Number of FRES III COREGET		bandwidth and subcarrier spacing
	Number of PDCCH candidates and		1/AL8
	aggregation levels		
	CCE-to-REG mapping type		Non-interleaved
	DCI format		1_1
	TCI state		TCI state #1
	PDCCH & PDCCH DMRS Precoding configuration		Single Panel Type I, Random per slot with equal probability of each
	Corniguration		applicable i <sub>1</sub> , i <sub>2</sub> combination, and with
			REG bundling granularity for number
			of Tx larger than 1
Cross carrier schedu			Not configured
CSI-RS for tracking	First subcarrier index in the PRB used for CSI-RS		k <sub>0</sub> =0 for CSI-RS resource 1,2,3,4
	First OFDM symbol in the PRB used for		I <sub>0</sub> = 6 for CSI-RS resource 1 and 3
	CSI-RS		$I_0 = 10$ 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 1,2,3,4
	Density (ρ)		3 for CSI-RS resource 1,2,3,4
	CSI-RS periodicity	Slots	15 kHz SCS: 20 for CSI-RS resource
			1,2,3,4 30 kHz SCS: 40 for CSI-RS resource
			1,2,3,4
	CSI-RS offset	Slots	15 kHz SCS:
			10 for CSI-RS resource 1 and 2
			11 for CSI-RS resource 3 and 4
			30 kHz SCS:
			20 for CSI-RS resource 1 and 2
			21 for CSI-RS resource 3 and 4
	Frequency Occupation		Start PRB 0
	OCL into		Number of PRB = BWP size
NZP CSI-RS for	QCL info First subcarrier index in the PRB used for		TCI state #0 k <sub>0</sub> = 0
CSI acquisition	CSI-RS		KU = U
5 2 1 2 3 <b>4</b> 3 1 3 1 3 1	First OFDM symbol in the PRB used for		l <sub>0</sub> = 12
	CSI-RS		
	Number of CSI-RS ports (X)		Same as number of transmit antenna
	CDM Type		'No CDM' for 1 transmit antenna
			'FD-CDM2' for 2 and 4 transmit antenna
	Density (ρ)		1
	CSI-RS periodicity	Slots	15 kHz SCS: 20
			30 kHz SCS: 40
	CSI-RS offset	Slots	0

Ī			1	0: + DDD 0
	Frequency Occ	cupation		Start PRB 0
	QCL info			Number of PRB = BWP size TCI state #1
ZD CCL DC for CCL		index in the PRB used for		
ZP CSI-RS for CSI acquisition	CSI-RS			k <sub>0</sub> = 4
	First OFDM syl	mbol in the PRB used for		I <sub>0</sub> = 12
	Number of CSI	-RS ports (X)		4
	CDM Type	(1.9)		'FD-CDM2'
	Density (ρ)			1
	CSI-RS periodi	city	Slots	15 kHz SCS: 20
	l control points		01010	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
configuration	·			{1000, 1001} for Rank 2 tests
				{1000-1002} for Rank 3 tests
				{1000-1003} for Rank 4 tests
	Position of the	first DMRS for PDSCH		2
	mapping type A			
	Number of PDS	SCH DMRS CDM group(s)		1 for Rank 1 and Rank 2 tests
	without data	-		2 for Rank 3 and Rank 4 tests
TCI state #0	Type 1 QCL	SSB index		SSB #0
	information			
		QCL Type		Type C
	Type 2 QCL information	SSB index		N/A
		QCL Type		N/A
TCI state #1	Type 1 QCL	CSI-RS resource		CSI-RS resource 1 from 'CSI-RS for
	information			tracking' configuration
		QCL Type		Type A
	Type 2 QCL information	CSI-RS resource		N/A
	Illionnation	QCL Type		N/A
PT-RS configuration		QOL Type		PT-RS is not configured
		ps for ACK/NACK feedback		1
Maximum number of				4
HARQ ACK/NACK b		5.011		Multiplexed
Redundancy version		Δ		{0,2,3,1}
PDSCH & PDSCH D				Single Panel Type I, Random
1 20011 01 20011 2	winto i roccaing	oormgaration		precoder selection updated per slot,
				with equal probability of each
				applicable i <sub>1</sub> , i <sub>2</sub> combination, and with
				PRB bundling granularity
Symbols for all unus	ed 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, cha	annels mapping a	nd precoding		As specified in Annex B.4.1
			al to the TO	I state applied for the PDCCH

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, 1-6, 1-7, 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	Unit	Value
Duplex mode			FDD
Active DL BWP index	(		1
PDSCH configuration	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		12
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		4 for Test 1-1
			2 for other tests
	Resource allocation type		Test 1-2: Type 1 with start RB = 23,
			$L_{RBs} = 6$
			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
PDSCH DMRS configuration	DMRS Type		Type 1
Comigaration	Number of additional DMRS		2 for Tests 1-1, 1-5, 1-6, 1-7 1 for other tests
	Maximum number of OFDM symbols for DL front loaded DMRS		1
CSI-RS for tracking	CSI-RS periodicity	Slots	Test 1-5, 1-6, 1-7: 10 for CSI-RS resource 1,2,3,4. Other tests: Table 5.2-1.
	CSI-RS offset	Slots	Test 1-5, 1-6, 1-7:
	CSI-RS Offset	Siots	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 I ACK information	petween PDSCH and corresponding HARQ-		2

Table 5.2.2.1.1-3: Minimum performance for Rank 1

Test num.	Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	Correlation matrix and antenna configuration	Reference v	alue
						Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-1.1 FDD	10 / 15	QPSK, 0.30	TDLB100-400	2x2, ULA Low	70	-0.8
1-2	R.PDSCH.1-1.2 FDD	10 / 15	QPSK, 0.30	TDLC300-100	2x2, ULA Low	70	0.2
1-3	R.PDSCH.1-4.1 FDD	10 / 15	256QAM, 0.82	TDLA30-10	2x2, ULA Low	70	24.6
1-4	R.PDSCH.1-2.1 FDD	10 / 15	16QAM, 0.48	TDLC300-100	2x2, ULA Low	30	1.1
1-5	R.PDSCH.1-8.1 FDD	10 / 15	16QAM, 0.48	HST-750	1x2	70	6.2
1-6	R.PDSCH.1-8.2 FDD	10 / 15	64QAM, 0.43	HST-972	1x2	70	[9.6]
1-7	R.PDSCH.1-8.1 FDD	10 / 15	16QAM, 0.48	TDLC300-600	2x2	70	[8.6]

Table 5.2.2.1.1-4: Minimum performance for Rank 2

Test num.		Bandwidth (MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	Correlation matrix and antenna configuration	Reference value	
num.						Fraction of maximum throughput (%)	SNR (dB)
2-1	R.PDSCH.1-3.1 FDD	10 / 15	64QAM, 0.50	TDLA30-10	2x2, ULA Low	70	19.4
2-2	R.PDSCH.2-1.1 FDD	20 / 30	64QAM, 0.50	TDLA30-10	2x2, ULA Low	70	19.7

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

Test num.	Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	Correlation matrix and antenna configuration	Reference value	
						Fraction of maximum throughput (%)	SNR (dB)
3-1	R.PDSCH.1-2.2 FDD	10 / 15	16QAM, 0.48	TDLA30-10	2x2, ULA Medium	70	17.6

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

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

The test purposes are specified in Table 5.2.2.1.2-1.

#### Table 5.2.2.1.2-1: Tests purpose

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

#### Table 5.2.2.1.2-2: Test parameters

	Parameter	Unit	Value
Duplex mode			FDD
Active DL BWP index			1
PDSCH configuration	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		12
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS configuration	DMRS Type		Type 1
	Number of additional DMRS		1
	Maximum number of OFDM symbols for DL front loaded DMRS		1
NZP CSI-RS for CSI acquisition	OFDM symbols in the PRB used for CSI-RS		I <sub>0</sub> = 13
•	CSI-RS periodicity	Slots	5
ZP CSI-RS for CSI acquisition	Subcarrier index in the PRB used for CSI-RS		$(k_0, k_1, k_2, k_3)=(2, 4, 6, 8)$
•	Number of CSI-RS ports (X)		8
	CSI-RS periodicity	Slots	5
Number of HARQ Pr	ocesses		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		nd condition matrix and antenna	Correlation	Reference value	
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate		matrix and	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	1-1
receive antenna conditions	

#### Table 5.2.2.1.3-2: Test parameters

	Parameter	Unit	Value
Duplex mode			FDD
Active DL BWP inde	ex		1
PDSCH configuration	Mapping type		Туре В
	k0		0
	Starting symbol (S)		5
	Length (L)		7
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS configuration	DMRS Type		Type 1
	Number of additional DMRS		1
	Maximum number of OFDM symbols for DL front loaded DMRS		1
Number of HARQ P	rocesses		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 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	2x2, ULA Low	70	-0.9

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

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

The test purposes are specified in Table 5.2.2.1.4-1.

Table 5.2.2.1.4-1: Tests purpose

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

Table 5.2.2.1.4-2: Test parameters

Duplex mode Active DL BWP index	FDD
Active DL BWP index	
	1
NR UL transmission with a 7.5 kHz shift to the LTE	true
PDCCH Symbols with PDCCH	Symbol# 2
PDSCH Mapping type	Type A
k0	0
Starting symbol (S)	3
Length (L)	9 for Test 1-1 11 for Test 1-2
PDSCH aggregation factor	1
PRB bundling type	Static
PRB bundling size	2
Resource allocation type	Type 0
RBG size	Config2
VRB-to-PRB mapping type	Non-interleaved
VRB-to-PRB mapping inter size	undle N/A
PDSCH DMRS configuration DMRS Type	Type 1
Position of the first DM-RS	nlink 3
Number of additional DMRS	1
Maximum number of OFDM DL front loaded DMRS	s for 1
CRS for rate matching (Note 1)  LTE carrier centre subcarrie	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 corresp ACK information	HARQ- 2
Note 1: No MBSFN is configured on LTE carrie	

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

# 5.2.2.1.5 Minimum requirements for PDSCH 0.001% BLER

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

The test purposes are specified in Table 5.2.2.1.5-1.

Table 5.2.2.1.5-1: Tests purpose

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

Table 5.2.2.1.5-2: Test parameters

	Parameter	Unit	Value
Duplex mode			FDD
Active DL BWP inde	ex		1
PDSCH configuration	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		12
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS configuration	DMRS Type		Type 1
J	Number of additional DMRS		1
	Maximum number of OFDM symbols for DL front loaded DMRS		1
Maximum number of HARQ transmission			1
Number of HARQ P	Number of HARQ Processes		4
The number of slots ACK information	between PDSCH and corresponding HARQ-		2

Table 5.2.2.1.5-3: Minimum performance for Rank 1

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

# 5.2.2.1.6 Minimum requirements for PDSCH repetitions over multiple slots

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

The test purposes are specified in Table 5.2.2.1.6-1.

Table 5.2.2.1.6-1: Tests purpose

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

Table 5.2.2.1.6-2: Test parameters

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

Table 5.2.2.1.6-3: Minimum performance for Rank 1

Test num.	Deference	Bandwidth (MHz) /	Modulation	Correlation	Reference value		
	Reference channel	Subcarrier spacing (kHz) format and code rate	Propagation condition	matrix and antenna configuration	Target BLER	SNR (dB)	
1-1	R.PDSCH.1-11.1 FDD	10 / 15	16QAM, 0.54	TDLA30-10	2x2, ULA Low	1% (Note 1)	TBD

Note 1: BLER is defined as residual BLER; i.e. ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block.

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

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

The test purposes are specified in Table 5.2.2.1.7-1.

Table 5.2.2.1.7-1: Tests purpose

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

Table 5.2.2.1.7-2: Test parameters

	Parameter	Unit	Value
Duplex mode			FDD
Active DL BWP index	X		1
PDSCH configuration	Mapping type		Type B
	k0		0
	Starting symbol (S)		2
	Length (L)		2
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS configuration	DMRS Type		Type 1
	Number of additional DMRS		0
	Maximum number of OFDM symbols for DL front loaded DMRS		1
Maximum number of HARQ transmission			1
Number of HARQ Processes			2
The number of slots ACK information	between PDSCH and corresponding HARQ-		0

Table 5.2.2.1.7-3: Minimum performance for Rank 1

		Bandwidth			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.1-12.1 FDD	10 / 15	QPSK, 0.30	TDLA30-10	2x2, ULA Low	70	[0.9]

## 5.2.2.1.8 Minimum requirements for PDSCH pre-emption

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

The test purposes are specified in Table 5.2.2.1.8-1.

Table 5.2.2.1.8-1: Tests purpose

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

Table 5.2.2.1.8-2: Test parameters

	Parameter	Unit	Value		
Duplex mode			FDD		
Active DL BWP index	(		1		
PDCCH configuration (Note 4)	Symbols with PDCCH		0, 1		
,	DCI format		2_1		
	timeFrequencySet		 14x1		
PDSCH configuration	Mapping type		Type A		
	k0		0		
	Starting symbol (S)		2		
	Length (L)		12		
	PDSCH aggregation factor		1		
	PRB bundling type		Static		
	PRB bundling size		2		
	Resource allocation type		Type 0		
	RBG size		Config2		
	VRB-to-PRB mapping type		Non-interleaved		
	VRB-to-PRB mapping interleaver bundle size		N/A		
PDSCH DMRS configuration	DMRS Type		Type 1		
J	Number of additional DMRS		1		
	Maximum number of OFDM symbols for DL front loaded DMRS		1		
Pre-emption configuration (Note 1, 2)	Starting symbol (S)		3		
	Length (L)		2		
	Pre-emption periodicity and offset (Note 3)		TBD 10/1 or (10,11)/1		
Number of HARQ Processes			4		
The number of slots ACK information	between PDSCH and corresponding HARQ-		2		
Note 1: If UE cannot decode PDSCH correctly upon receiving PI on PDCCH with DCI format 2_1, UE feeds back					

Note 1: If UE cannot decode PDSCH correctly upon receiving PI on PDCCH with DCI format 2\_1, UE feeds back NACK to gNB. Then UE flushes the buffer and waits for the next re-transmission for LLR combining to decode the PDSCH.

Note 2: Interference modelled as random data on pre-empted REs.

Note 3: Pre-emption is scheduled with a fixed scheduling with 10 or 20% probability within 10ms periodicity.

Note 4: In addition to PDCCH configuration in Table 5.2-1.

Table 5.2.2.1.8-3: Minimum performance for Rank 1

		Bandwidth (MHz) /	Madulation		Correlation	Reference va	alue
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.x FDD	10 / 15	TBD	TDLA30-10	2x2, ULA Low	TBD	TBD

# 5.2.2.1.9 Minimum requirements for PDSCH HST-SFN

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

The test purposes are specified in Table 5.2.2.1.9-1.

## Table 5.2.2.1.9-1: Tests purpose

Test index

## Table 5.2.2.1.9-2: Test parameters

	Parameter	Unit	Value
Duplex mode			FDD
Active DL BWP index	(		1
PDSCH	Mapping type		Type A
configuration			**
	k0		0
	Starting symbol (S)		2
	Length (L)		12
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle		N/A
	size		
PDSCH DMRS configuration	DMRS Type		Type 1
<b>3</b>	Number of additional DMRS		2
	Maximum number of OFDM symbols for DL front loaded DMRS		1
CSI-RS for tracking	CSI-RS periodicity	Slots	10 for CSI-RS resource 1,2,3,4.
· ·	CSI-RS offset	Slots	1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4.
Number of HARQ Pro	ocesses		4
The number of slots I ACK information	petween PDSCH and corresponding HARQ-		2

## Table 5.2.2.1.9-3: Minimum performance for Rank 2

		Bandwidth			Correlation	Reference v	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.1-8.3 FDD	10 / 15	16QAM, 0.48	HST-SFN	2x2	70	13.0

# 5.2.2.1.10 Minimum requirements for HST DPS

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

The test purposes are specified in Table 5.2.2.1.10-1.

Table 5.2.2.1.10-1: Tests purpose

. 45.0 0.2.2.1.	
Purpose	Test index
Verify UE performance in the HST-DPS scenario define in B.3.3	d 1-1, 1-2

Table 5.2.2.1.10-2: Test parameters

PDCCH configuration         TCI state         Note 1           PDSCH configuration         Mapping type         Type A           k0         0         0           Starting symbol (S)         2           Length (L)         12           PDSCH aggregation factor         1           PRB bundling type         Static           PRB bundling size         2           Resource allocation type         Type 0           RBG size         Config2           VRB-to-PRB mapping type         Non-interleaved           VRB-to-PRB mapping interleaver bundle size         N/A           TCI state         Note 1		Parameter		Unit	Value
Active DL BMP Index   PDSCH configuration   TC   state   Note 1	Duplex mode				FDD
Mapping type	Active DL BWP index				1
Mapping type	PDCCH configuration	TCI state			Note 1
Resource set #1   Resource set #2   Resource set #3   Resource set #4   Resource s					
Starting symbol (S)					
Length (L)		Starting symbol (S	)		
POSCH aggregation factor   1   1   PRB bundling type   Static   PRB bundling size   2   2   Resource allocation type   Type 0   RBG size   Conflig2   VRB-to-PRB mapping type   Non-interleaved   VRB-to-PRB mapping interleaver bundle size   Note 1   N/A   TCI state   Note 1   TOI state   Note 1   Tol state			,		
PRB bundling type			on factor		1
PRB bundling size					Static
Resource allocation type					
RBG size   VRB-to-PRB mapping type   VRB-to-PRB mapping interleaver bundle size   N/A					Type 0
VRB-to-PRB mapping type			71.		
VRB-to-PRB mapping interleaver bundle size		VRB-to-PRB mapp	ping type		
TC   state   Note 1   Type 1					N/A
DMRS Type					Note 1
Number of additional DMRS	PDSCH DMRS	DMRS Type			Type 1
Maximum number of OFDM symbols for DL front loaded DMRS	configuration	<u> </u>	1.0140.0		
Total table					
Resource set #1   First OFDM symbol in the PRB used for CSI-RS resource 1 and 3 to PRB used for CSI-RS resource 2 and 4					1
Resource set #1   the PRB used for CSI-RS		front loaded DMRS			1 54 001 50
RS	CCI DC for two obins	Danauman ant #4	1		
CSI-RS periodicity	COI-KO for tracking	Resource set #1			$I_0 = 9$ for CSI-RS resource 2 and 4
CSI-RS offset   Slots   1 for CSI-RS resource 1 and 2   2 for CSI-RS resource 3 and 4   QCL info   TCI state #2   First OFDM symbol in the PRB used for CSI-RS resource 5 and 6   10 = 10 for CSI-RS resource 5 and 6   10 = 10 for CSI-RS resource 7 and 8   CSI-RS offset   Slots   CSI-RS resource 5 and 6   2 for CSI-RS resource 7 and 8   CSI-RS offset   Slots   CSI-RS periodicity   Slots   CSI-RS resource 7 and 8   CSI-RS periodicity   Slots   CSI-RS periodicity   Slots   CSI-RS offset   Slots   O   O   O   O   O   O   O   O   O			_	Cloto	10 for CSL DS recourse 4.9.9.4
CSI-RS offset   2 for CSI-RS resource 3 and 4   TCI state #2			CSI-KS periodicity		
Resource set #2   First OFDM symbol in the PRB used for CSI-RS   10 for CSI-RS resource 5 and 6 lo = 10 for CSI-RS resource 7 and 8   CSI-RS offset   Slots   10 for CSI-RS resource 5 and 6 lo = 10 for CSI-RS for tracking Resource 5 and 6 lo = 10 for CSI-RS for tracking Resource 5 and 6 lo = 10 for CSI-RS for tracking Resource 5 and 6 lo = 10 for CSI-RS for tracking Resource 5 and 6 lo = 10 for CSI-RS for tracking Resource 5 and 6 lo = 10 for CSI-RS for tracking Resource 5 and 6 lo = 10 for CSI-RS for tracking Resource 5 and 6 lo = 10 for CSI-RS for tracking Resource 5 and 6 lo = 10 for CSI-RS for tracking Resource 5 and 6 lo = 10 for CSI-RS for tracking Resource 5 and 6 lo = 10 for CSI-RS for tracking Resource 5 and 6 lo = 10 for CSI-RS for tracking Resource 5 and 6 lo = 10 for CSI-RS for tracking Resource 5 and 6 lo = 10 for CSI-RS for tracking Resource 5 and 6 lo = 10 for CSI-RS for tracking for CSI-RS for tracking for CSI-RS for tracking for CSI-R			CSI-RS offset	Siots	
Resource set #2   First OFDM symbol in the PRB used for CSI-RS resource 5 and 6 lo = 10 for CSI-RS resource 5 and 6 lo = 10 for CSI-RS resource 7 and 8 lo = 10 for CSI-RS resource 7 and 8 lo = 10 for CSI-RS resource 7 and 8 lo = 10 for CSI-RS resource 5 and 6 lo = 10 for CSI-RS resource 7 and 8 lo = 10 for CSI-RS resource 5 and 6 lo = 10 for CSI-RS resource 7 and 8 lo = 10 for CSI-RS resource 5 and 6 lo = 10 for CSI-RS resource 7 and 8 lo = 10 for CSI-RS resource 5 and 6 lo = 10 for CSI-RS resource 7 and 8 lo = 10 for CSI-RS resource 5 and 6 lo = 10 for CSI-RS resource 5 and 6 lo = 10 for CSI-RS resource 5 and 6 lo = 10 for CSI-RS resource 5 and 6 lo = 10 for CSI-RS resource 5 and 6 lo = 10 for CSI-RS resource 5 and 6 lo = 10 for CSI-RS resource 5 and 6 lo = 10 for CSI-RS resource 5 and 6 lo = 10 for CSI-RS resource 5 and 6 lo = 10 for CSI-RS resource 5 and 6 lo = 10 for CSI-RS resource 5 and 6 lo = 10 for CSI-RS resource 5 and 6 lo = 10 for CSI-RS resource 5 and 6 lo = 10 for CSI-RS resource 5 and 6 lo = 10 for CSI-RS resource 5 and 6 lo = 10 for CSI-RS resource 5 and 6 lo = 10 for CSI-RS resource 5 lo CSI-RS resource 5 lo CSI-RS resource 5 lo CSI-RS resource 5 lo CSI-RS for tracking Resource set #1 configuration for tracking Resource 5 lo CSI-RS resource 5 lo CSI-RS resource 5 lo CSI-RS resource 5 lo CSI-RS for tracking Resource 5 lo CSI-RS resource 5 lo CSI-RS for tracking			QCL info		
Resource set #2   the PRB used for CSI- RS   lo = 10 for CSI-RS resource 7 and 8 RS   CSI-RS periodicity   Slots   10 for CSI-RS resource 5,6,7,8.					
RS		Resource set #2			
CSI-RS periodicity					
CSI-RS offset   Slots   1 for CSI-RS resource 5 and 6 2 for CSI-RS resource 7 and 8   QCL info   TCI state #3				Slots	10 for CSI-RS resource 5.6.7.8.
NZP CSI-RS for CSI acquisition   Resource set #3   First OFDM symbol in the PRB used for CSI-RS periodicity   Slots   20					
NZP CSI-RS for CSI acquisition			CSI-RS offset	0.0.0	
Resource set #3   the PRB used for CSI-RS   CSI-RS for CSI-RS offset   Slots   QC   CSI-RS offset   Slots   QC   TCI state #0			QCL info		
Resource set #3   To provide the property of the provided provid	NZD CCL DC for CCL		First OFDM symbol in		I <sub>0</sub> = 12
CSI-RS periodicity   Slots   20		Resource set #3	the PRB used for CSI-		
CSI-RS offset   QCL info   TCl state #0	acquisition		RS		
Resource set #4   First OFDM symbol in the PRB used for CSI-RS   Slots   20				Slots	20
Resource set #4   First OFDM symbol in the PRB used for CSI-RS   CSI-RS periodicity   Slots   20				Slots	,
Resource set #4			QCL info		TCI state #0
RS			First OFDM symbol in		$I_0 = 13$
CSI-RS periodicity   Slots   20		Resource set #4			
CSI-RS offset   Slots   0   TCI state #1					
Type 1 QCL info					
Type 1 QCL   Information   CSI-RS resource   CSI-RS resource 1 from 'CSI-RS for tracking Resource set #1' configuration   Type A				Slots	<u> </u>
Type 1 QCL   Information   CSI-RS resource   CSI-RS resource   CSI-RS resource   CSI-RS resource   Type A			QCL info		
Information		Type 1 OCI			
Configuration   QCL Type   Type A	TCI state #0		CSI-RS resource		
Type 2 QCL   Information   CSI-RS resource   N/A					
Information   CSI-RS resource   N/A			QCL Type		
Total configuration   Color configuration			CSI-RS resource		N/A
Type 1 QCL   Information   CSI-RS resource   CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2'   Configuration   Type 2 QCL   Information   CSI-RS resource   Type A   N/A      Type 1 QCL   Information   CSI-RS resource   Type A   N/A      Type 1 QCL   Information   SSB index   SSB #0      Type 2 QCL   SSB index   Type C   N/A      Type 3 QCL   Type   Type C   Type		ıntormation			N/*
TCI state #1   Type 1 QCL   Information   CSI-RS resource   CSI-RS resource   tracking Resource set #2'   Configuration   Type A			QCL Type		
Information   CSI-RS resource   CSI-RS resourc	TCI atota #4	Type 1 QCL	CCL DC reserves		
QCL Type   Type A	TOT State #1		COI-KO resource		
Type 2 QCL   Information   CSI-RS resource   N/A			OCL Type		
Information   CSI-RS resource		Type 2 OCI			
Type 1 QCL   SSB index   SSB #0			CSI-RS resource		1.97.1
SSB Index   SSB Index   Type C   Type 2 QCL   SSB Index   N/A   SSB Index   Type C   N/A   SSB Index   Type C   Type 2 QCL   SSB Index   Type C			QCL Type		
	TCI state #2		SSB index		SSB #0
Type 2 QCL SSR index N/A	. Of State #2	information			
		<b>T</b>	QCL Type		
Intermation			SSB index		N/A
		Intormation	<del></del>		

		QCL Type	N/A
TCI state #3	Type 1 QCL information	SSB index	SSB #1
		QCL Type	Type C
	Type 2 QCL information	SSB index	N/A
		QCL Type	N/A
Number of HARQ Processes			4
The number of slots between PDSCH and corresponding HARQ-ACK information			2

Note 1: SSB # (k mod 2) is transmitted by kth RRH.

For Test 1-1, TCl state switching command scheduled by MAC CE with MCS 4 is transmitted in slot #i that satisfy mod(i, 2n) = n. PDCCH and PDSCH associated with TCl # (k mod 2) is transmitted by k<sup>th</sup> RRH from slot#  $max[(2k-1)n+1+T_{HARQ}+T_{MAC\,proc}+T_{firstTRS}+T_{TRS\,proc},0]$ 

to slot#

$$(2k + 1)n + T_{HARO} + T_{MAC proc}$$

PDCCH and PDSCH are DTXed in other slots in which throughput statistics are not considered. For Test 1-2, TCI state switching command scheduled by MAC CE with MCS 4 is transmitted in slot #i that satisfy mod(i, 2n) = n. PDCCH and PDSCH associated with TCI # (k mod 2) is transmitted by k<sup>th</sup> RRH from slot#

 $\max[(2k-1)n + 1 + T_{HARO} + T_{MAC proc}, 0]$ 

to slot#

$$(2k + 1)n + T_{HARQ} + T_{MAC proc}$$

Where k=0, 1, 2... is the RRH number, n = 2520 is half of the number of slots between two RRH,  $T_{HARQ}$  = 2 is the number of slots between PDSCH and corresponding HARQ-ACK information,  $T_{MAC\;proc}$  = 3 is the number of slots for MAC CE processing,  $T_{firstTRS}$  = 6 is the number of slots to first TRS transmission occasion after MAC CE command is decoded by the UE,  $T_{TRS\;proc}$  = 2 is the number of slots for TRS processing.

Table 5.2.2.1.10-3: Minimum performance for HST DPS

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

#### 5.2.2.2 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, 1-10, 1-11, 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	(		1
PDSCH configuration	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		Specific to each Reference channel
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		4 for Tests 1-1, 1-8, 1-9 2 for other tests
	Resource allocation type		Test 1-2: Type 1 with start RB = 50, LRBs = 6 Other tests: Type 0
	RBG size		Test 1-2: N/A
	VDD to DDD manning true		Other tests: Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS configuration	DMRS Type		Type 1
-	Number of additional DMRS		2 for Tests 1-1, 1-7, 1-8, 1-9, 1-10, 1- 11 1 for other tests
	Maximum number of OFDM symbols for DL front loaded DMRS		1
CSI-RS for tracking	First OFDM symbol in the PRB used for CSI-RS		Tests 1-8, 1-9: $l_0 = 4$ 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, 1-10, 1-11: 20 for CSI-RS resource 1,2,3,4.
	CSI-RS offset	Slots	Other tests: Table 5.2-1.  Test 1-7, 1-10, 1-11: 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4.  Other tests: Table 5.2-1.
	Frequency Occupation		Test 1-7, 1-10, 1-11: Start PRB 0 Number of PRB = 52 Other tests: Table 5.2-1.
Number of HARQ Pro	ocesses		16 for Test 1-4 10 for Test 1-9 8 for other tests
The number of slots I 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	/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- 1.1 TDD	40 / 30	QPSK, 0.30	FR1.30- 1A	TDLB100- 400	2x2, ULA Low	70	-1.1
1-2	R.PDSCH.2- 1.2 TDD	40 / 30	QPSK, 0.30	FR1.30-1	TDLC300- 100	2x2, ULA Low	70	0.2
1-3	R.PDSCH.2- 4.1 TDD	40 / 30	256QAM, 0.82	FR1.30-1	TDLA30-10	2x2, ULA Low	70	25.3
1-4	R.PDSCH.2- 2.1 TDD	40 / 30	16QAM, 0.48	FR1.30-1	TDLC300- 100	2x2, ULA Low	30	1.6
1-5	R.PDSCH.2- 5.1 TDD	40 / 30	QPSK, 0.30	FR1.30-2	TDLA30-10	2x2, ULA Low	70	-0.9
1-6	R.PDSCH.2- 6.1 TDD	40 / 30	QPSK, 0.30	FR1.30-3	TDLA30-10	2x2, ULA Low	70	-0.8
1-7	R.PDSCH.2- 10.1 TDD	40 / 30	16QAM, 0.48	FR1.30-1	HST-1000	1x2	70	6.4
1-8	R.PDSCH.2- 11.1 TDD	40 / 30	QPSK, 0.30	FR1.30-5	TDLB100- 400	2x2, ULA Low	70	-1.0
1-9	R.PDSCH.2- 12.1 TDD	40 / 30	QPSK, 0.30	FR1.30-6	TDLB100- 400	2x2, ULA Low	70	-1.1
1-10	R.PDSCH.2- 10.2 TDD	40 / 30	16QAM, 0.48	FR1.30-1	TDLC300- 1200	2x2	70	[9.5]
1-11	R.PDSCH.2- 10.3 TDD	40 / 30	64QAM, 0.43	FR1.30-1	HST-1667	1x2	70	[9.6]

Table 5.2.2.2.1-4: Minimum performance for Rank 2

		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)	
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	<b>NA</b> . <b>1</b> 1 . 4	TDD !!!		Correlation	Reference	value
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	TDD UL- DL pattern	Propagation condition	1	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
PDSCH configuration	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		Specific to each Reference channel
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS configuration	DMRS Type		Type 1
	Number of additional DMRS		1
	Maximum number of OFDM symbols for DL front loaded DMRS		1
NZP CSI-RS for CSI acquisition	OFDM symbols in the PRB used for CSI-RS		l <sub>0</sub> = 13
	CSI-RS periodicity	Slots	5
ZP CSI-RS for CSI acquisition	Subcarrier index in the PRB used for CSI-RS		$(k_0, k_1, k_2, k_3)=(2, 4, 6, 8)$
·	Number of CSI-RS ports (X)		8
	CSI-RS periodicity	Slots	5
Number of HARQ Pr			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		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 5.2.2.3-1: Tests purpose

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

#### Table 5.2.2.2.3-2: Test parameters

	Parameter	Unit	Value
Duplex mode			TDD
Active DL BWP inde	ex		1
PDSCH configuration	Mapping type		Туре В
	k0		0
	Starting symbol (S)		5
	Length (L)		7
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS configuration	DMRS Type		Type 1
-	Number of additional DMRS		1
	Maximum number of OFDM symbols for DL front loaded DMRS		1
Number of HARQ 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 5.2.2.3-3: Minimum performance for Rank 1

		Bandwidth (MHz)/	Modulation	TDD		gation matrix and Fraction of ition antenna maximum	Reference value		
Test num.	Reference channel	Subcarrier spacing (kHz)	format and code rate	UL-DL pattern	Propagation condition		throughput	SNR (dB)	
1-1	R.PDSCH.2- 1.3 TDD	40 / 30	QPSK, 0.30	FR1.30- 1	TDLA30-10	2x2, ULA Low	70	-0.9	

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

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

The test purposes are specified in Table 5.2.2.2.4-1.

Table 5.2.2.4-1: 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 5.2.2.4-2: Test parameters

	Parameter	Unit	Value		
Duplex mode			TDD		
Active DL BWP index	(		1		
NR UL transmission	with a 7.5 kHz shift to the LTE raster		true		
PDSCH	Mapping type		Type A		
configuration					
	k0		0		
	Starting symbol (S)		3		
	Length (L)		9 for Test 1-1		
			11 for Test 1-2		
	PDSCH aggregation factor		1		
	PRB bundling type		Static		
	PRB bundling size		2		
	Resource allocation type		Type 0		
	RBG size		Config2		
	VRB-to-PRB mapping type		Non-interleaved		
	VRB-to-PRB mapping interleaver bundle		N/A		
	size				
PDSCH DMRS	DMRS Type		Type 1		
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	LTE carrier centre subcarrier location		Same as NR carrier centre subcarrier		
matching (Note 1)			location		
	LTE carrier BW	MHz	10		
	Number of antenna ports		4		
	v-shift		0		
Number of HARQ Processes			8		
	between PDSCH and corresponding HARQ-		Specific to each TDD UL-DL pattern		
ACK information			and as defined in Annex A.1.2		
Note 1: No MBSFI	N is configured on LTE carrier				

Table 5.2.2.4-3: Minimum performance for Rank 1

		Bandwidth		Mark today   TDD III		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.1- 1.1 TDD	10 / 15	QPSK, 0.30	FR1.15-1	TDLA30-10	4x2, ULA Low	70	-0.8
1-2	R.PDSCH.1- 1.2 TDD	10 / 15	QPSK, 0.30	FR1.15-1	TDLA30-10	4x2, ULA Low	70	-0.8

# 5.2.2.2.5 Minimum requirements for PDSCH 0.001% BLER

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

The test purposes are specified in Table 5.2.2.2.5-1.

Table 5.2.2.2.5-1: Tests purpose

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

Table 5.2.2.5-2: Test parameters

	Parameter	Unit	Value	
Duplex mode			TDD	
Active DL BWP index	X		1	
PDSCH	Mapping type		Type A	
configuration			·	
	k0		0	
	Starting symbol (S)		2	
	Length (L)		12	
	PDSCH aggregation factor		1	
	PRB bundling type		Static	
	PRB bundling size		2	
	Resource allocation type		Type 0	
	RBG size		Config2	
	VRB-to-PRB mapping type		Non-interleaved	
	VRB-to-PRB mapping interleaver bundle		N/A	
	size			
PDSCH DMRS	DMRS Type		Type 1	
configuration				
	Number of additional DMRS		1	
	Maximum number of OFDM symbols for		1	
	DL front loaded DMRS			
Maximum number of	HARQ transmission		1	
Number of HARQ Pr	ocesses		8	
The number of slots ACK information	between PDSCH and corresponding HARQ-		Defined in Annex A.1.2 for TDD pattern FR1.30-1	

Table 5.2.2.2.5-3: Minimum performance for Rank 1

Test num.	Reference (MHz) /	Bandwidth (MHz) /	Modulation	TDD UL-DL	Propagation	Correlation matrix and antenna configuration	Reference value	
		channel Subcarrier for spacing co	format and code rate	-	Propagation condition		Target BLER	SNR (dB)
1-1	R.PDSCH.2-1.4 TDD	40 / 30	QPSK, 0.59	FR1.30-1	AWGN	1x2, ULA Low	0.001%	[3.3]

# 5.2.2.2.6 Minimum requirements for PDSCH repetitions over multiple slots

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

The test purposes are specified in Table 5.2.2.2.6-1.

Table 5.2.2.2.6-1: Tests purpose

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

Table 5.2.2.2.6-2: Test parameters

	Parameter	Unit	Value
Duplex mode			TDD
Active DL BWP index	X		1
PDSCH	Mapping type		Type A
configuration			
	k0		0
	Starting symbol (S)		2
	Length (L)		12
	PDSCH aggregation factor		2
	PRB bundling type		Static
	PRB bundling size Resource allocation type		2
			Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle		N/A
	size		
PDSCH DMRS	DMRS Type		Type 1
configuration			
	Number of additional DMRS		1
	Maximum number of OFDM symbols for		1
	DL front loaded DMRS		
Number of HARQ Pr	lumber of HARQ Processes		4
	between PDSCH and corresponding HARQ-		TBD
ACK information			

Table 5.2.2.2.6-3: Minimum performance for Rank 1

Toot	Deference	Bandwidth (MHz) /	Modulation	TDD III DI	Dranagation	Correlation	Reference va	lue
Test num.	Reference channel	Subcarrier spacing (kHz) format and code rate	TDD UL-DL Propagation condition		matrix and antenna configuration	Target BLER	SNR (dB)	
1-1	R.PDSCH.1-16.1 TDD	40 / 30	16QAM, 0.54	FR1.30-1	TDLA30-10	2x2, ULA Low	1% (Note 1)	TBD

Note 1: BLER is defined as residual BLER; i.e. ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block.

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

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

The test purposes are specified in Table 5.2.2.2.7-1.

Table 5.2.2.2.7-1: Tests purpose

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

Table 5.2.2.2.7-2: Test parameters

	Parameter	Unit	Value
Duplex mode			TDD
Active DL BWP index	X		1
PDSCH	Mapping type		Type B
configuration			
	k0		0
	Starting symbol (S)		2
	Length (L)		2
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle		N/A
	size		
PDSCH DMRS	DMRS Type		Type 1
configuration			
	Number of additional DMRS		0
	Maximum number of OFDM symbols for		1
	DL front loaded DMRS		
Maximum number of	HARQ transmission		1
Number of HARQ Pr	ocesses		2
The number of slots ACK information	between PDSCH and corresponding HARQ-		0

Table 5.2.2.2.7-3: 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	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1- 17.1 TDD	40 / 30	QPSK, 0.30	FR1.30- 2	TDLA30-10	2x2, ULA Low	70	[0.7]

# 5.2.2.2.8 Minimum requirements for PDSCH pre-emption

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

The test purposes are specified in Table 5.2.2.2.8-1.

Table 5.2.2.2.8-1: Tests purpose

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

Table 5.2.2.2.8-2: Test parameters

	Parameter	Unit	Value
Duplex mode			TDD
Active DL BWP index	(		1
PDCCH	Symbols with PDCCH		0, 1
configuration (Note	DCI format		2_1
4)	timeFrequencySet		14x1
	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 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
Pre-emption	Starting symbol (S)		3
configuration (Note	Length (L)		2
1, 2)	Pre-emption periodicity and offset (Note 3)		TBD 10/1 or (10,11)/1
Number of HARQ Pro			8
ACK information	between PDSCH and corresponding HARQ-		FR1.30-1

Note 1: If UE cannot decode PDSCH correctly upon receiving PI on PDCCH with DCI format 2\_1, UE feeds back NACK to gNB. Then UE flushes the buffer and waits for the next re-transmission for LLR combining to decode the PDSCH.

Note 2: Interference modelled as random data on pre-empted REs.

Note 3: Pre-emption is scheduled with a fixed scheduling with 10 or 20% probability within 10ms periodicity.

Note 4: In addition to PDCCH configuration in Table 5.2-1.

Table 5.2.2.2.6-3: Minimum performance for Rank 1

		Bandwidth (MHz) /	Madulation			.tion		Correlation	Reference	value
Test num.	Reference channel	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.x TDD	40 / 30	TBD	FR1.30-1	TDLA30-10	2x2, ULA Low	TBD	TBD		

## 5.2.2.2.9 Minimum requirements for HST-SFN

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

The test purposes are specified in Table 5.2.2.2.9-1.

Table 5.2.2.2.9-1: Tests purpose

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

Table 5.2.2.9-2: 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)		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		2
configuration	Maximum number of OFDM symbols for		1
	DL front loaded DMRS		
	CSI-RS periodicity	Slots	20 for CSI-RS resource 1,2,3,4.
CSI-RS for tracking	CSI-RS offset	Slots	1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4.
	Frequency Occupation		Start PRB 0 Number of PRB = 52
Number of HARQ Pro	ocesses		8
	between PDSCH and corresponding HARQ-		Specific to each TDD UL-DL pattern
ACK information			and as defined in Annex A.1.2

Table 5.2.2.2.9-3: Minimum performance for Rank 2

		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)	
1-1	R.PDSCH.2- 10.4 TDD	40 / 30	16QAM, 0.48	FR1.30-1	HST-SFN	2x2	70	[14.2]	

# 5.2.2.2.10 Minimum requirements for HST DPS

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

The test purposes are specified in Table 5.2.2.2.10-1.

Table 5.2.2.2.10-1: Tests purpose

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

Table 5.2.3.2.10-2: Test parameters

	Parameter		Unit	Value
Duplex mode				TDD
Active DL BWP index				1
PDCCH configuration	TCI state			Note 1
	Mapping type			Type A
	k0			0
	Starting symbol (S)			2
	Length (L)			Specific to each Reference channel
	PDSCH aggregation			1
PDSCH configuration	PRB bundling type			Static
1 Door comigaration	PRB bundling size			2
	Resource allocatio	n type		Type 0
	RBG size			Config2
	VRB-to-PRB mapp			Non-interleaved
		ing interleaver bundle size		N/A
	TCI state			Note 1
PDSCH DMRS	DMRS Type	al DMDC		Type 1
configuration	Number of addition	of OFDM symbols for DL		2
Corniguration	front loaded DMRS			1
	TOTA TOURS	First OFDM symbol in the		$I_0 = 5$ for CSI-RS resource 1 and 3
		PRB used for CSI-RS		$l_0 = 9$ for CSI-RS resource 2 and 4
		CSI-RS periodicity	Slots	20 for CSI-RS resource 1,2,3,4
				1 for CSI-RS resource 1 and 2
	Resource set #1	CSI-RS offset	Slots	2 for CSI-RS resource 3 and 4
		QCL info		TCI state #2
				Start PRB 0
CCI DC for trooting		Frequency Occupation		Number of PRB = 52
CSI-RS for tracking		First OFDM symbol in the		l <sub>0</sub> = 6 for CSI-RS resource 5 and 6
		PRB used for CSI-RS		l <sub>0</sub> = 10 for CSI-RS resource 7 and 8
	Resource set #2	CSI-RS periodicity	Slots	20 for CSI-RS resource 5,6,7,8.
		CSI-RS offset	Slots	1 for CSI-RS resource 5 and 6
			51013	2 for CSI-RS resource 7 and 8
		QCL info		TCI state #3
		Frequency Occupation		Start PRB 0
				Number of PRB = 52
		First OFDM symbol in the		$I_0 = 12$
	D + #0	PRB used for CSI-RS	Class	40
	Resource set #3	CSI-RS periodicity CSI-RS offset	Slots Slots	40 0
NZP CSI-RS for CSI		QCL info	31015	TCI state #0
acquisition		First OFDM symbol in the		
acquisition		PRB used for CSI-RS		10 = 13
	Resource set #4	CSI-RS periodicity	Slots	40
	Trooburoo oot ii 1	CSI-RS offset	Slots	0
		QCL info		TCI state #1
				CSI-RS resource 1 from 'CSI-RS
	Type 1 QCL	CSI-RS resource		for tracking Resource set #1'
			i	configuration
I TCI stata #0	information			
TCI state #0		QCL Type		Type A
TCI state #0	Type 2 QCL	CSI-RS resource		Type A N/A
TCI state #0				Type A N/A N/A
TCI state #0	Type 2 QCL information	CSI-RS resource QCL Type		Type A N/A N/A CSI-RS resource 5 from 'CSI-RS
TCI state #0	Type 2 QCL information  Type 1 QCL	CSI-RS resource		Type A N/A N/A CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2'
TCI state #0  TCI state #1	Type 2 QCL information	CSI-RS resource QCL Type CSI-RS resource		Type A N/A N/A N/A CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration
	Type 2 QCL information  Type 1 QCL information	CSI-RS resource QCL Type CSI-RS resource QCL Type		Type A N/A N/A N/A CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration Type A
	Type 2 QCL information  Type 1 QCL information  Type 2 QCL	CSI-RS resource  QCL Type  CSI-RS resource  QCL Type  CSI-RS resource		Type A N/A N/A N/A CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration Type A N/A
	Type 2 QCL information  Type 1 QCL information  Type 2 QCL information	CSI-RS resource  QCL Type  CSI-RS resource  QCL Type  CSI-RS resource  QCL Type  QCL Type		Type A N/A N/A N/A CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration Type A N/A N/A
TCI state #1	Type 2 QCL information  Type 1 QCL information  Type 2 QCL information  Type 1 QCL	CSI-RS resource QCL Type CSI-RS resource QCL Type CSI-RS resource QCL Type SSB index		Type A N/A N/A N/A CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration Type A N/A N/A SSB #0
	Type 2 QCL information  Type 1 QCL information  Type 2 QCL information  Type 1 QCL information	CSI-RS resource QCL Type  CSI-RS resource  QCL Type  CSI-RS resource  QCL Type  SSB index  QCL Type		Type A N/A N/A N/A CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration Type A N/A N/A SSB #0 Type C
TCI state #1	Type 2 QCL information  Type 1 QCL information  Type 2 QCL information  Type 1 QCL information  Type 2 QCL information  Type 2 QCL	CSI-RS resource QCL Type  CSI-RS resource  QCL Type  CSI-RS resource  QCL Type  SSB index  QCL Type  SSB index		Type A N/A N/A N/A CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration Type A N/A N/A SSB #0 Type C N/A
TCI state #1	Type 2 QCL information  Type 1 QCL information  Type 2 QCL information  Type 1 QCL information  Type 2 QCL information  Type 2 QCL information	CSI-RS resource QCL Type  CSI-RS resource  QCL Type  CSI-RS resource  QCL Type  SSB index  QCL Type  SSB index  QCL Type  SSB index  QCL Type		Type A N/A N/A N/A CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration Type A N/A N/A SSB #0 Type C N/A N/A
TCI state #1  TCI state #2	Type 2 QCL information  Type 1 QCL information  Type 2 QCL information  Type 1 QCL information  Type 2 QCL information  Type 2 QCL	CSI-RS resource QCL Type  CSI-RS resource  QCL Type  CSI-RS resource  QCL Type  SSB index  QCL Type  SSB index		Type A N/A N/A N/A CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration Type A N/A N/A SSB #0 Type C N/A
TCI state #1	Type 2 QCL information  Type 1 QCL information  Type 2 QCL information  Type 1 QCL information  Type 2 QCL information  Type 2 QCL information  Type 1 QCL information  Type 1 QCL	CSI-RS resource QCL Type  CSI-RS resource  QCL Type  CSI-RS resource  QCL Type  SSB index		Type A N/A N/A N/A CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration Type A N/A N/A SSB #0 Type C N/A N/A SSB #1
TCI state #1  TCI state #2	Type 2 QCL information  Type 1 QCL information  Type 2 QCL information  Type 1 QCL information  Type 2 QCL information  Type 2 QCL information  Type 1 QCL information	CSI-RS resource QCL Type  CSI-RS resource  QCL Type  CSI-RS resource  QCL Type  SSB index  QCL Type		Type A N/A N/A N/A CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration Type A N/A N/A SSB #0 Type C N/A N/A SSB #1 Type C

Number of HARQ Processes	8
The number of slots between PDSCH and corresponding HARQ-ACK	Specific to each TDD UL-DL pattern
information	and as defined in Annex A.1.2

Note 1: SSB # (k mod 2) is transmitted by kth RRH.

For Test 1-1, TCI state switching command scheduled by MAC CE with MCS 4 is transmitted in slot #i that satisfy mod(i, 2n) = n. PDCCH and PDSCH associated with TCI # (k mod 2) is transmitted by k<sup>th</sup> RRH from slot#  $max[(2k-1)n+1+T_{HARO}+T_{MAC\ proc}+T_{firstTRS}+T_{TRS\ proc},0]$ 

to clot#

$$(2k + 1)n + T_{HARQ} + T_{MAC proc}$$

PDCCH and PDSCH are DTXed in other slots in which throughput statistics are not considered. For Test 1-2, TCl state switching command scheduled by MAC CE with MCS 4 is transmitted in slot #i that satisfy mod(i, 2n) = n. PDCCH and PDSCH associated with TCl # (k mod 2) is transmitted by k<sup>th</sup> RRH from slot#  $max[(2k-1)n + 1 + T_{HARO} + T_{MAC\ DTOC}, 0]$ 

to slot#

$$(2k+1)n + T_{HARQ} + T_{MAC proc}$$

Where k=0, 1, 2... is the RRH number, n = 5040 is half of the number of slots between two RRH,  $T_{HARQ}$  = 8 is the number of slots between PDSCH and corresponding HARQ-ACK information,  $T_{MAC\ proc}$  = 6 is the number of slots for MAC CE processing,  $T_{firstTRS}$  = 7 is the number of slots to first TRS transmission occasion after MAC CE command is decoded by the UE,  $T_{TRS\ proc}$  = 4 is the number of slots for TRS processing.

Table 5.2.2.2.10-3: Minimum performance for HST DPS

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

# 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	1-1, 1-2, 1-3, 1-5, 1-6, 1-7, 2-1, 2-2, 3-1, 4-1
under 4 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 5.2.3.1.1-2: 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
	PRB bundling type		Static
PDSCH	PRB bundling size		4 for Test 1-1 WB for Test 3-1 2 for other tests
configuration	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, 1-6, 1-7 1 for other tests
configuration	Maximum number of OFDM symbols for DL front loaded DMRS		1
	CSI-RS periodicity	Slots	Test 1-5, 1-6, 1-7: 10 for CSI-RS resource 1,2,3,4.
			Other tests: Table 5.2-1.
CSI-RS for tracking	CSI-RS offset	Slots	Test 1-5, 1-6, 1-7: 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4.
			Other tests: Table 5.2-1.
Number of HARQ Pro	Number of HARQ Processes		8 for Test 1-4, 2-1 4 for other tests
The number of slots I ACK information	petween PDSCH and corresponding HARQ-		2

Table 5.2.3.1.1-3: Minimum performance for Rank 1

		Bandwidth			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.1-1.1 FDD	10 / 15	QPSK, 0.30	TDLB100-400	2x4, ULA Low	70	-3.5
1-2	R.PDSCH.1-1.2 FDD	10 / 15	QPSK, 0.30	TDLC300-100	2x4, ULA Low	70	-2.9
1-3	R.PDSCH.1-4.1 FDD	10 / 15	256QAM, 0.82	TDLA30-10	2x4, ULA Low	70	21.0
1-4	R.PDSCH.1-2.1 FDD	10 / 15	16QAM, 0.48	TDLC300-100	2x4, ULA Low	30	-1.5
1-5	R.PDSCH.1-8.1 FDD	10 / 15	16QAM, 0.48	HST-750	1x4	70	3.3
1-6	R.PDSCH.1-8.2 FDD	10 / 15	64QAM, 0.43	HST-972	1x4	70	[6.8]
1-7	R.PDSCH.1-8.1 FDD	10 / 15	16QAM, 0.48	TDLC300-600	2x4	70	[5.8]

Table 5.2.3.1.1-4: Minimum performance for Rank 2

		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)
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	Mandadatian	Andulada.		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)	
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			Correlation	Reference v	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		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 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
NZP CSI-RS for	OFDM symbols in the PRB used for CSI-RS		I <sub>0</sub> = 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 Pro	ocesses		4
The number of slots I ACK information	petween 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	llue
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 P	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	M. I. I. di		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	2x4, ULA Low	70	-3.8

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

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

The test purposes are specified in Table 5.2.3.1.4-1.

Table 5.2.3.1.4-1: Tests purpose

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

Table 5.2.3.1.4-2: Test parameters

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	<u> </u>	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		Number of antenna ports		4
The number of slots between PDSCH and corresponding HARQ-ACK information		•		0
ACK information	Number of HARQ Processes			4
Note 1. No MDCFN is configured on LTC corrier	The number of slots 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 5.2.3.1.4-3: Minimum performance for Rank 1

		Bandwidth (MHz) /	Madaladan		Correlation		lue
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

## 5.2.3.1.5 Minimum requirements for PDSCH 0.001% BLER

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

The test purposes are specified in Table 5.2.3.1.5-1.

Table 5.2.3.1.5-1: Tests purpose

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

Table 5.2.3.1.5-2: Test parameters

	Parameter	Unit	Value
Duplex mode			FDD
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		·
	DMRS Type		Type 1
PDSCH DMRS	Number of additional DMRS		1
configuration	Maximum number of OFDM symbols for		1
DL front loaded DMRS			!
Maximum number of HARQ transmission			1
Number of HARQ Processes			4
The number of slots between PDSCH and corresponding HARQ-ACK information			2

Table 5.2.3.1.5-3: Minimum performance for Rank 1

Tool	Deference	Bandwidth (MHz) /	Modulation	Dranagation	Correlation	Reference va	lue
Test num.	Reference channel	Subcarrier spacing (kHz)	format and code rate	Propagation condition	matrix and antenna configuration	Target BLER	SNR (dB)
1-1	R.PDSCH.1-1.4 FDD	10 / 15	QPSK, 0.59	AWGN	1x4, ULA Low	0.001%	[0.6]

# 5.2.3.1.6 Minimum requirements for PDSCH repetitions over multiple slots

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

The test purposes are specified in Table 5.2.3.1.6-1.

Table 5.2.3.1.6-1: Tests purpose

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

Table 5.2.3.1.6-2: Test parameters

	Parameter	Unit	Value
Duplex mode			FDD
Active DL BWP inde	X		1
	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		12
	PDSCH aggregation factor		2
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 Pr	ocesses		4
The number of slots ACK information	between PDSCH and corresponding HARQ-		TBD

Table 5.2.3.1.6-3: Minimum performance for Rank 1

Tool	Deference	Bandwidth (MHz) /	Modulation	Duamanation	Correlation	Reference va	lue
Test num.	Reference channel	Subcarrier spacing (kHz)	format and code rate	Propagation condition	matrix and antenna configuration	Target BLER	SNR (dB)
1-1	R.PDSCH.1-11.1 FDD	10 / 15	16QAM, 0.54	TDLA30-10	2x4, ULA Low	1% (Note 1)	TBD

Note 1: BLER is defined as residual BLER; i.e. ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block.

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

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

The test purposes are specified in Table 5.2.3.1.7-1.

Table 5.2.3.1.7-1: Tests purpose

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

Table 5.2.3.1.7-2: Test parameters

	Parameter	Unit	Value
Duplex mode			FDD
Active DL BWP index	x		1
	Mapping type		Type B
	k0		0
	Starting symbol (S)		2
	Length (L)		2
	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		IV/A
	DMRS Type		Type 1
PDSCH DMRS	Number of additional DMRS		0
configuration	Maximum number of OFDM symbols for		1
	DL front loaded DMRS		ľ
Maximum number of	HARQ transmission		1
Number of HARQ Processes			2
The number of slots between PDSCH and corresponding HARQ-ACK information			0

Table 5.2.3.1.7-3: Minimum performance for Rank 1

		Bandwidth	M. I. I. di		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.1-12.1 FDD	10 / 15	QPSK, 0.30	TDLA30-10	2x4, ULA Low	70	[- 2.0]

# 5.2.3.1.8 Minimum requirements for PDSCH pre-emption

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

The test purposes are specified in Table 5.2.3.1.8-1.

Table 5.2.3.1.8-1: Tests purpose

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

Table 5.2.3.1.8-2: Test parameters

Parameter			Value
Duplex mode			FDD
Active DL BWP index			1
PDCCH	Symbols with PDCCH		0, 1
configuration (Note	DCI format		2_1
4)	timeFrequencySet		14x1
	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 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
Pre-emption	Starting symbol (S)		3
configuration (Note	Length (L)		2
1, 2)	Pre-emption periodicity and offset (Note 3)		TBD 10/1 or (10,11)/1
Number of HARQ Pro	Number of HARQ Processes		4
The number of slots between PDSCH and corresponding HARQ-ACK information			2
Note 1: If LIE cann	ot decode PDSCH correctly upon receiving PL	on PDCCI	with DCI format 2 1 LIE feeds back

Note 1: If UE cannot decode PDSCH correctly upon receiving PI on PDCCH with DCI format 2\_1, UE feeds back NACK to gNB. Then UE flushes the buffer and waits for the next re-transmission for LLR combining to decode the PDSCH.

Note 2: Interference modelled as random data on pre-empted REs.

Note 3: Pre-emption is scheduled with a fixed scheduling with 10 or 20% probability within 10ms periodicity.

Note 4: In addition to PDCCH configuration in Table 5.2-1.

Table 5.2.3.1.8-3: Minimum performance for Rank 1

		Bandwidth (MHz) /	Madulation		Correlation	Reference va	lue
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.x FDD	10 / 15	TBD	TDLA30-10	2x4, ULA Low	TBD	TBD

## 5.2.3.1.9 Minimum requirements for PDSCH HST-SFN

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

The test purposes are specified in Table 5.2.3.1.9-1.

Table 5.2.3.1.9-1: Tests purpose

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

Table 5.2.3.1.9-2: 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
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	<del>                                     </del>	Tuna 4
DD0011 D14D0	DMRS Type	<u> </u>	Type 1
PDSCH DMRS	Number of additional DMRS		2
configuration	Maximum number of OFDM symbols for DL front loaded DMRS		1
	CSI-RS periodicity	Slots	10 for CSI-RS resource 1,2,3,4.
CSI-RS for tracking	CSI-RS offset	Slots	1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4.
Number of HARQ Processes			4
The number of slots between PDSCH and corresponding HARQ-ACK information			2

Table 5.2.3.1.9-3: Minimum performance for Rank 2

		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.1-8.3 FDD	10 / 15	16QAM, 0.48	HST-SFN	2x4	70	10.4

# 5.2.3.1.10 Minimum requirements for HST DPS

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

The test purposes are specified in Table 5.2.3.1.10-1.

Table 5.2.3.1.10-1: Tests purpose

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

Table 5.2.3.1.10-2: Test parameters

	Parameter	Unit	Value	
Duplex mode			FDD	
Active DL BWP index	T		1	
PDCCH configuration	TCI state			Note 1
	Mapping type			Type A
	k0			0 2
	Starting symbol (S)			12
	Length (L) PDSCH aggregation	on factor		12
	PRB bundling type			Static
PDSCH configuration	PRB bundling size			2
	Resource allocatio	n type		Type 0
	RBG size	71		Config2
	VRB-to-PRB mapp	ing type		Non-interleaved
		ing interleaver bundle size		N/A
	TCI state			Note 1
	DMRS Type			Type 1
PDSCH DMRS	Number of addition			2
configuration	front loaded DMRS	of OFDM symbols for DL		1
		First OFDM symbol in		I <sub>0</sub> = 5 for CSI-RS resource 1 and 3
		the PRB used for CSI-		$I_0 = 9$ for CSI-RS resource 2 and 4
		RS : I' '	C:	40 ( 00) 50
	Resource set #1	CSI-RS periodicity	Slots	10 for CSI-RS resource 1,2,3,4. 1 for CSI-RS resource 1 and 2
		CSI-RS offset	Slots	2 for CSI-RS resource 1 and 2
		QCL info		TCI state #2
CSI-RS for tracking		First OFDM symbol in		l <sub>0</sub> = 6 for CSI-RS resource 5 and 6
		the PRB used for CSI-		$I_0 = 10$ for CSI-RS resource 7 and 8
	Resource set #2	RS		
		CSI-RS periodicity	Slots	10 for CSI-RS resource 5,6,7,8.
		CSI-RS offset	Slots	1 for CSI-RS resource 5 and 6
			01013	2 for CSI-RS resource 7 and 8
		QCL info First OFDM symbol in		TCI state #3
		the PRB used for CSI-		I <sub>0</sub> = 12
		RS		
	Resource set #3	CSI-RS periodicity	Slots	20
		CSI-RS offset	Slots	0
NZP CSI-RS for CSI		QCL info		TCI state #0
acquisition	Resource set #4	First OFDM symbol in		$I_0 = 13$
		the PRB used for CSI-		
		RS CSI-RS periodicity	Slots	20
		CSI-RS offset	Slots	0
		QCL info	01013	TCI state #1
				CSI-RS resource 1 from 'CSI-RS for
	Type 1 QCL	CSI-RS resource		tracking Resource set #1'
TCI state #0	information			configuration
1 OI SIGIE #U		QCL Type		Type A
	Type 2 QCL	CSI-RS resource		N/A
	information	QCL Type		N/A
	Type 1 OC	CSI-RS resource		CSI-RS resource 5 from 'CSI-RS for
TCI state #1	Type 1 QCL information	COLUCE 16200106		tracking Resource set #2' configuration
	ioimation	QCL Type		Type A
	Type 2 QCL	CSI-RS resource		N/A
	information	QCL Type		N/A
	Type 1 QCL	SSB index		SSB #0
TCI state #2	information	QCL Type		Type C
1 Of State #2	Type 2 QCL	SSB index		N/A
	information	QCL Type		N/A
	Type 1 QCL information	SSB index QCL Type		SSB #1
TCI state #3	Type 2 QCL	SSB index		Type C N/A
	information	QCL Type		N/A
L		1 ~~,,~~	·	1 1// 1

Number of HARQ Processes	4
The number of slots between PDSCH and corresponding HARQ-ACK	2
information	_

Note 1: SSB # (k mod 2) is transmitted by kth RRH.

For Test 1-1, TCI state switching command scheduled by MAC CE with MCS 4 is transmitted in slot #i that satisfy mod(i, 2n) = n. PDCCH and PDSCH associated with TCI # (k mod 2) is transmitted by k<sup>th</sup> RRH from slot#  $max[(2k-1)n+1+T_{HARO}+T_{MAC\ proc}+T_{firstTRS}+T_{TRS\ proc},0]$ 

to slot#

$$(2k + 1)n + T_{HARQ} + T_{MAC proc}$$

PDCCH and PDSCH are DTXed in other slots in which throughput statistics are not considered. For Test 1-2, TCl state switching command scheduled by MAC CE with MCS 4 is transmitted in slot #i that satisfy mod(i, 2n) = n. PDCCH and PDSCH associated with TCl # (k mod 2) is transmitted by k<sup>th</sup> RRH from slot#  $max[(2k-1)n+1+T_{HARO}+T_{MAC\ DTOC},0]$ 

to slot#

$$(2k+1)n + T_{HARQ} + T_{MAC proc}$$

Where k=0, 1, 2... is the RRH number, n = 2520 is half of the number of slots between two RRH,  $T_{HARQ}$  = 2 is the number of slots between PDSCH and corresponding HARQ-ACK information,  $T_{MAC\ proc}$  = 3 is the number of slots for MAC CE processing,  $T_{firstTRS}$  = 6 is the number of slots to first TRS transmission occasion after MAC CE command is decoded by the UE,  $T_{TRS\ proc}$  = 2 is the number of slots for TRS processing.

Table 5.2.3.1.10-3: Minimum performance for HST DPS

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

#### 5.2.3.2 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, 1-10, 1-11, 2-1, 2-2,
under4 receive antenna conditions and with different	3-1, 4-1
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, LRBs = 6 Other tests: Type 0
	RBG size		Test 1-2: N/A Other tests: Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
	DMRS Type		Type 1
PDSCH DMRS	Number of additional DMRS		2 for Tests 1-1, 1-7, 1-8, 1-9, 1-10, 1- 11
configuration			1 for other tests
	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 <sub>0</sub> = 4 for CSI-RS resource 1 and 3 l <sub>0</sub> = 8 for CSI-RS resource 2 and 4
			Other tests; Table 5.2-1.
	CSI-RS periodicity	Slots	Test 1-7, 1-10, 1-11: 20 for CSI-RS resource 1,2,3,4.
			Other tests: Table 5.2-1.
CSI-RS for tracking	CSI-RS offset	Slots	Test 1-7, 1-10, 1-11: 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4.
			Other tests: Table 5.2-1.
	Frequency Occupation		Test 1-7, 1-10, 1-11: Start PRB 0 Number of PRB = 52
			Other tests: Table 5.2-1.
Number of HARQ Pro	ocesses		16 for Test 1-4 10 for Test 1-9 8 for other tests
The number of slots I ACK information	petween PDSCH and corresponding HARQ-		Specific to each TDD UL-DL pattern and as defined in Annex A.1.2

Table 5.2.3.2.1-3: Minimum performance for Rank 1

		Bandwidth		<b>TDD</b> 111		Correlation	Reference v	/alue
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	TDD UL- DL pattern	Propagati on condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SN R (dB)
1-1	R.PDSCH.2- 1.1 TDD	40 / 30	QPSK, 0.30	FR1.30- 1A	TDLB100- 400	2x4, ULA Low	70	-4.1
1-2	R.PDSCH.2- 1.2 TDD	40 / 30	QPSK, 0.30	FR1.30-1	TDLC300- 100	2x4, ULA Low	70	-2.7
1-3	R.PDSCH.2- 4.1 TDD	40 / 30	256QAM, 0.82	FR1.30-1	TDLA30-10	2x4, ULA Low	70	21.6
1-4	R.PDSCH.2- 2.1 TDD	40 / 30	16QAM, 0.48	FR1.30-1	TDLC300- 100	2x4, ULA Low	30	-1.2
1-5	R.PDSCH.2- 5.1 TDD	40 / 30	QPSK, 0.30	FR1.30-2	TDLA30-10	2x4, ULA Low	70	-3.8
1-6	R.PDSCH.2- 6.1 TDD	40 / 30	QPSK, 0.30	FR1.30-3	TDLA30-10	2x4, ULA Low	70	-3.6
1-7	R.PDSCH.2- 10.1 TDD	40 / 30	16QAM, 0.48	FR1.30-1	HST-1000	1x4	70	3.4
1-8	R.PDSCH.2- 11.1 TDD	40 / 30	QPSK, 0.30	FR1.30-5	TDLB100- 400	2x4, ULA Low	70	-4.0
1-9	R.PDSCH.2- 12.1 TDD	40 / 30	QPSK, 0.30	FR1.30-6	TDLB100- 400	2x4, ULA Low	70	-4.0
1-10	R.PDSCH.2- 10.2 TDD	40 / 30	16QAM, 0.48	FR1.30-1	TDLC300- 1200	2x4	70	[5.8]
1-11	R.PDSCH.2- 10.3 TDD	40 / 30	64QAM, 0.43	FR1.30-1	HST-1667	1x4	70	[6.8]

#### Table 5.2.3.2.1-4: Minimum performance for Rank 2

		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)
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	Madulation			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	Mandadatian	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)
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		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 under 4 receive antenna conditions and CSI-RS overlapped with PDSCH	1-1

Table 5.2.3.2.2-2: Test parameters

	Parameter	Unit	Value
Duplex mode			TDD
Active DL BWP index	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
Ü	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 <sub>0</sub> = 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 Pr	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 III	TDD III		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- 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	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 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 (MUS) / Madulation	Mandadatian	T00		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- 1.3 TDD	40 / 30	QPSK, 0.30	FR1.30- 1	TDLA30-10	2x4, ULA Low	70	-3.9

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

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

The test purposes are specified in Table 5.2.3.2.4-1.

Table 5.2.3.2.4-1: Tests purpose

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

Table 5.2.3.2.4-2: Test parameters

	Parameter	Unit	Value
Duplex mode			TDD
Active DL BWP index			1
NR UL transmission	with a 7.5 kHz shift to the LTE raster		true
	Mapping type		Type A
	k0		0
	Starting symbol (S)		3
	Length (L)		9 for Test 1-1 11 for Test 1-2
	PDSCH aggregation factor		1
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
DD00H DMD0	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 matching (Note 1)	LTE carrier BW	MHz	10
matching (Note 1)	Number of antenna ports		4
v-shift			0
Number of HARQ Processes			8
The number of slots between PDSCH and corresponding HARQ-ACK information			Specific to each TDD UL-DL pattern and as defined in Annex A.1.2
Note 1: No MBSFI	N is configured on LTE carrier	•	

Table 5.2.3.2.4-3: Minimum performance for Rank 1

		Bandwidth (MHz) / Madulation TDD III			Correlation		Reference value	
Test num.	Reference channel	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.1- 1.1 TDD	10 / 15	QPSK, 0.30	FR1.15-1	TDLA30-10	4x4, ULA Low	70	-3.6
1-2	R.PDSCH.1- 1.2 TDD	10 / 15	QPSK, 0.30	FR1.15-1	TDLA30-10	4x4, ULA Low	70	-3.5

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

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

The test purposes are specified in Table 5.2.3.2.5-1.

Table 5.2.3.2.5-1: Tests purpose

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

Table 5.2.3.2.5-2: 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)		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		IVA
	DMRS Type		Type 1
PDSCH DMRS	Number of additional DMRS		1
configuration	Maximum number of OFDM symbols for		1
DL front loaded DMRS			'
Maximum number of HARQ transmission			1
Number of HARQ Processes			8
The number of slots between PDSCH and corresponding HARQ-			Defined in Annex A.1.2 for TDD pattern
ACK information			FR1.30-1

Table 5.2.3.2.5-3: Minimum performance for Rank 1

Test	Deference	Bandwidth (MHz) / Modu	Modulation TDD I		TDD III -DI	December	Dranagation	Correlation	Reference	value
num.	Reference channel	Subcarrier spacing (kHz)	format and code rate		Propagation condition	matrix and antenna configuration	Target BLER	SNR (dB)		
1-1	R.PDSCH.2-1.4 TDD	40 / 30	QPSK, 0.59	FR1.30-1	AWGN	1x4, ULA Low	0.001%	[0.7]		

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

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

The test purposes are specified in Table 5.2.3.2.6-1.

Table 5.2.3.2.6-1: Tests purpose

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

Table 5.2.3.2.6-2: 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)		12
	PDSCH aggregation factor		2
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			TBD
The number of slots between PDSCH and corresponding HARQ-ACK information			TBD

#### Table 5.2.3.2.6-3: Minimum performance for Rank 1

Test	Reference	Bandwidth (MHz) /	Modulation	TDD UL-DL	Propagation condition	Correlation matrix and	Reference va	lue
num.	channel	Subcarrier spacing (kHz)	format and code rate	pattern			Target BLER	SNR (dB)
1-1	R.PDSCH.1-16.1 TDD	40 / 30	16QAM, 0.54	FR1.30-1	TDLA30-10	2x4, ULA Low	1% (Note 1)	TBD

Note 1: BLER is defined as residual BLER; i.e. ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block.

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

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

The test purposes are specified in Table 5.2.3.2.7-1.

Table 5.2.3.2.7-1: Tests purpose

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

Table 5.2.3.2.7-2: Test parameters

	Parameter	Unit	Value
Duplex mode			TDD
Active DL BWP index			1
PDSCH Mapping type			Type B
configuration	k0		0

	Starting symbol (S)	2
	Length (L)	2
	PDSCH aggregation factor	1
	PRB bundling type	Static
	PRB bundling size	2
	Resource allocation type	Type 0
	RBG size	Config2
	VRB-to-PRB mapping type	Non-interleaved
	VRB-to-PRB mapping interleaver bundle	N/A
	size	IN/A
	DMRS Type	Type 1
PDSCH DMRS	Number of additional DMRS	0
configuration	Maximum number of OFDM symbols for DL front loaded DMRS	1
Maximum number of	HARQ transmission	1
Number of HARQ Pr	ocesses	2
The number of slots ACK information	between PDSCH and corresponding HARQ-	0

Table 5.2.3.2.7-3: Minimum performance for Rank 1

		Bandwidth	Madulation	TDD III	Propagation condition	Correlation	Reference value		
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	TDD UL- DL pattern		matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)	
1-1	R.PDSCH.1- 17.1 TDD	40 / 30	QPSK, 0.30	FR1.30- 2	TDLA30-10	2x4, ULA Low	70	[- 2.2]	

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

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

The test purposes are specified in Table 5.2.3.2.8-1.

Table 5.2.3.2.8-1: Tests purpose

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

Table 5.2.3.2.8-2: Test parameters

Parameter			Value
Duplex mode			TDD
Active DL BWP index	(		1
PDCCH	Symbols with PDCCH		0, 1
configuration (Note	DCI format		2_1
4)	timeFrequencySet		14x1
	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
Pre-emption	Starting symbol (S)		3
configuration (Note	Length (L)		2
1, 2)	Pre-emption periodicity and offset (Note 3)		TBD 10/1 or (10,11)/1
Number of HARQ Pro	ocesses		8
The number of slots I ACK information	petween PDSCH and corresponding HARQ-		FR1.30-1
Note 2: Interference	re modelled as random data on pre-empted RI	= -	

Note 2: Interference modelled as random data on pre-empted REs.

Note 1: If UE cannot decode PDSCH correctly upon receiving PI on PDCCH with DCI format 2\_1, UE feeds back NACK to gNB. Then UE flushes the buffer and waits for the next re-transmission for LLR combining to decode the PDSCH.

Note 2: Interference modelled as random data on pre-empted REs.

Note 3: Pre-emption is scheduled with a fixed scheduling with 10 or 20% probability within 10ms periodicity.

Note 4: In addition to PDCCH configuration in Table 5.2-1.

Table 5.2.3.2.8-3: Minimum performance for Rank 1

		Bandwidth (MHz) /	Mandadatian			Correlation	Reference value	
Test num.	Reference channel	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.x TDD	40 / 30	TBD	FR1.30-1	TDLA30-10	2x4, ULA Low	TBD	TBD

#### 5.2.3.2.9 Minimum requirements for HST-SFN

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

The test purposes are specified in Table 5.2.3.2.9-1.

Table 5.2.3.2.9-1: Tests purpose

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

Table 5.2.3.2.9-2: Test parameters

Parameter			Value
Duplex mode			TDD
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 size		N/A
	DMRS Type		Type 1
PDSCH DMRS	Number of additional DMRS		2
configuration	Maximum number of OFDM symbols for DL front loaded DMRS		1
	CSI-RS periodicity	Slots	20 for CSI-RS resource 1,2,3,4.
CSI-RS for tracking	CSI-RS offset	Slots	1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4.
	Frequency Occupation		Start PRB 0 Number of PRB = 52
Number of HARQ Processes			8
The number of slots I ACK information	petween PDSCH and corresponding HARQ-		Specific to each TDD UL-DL pattern and as defined in Annex A.1.2

Table 5.2.3.2.9-3: Minimum performance for Rank 2

		Bandwidth	Meduletien	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- 10.4 TDD	40 / 30	16QAM, 0.48	FR1.30- 1	HST-SFN	2x4	70	[11.7]	

#### 5.2.3.2.10 Minimum requirements for HST DPS

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

The test purposes are specified in Table 5.2.3.2.10-1.

**Table 5.2.3.2.10-1: Tests purpose** 

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

Table 5.2.3.2.10-2: Test parameters

	Parameter		Unit	Value
Duplex mode				TDD
Active DL BWP index				1
PDCCH configuration	TCI state			Note 1
	Mapping type			Type A
	k0			0
	Starting symbol (S)			2
	Length (L)			Specific to each Reference channel
	PDSCH aggregation			1
PDSCH configuration	PRB bundling type			Static
1 Door comigaration	PRB bundling size			2
	Resource allocation	n type		Type 0
	RBG size			Config2
	VRB-to-PRB mapp			Non-interleaved
		oing interleaver bundle size		N/A
	TCI state			Note 1
PDSCH DMRS	DMRS Type	and DMDC		Type 1
configuration	Number of addition	of OFDM symbols for DL		2
Corniguration	front loaded DMRS			1
	TOTA TOUGHER DIVING	First OFDM symbol in the		I0 = 5 for CSI-RS resource 1 and 3
		PRB used for CSI-RS		I0 = 9 for CSI-RS resource 2 and 4
		CSI-RS periodicity	Slots	20 for CSI-RS resource 1,2,3,4
				1 for CSI-RS resource 1 and 2
	Resource set #1	CSI-RS offset	Slots	2 for CSI-RS resource 3 and 4
		QCL info		TCI state #2
				Start PRB 0
CCI DC for trooting		Frequency Occupation		Number of PRB = 52
CSI-RS for tracking		First OFDM symbol in the		l <sub>0</sub> = 6 for CSI-RS resource 5 and 6
		PRB used for CSI-RS		l <sub>0</sub> = 10 for CSI-RS resource 7 and 8
		CSI-RS periodicity	Slots	20 for CSI-RS resource 5,6,7,8.
	Resource set #2	CSI-RS offset	Slots	1 for CSI-RS resource 5 and 6
	Tresource set #2		Oloto	2 for CSI-RS resource 7 and 8
		QCL info		TCI state #3
		Frequency Occupation		Start PRB 0
				Number of PRB = 52
		First OFDM symbol in the		10 = 12
	Dogguroo oot #2	PRB used for CSI-RS CSI-RS periodicity	Slots	40
	Resource set #3	CSI-RS offset	Slots	0
NZP CSI-RS for CSI		QCL info	51013	TCI state #0
acquisition		First OFDM symbol in the		
aoquioition		PRB used for CSI-RS		10 = 13
	Resource set #4	CSI-RS periodicity	Slots	40
		CSI-RS offset	Slots	0
		QCL info		TCI state #1
				CSI-RS resource 1 from 'CSI-RS
	Type 1 QCL	CSI-RS resource		for tracking Resource set #1'
TCI state #0	information			configuration
ו טו טומוט דיט		QCL Type		Type A
	Type 2 QCL	CSI-RS resource		N/A
	information	QCL Type		N/A
	T 4 00'	001 00		CSI-RS resource 5 from 'CSI-RS
	Type 1 QCL	CSI-RS resource		for tracking Resource set #2'
TCI state #1	information	QCL Type		configuration Type A
	Type 2 QCL	CSI-RS resource	1	N/A
I		QCL Type		N/A
	Linformation	I GOL I YPO	ļ	
	information Type 1 OCI			SSR #0
	Type 1 QCL	SSB index		SSB #0 Type C
TCI state #2	Type 1 QCL information	SSB index QCL Type		Type C
TCI state #2	Type 1 QCL information Type 2 QCL	SSB index QCL Type SSB index		
TCI state #2	Type 1 QCL information	SSB index QCL Type SSB index QCL Type		Type C N/A
	Type 1 QCL information Type 2 QCL information	SSB index QCL Type SSB index		Type C N/A N/A
TCI state #2 TCI state #3	Type 1 QCL information Type 2 QCL information Type 1 QCL information Type 2 QCL	SSB index QCL Type SSB index QCL Type SSB index		Type C N/A N/A SSB #1
	Type 1 QCL information Type 2 QCL information Type 1 QCL information	SSB index QCL Type SSB index QCL Type SSB index QCL Type QCL Type		Type C N/A N/A SSB #1 Type C

Number of HARQ Processes	8
The number of slots between PDSCH and corresponding HARQ-ACK	Specific to each TDD UL-DL pattern
information	and as defined in Annex A.1.2

Note 1: SSB # (k mod 2) is transmitted by kth RRH.

For Test 1-1, TCI state switching command scheduled by MAC CE with MCS 4 is transmitted in slot #i that satisfy mod(i, 2n) = n. PDCCH and PDSCH associated with TCI # (k mod 2) is transmitted by  $k^{th}$  RRH from slot#

$$\max[(2k-1)n + 1 + T_{HARQ} + T_{MAC proc} + T_{firstTRS} + T_{TRS proc}, 0]$$

to slot#

$$(2k+1)n + T_{HARQ} + T_{MAC proc}$$

PDCCH and PDSCH are DTXed in other slots in which throughput statistics are not considered. For Test 1-2, TCI state switching command scheduled by MAC CE with MCS 4 is transmitted in slot #i that satisfy mod(i, 2n) = n. PDCCH and PDSCH associated with TCI # (k mod 2) is transmitted by  $k^{th}$  RRH from slot#

$$\max[(2k-1)n + 1 + T_{HARQ} + T_{MAC proc}, 0]$$

to slot#

$$(2k+1)n + T_{HARQ} + T_{MAC proc}$$

Where k=0, 1, 2... is the RRH number, n = 5040 is half of the number of slots between two RRH,  $T_{HARQ}$  = 8 is the number of slots between PDSCH and corresponding HARQ-ACK information,  $T_{MAC\ proc}$  = 6 is the number of slots for MAC CE processing,  $T_{firstTRS}$  = 7 is the number of slots to first TRS transmission occasion after MAC CE command is decoded by the UE,  $T_{TRS\ proc}$  = 4 is the number of slots for TRS processing.

Table 5.2.3.2.10-3: Minimum performance for HST DPS

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

# 5.2A PDSCH demodulation requirements for CA

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

Table 5.2A-1: Common test parameters for CA

Parameter			Value
Duplex mode			FDD and TDD
Active DL BWP inde	x		1
	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		FDD: 12TDD: Specific to each Reference channel
PDSCH	PDSCH aggregation factor		1
configuration	PRB bundling type		Static
Comiguration	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 Pr	ocesses		As defined in Table 5.2A-2
TDD UL-DL pattern			15kHz SCS: FR1.15-1 30kHz SCS: FR1.30-1
The number of slots between PDSCH and corresponding HARQ-ACK information			As defined in Table 5.2A-3
Number of PUCCH ResourceGroups			1
PUCCH format for HARQ-ACK feedback			PUCCH format 1 for cases with no more chan 2 DL CCs PUCCH format 3 for cases with more than 2 DL CCs

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

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

Table 5.2A-3: Test parameters for K1 values

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

### 5.2A.1 1RX requirements

(Void)

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

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

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

Table 5.2A.2.2-1: Tests purpose

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

Table 5.2A.2.2-2: Test parameters

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

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

Test Number	Bandwid	dth (MHz)	Reference	channel		antenna Bm/Hz)	Referen Fraction of Through	
	PCell	SCell	PCell	SCell	$\hat{E}_{s\_PCell}$ for PCell	$\hat{E}_{s\_SCell}$ for Scell	PCell	SCell
1	bandwid	Channel th as per 5.1.1.6	Derived as per section 5.1.3.2 of TS 38.214 [12]	NA	-112	-106	85	NA

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

Test Number	Bandwidth (MHz)		` '			Power at antenna port (dBm/Hz)		Reference value Fraction of Maximum Throughput (%)	
	PCell	SCell	PCell	SCell	$\hat{E}_{s\_PCell}$ for PCell	$\hat{E}_{s\_SCell}$ for Scell	PCell	SCell	
1	bandwic	Channel Ith as per 5.1.1.6	Derived as per section 5.1.3.2 of TS 38.214 [12]	NA	-112	-106	85	NA	

### 5.2A.2 2RX requirements

#### 5.2A.2.1 Minimum requirements

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

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

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

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

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

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

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

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

Test numbe	r CA duplex mode	Minimum performance requirements				
1	FDD 15 kHz + FDD 15 kHz	As defined in Table 5.2A.2.1-1				
2	TDD 30 kHz + TDD 30 kHz As defined in Table 5.2A.2.1-3					
3	FDD 15 kHz + TDD 30 kHz	As defined in Table 5.2A.2.1-1 and Table 5.2A.2.1-3 per CC				
4	FDD 15 kHz + TDD 15 kHz	As defined in Table 5.2A.2.1-1 and Table 5.2A.2.1-2 per CC				
5	TDD 15 kHz + TDD 30 kHz	As defined in Table 5.2A.2.1-2 and Table 5.2A.2.1-3 per CC				
Note 1: Th	Note 1: The applicability of requirements for different CA duplex modes, SCSs, CA configurations and bandwidth					
COI	mbination sets is defined in 5.1.1.5.	-				

### 5.2A.3 4RX requirements

#### 5.2A.3.1 Minimum requirements

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

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

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

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

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

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

D. 1 'W	D. (	Deference Modulation B		Correlation	Reference val	lue
Bandwidth (MHz)	Reference channel	format and code rate	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
5	R.PDSCH.2- 13.1 TDD	16QAM, 0.48	TDLA30-10	2x4, ULA Low	70	[8.5]
10	R.PDSCH.2- 13.2 TDD	16QAM, 0.48	TDLA30-10	2x4, ULA Low	70	[8.5]
15	R.PDSCH.2- 13.3 TDD	16QAM, 0.48	TDLA30-10	2x4, ULA Low	70	[8.5]
20	R.PDSCH.2- 13.4 TDD	16QAM, 0.48	TDLA30-10	2x4, ULA Low	70	[8.6]
25	R.PDSCH.2- 13.5 TDD	16QAM, 0.48	TDLA30-10	2x4, ULA Low	70	[8.6]
30	R.PDSCH.2- 14.1 TDD	16QAM, 0.48	TDLA30-10	2x4, ULA Low	70	[8.6]
40	R.PDSCH.2- 2.2 TDD	16QAM, 0.48	TDLA30-10	2x4, ULA Low	70	[8.7]
50	R.PDSCH.2- 14.2 TDD	16QAM, 0.48	TDLA30-10	2x4, ULA Low	70	[8.9]
60	R.PDSCH.2- 14.3 TDD	16QAM, 0.48	TDLA30-10	2x4, ULA Low	70	[8.8]
80	R.PDSCH.2- 14.4 TDD	16QAM, 0.48	TDLA30-10	2x4, ULA Low	70	[9.1]
90	R.PDSCH.2- 14.5 TDD	16QAM, 0.48	TDLA30-10	2x4, ULA Low	70	[9.0]
100	R.PDSCH.2- 15.1 TDD	16QAM, 0.48	TDLA30-10	2x4, ULA Low	70	[9.3]

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

Test number	CA duplex mode	Minimum performance requirements							
1	FDD 15 kHz + FDD 15 kHz	As defined in Table 5.2A.3.1-1							
2 TDD 30 kHz + TDD 30 kHz As de		As defined in Table 5.2A.3.1-3							
3	FDD 15 kHz + TDD 30 kHz	As defined in Table 5.2A.3.1-1 and Table 5.2A.3.1-3 per CC							
4	FDD 15 kHz + TDD 15 kHz	As defined in Table 5.2A.3.1-1 and Table 5.2A.3.1-2 per CC							
5	TDD 15 kHz + TDD 30 kHz	As defined in Table 5.2A.3.1-2 and Table 5.2A.3.1-3 per CC							
Note 1: The	Note 1: The applicability of requirements for different CA duplex modes, SCSs, CA configurations and bandwidth								
com	combination sets is defined in 5.1.1.5.								

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

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

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

Table 5.2A.3.2-1: Tests purpose

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

#### Table 5.2A.3.2-2: Test parameters

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

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

Test Number	Bandwidth (MHz)		width (MHz) Reference channel		Power at antenna port (dBm/Hz)		Reference value Fraction of Maximum Throughput (%)	
	PCell	SCell	PCell	SCell	$\hat{E}_{s\_PCell}$ for PCell	$\hat{E}_{s\_SCell}$ for Scell	PCell	SCell
1	Selected Channel bandwidth as per section 5.1.1.6		Derived as per section 5.1.3.2 of TS 38.214 [12]	NA	-112	-106	85	NA

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

Test Number	Bandwidth (MHz)		andwidth (MHz) Reference channel		Power at antenna port (dBm/Hz)		Reference value Fraction of Maximum Throughput (%)	
	PCell	SCell	PCell	SCell	$\hat{E}_{s\_PCell}$ for PCell	$\hat{E}_{s\_SCell}$ for Scell	PCell	SCell
1	Selected Channel bandwidth as per section 5.1.1.6		Derived as per section 5.1.3.2 of TS 38.214 [12]	NA	-112	-106	85	NA

# 5.3 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 $(\rho)$			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 & PDCCH DMRS Precoding configuration	Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i <sub>1</sub> , i <sub>2</sub> combination with REG bundling granularity for number of Tx larger than 1					
Physical signals, channels mapping and precoding	As specified in Annex B.4.1					
Symbols for all unused REs	OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1					
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 handwidth 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		nonInterleaved		
REG bundle size		6		
Shift index		0		

#### 5.3.2.1.1 1 Tx Antenna performances

For the parameters specified in Table 5.3.2.1-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 5.3.2.1.1-1. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.3.2.1.1-1: Minimum performance for PDCCH with 15 kHz SCS

			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		10	2-2.1 TDD	100	IXZ LOW	ı	-3.6

#### 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

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

#### 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

			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-	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		C	

#### 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	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. 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 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.	TDLC300-	2x4 Low	1	-4.3
					2-1.3 TDD	100			

## 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) /	width (MHz) / Reference		Antenna configuration	Referen	ce 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	Reference value	
	(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	Reference value	
		(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	Reference value	
	(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	Reference value	
	(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- bch	SNR (dB)
					(%)	, ,
1	40 / 30	R.PBCH.2	TDLA30-10	1 x 4 Low	1	-9.6

### 5.5 Sustained downlink data rate provided by lower layers

### 5.5.1 FR1 single carrier requirements

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

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

## 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			N/A
Channel bandwidth			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 <sub>0</sub> = 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 CSI-RS resource 1,2,3,4
	Density (ρ)			3 for CSI-RS resource 1,2,3,4
	, , , , , , , , , , , , , , , , , , ,			15 kHz SCS: 20 for CSI-RS resource 1,2,3,4
	CSI-RS period	dicity	Slots	30 kHz SCS: 40 for CSI-RS resource 1,2,3,4
				15 kHz SCS: 10 for CSI-RS resource 1 and 2
	CSI-RS offset	i	Slots	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 Od	ccupation		Start PRB 0 Number of PRB = BWP size
	QCL info			TCI state #0
	CSI-RS	dexes in the PRB used for		k <sub>0</sub> = 4
	RS	ols in the PRB used for CSI-		I <sub>0</sub> = 12
		SI-RS ports (X)		Same as number of transmit antenna
NZP CSI-RS for	CDM Type			'FD-CDM2'
CSI acquisition	Density (ρ)			1 15 kHz SCS: 20
·	CSI-RS period	dicity		15 KHZ SCS: 20 30 kHz SCS: 40
	CSI-RS offset	 [		0 KHZ 9C3. 40
				Start PRB 0
	Frequency Od	ccupation		Number of PRB = BWP size
	QCL info			TCI state #1
	CSI-RS	dexes in the PRB used for		$k_0 = 0$
	RS	ols in the PRB used for CSI-		I <sub>0</sub> = 12
	Number of CS	SI-RS ports (X)		4
ZP CSI-RS for CSI	CDM Type			'FD-CDM2'
acquisition	Density (ρ)			1
	CSI-RS perio	dicity		15 kHz SCS: 20 30 kHz SCS: 40
	CSI-RS offset			0
	Frequency Occupation			Start PRB 0 Number of PRB = BWP size
	Type 1 QCL			SSB #0
TCI state #0	information	QCL Type		Type C
101 state #6	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
		ups for ACK/NACK feedback		1
Maximum number of		ssion		4
HARQ ACK/NACK bundling				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 <sub>1</sub> , i <sub>2</sub>	
				combination with PRB bundling granularity OR 1 EDD as defined in Appear A 5 1 1
Symbols for all unuse	Symbols for all unused REs			OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1
Propagation condition				Static propagation condition No external noise sources are applied
Antenna	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:	Note 1: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH					
	transmission					
Note 2:	2: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-1 [6] for tested					
	channel bandwidth and subcarrier spacing					

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

Parameter			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	Starting symbol (S)		1			
configuration	Length (L)		13			
Number of HARC	Processes		8			
K1 value			Specific to each UL-DL pattern			
TDD III DI sotto	<b>*</b> ***********************************		15 kHz SCS: FR1.15-1			
TDD UL-DL patte	III		30 kHz SCS: FR1.30-1			
Note 1: PDSCH is scheduled only on full DL slots						

#### Table 5.5A-4: Number of PRBs in CORESET

S (k	CS (Hz)	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
	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	type	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 6.4.2.2	
Supported maximum number of	FR1 FDD	PMI	Clause 6.3.2.1.1	The requirements
ports across all configured	11(1100	' '''	Clause 6.3.2.1.2	apply only in case
NZP-CSI-RS resources per CC			Clause 6.3.2.1.3	the number of NZP-
(maxConfigNumberPortsAcros			Clause 6.3.2.1.4	CSI-RS ports in the
sNZP-CSI-RS-PerCC)			Clause 6.3.3.1.1	test case satisfies UE
			Clause 6.3.3.1.2	capability on
			Clause 6.3.3.1.3	maximum number of
			Clause 6.3.3.1.4	NZP-CSI-RS ports
		RI	Clause 6.4.3.1 (Test 4)	
	FR1 TDD	PMI	Clause 6.3.2.2.1	
			Clause 6.3.2.2.2	
			Clause 6.3.2.2.3	
			Clause 6.3.2.2.4	
			Clause 6.3.3.2.1	
			Clause 6.3.3.2.2	
			Clause 6.3.3.2.3	
		DI	Clause 6.3.3.2.4	
		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
		O.I.R	Transmission
PDSCH transmis	sion scheme		scheme 1
Actual carrier configuration	Offset between Point A and the lowest usable subcarrier on this carrier (Note 3)	subcarrier on this RBs	
Goringaration	Subcarrier spacing	kHz	15 or 30
	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 38.101-1 [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
DD GG::	Symbols with PDCCH		0,1
PDCCH	Number of PDCCH candidates		1/AL8
configuration	and aggregation levels  DCI format		4 4
	TCI state		1_1 TCI state #1
Cross carrier sch			Not configured
Cross carrier sch	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		12
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		type 0
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver		NI/A
	bundle size		N/A
PDSCH 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
	DMRS Type		Static propagation conditions: Single Panel Type I, Random precoder chosen from precoder index 0 an 2, selection updated per slot Type 1
DDCCH DMDC	Number of additional DMRS		1
PDSCH DMRS configuration	Maximum number of OFDM		
Comiguration	symbols for DL front loaded DMRS		1

				{1000} for Rank1
				{1000,1001} for
	DMRS ports i	ndexes		Rank2 {1000,1001,1002} for
				Rank3 {1000,1001,1002,100
				3} for Rank4
	Number of PE group(s) with	DSCH DMRS CDM		2
PTRS	Frequency de			N/A
configuration	Time density			N/A
		er index in the PRB		0 for CSI-RS
	used for CSI-	RS ( <i>k</i> <sub>0</sub> )		resource 1,2,3,4
	First OFDM o	umbal in the DDD		4 for CSI-RS
	used for CSI-	ymbol in the PRB		resource 1 and 3 8 for CSI-RS
	usea 101 CO1-	10 (10)		resource 2 and 4
	Number of Co	CLDC norte (V)		1 for CSI-RS
	Number of Ca	SI-RS ports (X)		resource 1,2,3,4
	CDM Type			'No CDM' for CSI-RS
				resource 1,2,3,4
	Density $(\rho)$			3 for CSI-RS resource 1,2,3,4
				15 kHz SCS: 20 for
				CSI-RS resource
	CSI-RS perio	dicity	slot	1,2,3,4
CSI-RS for				30 kHz SCS: 40 for
tracking				CSI-RS resource
				15 kHz SCS: 10 for CSI-RS
				resource 1 and 2
				11 for CSI-RS
				resource 3 and 4
	CSI-RS offset	t	slot	
				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 =
				BWP size
	QCL info			TCI state #0
NZP CSI-RS for	Frequency O	ccunation		Start PRB 0 Number of PRB =
CSI acquisition	i requeriey of	ocapation		BWP size
	QCL info			TCI state #1
ZP CSI-RS for				Start PRB 0
CSI acquisition	Frequency O	ccupation		Number of PRB =
	Type 1 QCL	SSB index		BWP size SSB #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 1 from 'CSI-RS for
	information	CSI-RS resource		tracking'
TCI state #1				configuration
TOT State #1		QCL Type		Type A
	Type 2 QCL	CSI-RS resource		N/A
	information	QCL Type		N/A
Number of HARC	Processes			4 For FDD
HARQ ACK/NAC	K hundling			8 for TDD Multiplexed
LIVING VOLVINAC	r bunuling		I	Manupiezea

Redunda	ncy version coding sequence		{0,2,3,1}			
K1 value (PDSCH-to-HARQ-timing-indicator)			2 for FDD 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			
Symbols	for 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:	DL.					
Note 3:	applied for the PDCCH transmission.					

## 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  $\pm 1$  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	Te	est 1	Те	st 2
Bandwidth	andwidth			10	O	
Duplex Mode				FD	D	
Subcarrier spacing	g	kHz		1:	5	
SNR		dB	8	9	14	15
Propagation chan	nel			AW	GN	
Antenna configura	ation		2×2 wi	th static cha Anne:		ecified in
Beamforming Mod	101		As	specified in		3 4 1
200	CSI-RS resource Type		7.0	Perio		
	Number of CSI-RS ports (X)			4		
	CDM Type			FD-C	DM2	
7D 001 D0	Density (ρ)			1		
ZP CSI-RS configuration	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> )			Row	5,4	
	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> )			9	)	
	CSI-RS					
	periodicity and offset	slot		5/	1	
	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			Pow 3	! (6 <sub>-</sub> )	
OOI acquisition	used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 3,(6,-)			
	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> )			13	3	
	NZP CSI-RS-timeConfig	slot		5/	1	
	periodicity and offset	SIOL				
	CSI-IM resource Type			Perio	odic	
	CSI-IM RE pattern			0	1	
CSI-IM configuration	CSI-IM Resource Mapping (kcsi-im,lcsi-im)			(4,	9)	
	CSI-IM timeConfig periodicity and offset	slot		5/	1	
ReportConfigType				Perio	odic	
CQI-table				Tabl		
reportQuantity				cri-RI-P		
	rChannelMeasurements			Not con	figured	
timeRestrictionFo	rInterferenceMeasurements			Not con	figured	
cqi-FormatIndicate	or			Widel	oand	
pmi-FormatIndicat	tor			Widel	band	
Sub-band Size		RB		8		
Csi-ReportingBan				1111		
	CSI-Report periodicity and offset slot 5/0					
aperiodicTriggeringOffset Not config						
	Codebook Type			typel-Sin	glePanel	
	Codebook Mode			1		
Codebook configuration	(CodebookConfig- N1,CodebookConfig-N2)			Not con	figured	
	CodebookSubsetRestriction			0100	000	
	RI Restriction			N/		
Physical channel	for CSI report			PUC	CH	
CQI/RI/PMI delay		ms		8		
Maximum number	of HARQ transmission			1		
Measurement cha	Measurement channel  As specified in Table A.4- 2		As spe	_		, TBS.2-

#### 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  $\alpha$ % of the time where  $\alpha$ % 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  $\gamma$  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	ubcarrier spacing		15
Duplex Mode			FDD
SNR	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 54
configuration	used for CSI-RS (k <sub>0</sub> )		Row 5,4
	First OFDM symbol in the PRB used		0
	for CSI-RS (I <sub>0</sub> )		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 COLDO for	Density (p)		1
NZP CSI-RS for	First subcarrier index in the PRB		Day: 2 (C.)
CSI acquisition	used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 3,(6,-)
	First OFDM symbol in the PRB used		13
	for CSI-RS (I <sub>0</sub> )		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-
		L	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  $\alpha$  and  $\beta$  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  $\gamma$  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	
	Subcarrier spacing		15	
Duplex Mode	5	kHz	FDD	)
SNR	SNR		8 9	14 15
Propagation chan			Two tap model specified in Ann B.2.4 with a=1, f <sub>D</sub> = 5Hz, and t <sub>d</sub> =0.45µs	
Antenna configura	ation		2×2	)
Correlation config			As per Anı	
Beamforming Mod			As specified in	
	CSI-RS resource Type		Perio	dic
	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 <sub>0</sub> )		Row	5,4
	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> )		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
NZP CSI-RS for	Density (ρ)		1	
CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 3,	(6,-)
	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> )		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	))
CSI-IM timeConfig periodicity and offset		slot	5/1	
ReportConfigType	)		Aperio	dic
CQI-table			Table	2
reportQuantity			cri-RI-PM	
	rChannelMeasurements		Not confi	
	rInterferenceMeasurements		Not confi	
cqi-FormatIndicate			Subba	
pmi-FormatIndicat	tor		Wideb	and
Sub-band Size		RB	8	
csi-ReportingBand			11111	
CSI-Report interva		slot	Not confi	gured
Aperiodic Report S	Slot Offset		1 in slots i, where	
·			otherwise it is	equal to 0
reportTriggerSize			One State with one	Associated
CSI-AperiodicTriggerStateList			Report Configuration Associated Report	on
,			contains pointers and CS	to NZP CSI-RS
aperiodicTriggerin	gOffset		Not confi	
	Codebook Type		typel-Sing	lePanel
	Codebook Mode		1	
Codebook	(CodebookConfig-		Not confi	gured
configuration	N1,CodebookConfig-N2)		Not confi	
	CodebookSubsetRestriction		0000	
	RI Restriction		N/A	
Physical channel to	or CSI report		PUSC	H
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
α [%]	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. To account for sensitivity of the input SNR the reporting definition is considered to be verified if the reporting accuracy is met for at least one of two SNR levels separated by an offset of 1 dB.

For the parameters specified in Table 6.2.2.2.1.1-1, 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  $\pm 1$  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 COI-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 spacing		kHz	30
Duplex Mode			TDD
TDD UL-DL pattern			FR1.30-1
SNR		dB	8 9 14 15
Propagation chan	nel		AWGN
Antenna configura	ation		2x2 with static channel specified in Annex B.1
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)		1
configuration	First subcarrier index in the PRB		Row 5,4
oormgaration	used for CSI-RS (k <sub>0</sub> )		110W 0,4
	First OFDM symbol in the PRB used		9
	for CSI-RS (I <sub>0</sub> )		ű
	CSI-RS	slot	10/1
	periodicity and offset		
	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		Row 3,(6,-)
·	used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Α , ,
	First OFDM symbol in the PRB used		13
	for CSI-RS (I <sub>0</sub> )		-
	NZP CSI-RS-timeConfig periodicity and offset	slot	10/1
	CSI-IM resource Type		Periodic
	CSI-IM RE pattern		0
	CSI-IM Resource Mapping		Ŭ
CSI-IM	(kcsi-im,lcsi-im)		(4, 9)
configuration	(NOOT IM, NOOT IM)		( ', ")
	CSI-IM timeConfig		40/4
	periodicity and offset	slot	10/1
ReportConfigType			Periodic
CQI-table			Table 2
reportQuantity			cri-RI-PMI-CQI
timeRestrictionFo	rChannelMeasurements		Not configured
timeRestrictionFo	rInterferenceMeasurements		Not configured
cqi-FormatIndicate	or		Wideband
pmi-FormatIndicat	tor		Wideband
Sub-band Size		RB	16
Csi-ReportingBan			1111111
CSI-Report period		slot	10/9
aperiodicTriggerin	<u> </u>		Not configured
	Codebook Type		typel-SinglePanel
	Codebook Mode		1
Codebook	(CodebookConfig-		Not configured
configuration	N1,CodebookConfig-N2)		
	CodebookSubsetRestriction		010000
	RI Restriction		N/A
Physical channel	for CSI report		PUCCH
CQI/RI/PMI delay	(11450)	ms	9.5
Maximum number	of HARQ transmission		1
Measurement cha	nnel		As specified in Table A.4-2, TBS.2-
Modod official official		<u> </u>	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  $\alpha$ % of the time where  $\alpha$ % 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  $\gamma$  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	Te	est 1	Tes	st 2
Bandwidth		MHz	40			
Subcarrier spacing	g	kHz	z 30			
Duplex Mode			TDD			
TDD UL-DL patter	'n		FR1.30-1		T	
SNR		dB	6	7	12	13
Propagation chan				TDLA		
Antenna configura				2>		
Correlation config			\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	ULA		1.1
Beamforming Mod			AS	specified in Peri		.4.1
	CSI-RS resource Type Number of CSI-RS ports (X)			Peri		
	CDM Type			FD-C	-	
	Density (p)			10-0	l I	
ZP CSI-RS configuration	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> )			Row	5,4	
	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> )			Ç	)	
	CSI-RS periodicity and offset	slot		10	)/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)					
CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )			Row	3,(6,-)	
	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> )			1	3	
	NZP CSI-RS-timeConfig periodicity and offset	slot		10	)/1	
	CSI-IM resource Type			Peri	odic	
	CSI-IM RE pattern			(	)	
CSI-IM configuration	CSI-IM Resource Mapping (kcsi-im,lcsi-im)			(4,	9)	
	CSI-IM timeConfig periodicity and offset	slot		10	)/1	
ReportConfigType				Peri	odic	
CQI-table					le 2	
reportQuantity				cri-RI-P	MI-CQI	
	ChannelMeasurements			Not cor		
	InterferenceMeasurements			Not cor		
cqi-FormatIndicate			1	Wide		
pmi-FormatIndicate Sub-band Size	.UI	RB	+	Wide 1	band 6	
Csi-ReportingBan	d	ועט	+	111		
CSI-Report period		slot	+	10		
aperiodicTriggerin		0.01		Not cor		
	Codebook Type		<u> </u>	typel-Sin		
	Codebook Mode			.,		
Codebook configuration	(CodebookConfig- N1,CodebookConfig-N2)			Not cor	nfigured	
_	CodebookSubsetRestriction			000	001	
	RI Restriction			N,		
Physical channel	for CSI report			PUC		
CQI/RI/PMI delay		ms		9.		
Maximum number	of HARQ transmission		<del>   </del>	<u> ^</u>		
Measurement cha	nnel		As spec	cified in Ta		TBS.2-

Table 6.2.2.2.1-2: Minimum requirements

Parameters	Test 1	Test 2
α[%]	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  $\alpha$  and  $\beta$  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  $\gamma$  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			40
Subcarrier spacin	g	kHz	30
Duplex Mode			TDD
TDD UL-DL patte	rn		FR1.30-1
SNR		dB	8 9 14 15
Propagation chan	Propagation channel		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		2x2
Correlation config			As per Annex B.1
Beamforming Mo	del		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)		1
configuration	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> )		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 <sub>0</sub> , k <sub>1</sub> )		Row 3,(6,-)
	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> )		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	rInterferenceMeasurements		Not configured
cqi-FormatIndicat			Subband
pmi-FormatIndica	itor		Wideband
Sub-band Size		RB	16
csi-ReportingBan			1111111
CSI-Report interv		slot	Not configured
Aperiodic Report  CSI request	Slot Offset		1 in slots i, where mod(i, 10) = 1,
reportTriggerSize			otherwise it is equal to 0
reportringgersize			One State with one Associated Report Configuration
CSI-AperiodicTriggerStateList			Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
aperiodicTriggerir	ngOffset		Not configured
aponodio i riggorii	Codebook Type		typel-SinglePanel
	Codebook Node		1
Codebook	(Codebook Config-		'
configuration	N1,CodebookConfig-N2)		Not configured
209010001	CodebookSubsetRestriction		000001
	RI Restriction		N/A
Physical channel for CSI report			PUSCH

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
α <b>[%]</b>	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  $\pm 1$  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	
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 <sub>0</sub> )		Row 5	5,4
	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> )		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 <sub>0</sub> , k <sub>1</sub> )		Row 3,(	(6,-)
	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> )		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	11
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	
DI	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	Measurement channel		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  $\alpha$ % of the time where  $\alpha$ % 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  $\gamma$  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	ndwidth		10	
Subcarrier spacing	g	kHz	15	
Duplex Mode			FDD	
SNR		dB	3 4 9	
Propagation chan	ropagation channel		TDLA3	0-5
Antenna configura			2×4	
Correlation config	uration		XP Hiç	gh
Beamforming Mod	del		As specified in A	Annex B.4.1
	CSI-RS resource Type		Period	lic
	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		Row 5	1
Corniguration	used for CSI-RS (k <sub>0</sub> )		Kow 5	,4
	First OFDM symbol in the PRB used		9	
	for CSI-RS (I <sub>0</sub> )		9	
	CSI-RS	slot	5/1	
	periodicity and offset	5101		
	CSI-RS resource Type		Period	lic
	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		Row 3,(	6 -)
OOI doquisition	used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		10W 3,(	. O,- )
	First OFDM symbol in the PRB used		13	
	for CSI-RS (I <sub>0</sub> )		.0	
	NZP CSI-RS-timeConfig	slot	5/1	
	periodicity and offset	0.01		
	CSI-IM resource Type		Period	lic
	CSI-IM RE pattern		0	
CSI-IM	CSI-IM Resource Mapping		// 0	
configuration	(kcsi-im,lcsi-im)		(4, 9	)
	CSI-IM timeConfig			
	periodicity and offset	slot	5/1	
ReportConfigType			Period	lic
CQI-table	,		Table	
reportQuantity			cri-RI-PM	
	rChannelMeasurements		Not config	
	rInterferenceMeasurements		Not config	
cgi-FormatIndicate			Wideba	•
pmi-FormatIndicat			Wideba	
Sub-band Size		RB	8	4114
csi-ReportingBand	1	ואט	11111	11
CSI-Report period		slot	5/0	1.1
aperiodicTriggerin		3101	Not config	nured
aponodio i riggetti	Codebook Type		typel-Single	
	Codebook Type  Codebook Mode		1	or arior
Codebook	(CodebookConfig-		<del> </del>	
configuration	N1,CodebookConfig-N2)		Not config	gured
Jonnigaration	CodebookSubsetRestriction		00000	)1
	RI Restriction		N/A	
Physical channel for CSI report			PUCC	
CQI/RI/PMI delay		ms	8	•
	of HARQ transmission		1	
			As specified in Tabl	e A.4-2. TBS 2-
Measurement cha	Measurement channel		1	

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  $\alpha$  and  $\beta$  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  $\gamma$  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 Control of the control of		MHz	10
Subcarrier spacing		kHz	15
Duplex Mode			FDD
SNR		dB	5 6 11 12
Propagation channel			Two tap model specified in Anne
			B.2.4 with $a=1$ , $f_D = 5$ Hz, and
			т <sub>d</sub> =0.45µs
Antenna configura			2×4
Correlation config	uration		As per Annex B.1
Beamforming Mo	del		As specified in Annex B.4.1
	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (X)		4
	CDM Type		FD-CDM2
70 001 00	Density (ρ)		1
ZP CSI-RS	First subcarrier index in the PRB		
configuration	used for CSI-RS (k <sub>0</sub> )		Row 5,4
	First OFDM symbol in the PRB used		
	for CSI-RS (I <sub>0</sub> )		9
	CSI-RS		
		slot	5/1
	periodicity and offset		Deviation
	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		Row 3,(6,-)
OOI acquisition	used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		1.0W 3,(0,-)
	First OFDM symbol in the PRB used		12
	for CSI-RS (I <sub>0</sub> )		13
	NZP CSI-RS-timeConfig		5/4
	periodicity and offset	slot	5/1
	CSI-IM resource Type		Periodic
	CSI-IM RE pattern		0
	CSI-IM Resource Mapping		
CSI-IM	(kcsi-im,lcsi-im)		(4, 9)
configuration	(RCSI-IMI,ICSI-IMI)		(4, 9)
	CSI-IM timeConfig		
	periodicity and offset	slot	5/1
PanartConfigTvn	, ,		Aporiodio
ReportConfigType	=		Aperiodic
CQI-table			Table 2
reportQuantity			cri-RI-PMI-CQI
	rChannelMeasurements		Not configured
timeRestrictionForInterferenceMeasurements			Not configured
			Not configured
cqi-FormatIndicat			Subband
cqi-FormatIndicat		RB	Subband
cqi-FormatIndicat pmi-FormatIndica Sub-band Size	tor	RB	Subband Wideband 8
cqi-FormatIndicat pmi-FormatIndica Sub-band Size csi-ReportingBan	tor d	RB slot	Subband Wideband 8 1111111
cqi-FormatIndicat pmi-FormatIndica Sub-band Size csi-ReportingBan CSI-Report interv	tor d al and offset		Subband Wideband 8
cqi-FormatIndicat pmi-FormatIndica Sub-band Size csi-ReportingBan CSI-Report interv Aperiodic Report	tor d al and offset		Subband Wideband 8 1111111 Not configured 5
cqi-FormatIndicat pmi-FormatIndica Sub-band Size csi-ReportingBan CSI-Report interv	tor d al and offset		Subband Wideband 8 1111111 Not configured 5 1 in slots i, where mod(i, 5) = 1
cqi-FormatIndicat pmi-FormatIndica Sub-band Size csi-ReportingBan CSI-Report interv Aperiodic Report CSI request	tor  d al and offset Slot Offset		Subband Wideband 8 1111111 Not configured 5
cqi-FormatIndicat pmi-FormatIndica Sub-band Size csi-ReportingBan CSI-Report interv Aperiodic Report	tor  d al and offset Slot Offset		Subband Wideband 8 1111111 Not configured 5 1 in slots i, where mod(i, 5) = 1 otherwise it is equal to 0
cqi-FormatIndicat pmi-FormatIndica Sub-band Size csi-ReportingBan CSI-Report interv Aperiodic Report CSI request	tor  d al and offset Slot Offset		Subband Wideband 8 1111111 Not configured 5 1 in slots i, where mod(i, 5) = 1 otherwise it is equal to 0 1 One State with one Associated
cqi-FormatIndicat pmi-FormatIndica Sub-band Size csi-ReportingBan CSI-Report interv Aperiodic Report CSI request reportTriggerSize	tor  d al and offset Slot Offset		Subband Wideband 8 1111111 Not configured 5 1 in slots i, where mod(i, 5) = 1 otherwise it is equal to 0 1 One State with one Associated Report Configuration
cqi-FormatIndicat pmi-FormatIndica Sub-band Size csi-ReportingBan CSI-Report interv Aperiodic Report CSI request	tor  d al and offset Slot Offset		Subband Wideband 8 1111111 Not configured 5 1 in slots i, where mod(i, 5) = 1 otherwise it is equal to 0 1 One State with one Associated Report Configuration Associated Report Configuration
cqi-FormatIndicat pmi-FormatIndica Sub-band Size csi-ReportingBan CSI-Report interv Aperiodic Report CSI request reportTriggerSize	tor  d al and offset Slot Offset		Subband  Wideband  8  1111111  Not configured  5  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0  1  One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS
cqi-FormatIndicat pmi-FormatIndica Sub-band Size csi-ReportingBan CSI-Report interv Aperiodic Report CSI request reportTriggerSize	d al and offset Slot Offset		Subband  Wideband  8  1111111  Not configured  5  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0  1  One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
cqi-FormatIndicat pmi-FormatIndica Sub-band Size csi-ReportingBan CSI-Report interv Aperiodic Report CSI request reportTriggerSize	d al and offset Slot Offset  ggerStateList		Subband  Wideband  8  1111111  Not configured  5  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0  1  One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM  Not configured
cqi-FormatIndicat pmi-FormatIndica Sub-band Size csi-ReportingBan CSI-Report interv Aperiodic Report CSI request reportTriggerSize	d al and offset Slot Offset  ggerStateList  ngOffset Codebook Type		Subband  Wideband  8  1111111  Not configured  5  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0  1  One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
cqi-FormatIndicat pmi-FormatIndicat pmi-FormatIndicat Sub-band Size csi-ReportingBan CSI-Report interv Aperiodic Report CSI request reportTriggerSize CSI-AperiodicTrig aperiodicTriggerin	d al and offset Slot Offset  ggerStateList  ngOffset Codebook Type Codebook Mode		Subband  Wideband  8  1111111  Not configured  5  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0  1  One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM  Not configured
cqi-FormatIndicat pmi-FormatIndicat pmi-FormatIndicat Sub-band Size csi-ReportingBan CSI-Report interv Aperiodic Report CSI request reportTriggerSize  CSI-AperiodicTrig aperiodicTriggerin  Codebook	d al and offset Slot Offset  ggerStateList  gOffset  Codebook Type Codebook Mode (CodebookConfig-		Subband  Wideband  8  1111111  Not configured  5  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0  1  One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM  Not configured typel-SinglePanel
cqi-FormatIndicat pmi-FormatIndicat pmi-FormatIndicat Sub-band Size csi-ReportingBan CSI-Report interv Aperiodic Report CSI request reportTriggerSize CSI-AperiodicTrig aperiodicTriggerin	d al and offset Slot Offset  ggerStateList  gOffset  Codebook Type Codebook Mode (CodebookConfig- N1,CodebookConfig-N2)		Subband  Wideband  8  1111111  Not configured  5  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0  1  One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM  Not configured
cqi-FormatIndicat pmi-FormatIndicat pmi-FormatIndicat Sub-band Size csi-ReportingBan CSI-Report interv Aperiodic Report CSI request reportTriggerSize  CSI-AperiodicTrig aperiodicTriggerin  Codebook	d al and offset Slot Offset  ggerStateList  gOffset  Codebook Type Codebook Mode (CodebookConfig-		Subband  Wideband  8  1111111  Not configured  5  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0  1  One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM  Not configured typel-SinglePanel
cqi-FormatIndicat pmi-FormatIndicat pmi-FormatIndicat Sub-band Size csi-ReportingBan CSI-Report interv Aperiodic Report CSI request reportTriggerSize  CSI-AperiodicTrig aperiodicTriggerin  Codebook	d al and offset Slot Offset  ggerStateList  gOffset  Codebook Type Codebook Mode (CodebookConfig- N1,CodebookConfig-N2)		Subband  Wideband  8  1111111  Not configured  5  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0  1  One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM  Not configured  typeI-SinglePanel  1  Not configured
cqi-FormatIndicat pmi-FormatIndicat pmi-FormatIndicat Sub-band Size csi-ReportingBan CSI-Report interv Aperiodic Report CSI request reportTriggerSize  CSI-AperiodicTrig aperiodicTriggerin  Codebook	d al and offset Slot Offset  ggerStateList  ggerStateList  Codebook Type Codebook Mode (CodebookConfig- N1,CodebookConfig- N1,CodebookSubsetRestriction RI Restriction		Subband  Wideband  8  1111111  Not configured  5  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0  1  One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM  Not configured  typeI-SinglePanel  1  Not configured  000001

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
α <b>[%]</b>	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  $\pm 1$  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		MHz	40	
Subcarrier spacing			30	
Duplex Mode			TDD	
TDD UL-DL patter	TDD UL-DL pattern		FR1.3	30-1
SNR		dB	5 6	11 12
Propagation chan	nel		AWC	SN .
Antenna configura	ation		2×4 with static channel specified in Annex B.1	
Beamforming Mod	del		As specified in Annex B.4.1	
J	CSI-RS resource Type		Perio	
	Number of CSI-RS ports (X)		4	
	CDM Type		FD-CDM2	
ZP CSI-RS	Density (ρ)		1	
	First subcarrier index in the PRB		5 54	
configuration	used for CSI-RS (k <sub>0</sub> )		Row	5,4
	First OFDM symbol in the PRB used		0	
	for CSI-RS (I <sub>0</sub> )		9	
	CSI-RS	1.4	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 <sub>0</sub> , k <sub>1</sub> )		Row 3,(6,-)	
	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> )		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	timeRestrictionForInterferenceMeasurements		Not conf	igured
cqi-FormatIndicator			Wideb	
pmi-FormatIndicator			Wideb	and
Sub-band Size		RB	16	
csi-ReportingBand			1111	111
CSI-Report periodicity and offset		slot	10/	
aperiodicTriggeringOffset			Not conf	
Codebook configuration	Codebook Type		typel-Sing	
	Codebook Mode		1	
	(CodebookConfig- N1,CodebookConfig-N2)		Not conf	igured
	CodebookSubsetRestriction		0100	
	RI Restriction		N/A	<i>H</i>
Physical channel for CSI report			PUC	CH
CQI/RI/PMI delay		ms	9.5	
Maximum number of HARQ transmission		-	1	
Measurement channel			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  $\alpha$ % of the time where  $\alpha$ % 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  $\gamma$  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		MHz	40	
Subcarrier spacing		kHz	30	
Duplex Mode			TDD	
TDD UL-DL pattern			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 (ρ)		FD-CDM2	
ZP CSI-RS	First subcarrier index in the PRB		1	
configuration	used for CSI-RS (k₀)		Row 5,4	
	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> )		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 <sub>0</sub> , k <sub>1</sub> )		Row 3,(6,-)	
	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> )		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	
timeRestrictionForInterferenceMeasurements			Not configured	
cqi-FormatIndicate			Wideband	
pmi-FormatIndicator			Wideband	
Sub-band Size		RB	16	
csi-ReportingBand		1.4	1111111	
CSI-Report periodicity and offset		slot	10/9	
aperiodicTriggeringOffset			Not configured	
Codebook	Codebook Type		typel-SinglePanel	
	Codebook Mode (CodebookConfig-		1	
configuration	N1,CodebookConfig-N2)		Not configured	
	CodebookSubsetRestriction	1	000001	
RI Restriction			N/A PUCCH	
Physical channel for CSI report		ma	9.5	
CQI/RI/PMI delay  Maximum number of HARQ transmission		ms	9.5	
IVIAXIMUM NUMBER OF HARQ TRANSMISSION		<del>                                     </del>	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  $\alpha$  and  $\beta$  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  $\gamma$  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 spacing		kHz	30	
Duplex Mode			TDD	
TDD UL-DL pattern			FR1.30-1	
SNR		dB		11 12
			Two tap model specif	ied in Annex
Propagation chan	nel		B.2.4 with $a=1$ , $f_D =$	: 5Hz, and
			τ <sub>d</sub> =0.1125μ	ıs
Antenna configura			2×4	
Correlation config			As per Annex B.1	
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	2
ZP CSI-RS	Density (ρ)		1	
configuration	First subcarrier index in the PRB		Row 5,4	
3	used for CSI-RS (k <sub>0</sub> )		,	
	First OFDM symbol in the PRB used		9	
	for CSI-RS (I <sub>0</sub> ) CSI-RS			
	periodicity and offset	slot	10/1	
	CSI-RS resource Type		Periodic	
	Number of CSI-RS ports (X)		2	
			FD-CDM2	)
	CDM Type Density (p)		7 D-CDIVI2	<u>2</u>
NZP CSI-RS for	First subcarrier index in the PRB		I	
CSI acquisition	used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 3,(6,-	-)
	First OFDM symbol in the PRB used			
	for CSI-RS (I <sub>0</sub> )		13	
	NZP CSI-RS-timeConfig	_		
	periodicity and offset	slot	10/1	
	CSI-IM resource Type		Periodic	
	CSI-IM RE pattern		0	
CSI-IM	CSI-IM Resource Mapping			
configuration	(kcsi-im,lcsi-im)		(4, 9)	
Comiguration				
	CSI-IM timeConfig	slot	10/1	
	periodicity and offset	0.01		
ReportConfigType	9		Aperiodic	;
CQI-table			Table 2	
reportQuantity	0		cri-RI-PMI-C	
	rChannelMeasurements		Not configured Not configured	
	rInterferenceMeasurements		· · · · · · · · · · · · · · · · · · ·	
cqi-FormatIndicat			Subband Wideband	
pmi-FormatIndica Sub-band Size	lOI	DD		<u>1</u>
	<u> </u>	RB	16 1111111	
csi-ReportingBand CSI-Report interval and offset		slot	Not configur	red
Aperiodic Report Slot Offset		SIUL	8	ou
Apeniodic Report Slot Offset			1 in slots i, where mo	nd(i 10) – 1
CSI request			otherwise it is eq	
reportTriggerSize			1	1
Toportringgoroizo			One State with one As	ssociated
CSI-AperiodicTriggerStateList			Report Configuration	
			Associated Report C	onfiguration
			contains pointers to N	NZP CSI-RS
			and CSI-IN	M
aperiodicTriggeringOffset			0	
	Codebook Type		typel-SingleP	anel
	Codebook Mode		1	
Codebook	(CodebookConfig-		Not configur	red
configuration	N1,CodebookConfig-N2)		-	
	CodebookSubsetRestriction		000001	
Dhariasi	RI Restriction		N/A	
Physical channel for CSI report			PUSCH	

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 <b>[%]</b>	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  $\gamma$ , for 4TX, 8TX, 16TX, and 32TX 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 TypeI-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)

Pa	rameter	Unit	Test 1
Bandwidth		MHz	10
	Subcarrier spacing		15
Duplex Mode			FDD
Propagation cha	annel		TDLA30-5
Antenna configu			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-RS		4
	ports (X)		ED CDM2
	CDM Type		FD-CDM2
	Density (ρ) First subcarrier		1
ZP CSI-RS	index in the PRB		
configuration	used for CSI-RS		Row 5, (4,-)
	(k <sub>0</sub> , k <sub>1</sub> )		
	First OFDM		
	symbol in the PRB		(0.)
	used for CSI-RS		(9,-)
	$(I_0, I_1)$		
	CSI-RS	slot	5/1
	interval and offset	3101	3/1
	CSI-RS resource		Aperiodic
	Type		
	Number of CSI-RS		4
	ports (X)		FD-CDM2
	CDM Type		1 1
	Density (ρ) First subcarrier		I I
NZP CSI-RS	index in the PRB		
for CSI	used for CSI-RS		Row 4, (0,-)
acquisition	(k <sub>0</sub> , k <sub>1</sub> )		
'	First OFDM		
	symbol in the PRB		(12.)
	used for CSI-RS		(13,-)
	(l <sub>0</sub> , l <sub>1</sub> )		
	CSI-RS		Not configured
	interval and offset		rtet eeningarea
	aperiodicTriggering		0
	Offset		
	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM	CSI-IM Resource		i attern o
configuration	Mapping		(4,9)
3	(kcsi-im,lcsi-im)		(1,0)
	CSI-IM timeConfig	عامه	Not soufiered
	interval and offset	slot	Not configured
ReportConfigTy	pe		Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
	timeRestrictionForChannelMeasure		Not configured
ments timeRestrictionForInterferenceMeasu			<u> </u>
rements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	8 8
csi-ReportingBand		.,,,,	111111
CSI-Report interval and offset		slot	Not configured
Aperiodic Report Slot Offset		5.51	4
CSI request			1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
reportTriggerSiz	e		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,CodebookConfi g-N2)		(2,1)
configuration	(CodebookConfig- O1,CodebookConfi g-O2)		(4,1)
	CodebookSubsetR estriction		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 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.

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

Bandwidth	Pai	rameter	Unit	Test 1
Duplex Mode		Bandwidth		I.
Propagation channel		ing	kHz	
Antenna configuration				
Beamforming Model	Propagation cha	annel		
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 (b, h') CSI-RS source Type Number of CSI-RS (b, h') CSI-RS interval and offset sort cSI acquisition  Not configured  CSI-RS (b, h') CSI-RS (c), h') CSI-MR resource Type CSI-MR Resource Type CSI-MR Resource Mapping (cSI-MR resource Mapping (cS	Antenna configu	ıration		
CSI-RS resource Type Periodic  Type   Density (p)   Tirst subcarrier index in the PRB used for CSI-RS (b, h;)  CSI-RS resource   Periodic    Type   Density (p)   Tirst subcarrier index in the PRB used for CSI-RS (b, h;)  CSI-RS resource   Aperiodic    Type   Aperiodic    Number of CSI-RS   Slot    CSI-RS resource   Aperiodic    Number of CSI-RS    (b, h)   CSI-RS    Type   Density (p)   Tirst subcarrier index in the PRB used for CSI-RS    (cDM Type   CDM4 (FD2, TD2)    Density (p)   Tirst subcarrier index in the PRB used for CSI-RS    (cDM Type   CDM4 (FD2, TD2)    Density (p)   Tirst subcarrier index in the PRB used for CSI-RS    (ko, k:)   First OFDM    Symbol in the PRB used for CSI-RS (b, h;)    CSI-RS   Slot   Not configured    Type   CSI-RS    (SI-R)   CSI-RS    (A, 9)    (CSI-MI REsource   Aperiodic    CSI-MI Resource   Aperiodic    CSI-MI Resource   Aperiodic    CSI-RS   CSI-RS    (A, 9)    (CSI-RI-PMI-COI    Type   CSI-RI-PMI-COI    Type   CSI-RS    (CSI-RI-PMI-COI    Type   CSI-RS    Table 1    Table				
Type	Beamforming M			As specified in Annex B.4.1
Number of CSI-RS   ports (X)   CDM Type   FD-CDM2				Periodic
Donts (X)   CDM Type   Density (p)   To-CDM2				
CDM Type Density (p) 1  Density (p) 1  First subcarrier index in the PRB used for CSI-RS (ko, kr)  First OFDM symbol in the PRB used for CSI-RS (lo, lr)  CSI-RS resource Type  Number of CSI-RS ports (X)  CDM Type CDM4 (FD2, TD2)  Density (p) 1  First subcarrier index in the PRB used for CSI-RS ports (X)  CDM Type CDM4 (FD2, TD2)  Density (p) 1  First subcarrier index in the PRB used for CSI-RS acquisition  NZP CSI-RS for CSI as interval and offset aperiodic Triggerin QOffset  CSI-RS (ko, kr)  First OFDM symbol in the PRB used for CSI-RS (ko, lr)  CSI-RS interval and offset aperiodic Triggerin QOffset  CSI-IM resource Type Aperiodic  CSI-IM RE pattern Pattern Pattern 0  CSI-IM Resource Mapping (kcs)IIM Resource Mapping (kcs)IIM Resource Type Aperiodic  ReportConfigType Aperiodic  ReportConfigType Aperiodic  ReportConfigType Aperiodic  ReportConfigType Aperiodic  ReportConfigType Aperiodic  Table 1  reportQuantity timeRestrictionFortchannelMeasure ments  timeRestrictionForChannelMeasure ments  UnimeRestrictionForChannelMeasure ments  UnimeRestrictionForInterferenceMeas urements  QGI-FormatIndicator Wideband  Sub-band Size RB 8  CSI-ReportingBand 11111111  CSI-Report interval and offset slot Not configured  Aperiodic Report Slot Offset Slot Not configured  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0				4
Density (p)   First subcarrier index in the PRB used for CSI-RS (ko, kr)				ED CDM2
ZP CSI-RS   Configuration   First subcarrier index in the PRB used for CSI-RS (ko, kt)				
index in the PRB used for CSI-RS (ko, k1) First OFDM symbol in the PRB used for CSI-RS (lo, l1) CSI-RS (lo, l1) CSI-RS (lo, l1) 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 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) CSI-RS interval and offset aperiodic Triggerin gOffset CSI-IM resource Type CSI-IM RE pattern CSI-IM REsource Type CSI-IM Resource Mapping (kcsi-Mi-Csi-M) CSI-RB slot Not configured interval and offset aperiodic Triggerin goffset CSI-IM resource Type CSI-IM Sesource Mapping (kcsi-Mi-Csi-M) CSI-IM timeConfig interval and offset ReportConfigType CQI-table Table 1  reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments urements Videband Density (p) Table 1  reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments RB 8 CGI-FormatIndicator Wideband Density (p) Table 1 Table				'
used for CSI-RS (ko, kr) First OFDM symbol in the PRB 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 acquisition  NZP CSI-RS for CSI acquisition  NZP CSI-RS (ko, kr) First OFDM symbol in the PRB used for CSI-RS (lo, lr) CSI-RS interval and offset aperiodicTriggerin qOffset  CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource CSI-IM Resource CSI-IM Immeconfig interval and offset solot ReportConfigType CSI-IM timeConfig interval and offset configuration  ReportConfigType CQI-table ReportConfigType CQI-table ReportConfigTorChannelMeasure ments urements cqi-FormatIndicator Wideband Dyni-FormatIndicator SI-RB offset SI-I in slots i, where mod(i, 5) = 1, otherwise it is equal to 0  CSI request  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0				
ReportConfiguration   CSI-IM Resource Type   CSI-IM Resource Type   Aperiodic Tiggerin qOffset   CSI-IM Resource Type   Aperiodic Type   Aperiodic Type   CSI-RS (lo, lt)   CSI-IM Resource Type   Aperiodic Tiggerin qOffset   Aperiodic Tiggerin (RSI-IMI)   CSI-IM Resource Type   Aperiodic Tiggerin qOffset   CSI-IM Resource Type   Aperiodic Tiggerin qOffset   CSI-IM Resource Type   Aperiodic   CSI-IM Resource Type   Aperiodic   CSI-IM Resource Type   Aperiodic   CSI-IM Resource Type   Aperiodic   CSI-IM TimeConfig interval and offset   Slot   Not configured   Aperiodic   CCI-IT-IM TimeConfig   Slot   Not configured   Table 1   Table	configuration			Row 5, (4,-)
First OFDM   symbol in the PRB   used for CSI-RS   (lo, lr)				
Used for CSI-RS				
Used for CSI-RS				(0.)
CSI-RS   interval and offset   slot   S/1				(9,-)
Interval and offset		(l <sub>0</sub> , l <sub>1</sub> )		
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 (k <sub>0</sub> , k <sub>1</sub> ) First OFDM symbol in the PRB used for CSI-RS (l <sub>0</sub> , l <sub>1</sub> ) CSI-RS interval and offset aperiodicTriggerin gOffset CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (k <sub>CSI-IM</sub> , l <sub>CSI-IM</sub> ) CSI-IM timeConfig interval and offset ReportConfigType CQI-table ReportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements CSI-RB Row 8, (4,6)  (5,-) (5,-) (5,-) (5,-) (6,-) (6,-) (6,-) (7,-) (1,-)		CSI-RS	clot	5/1
Type Number of CSI-RS ports (X) CDM Type Density (p) Tirst subcarrier index in the PRB used for CSI-RS (ko, kr) Tirst 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 CSI-IM Resource Mapping (kosI-IM-LCSI-IM) CSI-IM timeConfig interval and offset slot Not configured Type Aperiodic CSI-IM resource Type Not configured Table 1 Table 1 TeportQuantity TimeRestrictionForChannelMeasure ments TimeRestrictionForChannelMeasure ments TimeRestrictionForInterferenceMeas urements Cqi-FormatIndicator Wideband Type-FormatIndicator Wideband Sub-band Size Si-ReportingBand Till1111 CSI-Report interval and offset Aperiodic Report Slot Offset  CSI request Tin slots i, where mod(i, 5) = 1, otherwise it is equal to 0			SIUL	3/1
Number of CSI-RS   ports (X)   CDM Type   CDM4 (FD2, TD2)				Aperiodic
Density (P)   CDM4 (FD2, TD2)		Туре		7 (portionio
Dotts (X)   CDM Type   Density (p)   1				8
Density (p)				
First subcarrier index in the PRB used for CSI-RS (ko, k1)				
NZP CSI-RS for CSI acquisition   Index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )				1
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	NZD COLDO			
acquisition  (ko, k1) 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 ginterval and offset Table 1 reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements timeRestrictionForInterferenceMeas urements sub-band Size csi-ReportingBand CSI request  (ko, k1) First OFDM symbol (5,-) Slot Not configured Aperiodic Not configured Table 1 reportQuantity timeRestrictionForInterferenceMeas urements Not configured Viideband Sub-band Size Si-ReportingBand Tin In 111111 ScSI request  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0				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 cqi-FormatIndicator Sub-band Size RB				
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   Pattern 0	acquisition			
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 Table 1 reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size RB RB RB RS csi-Report Slot Offset CSI request  Not configured Not configured  Not configured  1111111  Not configured  1111111  Not configured  11 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0				(- )
CSI-RS interval and offset aperiodic Triggerin gOffset				(5,-)
CSI-RS interval and offset aperiodicTriggerin gOffset				
Interval and offset   aperiodicTriggerin gOffset   CSI-IM resource Type		CSI-RS	alat	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 RB 8 csi-Report Slot Offset CSI request  Aperiodic Not configured Not configured Wideband Wideband Table 1 Not configured Not configured Not configured Tourier Not configured Not configured Tourier Not configured Not configured Tourier Not configured Tourier Not configured Tourier Not configured Not configured Tourier Not configured Tourier Not configured Tourier Not configured Tourier			SIOL	Not configured
CSI-IM resource   Type   CSI-IM RE pattern   Pattern 0		aperiodicTriggerin		0
CSI-IM COSI-IM RE pattern CSI-IM Resource Mapping (k <sub>CSI-IM</sub> ,l <sub>CSI-IM</sub> )  CSI-IM timeConfig interval and offset Slot 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-Report interval and offset Slot Not configured  Aperiodic  Aperiodic  Not configured  Not configured  Wideband  Sub-band Size RB 8  csi-Report interval and offset Slot Not configured  Aperiodic Report Slot Offset Slot Not configured  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0				Ů
CSI-IM RE pattern CSI-IM Resource Mapping (KcSI-IM, IcSI-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  CSI-IM Resource Mapping (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  CSI request  Table 1  Not configured  Not configured  Wideband  Sub-band Size Size Size Size Size Size Size Size				Aperiodic
CSI-IM configuration  CSI-IM Resource Mapping (k_CSI-IM, I_CSI-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  Sub-band Size RB 8  csi-ReportingBand 1111111  CSI-Report interval and offset Slot Offset  CSI request 1slot Not configured  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0				·
configuration  Mapping (kcsi-im, lcsi-im)  CSI-IM timeConfig interval and offset  ReportConfigType  Aperiodic  CQI-table  reportQuantity  timeRestrictionForChannelMeasure ments  timeRestrictionForInterferenceMeas urements  cqi-FormatIndicator  pmi-FormatIndicator  Sub-band Size  csi-ReportingBand  CSI-Report interval and offset  Aperiodic  (4,9)  Not configured  Not configured  Not configured  Wideband  Wideband  Sub-band Size  RB  8  csi-ReportingBand  CSI-Report interval and offset  Aperiodic Report Slot Offset  CSI request  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0				Pattern 0
(kcsI-IM, IcsI-IM)       CSI-IM timeConfig interval and offset       slot       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, otherwise it is equal to 0				(4.5)
CSI-IM timeConfig interval and offset       slot       Not configured         ReportConfigType       Aperiodic         CQI-table       Table 1         reportQuantity       cri-RI-PMI-CQI         timeRestrictionForChannelMeasure ments       Not configured         timeRestrictionForInterferenceMeas urements       Wideband         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, otherwise it is equal to 0	configuration			(4,9)
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, otherwise it is equal to 0				
ReportConfigType       Aperiodic         CQI-table       Table 1         reportQuantity       cri-RI-PMI-CQI         timeRestrictionForChannelMeasure ments       Not configured         timeRestrictionForInterferenceMeas urements       Wideband         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, otherwise it is equal to 0			slot	Not configured
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, otherwise it is equal to 0	PoportConfigTy			Aporiodia
reportQuantity  timeRestrictionForChannelMeasure ments  timeRestrictionForInterferenceMeas urements  cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-Report interval and offset Aperiodic Report Slot Offset  CSI request  Cri-RI-PMI-CQI Not configured  Not configured  Wideband Wideband  8 8 1111111 CSI-Report interval and offset Aperiodic Report Slot Offset  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0		PΘ		
timeRestrictionForChannelMeasure ments  timeRestrictionForInterferenceMeas urements  cqi-Formatlndicator  pmi-Formatlndicator  Sub-band Size  csi-ReportingBand  CSI-Report interval and offset  Aperiodic Report Slot Offset  CSI request  Not configured  Wideband  Wideband  8  8  1111111  Not configured  Not configured  Tin slots i, where mod(i, 5) = 1, otherwise it is equal to 0				
ments  timeRestrictionForInterferenceMeas urements  cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-Report interval and offset Aperiodic Report Slot Offset  CSI request  Not configured Wideband Wideband 8 8 1111111  Not configured  Not configured  To have the second of the second o	timeRestrictionForChannelMeasure			
timeRestrictionForInterferenceMeas urements  cqi-FormatIndicator  pmi-FormatIndicator  Sub-band Size  csi-ReportingBand  CSI-Report interval and offset  Aperiodic Report Slot Offset  CSI request  Not configured  Wideband  8  8  1111111  Not configured  Not configured  1111111  Not configured  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0				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, otherwise it is equal to 0				Nier C .
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, otherwise it is equal to 0		urements		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, otherwise it is equal to 0				Wideband
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, otherwise it is equal to 0				Wideband
CSI-Report interval and offset slot Not configured  Aperiodic Report Slot Offset 5  CSI request 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0	Sub-band Size		RB	
Aperiodic Report Slot Offset  CSI request  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0				
CSI request			slot	
otherwise it is equal to 0	Aperiodic Report Slot Offset			I.
reportTriggerSize 1	-	CSI request		
	reportTriggerSiz	e		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	(CodebookConfig- O1,CodebookConfig-O2)		(4,1)
	CodebookSubsetR estriction		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 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

### 6.3.2.1.3 Single PMI with 16TX TypeI-SinglePanel Codebook

For the parameters specified in Table 6.3.2.1.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.1.3-2.

Table 6.3.2.1.3-1: Test parameters (dual-layer)

Parameter		Unit	Test 1
Bandwidth		MHz	10
Subcarrier space	ing	kHz	15
Duplex Mode			FDD
Propagation ch	annel		TDLC300-5
Antenna config	uration		High XP 16 x 2 (N1,N2) = (4,2)
Beamforming M	1odel		As specified in Annex B.4.1
	CSI-RS resource Type		Aperiodic
	Number of CSI- RS ports (X)		4
ZP CSI-RS	CDM Type		FD-CDM2
configuration	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 5, (4,-)

	_		
	First OFDM symbol in the PRB used for CSI-RS (l <sub>0</sub> , l <sub>1</sub> )		(9,-)
	CSI-RS interval and offset	slot	Not configured
	ZP CSI-RS trigger		1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
	CSI-RS resource Type		Aperiodic
	Number of CSI- RS ports (X)		16
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
NZP CSI-RS for CSI	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> , k <sub>2</sub> , k <sub>3</sub> )		Row 12, (2, 4, 6, 8)
acquisition	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		(5, -)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggerin gOffset		0
	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM configuration	CSI-IM Resource Mapping		(4,9)
	(kcsi-im,lcsi-im) CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfigTy	/pe		Aperiodic
CQI-table	•		Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionI ments	ForChannelMeasure		Not configured
timeRestrictionI urements	ForInterferenceMeas		Not configured
cqi-FormatIndic			Wideband
pmi-FormatIndi	cator		Subband
Sub-band Size		RB	8
csi-ReportingBa			1111111
CSI-Report inte		slot	Not configured
Aperiodic Repo	rt Slot Offset		5 1 in slots i, where mod(i, 5) = 1,
•	reportTriggerSize		otherwise it is equal to 0
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)		(4,2)
	(CodebookConfig- O1,CodebookCon fig-O2)		(4,4)
	CodebookSubset Restriction		0x FFFF
	RI Restriction	-	0000010

Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	8
	n number of HARQ		4
transmiss	sion		7
Measure	ment channel		R.PDSCH.1-6.3
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 i <sub>1</sub> , i <sub>2</sub> combination.  Note 2: If the UE reports in an available uplink reporting instance at slot#n		ot (1 ms granularity) with equal mbination.  k 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.			t the gNB downlink before

Table 6.3.2.1.3-2: Minimum requirement

Parameter	Test 1
γ	2.5

# 6.3.2.1.4 Single PMI with 32TX TypeI-SinglePanel Codebook

For the parameters specified in Table 6.3.2.1.4-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.1.4-2.

Table 6.3.2.1.4-1: Test parameters (dual-layer)

Parameter		Unit	Test 1
Bandwidth		MHz	10
Subcarrier space	cing	kHz	15
Duplex Mode			FDD
Propagation cha	annel		TDLA30-5
Antenna configu	uration		High XP 32 x 2 (N1,N2) = (4,4)
Beamforming M	lodel		As specified in Annex B.4.1
	CSI-RS resource Type		Aperiodic
	Number of CSI- RS ports (X)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
ZP CSI-RS configuration	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 5, (4,-)
<b>3</b>	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		(9,-)
	CSI-RS interval and offset	slot	Not configured
	ZP CSI-RS trigger		1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
	CSI-RS resource Type		Aperiodic
NZP CSI-RS for CSI acquisition	Number of CSI- RS ports (X)		32
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> , k <sub>2</sub> , k <sub>3</sub> )		Row 17, (2, 4, 6, 8)

	1		1
	First OFDM symbol in the PRB used for CSI-RS		(5, 12)
	(I <sub>0</sub> , I <sub>1</sub> ) CSI-RS interval and offset	slot	Not configured
	aperiodicTriggerin gOffset		0
	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM configuration	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfigTy	ре		Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionF ments	ForChannelMeasure		Not configured
timeRestrictionF urements	orInterferenceMeas		Not configured
cqi-FormatIndic	ator		Wideband
pmi-FormatIndio			Wideband
Sub-band Size		RB	8
csi-ReportingBand			111111
CSI-Report interval and offset		slot	Not configured
Aperiodic Report Slot Offset			5
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		typel-SinglePanel
	Codebook Mode		1
Cadabaak	(CodebookConfig- N1,CodebookConfig-N2)		(4,4)
Codebook configuration	(CodebookConfig- O1,CodebookCon fig-O2)		(4,4)
	CodebookSubset Restriction		0x FFFF
	RI Restriction		0000010
Physical channe			PUSCH
CQI/RI/PMI delay		ms	8
Maximum number of HARQ transmission			4
Measurement c	hannel		R.PDSCH.1-6.3
Nata de Mila de Tilia de Ci			1 1 1 2 4

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 6.3.2.1.4-2: Minimum requirement

Parameter	Test 1
γ	5.0

### 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)

Par	rameter	Unit	Test 1
Bandwidth		MHz	40
Subcarrier spacing		kHz	30
Dup	lex 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 3, (4, )
	$(k_0, k_1)$		
	First OFDM		
	symbol in the PRB		(9,-)
	used for CSI-RS		(0, )
	(l <sub>0</sub> , l <sub>1</sub> )		
	CSI-RS	slot	10/1
	interval and offset		
	CSI-RS resource Type		Aperiodic
	Number of CSI-		4
	RS ports (X)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier		
NZP CSI-RS	index in the PRB		Pow 4 (0 -)
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 <sub>0</sub> , l <sub>1</sub> )		
	CSI-RS	slot	Not configured
	interval and offset		3
	aperiodicTriggerin		0
	gOffset CSI-IM resource		
	Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM	CSI-IM Resource		T attern 0
configuration	Mapping		(4,9)
oomigaraor	(kcsi-im,lcsi-im)		(1,0)
	CSI-IM timeConfig		
	interval and offset	slot	Not configured
ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasure ments			Not configured
	ForInterferenceMeas		
urements			Not configured
	cqi-FormatIndicator		Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	16
csi-ReportingBand		-	111111
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
<u> </u>		<u> </u>	., care most in o oqual to o

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	(CodebookConfig- N1,CodebookConfig-N2)		(2,1)
configuration	(CodebookConfig- O1,CodebookCon fig-O2)		(4,1)
	CodebookSubset Restriction		11111111
	RI Restriction		0000001
Physical chann	el for CSI report		PUSCH
CQI/RI/PMI del	ay	ms	5.5
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.2-8.1 TDD
Note 1: When Throughput is measured using random precoder selection, t precoder shall be updated in each slot (0.5 ms granularity) with equivalent probability of each applicable i <sub>1</sub> , i <sub>2</sub> combination.		ot (0.5 ms granularity) with equal	
Note 2: If the UE reports in an available uplink reporting instance at slot #n			k 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)

Bandwidth	Parameter Unit Test 1				
Duplex Mode					
TDD DL-UL configurations			kHz		
Propagation channel	Duplex Mode				
Antenna configuration    Beamforming Model	TDD DL-UL configurations			1	
Beamforming Mode	Propaga	ation channel			
CSI-RS resource Type	Antenna	configuration			
CSI-RS resource   Type	Beamfo	rming Model			
Type					
RS ports (X)				1 chodie	
Density (p)				4	
First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		CDM Type		FD-CDM2	
Index in the PRB   Index in th				1	
Index in the PRB   used for CSI-RS   (k₀, k₁)	ZP CSI-RS				
Used tot CSI-RS				Row 5. (4)	
First OFDM   symbol in the PRB   used for CSI-RS   (lo, l·)	J. 3.			, , , ,	
Symbol in the PRB   used for CSI-RS   ([0, 1))					
Used for CSI-RS   ((lo, ln)   (lo, ln)   (slot)					
(Io, Ir)   CSI-RS   interval and offset   Slot   10/1				(9,-)	
CSI-RS   interval and offset   Slot   10/1					
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, l1) CSI-RS interval and offset aperiodicTriggerin gOffset  CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (kcsi-Mi,lcsi-IM) CSI-RB interval and offset slot  ReportConfigtype CSI-IM timeConfig interval and offset reportQuantity TimeRestrictionForlChannelMeasur ements urements uremen					
CSI-RS resource   Type			slot	10/1	
Type				Aii	
RS ports (X)				Aperiodic	
RS ports (x)   CDM Type   Density (p)   1				8	
Density (p)					
First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )  First OFDM symbol in the PRB used for CSI-RS (l <sub>0</sub> , l <sub>1</sub> )  CSI-RS interval and offset aperiodic Triggerin gOffset  CSI-IM resource Type  CSI-IM Resource Mapping (k <sub>CSI-IM</sub> , l <sub>CSI-IM</sub> )  CSI-IM timeConfig interval and offset  ReportConfigtType  ReportConf		CDM Type		CDM4 (FD2, TD2)	
NZP CSI-RS for CSI acquisition   Index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )   First OFDM symbol in the PRB used for CSI-RS (l <sub>0</sub> , l <sub>1</sub> )   CSI-RS interval and offset aperiodicTriggerin gOffset   CSI-IM resource Type   CSI-IM Resource Mapping (k <sub>CSI-IM</sub> , l <sub>CSI-IM</sub> )   CSI-IM Resource Mapping (k <sub>CSI-IM</sub> , l <sub>CSI-IM</sub> )   CSI-IM timeConfig interval and offset   Slot   Not configured				1	
Separation   Sep					
CSI   M RE pattern   CSI   Mapping   CSI   Mapping   CSI   Mile   Mapping   Mapping   CSI   Mile   Mapping				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 Resource Mapping (kcsi-im, lcsi-im)  CSI-IM timeConfig interval and offset  ReportConfigType  CQI-table  ReportQuantity  timeRestrictionForIChannelMeasur ements  timeRestrictionForInterferenceMeas urements  timeRestrictionForInterferenceMeas urements  timeRestrictionForInterferenceMeas urements  cqi-FormatIndicator  Sub-band Size  CSI-request  First OFDM  symbol in the PRB used for CSI-RS (lo, l₁)  CSI-RS interval and offset  Slot  Not configured  Not configured  Not configured  1 1111111  CSI-Report interval and offset  Slot  Not configured				1 (0 (1,0)	
symbol in the PRB used for CSI-RS (lo, li)  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  ReportConfigType Aperiodic  CQI-table Table 1  reportQuantity cri-RI-PMI-CQI  timeRestrictionForInterferenceMeas urements  timeRestrictionForInterferenceMeas urements  cqi-FormatIndicator Wideband  Sub-band Size RB 16  CSI-request 1 in slots i, where mod(i, 10) =  CSI-request  CSI-request  Slot Not configured  Not configured  Not configured  1 in slots i, where mod(i, 10) =	acquisition				
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 CSI-IM timeConfig interval and offset  ReportQuantity  timeRestrictionForIChannelMeasur ements timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator pmi-FormatIndicator Sub-band Size CSI-Report interval and offset  RB 16 CSI-request  Not configured  11111111 CSI-Report interval and offset  RB 1 in slots i, where mod(i, 10) =					
CSI-RS   interval and offset   aperiodicTriggerin   gOffset   CSI-IM resource   Type   CSI-IM RE pattern   Pattern 0				(5,-)	
CSI-RS interval and offset aperiodicTriggerin gOffset  CSI-IM resource Type CSI-IM Resource Mapping (kcsI-IM, lcsI-IM) CSI-IM timeConfig interval and offset  ReportConfigType CQI-table TeportQuantity TreportQuantity TimeRestrictionForIChannelMeasur ements timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator pmi-FormatIndicator Sub-band Size Report Configured  ReportConfigType ReportConfigType Aperiodic CqI-table Table 1 Table 1 TreportQuantity Tri-RI-PMI-CQI Tri-RI-					
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  timeRestrictionForIChannelMeasur ements  timeRestrictionForInterferenceMeas urements  timeRestrictionForInterferenceMeas urements  cqi-FormatIndicator  Sub-band Size  csi-Report interval and offset  RB  CSI request  Not configured  Not configured  Not configured  Not configured  Not configured  Not configured  Table 1  Table 1  Table 1  Tori-RI-PMI-CQI  Not configured  Table 1  Tori-RI-PMI-CQI  Not configured  Not configured  Not configured  Not configured  Not configured  1 in slots i, where mod(i, 10) =					
aperiodicTriggerin gOffset  CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (4,9)  (KcSI-IM,ICSI-IM) CSI-IM timeConfig interval and offset  ReportConfigType CQI-table reportQuantity timeRestrictionForIChannelMeasur ements timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Sub-band Size CSI-Report interval and offset Aperiodic RB 16 CSI-Report Interval and offset Aperiodic Not configured Wideband Sub-band Size RB 16 CSI-Report interval and offset Aperiodic Report Slot Offset  8 CSI request  CSI-request  CSI-request  Aperiodic Not configured Not configured Aperiodic Report Slot Offset  8  1 in slots i, where mod(i, 10) =			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 timeRestrictionForIChannelMeasur ements timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Sub-band Size csi-Report Interval and offset  CSI-IM timeConfig interval and offset Slot Not configured Not configured Not configured Not configured Table 1  reportQuantity timeRestrictionForIChannelMeasur ements timeRestrictionForInterferenceMeas urements Cqi-FormatIndicator Sub-band Size Csi-ReportingBand CSI-Report interval and offset Aperiodic Report Slot Offset  CSI-request  Aperiodic  Aperiod					
Type  CSI-IM RE pattern  CSI-IM Resource Mapping (kcsi-im,lcsi-im)  CSI-IM timeConfig interval and offset  ReportConfigType  CQI-table reportQuantity timeRestrictionForIChannelMeasur ements timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Sub-band Size CSI-request  Type  CSI-IM RE pattern Pattern 0  Pattern 0  (4,9)  (4,9)  Not configured  Not configured  Not configured  Not configured  Wideband  1111111  CSI-Report interval and offset  Not configured  1 in slots i, where mod(i, 10) =				0	
CSI-IM RE pattern  CSI-IM Resource Mapping (kcsi-iM,lcsi-iM) CSI-IM timeConfig interval and offset  ReportConfigType CQI-table reportQuantity timeRestrictionForlChannelMeasur ements timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-Report interval and offset Aperiodic ReportConfigType Aperiodic Table 1 Table 1 TerportQuantity Cri-RI-PMI-CQI Not configured Not configured Wideband Wideband Wideband Sub-band Size RB 16 Csi-Report interval and offset Aperiodic Report Slot Offset  SI request  1 in slots i, where mod(i, 10) =				Aperiodic	
CSI-IM configuration  CSI-IM Resource Mapping (kcsi-IM, lcsi-IM)  CSI-IM timeConfig interval and offset  ReportConfigType  CQI-table  reportQuantity  timeRestrictionForlChannelMeasur ements  timeRestrictionForlnterferenceMeas urements  cqi-FormatIndicator  Sub-band Size  CSI-IM Resource (4,9)  (4,9)  Not configured  Not configured  Not configured  Wideband  Wideband  Sub-band Size  RB  16  csi-ReportingBand  CSI-Report interval and offset  Aperiodic Report Slot Offset  8  CSI-request  In slots i, where mod(i, 10) =				·	
configuration  Mapping (kcsi-iM,lcsi-iM)  CSI-IM timeConfig interval and offset  ReportConfigType Aperiodic  CQI-table Table 1  reportQuantity cri-RI-PMI-CQI  timeRestrictionForlChannelMeasur ements  timeRestrictionForInterferenceMeas urements  cqi-FormatIndicator Wideband  pmi-FormatIndicator Wideband  Sub-band Size RB 16  csi-Report interval and offset slot Not configured  Aperiodic Report Slot Offset  CSI request  Not configured  Not configured  Not configured  Wideband  11111111  CSI-Report interval and offset slot Not configured  Aperiodic Report Slot Offset  1 in slots i, where mod(i, 10) =	001.114			Pattern 0	
CSI-IM, ICSI-IM)   CSI-IM timeConfig interval and offset   slot   Not configured				(4.0)	
CSI-IM timeConfig interval and offset   Slot   Not configured	Comiguration			(4,9)	
Interval and offset   Slot   Not configured					
ReportConfigType Aperiodic  CQI-table Table 1  reportQuantity cri-RI-PMI-CQI  timeRestrictionForlChannelMeasur ements timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 16 csi-Report interval and offset Slot Not configured  Aperiodic Report Slot Offset 1 in slots i, where mod(i, 10) =			slot	Not configured	
CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForlChannelMeasur ements Not configured timeRestrictionForInterferenceMeas urements Not configured cqi-FormatIndicator 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) =				Aperiodic	
timeRestrictionForlChannelMeasur ements  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, 10) =					
timeRestrictionForlChannelMeasur ements  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, 10) =					
timeRestrictionForInterferenceMeas urements  cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-Report interval and offset Aperiodic Report Slot Offset  Not configured Wideband Wideband 116 1111111 CSI-Report interval and offset Aperiodic Report Slot Offset  1 in slots i, where mod(i, 10) =				Not configured	
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  1 in slots i, where mod(i, 10) =		ForInterferenceMeas			
cqi-FormatIndicator  pmi-FormatIndicator  Sub-band Size  Csi-ReportingBand  CSI-Report interval and offset  Aperiodic Report Slot Offset  CSI-request  Wideband  Wideband  Wideband  Slot  Not configured  Not configured  8  1 in slots i, where mod(i, 10) =				Not configured	
pmi-FormatIndicator  Sub-band Size  CSI request  Wideband  Wideband  RB  16  1111111  Not configured  Not configured  8  1 in slots i, where mod(i, 10) =		ator		Wideband	
Sub-band Size  CSI-ReportingBand  CSI-Report interval and offset  Aperiodic Report Slot Offset  CSI-request  RB  16  1111111  Not configured  8  1 in slots i, where mod(i, 10) =					
csi-ReportingBand  CSI-Report interval and offset  Aperiodic Report Slot Offset  Slot  Not configured  8  CSI request  1 in slots i, where mod(i, 10) =			RB		
CSI-Report interval and offset slot Not configured  Aperiodic Report Slot Offset 8  CSI request 1 in slots i, where mod(i, 10) =					
Aperiodic Report Slot Offset 8  CSI request 1 in slots i, where mod(i, 10) =			slot		
CSI request 1 in slots i, where mod(i, 10) =				8	
	CSI request				
1, otherwise it is equal to 0	Joi request			1, otherwise it is equal to 0	

reportTrigge	rSize		1
CSI-Aperiod	icTriggerStateList		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	(CodebookConfig- O1,CodebookCon fig-O2)		(4,1)
	CodebookSubset Restriction		0x FFFF
	RI Restriction		0000010
Physical cha	nnel for CSI report		PUSCH
CQI/RI/PMI	delay	ms	6.5
	umber of HARQ		4
	transmission		
Measurement channel			R.PDSCH.2-8.2 TDD
p p	precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable i <sub>1</sub> , i <sub>2</sub> combination.		
b	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		

Table 6.3.2.2.2: Minimum requirement

Randomization of the principle beam direction shall be used as

Parameter	Test 1
γ	1.5

### 6.3.2.2.3 Single PMI with 16TX TypeI-SinglePanel Codebook

specified in Annex B.2.3.2.3.

slot#(n+6).

Note 3:

For the parameters specified in Table 6.3.2.2.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.2.3-2.

Table 6.3.2.2.3-1: Test parameters (dual-layer)

Pai	rameter	Unit	Test 1
Ва	ndwidth	MHz	40
Subcar	rier spacing	kHz	30
Dup	lex Mode		TDD
TDD DL-UI	L configurations		FR1.30-1 as specified in Annex A
Propaga	ation channel		TDLC300-5
Antenna	configuration		High XP 16 x 2 (N1,N2) = (4,2)
Beamforming Model			As specified in Annex B.4.1
	CSI-RS resource Type		Aperiodic
ZP CSI-RS configuration	Number of CSI- RS ports (X)		4
	CDM Type		FD-CDM2
	Density (ρ)		1

	1	1	
	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		(9,-)
	CSI-RS interval and offset	slot	Not configured
	ZP CSI-RS trigger		1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
	CSI-RS resource Type		Aperiodic
	Number of CSI- RS ports (X)		16
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier		
NZP CSI-RS for CSI acquisition	index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> , k <sub>2</sub> , k <sub>3</sub> )		Row 12, (2, 4, 6, 8)
aoquiomon	First OFDM symbol in the PRB used for CSI-RS (l <sub>0</sub> , l <sub>1</sub> )		(5, -)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggerin gOffset		0
	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM configuration	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfigTy	rpe		Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
	ForlChannelMeasur		
ements	on on an interest of		Not configured
	timeRestrictionForInterferenceMeas		Not configured
cqi-FormatIndic	ator		Wideband
pmi-FormatIndio			Subband
Sub-band Size		RB	16
csi-ReportingBa	and	110	111111
CSI-Report inte		slot	Not configured
Aperiodic Repo		5,50	8
CSI request			1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
reportTriggerSiz	7P		1, 00101 1/100 10 10 0
Toportringgeroiz			One State with one Associated
			Report Configuration
CSI-AperiodicT	riggerStateList		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)		(4,2)
J	(CodebookConfig- O1,CodebookCon fig-O2)		(4,4)
<u> </u>	· 3/		<b>.</b>

	CodebookSubset Restriction		0x FFFF
	RI Restriction		0000010
Physical	channel for CSI report		PUSCH
CQI/RI/P	MI delay	ms	6.5
Maximun transmiss	n number of HARQ sion		4
Measurement channel			R.PDSCH.2-8.3 TDD
Note 1:	Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal		
Note 2:	probability of each applicable i <sub>1</sub> , i <sub>2</sub> 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-6), this reported PMI cannot be applied at the gNB downlink before slot#(n+6).		
Note 3:	,		

Table 6.3.2.2.3-2: Minimum requirement

Parameter	Test 1
γ	2.5

# 6.3.2.2.4 Single PMI with 32TX TypeI-SinglePanel Codebook

For the parameters specified in Table 6.3.2.2.4-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.2.4-2.

Table 6.3.2.2.4-1: Test parameters (dual-layer)

Pai	rameter	Unit	Test 1
Bandwidth		MHz	40
	rier spacing	kHz	30
Dup	lex Mode		TDD
TDD DL-UI	L configurations		FR1.30-1 as specified in Annex A
Propaga	ation channel		TDLA30-5
Antenna	configuration		High XP 32 x 2 (N1,N2) = (4,4)
Beamfo	rming Model		As specified in Annex B.4.1
	CSI-RS resource Type		Aperiodic
	Number of CSI- RS ports (X)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
ZP CSI-RS configuration	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (lo, l1)		(9,-)
	CSI-RS interval and offset	slot	Not configured
	ZP CSI-RS trigger		1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
NZP CSI-RS for CSI	CSI-RS resource Type		Aperiodic
acquisition	Number of CSI- RS ports (X)		32

	CDM Typo		CDM4 (FD2, TD2)
	CDM Type Density (ρ)		1 (FDZ, TDZ)
			<u>'</u>
	First subcarrier		
	index in the PRB		Row 17, (2, 4, 6, 8)
	used for CSI-RS		
	(k <sub>0</sub> , k <sub>1</sub> , k <sub>2</sub> , k <sub>3</sub> )		
	First OFDM		
	symbol in the PRB		(5, 12)
	used for CSI-RS		,
	(l <sub>0</sub> , l <sub>1</sub> )		
	CSI-RS	slot	Not configured
	interval and offset		3
	aperiodicTriggerin		0
	gOffset		-
	CSI-IM resource		Aperiodic
	Туре		·
	CSI-IM RE pattern		Pattern 0
CSI-IM	CSI-IM Resource		
configuration	Mapping		(4,9)
	(ксы-ім,Ісы-ім)		
	CSI-IM timeConfig	alat	Not configured
	interval and offset	slot	Not configured
ReportConfigTy	pe		Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
	ForIChannelMeasur		
ements			Not configured
timeRestrictionF	ForInterferenceMeas		Not configured
urements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndio	cator		Wideband
Sub-band Size		RB	16
csi-ReportingBa	and		1111111
CSI-Report inte		slot	Not configured
Aperiodic Repo			8
			1 in slots i, where mod(i, 10) =
CSI request			1, otherwise it is equal to 0
reportTriggerSiz	7 <del>.</del>		1
Toportringgoron			One State with one Associated
			Report Configuration
CSI-AperiodicT	ringerStatel ist		Associated Report
OOI / (periodie)	nggerotateList		Configuration contains pointers
			to NZP CSI-RS and CSI-IM
	Codebook Type		typel-SinglePanel
	Codebook Type  Codebook Mode		1
	(CodebookConfig-		1
	N1,CodebookConf		(4.4)
Codebook configuration	ig-N2)		(4,4)
	(CodebookConfig-		(4.4)
	O1,CodebookCon		(4,4)
	fig-O2)		
	CodebookSubset		0x FFFF
	Restriction		
	RI Restriction	1	0000010

Physical channel for CSI report			PUSCH
CQI/RI/P	MI delay	ms	6.5
Maximum	n number of HARQ		4
transmiss	sion		4
Measure	ment channel		R.PDSCH.2-8.3 TDD
Note 1:	precoder shall be updated in each slot (0.5 ms granularity) with equal		
Note 2:	probability of each applicable i <sub>1</sub> , i <sub>2</sub> combination.  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		
Note 3:	slot#(n+6). Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.		

Table 6.3.2.2.4-2: Minimum requirement

Parameter	Test 1
γ	5.0

# 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)

Bandwidth	Parameter		Unit	Test 1
Duplex Mode	Bandwidth		MHz	10
Propagation channel			kHz	15
Antenna configuration	Duplex Mode			
Beamforming Mode	Propagation cha	annel		
Beamforming   Model	Antenna configu	ıration		
CSI-RS resource   Type   Periodic				
Type	Beamforming M			As specified in Annex B.4.1
Number of CSI-R   Sports (X)   CDM Type				Periodic
RS ports (X)				
CDM Type				4
Density (p)				ED CDM2
First subcarrier index in the PRB used for CSI-RS (ko, kr)				FD-CDIVI2
Index in the PRB used for CSI-RS ((o, k))				'
Used for CSI-RS   (k0, k1)   First OFDM   symbol in the PRB   used for CSI-RS   (l0, l1)   CSI-RS   interval and offset   Type   Number of CSI-RS   (SO, k1)   First Subcarrier   index in the PRB   used for CSI-RS   (k0, k1)   Tirst subcarrier   index in the PRB   used for CSI-RS   (k0, k1)   First Subcarrier   index in the PRB   used for CSI-RS   (k0, k1)   First OFDM   symbol in the PRB   used for CSI-RS   (l0, l1)   CS				
(Ko, k1)   First OFDM   symbol in the PRB   used for CSI-RS   (Io, I1)   CSI-RS resource   Type   Aperiodic	configuration			Row 5, (4,-)
First OFDM   symbol in the PRB   used for CSI-RS   (lo, lr)				
Symbol in the PRB   used for CSI-RS   (lo, h)				
Used for CSI-RS				(0.)
CSI-RS   interval and offset   Slot   S/1				(9,-)
CSI-RS   interval and offset   Slot   S/1		$(I_0, I_1)$		
Interval and offset			olot	E/1
Type		interval and offset	SIOL	5/1
Type				Aperiodic
RS ports (X)		Туре		преполе
RS ports (X)				4
Density (p)				-
First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )  First OFDM symbol in the PRB used for CSI-RS (l <sub>0</sub> , l <sub>1</sub> )  CSI-RS interval and offset aperiodicTriggerin gOffset  CSI-IM resource Type Aperiodic  CSI-IM RE pattern Pattern 0  CSI-IM Resource Mapping (k <sub>CSI-IM</sub>  cSI-IM)  CSI-IM ImeConfig interval and offset aperiodic Triguerin goffset  ReportConfigType Aperiodic  ReportQuantity SIot Not configured  ReportQuantity TimeRestrictionForChannelMeasure ments  ImeRestrictionForInterferenceMeas urements  ImeRestrictionForInterferenceMeas urements  Sub-band Size RB 8  CSI-Report interval and offset Slot Not configured  Aperiodic Table 1  Cri-RI-PMI-CQI  Wideband  Wideband  Sub-band Size RB 8  Siot Not configured  Cri-RI-PMI-CQI  Wideband  Wideband  Pmi-FormatIndicator Wideband  Sub-band Size RB 8  Siot Not configured  Cri-RI-PMI-CQI  Wideband  Mideband  1111111  CSI-Report interval and offset Slot Not configured  Aperiodic Report Slot Offset 4  CSI request				
NZP CSI-RS for CSI acquisition   Index in the PRB used for CSI-RS (ko, k₁)				1
Second content of the content of t	NZD COLDO			
acquisition    Rist OFDM   Symbol in the PRB   Used for CSI-RS   ([0, I+)   ([0, I+)   CSI-RS   ([0, I+)   (				Row 4, (0,-)
First OFDM symbol in the PRB used for CSI-RS (lo, l1) CSI-RS interval and offset aperiodicTriggerin gOffset  CSI-IM resource Type Aperiodic CSI-IM Resource Mapping (kosi-im,losi-im) CSI-IM timeConfig interval and offset  ReportConfigType Aperiodic  CQI-table Table Table 1  reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband Sub-band Size RB 8 csi-Report interval and offset slot Not configured  Aperiodic Not configured  Wideband Sub-band Size RB 8 csi-Report interval and offset slot Not configured  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0				
symbol in the PRB used for CSI-RS (lo, lr)  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  CQI-table TeportQuantity Cri-RI-PMI-CQI  timeRestrictionForChannelMeasure ments  timeRestrictionForInterferenceMeas urements  timeRestrictionForInterferenceMeas urements  cqi-FormatIndicator Wideband  Sub-band Size RB 8  csi-Report Slot Offset 4  CSI request  (13,-)  Not configured  1111111  CSI-Report interval and offset slot Not configured  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0	acquisition			
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 cqi-FormatIndicator Sub-band Size RB RB RB RB RS CSI-Report Slot Offset Aperiodic RB RC CSI request  Not configured RISTORIA ROTE CALL R				4.5
CSI-RS interval and offset aperiodic Triggerin gOffset   CSI-IM resource Type   CSI-IM RE pattern   Pattern 0				(13,-)
CSI-RS   interval and offset   aperiodicTriggerin gOffset   CSI-IM resource Type   CSI-IM RE pattern   Pattern 0				
CSI-IM   CSI-IM resource   Type   CSI-IM Resource   Type   CSI-IM Resource   CSI-IM Resource   CSI-IM Resource   Mapping   (4,9)   (4,9)			olot	Not configured
CSI-IM resource Type CSI-IM RE pattern Pattern 0  CSI-IM Resource Mapping (4,9)  CSI-IM Resource Mapping (kcsi-iM, lcsi-iM)  CSI-IM timeConfig interval and offset Silot 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-Report interval and offset Slot Not configured  Aperiodic Report Slot Offset 4  CSI request 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0		interval and offset	SIOL	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 Aperiodic CQI-table TeportQuantity TemeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-Report interval and offset Aperiodic ReportConfigured Table 1 Table 1 TreportQuantity Not configured Not configured Wideband Wideband Wideband Sub-band Size RB 8 8 csi-ReportingBand CSI-Report interval and offset Aperiodic Report Slot Offset  CSI request  Aperiodic Aperiodic Report Slot Offset  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0		aperiodicTriggerin		0
CSI-IM CONFIGURATION  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  CSI request  Type  CSI-IM RE pattern Pattern 0  (4,9)  (4,9)  Not configured  Not configured  Not configured  Not configured  Wideband  Wideband  1111111  CSI-Report interval and offset  Aperiodic Report Slot Offset  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0				Ů
CSI-IM RE pattern  CSI-IM Resource Mapping (KcSI-IM,IcSI-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 CSI request  ReportConfigType Aperiodic Not configured Not configured Not configured  Not configured  Table 1  Not configured  Not configured  Not configured  Not configured  Table 1  ReportConfigType Aperiodic Report Slot Offset At 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0				Aperiodic
CSI-IM Resource Mapping (KcSI-IM,IcSI-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 4  CSI request  CSI-IM Resource (4,9)  (4,9)  (4,9)  (4,9)				
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  CSI request  Mapping (kcsi-im,lcsi-im) (kcsi-im,lcsi-im) (kcsi-im,lcsi-im) slot slot Not configured  Not configured  Not configured  Wideband  Wideband  1111111  CSI-Report interval and offset Aperiodic Report Slot Offset  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0				Pattern 0
CSI-IM, ICSI-IM)   CSI-IM timeConfig interval and offset   Slot   Not configured				(4.5)
CSI-IM timeConfig interval and offset       slot       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       4         CSI request       1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0	configuration			(4,9)
Interval and offset   Siot   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         csi-ReportingBand       1111111         CSI-Report interval and offset       slot       Not configured         Aperiodic Report Slot Offset       4         CSI request       1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0			slot	Not configured
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       4         CSI request       1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0	ReportConfigTy			Aperiodic
reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments Not configured timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size RB Scsi-ReportingBand CSI-Report interval and offset Aperiodic Report Slot Offset  CSI request  CSI request  Not configured Wideband Wideband Sub-band Size RB Scsi-ReportingBand T111111  CSI-Report interval and offset Aperiodic Report Slot Offset  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0		pυ		
timeRestrictionForChannelMeasure ments  timeRestrictionForInterferenceMeas urements  cqi-FormatIndicator pmi-FormatIndicator Sub-band Size Csi-ReportingBand CSI-Report interval and offset Aperiodic Report Slot Offset  CSI request  Not configured Wideband Wideband Sub-band Size RB 8 1111111 CSI-Report interval and offset Aperiodic Report Slot Offset  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0				
ments     Not configured       timeRestrictionForInterferenceMeas 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     4       CSI request     1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0		ForChannelMeasure		
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     4       CSI request     1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0				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     4       CSI request     1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0	timeRestrictionForInterferenceMeas			Not southwared
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       4         CSI request       1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0	urements		<u> </u>	inot configured
Sub-band Size  CSi-ReportingBand  CSI-Report interval and offset  Aperiodic Report Slot Offset  CSI request  RB  8  1111111  Not configured  4  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0				Wideband
csi-ReportingBand       1111111         CSI-Report interval and offset       slot       Not configured         Aperiodic Report Slot Offset       4         CSI request       1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0	pmi-FormatIndicator			Wideband
CSI-Report interval and offset slot Not configured  Aperiodic Report Slot Offset 4  CSI request 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0			RB	_
Aperiodic Report Slot Offset  CSI request  4  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0				
CSI request				
otherwise it is equal to 0	Aperiodic Repo	rt Slot Offset		-
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	(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 channel			R.PDSCH.1-6.1 FDD
Note 1: When Throughput is measured using random precoder selection precoder shall be updated in each slot (1 ms granularity) with each slot (2 ms granularity).			•

probability of each applicable i<sub>1</sub>, i<sub>2</sub> 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

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 <b>6.3.3.1.2</b>	2-1: Test parameters		
	er) Parameter	Unit	Test 1
Bandwidth			10
Subcarrier space	cing	kHz	15
Duplex Mode			FDD
Propagation cha	annel		TDLA30-5
Antenna configu	uration		High XP 8 x 4 (N1,N2) = (4,1)
Beamforming M	lodel		As specified in Annex B.4.1
	CSI-RS resource		Periodic
	Туре		1 enouic
	Number of CSI-		4
	RS ports (X)		ED CDM2
	CDM Type Density (ρ)		FD-CDM2
	First subcarrier		<u>'</u>
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		(0, )
	(I <sub>0</sub> , I <sub>1</sub> ) CSI-RS		
	interval and offset	slot	5/1
	CSI-RS resource		A
	Type		Aperiodic
	Number of CSI-		8
	RS ports (X)		
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
NZP CSI-RS	First subcarrier index in the PRB		
for CSI	used for CSI-RS		Row 8, (4,6)
acquisition	$(k_0, k_1)$		
	First OFDM		
	symbol in the PRB		(5,-)
	used for CSI-RS		(0, )
	(l <sub>0</sub> , l <sub>1</sub> ) CSI-RS		
	interval and offset	slot	Not configured
	aperiodicTriggerin		
	gOffset		0
	CSI-IM resource		Aperiodic
	Type		·
CSI-IM	CSI-IM RE pattern CSI-IM Resource		Pattern 0
configuration	Mapping		(4,9)
garamen	(kcsi-im,lcsi-im)		(1,0)
	CSI-IM timeConfig	alat	Not configured
	interval and offset	slot	Not configured
ReportConfigTy	rpe		Aperiodic
CQI-table			Table 1 cri-RI-PMI-CQI
reportQuantity timeRestriction	ForChannelMeasure		
ments	J. O. G. II IOIIVIOGOGI G		Not configured
timeRestrictionForInterferenceMeas			Not configured
urements			
cqi-FormatIndicator			Wideband
pmi-FormatIndicator		DD	Wideband
Sub-band Size		RB	8 1111111
csi-ReportingBand CSI-Report interval and offset		slot	Not configured
Aperiodic Repo		0.01	5
CSI request			1 in slots i, where $mod(i, 5) = 1$ ,
CSI request			otherwise it is equal to 0

reportTrig	ggerSiz	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
Codeboo	le.	(CodebookConfig- N1,CodebookConfig-N2)		(4,1)
configura	• •	(CodebookConfig- O1,CodebookCon fig-O2)		(4,1)
		CodebookSubset Restriction		0x FFFF
		RI Restriction		0000010
Physical channel for CSI report			PUSCH	
CQI/RI/P		,	ms	8
	Maximum number of HARQ transmission			4
Measurer	ment c	hannel		R.PDSCH.1-6.2 FDD
Note 1:				random precoder selection, the
	precoder shall be updated in each slot (1 ms granularity) with equaprobability of each applicable $i_1$ , $i_2$ combination.			mbination.
Note 2:	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).			k slot not later than slot#(n-4),
Note 3:	te 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.			direction shall be used as

Table 6.3.3.1.2-2: Minimum requirement

Parameter	Test 1
γ	1.5

# 6.3.3.1.3 Single PMI with 16TX TypeI-SinglePanel Codebook

For the parameters specified in Table 6.3.3.1.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.1.3-2.

Table 6.3.3.1.3-1: Test parameters (dual-layer)

Parameter		Unit	Test 1
Bandwidth		MHz	10
Subcarrier space	ing	kHz	15
Duplex Mode			FDD
Propagation cha	annel		TDLC300-5
Antenna configuration			High XP 16 x 4 (N1,N2) = (4,2)
Beamforming M	Beamforming Model		As specified in Annex B.4.1
	CSI-RS resource Type		Aperiodic
ZP CSI-RS configuration	Number of CSI- RS ports (X)		4
	CDM Type		FD-CDM2
	Density (ρ)		1

		1	
	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		(9,-)
	CSI-RS interval and offset	slot	Not configured
	ZP CSI-RS trigger		1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
	CSI-RS resource Type		Aperiodic
	Number of CSI- RS ports (X)		16
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
NZP CSI-RS for CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> , k <sub>2</sub> , k <sub>3</sub> )		Row 12, (2, 4, 6, 8)
acquisition	First OFDM symbol in the PRB used for CSI-RS (lo, l1)		(5, -)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggerin gOffset		0
	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM configuration	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfigTy	/pe		Aperiodic
CQI-table	•		Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestriction	ForChannelMeasure		Not configured
timeRestrictionI	ForInterferenceMeas		Not configured
cqi-FormatIndic	rator		Wideband
pmi-FormatIndio			Subband
Sub-band Size	cator	RB	8
	and	KD	-
csi-ReportingBa		slot	1111111
	CSI-Report interval and offset Aperiodic Report Slot Offset		Not configured 5
CSI request			1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
reportTriggerSize			1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
	Codebook Type		typel-SinglePanel
	Codebook Mode		1
Codebook configuration	(CodebookConfig- N1,CodebookConf ig-N2)		(4,2)
	(CodebookConfig- O1,CodebookCon fig-O2)		(4,4)

	CodebookSubset Restriction		0x FFFF
	RI Restriction		0000010
Physical channel for CSI report			PUSCH
CQI/RI/P	'MI delay	ms	8
Maximun	n number of HARQ sion		4
Measurement channel			R.PDSCH.1-6.3 FDD
Note 1: When Throughput is measured using random precoder selection precoder shall be updated in each slot (1 ms granularity) with equivalent probability of each applicable i <sub>1</sub> , i <sub>2</sub> combination.  Note 2: If the UE reports in an available uplink reporting instance at slot# based on PMI estimation at a downlink slot not later than slot#(n-this reported PMI cannot be applied at the gNB downlink before slot#(n+4).		ot (1 ms granularity) with equal mbination. k reporting instance at slot#n k slot not later than slot#(n-4),	
Note 3:	Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.		

Table 6.3.3.1.3-2: Minimum requirement

Parameter	Test 1
γ	3.0

# 6.3.3.1.4 Single PMI with 32TX TypeI-SinglePanel Codebook

For the parameters specified in Table 6.3.3.1.4-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.1.4-2.

Table 6.3.3.1.4-1: Test parameters (dual-layer)

Parameter		Unit	Test 1
Bandwidth		MHz	10
Subcarrier space	cing	kHz	15
Duplex Mode			FDD
Propagation cha	annel		TDLA30-5
Antenna configu	uration		High XP 32 x 4 (N1,N2) = (4,4)
Beamforming M	lodel		As specified in Annex B.4.1
	CSI-RS resource Type		Aperiodic
	Number of CSI- RS ports (X)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
ZP CSI-RS configuration	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (lo, l1)		(9,-)
	CSI-RS interval and offset	slot	Not configured
	ZP CSI-RS trigger		1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
NZP CSI-RS	CSI-RS resource Type		Aperiodic
for CSI	Number of CSI- RS ports (X)		32
acquisition	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1

	F: / .		
	First subcarrier		
	index in the PRB		Row 17, (2, 4, 6, 8)
	used for CSI-RS		, , , , ,
	(k <sub>0</sub> , k <sub>1</sub> , k <sub>2</sub> , k <sub>3</sub> )		
	First OFDM		
	symbol in the PRB		(5, 12)
	used for CSI-RS		
	(l <sub>0</sub> , l <sub>1</sub> )		
	CSI-RS	slot	Not configured
	interval and offset		3
	aperiodicTriggerin		0
	gOffset		-
	CSI-IM resource		Aperiodic
	Туре		•
	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	0.00	-
ReportConfigTy	pe		Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionF	ForChannelMeasure		Not configured
ments	ments		140t configured
timeRestrictionF	ForInterferenceMeas		Not configured
urements			-
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	8
	•		
csi-ReportingBa	and		1111111
csi-ReportingBa		slot	1111111 Not configured
	rval and offset	slot	
CSI-Report inte Aperiodic Repo	rval and offset	slot	Not configured
CSI-Report inte	rval and offset	slot	Not configured 5
CSI-Report inte Aperiodic Repo	rval and offset rt Slot Offset	slot	Not configured 5 1 in slots i, where mod(i, 5) = 1,
CSI-Report inte Aperiodic Repo CSI request	rval and offset rt Slot Offset	slot	Not configured 5 1 in slots i, where mod(i, 5) = 1,
CSI-Report inte Aperiodic Repo CSI request	rval and offset rt Slot Offset	slot	Not configured  5  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0  1  One State with one Associated
CSI-Report inte Aperiodic Repo CSI request	rval and offset rt Slot Offset ze	slot	Not configured  5 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0  1
CSI-Report inte Aperiodic Repo CSI request reportTriggerSiz	rval and offset rt Slot Offset ze	slot	Not configured  5  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0  1  One State with one Associated Report Configuration
CSI-Report inte Aperiodic Repo CSI request reportTriggerSiz	rval and offset rt Slot Offset ze	slot	Not configured 5 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0 1 One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
CSI-Report inte Aperiodic Repo CSI request reportTriggerSiz	rval and offset rt Slot Offset ze	slot	Not configured 5 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0 1 One State with one Associated Report Configuration Associated Report Configuration contains pointers
CSI-Report inte Aperiodic Repo CSI request reportTriggerSiz	rval and offset rt Slot Offset ze riggerStateList	slot	Not configured 5 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0 1 One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
CSI-Report inte Aperiodic Repo CSI request reportTriggerSiz	rval and offset rt Slot Offset ze riggerStateList Codebook Type	slot	Not configured 5 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0 1 One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
CSI-Report inte Aperiodic Repo CSI request reportTriggerSiz	rval and offset rt Slot Offset ze riggerStateList Codebook Type Codebook Mode	slot	Not configured 5 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0 1 One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
CSI-Report inte Aperiodic Repo CSI request reportTriggerSiz  CSI-AperiodicTri	rval and offset rt Slot Offset  ze riggerStateList  Codebook Type Codebook Mode (CodebookConfig-	slot	Not configured 5  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0  1 One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM typeI-SinglePanel  1
CSI-Report inte Aperiodic Repo CSI request reportTriggerSiz  CSI-AperiodicTri  Codebook	rval and offset rt Slot Offset  ze  riggerStateList  Codebook Type Codebook Mode (CodebookConfig- N1,CodebookConf	slot	Not configured 5  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0  1 One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM typeI-SinglePanel  1
CSI-Report inte Aperiodic Repo CSI request reportTriggerSiz  CSI-AperiodicTri	rval and offset rt Slot Offset  ze  riggerStateList  Codebook Type Codebook Mode (CodebookConfig- N1,CodebookConfig- ig-N2)	slot	Not configured 5  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0  1 One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM typeI-SinglePanel  1
CSI-Report inte Aperiodic Repo CSI request reportTriggerSiz  CSI-AperiodicTri  Codebook	rval and offset rt Slot Offset  ze  riggerStateList  Codebook Type Codebook Mode (CodebookConfig-N1,CodebookConfig-N2) (CodebookConfig-O1,CodebookConfig-O1,CodebookConfig-O2)	slot	Not configured 5  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0  1  One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM typeI-SinglePanel  1  (4,4)
CSI-Report inte Aperiodic Repo CSI request reportTriggerSiz  CSI-AperiodicTri  Codebook	rval and offset rt Slot Offset  ze  riggerStateList  Codebook Type Codebook Mode (CodebookConfig- N1,CodebookConfig- N2) (CodebookConfig- O1,CodebookConfig- O1,CodebookConfig- O1,CodebookConfig-	slot	Not configured 5  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0  1  One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM typel-SinglePanel  1  (4,4)
CSI-Report inte Aperiodic Repo CSI request reportTriggerSiz  CSI-AperiodicTri  Codebook	rval and offset rt Slot Offset  ze  riggerStateList  Codebook Type Codebook Mode (CodebookConfig-N1,CodebookConfig-N2) (CodebookConfig-O1,CodebookConfig-O1,CodebookConfig-O2)	slot	Not configured 5  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0  1 One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM typeI-SinglePanel  1 (4,4)
CSI-Report inte Aperiodic Repo CSI request reportTriggerSiz  CSI-AperiodicTri  Codebook	rval and offset rt Slot Offset  ze  riggerStateList  Codebook Type CodebookConfig- N1,CodebookConfig- N2) (CodebookConfig- O1,CodebookCon fig-O2) CodebookSubset	slot	Not configured 5  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0  1  One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM typel-SinglePanel  1  (4,4)
CSI-Report inte Aperiodic Repo CSI request reportTriggerSiz  CSI-AperiodicTri  Codebook	rval and offset rt Slot Offset  ze  riggerStateList  Codebook Type CodebookConfig- N1,CodebookConfig- N2) (CodebookConfig- O1,CodebookConfig- O1,CodebookConfig- O2) CodebookSubset Restriction RI Restriction	slot	Not configured 5  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0  1  One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM typeI-SinglePanel  1  (4,4)  (4,4)
CSI-Report inte Aperiodic Repo CSI request reportTriggerSiz  CSI-AperiodicTri  Codebook configuration	rval and offset rt Slot Offset  ze  riggerStateList  Codebook Type Codebook Mode (CodebookConfig-N1,CodebookConfig-N2) (CodebookConfig-O1,CodebookConfig-O2) CodebookSubset Restriction RI Restriction el for CSI report	slot	Not configured 5  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0  1  One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM typel-SinglePanel  1  (4,4)  (4,4)  0x FFFF  00000010
CSI-Report inte Aperiodic Repo CSI request reportTriggerSiz  CSI-AperiodicTri  Codebook configuration	rval and offset rt Slot Offset  ze  riggerStateList  Codebook Type Codebook Mode (CodebookConfig- N1,CodebookConfig- N2) (CodebookConfig- O1,CodebookConfig- O1,CodebookCon fig-O2) CodebookSubset Restriction RI Restriction el for CSI report		Not configured 5  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0  1 One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM typeI-SinglePanel  1 (4,4)  0x FFFF 00000010 PUSCH 8
CSI-Report inte Aperiodic Repo CSI request reportTriggerSiz  CSI-AperiodicTr  Codebook configuration  Physical channe CQI/RI/PMI dela	rval and offset rt Slot Offset  ze  riggerStateList  Codebook Type Codebook Mode (CodebookConfig- N1,CodebookConfig- N2) (CodebookConfig- O1,CodebookConfig- O1,CodebookCon fig-O2) CodebookSubset Restriction RI Restriction el for CSI report		Not configured 5  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0  1  One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM typel-SinglePanel  1  (4,4)  (4,4)  0x FFFF  00000010 PUSCH
CSI-Report inte Aperiodic Repo CSI request reportTriggerSiz  CSI-AperiodicTr  Codebook configuration  Physical channe CQI/RI/PMI dela Maximum numb	rval and offset rt Slot Offset  ze  riggerStateList  Codebook Type Codebook Mode (CodebookConfig- N1,CodebookConfig- O1,CodebookConfig- O1,CodebookConfig- O2) CodebookSubset Restriction RI Restriction el for CSI report ay per of HARQ		Not configured 5  1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0  1 One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM typeI-SinglePanel  1 (4,4)  0x FFFF 00000010 PUSCH 8

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 6.3.3.1.4-2: Minimum requirement

Parameter	Test 1
γ	7.0

### 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)

Pai	rameter	Unit	Test 1
Bandwidth		MHz	10
Subcarrier spac	ing	kHz	15
Duplex Mode			FDD
Propagation cha	annel		TDLA30-5
Antenna configu	ıration		High XP 8 x 4
			(N1,N2) = (4,1)
Beamforming M			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 D-0DIVIZ
	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		(0.)
	used for CSI-RS		(9,-)
	(l <sub>0</sub> , l <sub>1</sub> )		
	CSI-RS	slot	5/1
	interval and offset	0.01	G, .
	CSI-RS resource		Aperiodic
	Type Number of CSI-RS		·
			8
	ports (X) CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier		I I
NZP CSI-RS	index in the PRB		
for CSI	used for CSI-RS		Row 8, (4,6)
acquisition	(k <sub>0</sub> , k <sub>1</sub> )		
'	First OFDM		
	symbol in the PRB		(5.)
	used for CSI-RS		(5,-)
	(l <sub>0</sub> , l <sub>1</sub> )		
	CSI-RS	slot	Not configured
	interval and offset	0.01	. tot cogarca
	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)
Comigaration	(k <sub>CSI-IM</sub> ,l <sub>CSI-IM</sub> )		(4,0)
	CSI-IM timeConfig		
	interval and offset	slot	Not configured
ReportConfigTy	ReportConfigType		Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
	timeRestrictionForChannelMeasure		Not configured
ments			. ist somigatod
	timeRestrictionForInterferenceMeas		Not configured
urements			-
	cqi-FormatIndicator		Wideband
pmi-FormatIndio	zaเ0f	DD	Wideband
	and .	RB	8 1111111
csi-ReportingBa		slot	Not configured
Aperiodic Report		ગાળા	5
CSI request	t Siot Oliset		1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
reportTriggerSiz	'Δ		1
reportinggeroiz		<u> </u>	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,CodebookConfig-O2)		(4,1)
	CodebookSubsetR estriction		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 FDD

When Throughput is measured using random precoder selection, the Note 1: precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable i<sub>1</sub>, i<sub>2</sub> combination.

If the UE reports in an available uplink reporting instance at slot#n

Note 2: 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). Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.

Note 3:

	nex B.2.3.2.3.		
Parameter		Unit	Test 1
Bandwidth		MHz	40
Subcarrier spac	ing	kHz	30
Duplex Mode			TDD
TDD DL-UL con	figuration		FR1.30-1 as specified in Annex A
Propagation cha	nnel		TDLA30-5
Antenna configu	ıration		High XP 4 x 4 (N1,N2) = (2,1)
Beamforming M	odel		As specified in Annex B.4.1
-	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (X)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
ZP CSI-RS configuration	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (lo, l1)		(9,-)
	CSI-RS interval and offset	slot	10/1
	CSI-RS resource Type		Aperiodic
NZP CSI-RS	Number of CSI-RS ports (X)		4
for CSI	CDM Type		FD-CDM2
acquisition	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 4, (0,-)

	First OFDM symbol in the PRB used for CSI-RS (lo, l1)		(13,-)
	CSI-RS interval and offset		Not configured
	aperiodicTriggerin gOffset		0
	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM configuration	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfigTy	pe		Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionF ments	orChannelMeasure		Not configured
timeRestrictionF urements	ForInterferenceMeas		Not configured
cgi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	16
csi-ReportingBand			1111111
CSI-Report interval and offset		slot	Not configured
Aperiodic Repor			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,CodebookConfig-O2)		(4,1)
	CodebookSubsetR estriction		11111111
	RI Restriction		0000001
Physical channel for CSI report			PUSCH
	CQI/RI/PMI delay		5.5
Maximum number of HARQ transmission			4
Measurement cl	nannel		R.PDSCH.2-8.1 TDD
			random precoder selection, the

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<sub>1</sub>, i<sub>2</sub> 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 6.3.3.2.1-2: Minimum requirement

Parameter	Test 1
γ	1.3

# 6.3.3.2.2 Single PMI with 8TX TypeI-SinglePanel Codebook

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	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 <sub>0</sub> , l <sub>1</sub> )		
	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 <sub>0</sub> , k <sub>1</sub> ) First OFDM		
	symbol in the PRB		<b>/-</b> \
	used for CSI-RS		(5,-)
	(l <sub>0</sub> , l <sub>1</sub> )		
	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			Table 1 cri-RI-PMI-CQI
reportQuantity timeRestrictionForChannnelMeasur			
ements			Not configured
timeRestrictionForInterferenceMeas			Not configured
urements			
cqi-FormatIndicator			Wideband
pmi-FormatIndicator		DD	Wideband
Sub-band Size csi-ReportingBand		RB	16 1111111
CSI-Report inte	rval and offset	slot	Not configured
Aperiodic Repo		0.00	8
CSI request			1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0

Note 3:

reportTrigge	rSize		1
CSI-Aperiod	icTriggerStateList		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
Measuremer	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 <sub>1</sub> , i <sub>2</sub> 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-6), this reported PMI cannot be applied at the gNB downlink before slot#(n-6)			

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

## 6.3.3.2.3 Single PMI with 16TX TypeI-SinglePanel Codebook

specified in Annex B.2.3.2.3.

For the parameters specified in Table 6.3.3.2.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.2.3-2.

Table 6.3.3.2.3-1: 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
Propagation channel			TDLC300-5
Antenna configuration			High XP 16 x 4 (N1,N2) = (4,2)
Beamforming Model			As specified in Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Aperiodic
	Number of CSI- RS ports (X)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 5, (4,-)

	_		1
	First OFDM symbol in the PRB used for CSI-RS (l <sub>0</sub> , l <sub>1</sub> )		(9,-)
	CSI-RS interval and offset	slot	Not configured
	ZP CSI-RS trigger		1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
	CSI-RS resource Type		Aperiodic
	Number of CSI- RS ports (X)		16
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
NZP CSI-RS for CSI	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> , k <sub>2</sub> , k <sub>3</sub> )		Row 12, (2, 4, 6, 8)
acquisition	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		(5, -)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggerin gOffset		0
	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM configuration	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfigTy	ReportConfigType		Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
ements	ForChannnelMeasur		Not configured
urements	ForInterferenceMeas		Not configured
cqi-FormatIndic			Wideband
pmi-FormatIndi	cator		Subband
Sub-band Size		RB	16
csi-ReportingBa			1111111
CSI-Report inte		slot	Not configured
Aperiodic Repo	rt Slot Offset		1 in slots i, where mod(i, 10) =
reportTriggerSiz	ze		1, otherwise it is equal to 0
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
Codebaal	(CodebookConfig- N1,CodebookConfig-N2)		(4,2)
Codebook configuration	(CodebookConfig- O1,CodebookCon fig-O2)		(4,4)
	CodebookSubset Restriction		0x FFFF
	RI Restriction		0000010

Physical	Physical channel for CSI report		PUSCH
CQI/RI/P	MI delay	ms	6.5
Maximum	n number of HARQ		4
transmiss	sion		4
Measurer	ment channel		R.PDSCH.2-8.3 TDD
Note 1:	Note 1: When Throughput is measured using random precoder selection, th		
Note 2:	precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable i <sub>1</sub> , i <sub>2</sub> 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-6), this reported PMI cannot be applied at the gNB downlink before		
Note 3:	slot#(n+6).  Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.		

Table 6.3.3.2.3-2: Minimum requirement

Parameter	Test 1
γ	3.0

## 6.3.3.2.4 Single PMI with 32TX TypeI-SinglePanel Codebook

For the parameters specified in Table 6.3.3.2.4-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.2.4-2.

Table 6.3.3.2.4-1: Test parameters (dual-layer)

Parameter		Unit	Test 1
Bandwidth		MHz	40
Subcarrier space	Subcarrier spacing		30
Duplex Mode			TDD
TDD DL-UL cor	ifigurations		FR1.30-1 as specified in Annex A
Propagation cha	annel		TDLA30-5
Antenna configu	uration		High XP 32 x 4 (N1,N2) = (4,4)
Beamforming M	lodel		As specified in Annex B.4.1
	CSI-RS resource Type		Aperiodic
	Number of CSI- RS ports (X)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
ZP CSI-RS configuration	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (l <sub>0</sub> , l <sub>1</sub> )		(9,-)
	CSI-RS interval and offset	slot	Not configured
	ZP CSI-RS trigger		1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
NZP CSI-RS	CSI-RS resource Type		Aperiodic
for CSI	Number of CSI- RS ports (X)		32
acquisition	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1

	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> , k <sub>2</sub> , k <sub>3</sub> )		Row 17, (2, 4, 6, 8)
	First OFDM symbol in the PRB used for CSI-RS (l <sub>0</sub> , l <sub>1</sub> )		(5, 12)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggerin gOffset		0
	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM configuration	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfigTy	pe		Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionF ements	timeRestrictionForChannnelMeasur ements		Not configured
timeRestrictionF urements	timeRestrictionForInterferenceMeas urements		Not configured
cqi-FormatIndic	ator		Wideband
pmi-FormatIndio			Wideband
Sub-band Size		RB	16
csi-ReportingBa	ınd		111111
CSI-Report inte		slot	Not configured
Aperiodic Repo		0.01	8
CSI request			1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
reportTriggerSiz	7e		1
CSI-AperiodicTi	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 (CodebookConfig- N1,CodebookConf		1 (4,4)
Codebook configuration	ig-N2) (CodebookConfig-O1,CodebookConfig-O2)		(4,4)
	CodebookSubset Restriction		0x FFFF
	RI Restriction		0000010
Physical channe			PUSCH
CQI/RI/PMI dela		ms	6.5
Maximum numb	er of HARQ		4
Measurement c	hannel		R.PDSCH.2-8.3 TDD
Note 1: When Throughput is more			

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<sub>1</sub>, i<sub>2</sub> 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-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 6.3.3.2.4-2: Minimum requirement

Parameter	Test 1
γ	7.0

## 6.4 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.

## 6.4.1 1RX requirements

(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	acing	kHz	15	15	15
Duplex Mode			FDD	FDD	FDD
SNR		dB	0	20	20
Propagation c			TDLA30-5	TDLA30-5	TDLA30-5
Antenna confi	guration		ULA Low 2x2	ULA Low 2x2	ULA High 2x2
Beamforming	Model		As defined in	As defined in	As defined in
			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
ZP CSI-RS	CDM Type Density (p)		FD-CDM2 1	FD-CDM2	FD-CDM2
configuratio	First subcarrier index in the		1	1	1
n	PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 5, (4,-)	Row 5, (4,-)	Row 5, (4,-)
''	First OFDM symbol in the PRB				
	used for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		(9,-)	(9,-)	(9,-)
	CSI-RS				-11
	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
NZD OOL	CDM Type		FD-CDM2	FD-CDM2	FD-CDM2
NZP CSI- RS for CSI	Density (ρ)		1	1	1
acquisition	First subcarrier index in the		Row 3 (6,-)	Row 3 (6,-)	Row 3 (6,-)
	PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> ) First OFDM symbol in the PRB		- (-, )	- (-, /	- (-, )
	used for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		(13,-)	(13,-)	(13,-)
	NZP CSI-RS-timeConfig				
	periodicity and offset	slot	5/1	5/1	5/1
	CSI-IM resource Type		Periodic	Periodic	Periodic
001.104	CSI-IM RE pattern		Pattern 0	Pattern 0	Pattern 0
CSI-IM configuratio	CSI-IM Resource Mapping		(4.0)	(4.0)	
n	(kcsi-im,lcsi-im)		(4,9)	(4,9)	(4,9)
	CSI-IM timeConfig periodicity and offset	slot	5/1	5/1	5/1
ReportConfig			Periodic	Periodic	Periodic
CQI-table	. , , , ,		Table 2	Table 2	Table 2
	_			cri-RI-PMI-	cri-RI-PMI-
reportQuantity	1		cri-RI-PMI-CQI	CQI	CQI
timeRestrictio	nForChannelMeasurements		not configured	not configured	not configured
				not	not
timeRestriction	nForInterferenceMeasurements		not configured	configured	configured
cqi-FormatInd	icator		Wideband	Wideband	Wideband
pmi-FormatInd			Wideband	Wideband	Wideband
Sub-band Size		RB	8	8	8
csi-ReportingI	Band		1111111	1111111	1111111
CSI-Report pe	eriodicity and offset	slot	5/0	5/0	5/0
	Codebook Type		typel-	typel-	typel-
			SinglePanel	SinglePanel	SinglePanel
	Codebook Mode		1	1	1
0-4-1	(CodebookConfig-		N/A	N/A	N/A
Codebook	N1,CodebookConfig-N2)			000011 for	
configuration	CodebookSubsetRestriction		010000 for fixed rank 2,	fixed rank 1,	000011 for fixed rank 1,
			010011 for	010011 for	010011 for
			following rank	following rank	following rank
	RI Restriction		N/A	N/A	N/A
Physical chan	nel for CSI report		PUCCH	PUCCH	PUCCH
CQI/RI/PMI de		ms	8	8	8
	nber of HARQ transmission		1	1	1
RI Configurati			Fixed RI = 2	Fixed RI = 1	Fixed RI = 1
AT Comigurati	OII		and follow RI	and follow RI	and follow RI

Table 6.4.2.1-2: Minimum requirement (FDD)

	Test 1	Test 2	Test 3
21	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	1 diameter	MHz	40	40	40
Subcarrier sp	acing	kHz	30	30	30
Duplex Mode			TDD	TDD	TDD
TDD Slot Cor			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	iguration		ULA Low 2x2	ULA Low 2x2	ULA High 2x2
Doomforming	Madal		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 (ρ)		1	1	1
configuratio n	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 5, (4,-)	Row 5, (4,-)	Row 5, (4,-)
	First OFDM symbol in the PRB		(2.)	(5.)	(5.)
	used for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		(9,-)	(9,-)	(9,-)
	CSI-RS	-1-4	40/4	40/4	40/4
	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 (ρ)		1	1	1
RS for CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 3 (6,-)	Row 3 (6,-)	Row 3 (6,-)
acquioinon	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		(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 configuratio	CSI-IM Resource Mapping		(4,9)	(4,9)	(4,9)
n	(kcsi-im,lcsi-im) CSI-IM timeConfig				
	periodicity and offset	slot	10/1	10/1	10/1
ReportConfig			Periodic	Periodic	Periodic
CQI-table	71		Table 2	Table 2	Table 2
ranartOuantity	,		ori DI DMI COL	cri-RI-PMI-	cri-RI-PMI-
reportQuantity	y		cri-RI-PMI-CQI	CQI	CQI
timeRestrictio	nForChannelMeasurements		not configured	not configured	not configured
timePestrictio	nForInterferenceMeasurements		not configured	not	not
umercestrictio	The office reference we as a rements		•	configured	configured
cqi-FormatInd			Wideband	Wideband	Wideband
pmi-FormatIn			Wideband	Wideband	Wideband
Sub-band Siz		RB	16	16	16
csi-Reporting			1111111	1111111	1111111
CSI-Report pe	eriodicity and offset	slot	10/9	10/9	10/9
	Codebook Type		typel-	typel-	typel-
	Codebook Mode		SinglePanel 1	SinglePanel	SinglePanel 1
	(CodebookConfig-		N/A	N/A	N/A
Codebook	N1,CodebookConfig-N2)				
configuration	CodebookSubsetRestriction		010000 for	000011 for	000011 for
			fixed rank 2,	fixed rank 1,	fixed rank 1,
			010011 for	010011 for	010011 for
	RI Restriction		following rank N/A	following rank	following rank N/A
Dhysical char	nnel for CSI report		PUCCH	N/A PUCCH	PUCCH
CQI/RI/PMI d		ms	9.5	9.5	9.5
	nber of HARQ transmission	1115	9.5	9.5	9.5 1
			Fixed RI = 2	Fixed RI = 1	Fixed RI = 1
RI Configurati	ion		and follow RI	and follow RI	and follow RI
			•	•	

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 <sub>0</sub> , k <sub>1</sub> )		10W 3, (+,-)	110W 3, (+,-)	110W 3, (+,-)	110W 3, (+,-)
	First OFDM symbol in the PRB		(9,-)	(9,-)	(9,-)	(9,-)
ļ	used for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		(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 <sub>0</sub> , k <sub>1</sub> )		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 <sub>0</sub> , I <sub>1</sub> )		(.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

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

Table 6.4.3.1-2: Minimum requirement (FDD)

	Test 1	Test 2	Test 3	Test 4
<i>γ</i> 1	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 <sub>0</sub> , k <sub>1</sub> )		Row 5, (4,-)	Row 5, (4,-)	Row 5, (4,-)	Row 5, (4,-)
n	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		(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 <sub>0</sub> , k <sub>1</sub> )		Row 3 (6,-)	Row 3 (6,-)	Row 3 (6,-)	Row 4 (0,-)
·	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		(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
Dhysical shannel for CCI report		<b> </b>	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

DI 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

Table 6.4.3.2-2: Minimum requirement (TDD)

	Test 1	Test 2	Test 3	Test 4
71	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
PDSCH repetitions over multiple slots (pdsch- RepetitionMultiSlots)	FR2 TDD	PDSCH	Clause 7.2.2.2	

## 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.

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 7.2 Clause 7.5.1 Clause 7.5A.1	
PCell operation on FR2 ( <i>pCell-FR2</i> )	FR2 TDD	SDR	Clause 7.5A.1	
PDSCH mapping type B (pdsch-MappingTypeB)	FR2 TDD	PDSCH	Clause 7.2.2.2.3	

#### 7.1.1.5 Applicability of CA requirements

#### 7.1.1.5.1 Definition of CA capability

The definition with respect to CA capabilities is given as in Table 7.1.1.5.1-1.

Table 7.1.1.5.1-1: Definition of CA capability

CA Capability	CA Capability Description
CA_C	Intra-band contiguous CA
CA_N	Intra-band non-contiguous CA
CA_AX	Inter-band CA (X bands)
se CA se CA	C corresponds to NR CA configurations and bandwidth combination is defined in Clause 5.5A.1 of TS 38.101-2 [7]. N corresponds to NR CA configurations and bandwidth combination is defined in Clause 5.5A.2 of TS 38.101-2 [7]. AX corresponds to NR CA configurations and bandwidth combination is defined in Clause 5.5A.3 of TS 38.101-2 [7].

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

The performance requirement for CA UE demodulation tests in Clause 7.2A are defined independent of CA configurations and bandwidth combination sets specified in Clause 5.5A of TS 38.101-2. For UEs supporting different CA configurations and bandwidth combination sets, the applicability and test rules are defined in Table 7.1.1.5.2-1 and Table 7.1.1.5.2-2. For simplicity, CA configuration below refers to combination of CA configuration and bandwidth combination set.

Table 7.1.1.5.2-1: Applicability and test rules for CA UE demodulation tests

Tests	CA capability where the tests apply	CA configuration from the selected CA capability where the tests apply	CA Bandwidth combination to be tested in priority order	PCell CC configuration
Test 1 in Clause 7.2A.2.1	CA_C, CA_N, CA_AX	Table 7.1.1.5.2-2	Largest aggregated CA bandwidth combination	Any of CCs

Table 7.1.1.5.2-2: Selection of CA configurations

CA capability	Step 1	Step 2	Step 3		
CA_C or CA_N or CA_AX	Select CA configuration(s), which contain all CA bandwidth combinations requiring SNR below test equipment maximum achievable SNR	Select the CA configurations with the maximum number of CCs, for which the supported maximum number of MIMO layers is not lower than 2, among all the selected CA configurations from Step 1.	Select any one of CA configurations, which contain CA bandwidth combination with the largest aggregated channel bandwidth and supported maximum data rate is not lower than the tested date rate, among all the selected CA configurations from Step 2.		
NOTE 1: Maximum supported data rate for Step 3 is calculated based clause 4.1.2 of TS 38.306 [14]					
NOTE 2: Tested data rate for Step 3 is calculated based on the equation $DataRate = 10^{-3} \sum_{i=1}^{J} TBS_i 2^{\mu_i}$ and FRCs					
used in the te	est.		•		

## 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			0
Actual carrier configuration	Offset between Point A and the lowest usable subcarrier on this carrier (Note 2)	RBs	0
configuration	Subcarrier spacing	kHz	60 or 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
Common conting	Physical Cell ID		0
Common serving	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
	CCE-to-REG mapping type		Non-interleaved
PDCCH	DCI format		1_1
configuration	TCI state		TCI state #1
	PDCCH & PDCCH DMRS Precoding configuration		Single Panel Type I, Random per slot with equal probability of each applicable i <sub>1</sub> , i <sub>2</sub> combination, and with REG bundling granularity for number of Tx larger than 1
Cross carrier scheduli			Not configured
	First subcarrier index in the PRB used for CSIRS ( $k_0$ )		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
	CDM Type		'No CDM' for CSI-RS resource 1,2,3,4
	Density (ρ)		3 for CSI-RS resource 1,2,3,4
CSI-RS 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 <sub>0</sub> )			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 <sub>0</sub> =0 for CSI-RS resource 1,2
	First OFDM syr	nbol in the PRB used for CSI-RS		I <sub>0</sub> = 8 for CSI-RS resource 1 I <sub>0</sub> = 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 indexes			{1000} for Rank 1 tests {1000, 1001} for Rank 2 tests
PDSCH DMRS configuration	Position of the first DMRS for PDSCH mapping type A			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
TOI -1-1- //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 <sub>PT-RS</sub> )	2
PTRS configuration	Time density (I	PT-RS)	1
	Resource Elem		2
		s for ACK/NACK feedback	1
Maximum number of		ion	4
HARQ ACK/NACK bu	ındling		Multiplexed
Redundancy version	coding sequence		{0,2,3,1} Single Panel Type I,
PDSCH & PDSCH DI	PDSCH & PDSCH DMRS Precoding configuration		
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, char	As specified in Annex B.4.1		
Note 1: UE assum	es that the TCI st	ate 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

(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
PDSCH configuration	Mapping type  k0 Starting symbol (S)  Length (L)  PDSCH aggregation factor PRB bundling type  PRB bundling size  Resource allocation type  RBG size  VRB-to-PRB mapping type  VRB-to-PRB mapping interleaver bundle size		Type A  0  1  Specific to each Reference channel as defined in A.3.2.2  1  Static  WB for Test 1-1, 2 for other tests  Test 2-1: Type 1 with start RB = 30, L <sub>RBs</sub> = 6 Other tests: Type 0  Test 2-1: N/A 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 <sub>B</sub> <sub>B</sub> (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	Reference 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 <sub>BB</sub> (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				Correlation	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 <sub>B</sub> <sub>B</sub> (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

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

For PDSCH with slot aggregation, the requirements are specified in Table 7.2.2.2.2-3, additional parameters in Table 7.2.2.2.2-2 and the downlink physical channel setup according to Annex C.5.1.

The test purpose is specified in Table 7.2.2.2.1.

#### Table 7.2.2.2.1: Test purpose

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

#### Table 7.2.2.2.2-2: Test Parameters

	Parameter	Unit	Value
Duplex mode			TDD
Active DL BWP index			1
	Mapping type		Type A
	kO		0
	Starting symbol (S)		1
	Length (L)		13
	PDSCH aggregation factor		2
PDSCH configuration	PRB bundling type		Static
Deer coningulation	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 Process	ees		2
The number of slots between PDSCH and corresponding HARQ-ACK information			[As defined in Annex A.1.3]

#### Table 7.2.2.2.3: Minimum performance for Rank 1 (FRC)

Т	est	Reference	Bandwidth  (MHz) / Modulation  TDD UL- Propagation		Propagation	Correlation matrix and	Reference value		
	ım	channel	Sincarrier   and code     '	condition	antenna configuration	Target BLER	SNR (dB)		
1	-1	R.PDSCH. X1 TDD	100 / 120	TBD	FR2.120-2	TDLA30-75	2x2 ULA Low	1% (Note 1)	TBD

Note 1: BLER is defined as residual BLER; i.e. ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block.

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

The performance requirements are specified in Table 7.2.2.2.2-3, with the addition of test parameters in Table 7.2.2.2.2-2 and the downlink physical channel setup according to Annex C.5.1. The purpose is to verify the performance of PDSCH Type B scheduling.

The test purposes are specified in Table 7.2.2.2.1.

Table 7.2.2.2-1: Test purpose

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

Table 7.2.2.2.2: Test parameters

Parameter			Value
Duplex mode			TDD
Active DL BWP index			1
PDCCH	Number of PDCCH candidates and		1/AL8
configuration	aggregation levels		I/ALO
	Mapping type		Туре В
	k0		0
	Starting symbol (S)		1
	Length (L)		2
	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		0
configuration	Maximum number of OFDM symbols for DL front loaded DMRS		1
Number of HARQ Processes			8
The number of slots between PDSCH and corresponding HARQ-ACK information			Specific to each TDD UL-DL pattern and as defined in Annex A.1.3

Table 7.2.2.2-3: Minimum performance for Rank 1

		Bandwidth (MHz)/	Modulation   TDD III -	TDD UI -	_	Correlation	Reference value	
Test num.	Reference channel	\ /·		Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)	
1-1	R.PDSCH.x TDD	100 / 120	[QPSK, 0.30]	FR2.120- 1	[TDLA30-75]	2x2, ULA Low	70	TBD

## 7.2A PDSCH demodulation requirements for CA

The parameters specified in Table 7.2-1 for PDSCH single carrier tests are reused for PDSCH CA test unless otherwise stated.

## 7.2A.1 1RX requirements

(Void)

## 7.2A.2 2RX requirements

#### 7.2A.2.1 Minimum requirements

For CA with different numbers of DL component carriers, the requirements are defined in Table 7.2A.2.1-3 based on the single carrier requirements for different bandwidth specified in Table 7.2A.2.1-2, with the parameters in Table 7.2A.2.1-1 and the downlink physical channel setup according to Annex C.5.1. The performance requirements specified in this sub-cluase do not apply for UE single carrier test.

Table 7.2A.2.1-1: Test parameters for CA

	Parameter	Unit	Value
Duplex mode			TDD
Active DL BWP index	X		1
	Mapping type		Type A
	k0		0
	Starting symbol (S)		1
	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		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		I.
Number of HARQ Processes			8
TDD UL-DL pattern			120kHz SCS: FR2.120-1
The number of slots between PDSCH and corresponding HARQ-ACK information			As defined in Annex A.1.3

Table 7.2A.2.1-2: Single carrier performance for TDD 120 kHz SCS for CA configurations

B	D. C.	Modulation		Correlation	Reference value		
Bandwidth (MHz)	Reference channel	format and code rate	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)	
50	R.PDSCH.5- 9.1 TDD	16QAM, 0.33	TDLA30-75	2x2, ULA Low	70	[10.4]	
100	R.PDSCH.5- 9.2 TDD	16QAM, 0.33	TDLA30-75	2x2, ULA Low	70	[10.2]	
200	R.PDSCH.5- 9.3 TDD	16QAM, 0.33	TDLA30-75	2x2, ULA Low	70	[10.3]	
400	R.PDSCH.5- 9.4 TDD	16QAM, 0.33	TDLA30-75	2x2, ULA Low	70	[10.3]	

Table 7.2A.2.1-3: Minimum performance for multiple CA configurations

Test number		CA duplex mode	Minimum performance requirements					
	1	TDD 120 kHz + TDD 120 kHz	As defined in Table 7.2A.2.1-2					
	Note 1: The a	e 1: The applicability of requirements for different CA duplex modes, SCSs, CA configurations and bandwidth						
	comb	ination sets is defined in 7.1.1.5.						

## 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** 

Carrier configuration
Carrier (Note 1)   Cyclic prefix   Normal
DL BWP
Comfiguration #1   Cyclic prefix   Normal
Physical Cell ID   SSB position in burst   1   20
SSB position in burst   SSB periodicity   ms   20
SSB periodicity
Slots for PDCCH monitoring   Each slot
Number of PDCCH candidates
PDCCH configuration   Frequency domain resource allocation for CORESET   Start from RB = 0 with contiguous RB allocation TCI state
Allocation for CORESET
TCl state
First subcarrier index in the PRB used for CSI-RS (k0)
Used for CSI-RS (k0)
CSI-RS resource 1: 4   CSI-RS resource 2: 8   CSI-RS resource 3: 4   CSI-RS resource 3: 4   CSI-RS resource 3: 4   CSI-RS resource 4: 8   CSI-RS resource 1: 60   RS for CSI-RS resource 1 and 2   RS for CSI-RS resource 3 and 4   CSI-RS resource 3
CSI-RS for tracking
First OFDM symbol in the PRB used for CSI-RS (I0)
First OFDM symbol in the PRB used for CSI-RS (I0)
Used for CSI-RS (I0)
CSI-RS for tracking   Number of CSI-RS ports (X)   1   1   1   1   1   1   1   1   1
Number of CSI-RS ports (X)
Number of CSI-RS ports (X)
CDM Type
Density (ρ)
CSI-RS periodicity         Slots         160           CSI-RS offset         80 for CSI-RS resource 1 and 2 81 for CSI-RS resource 3 and 4           Start PRB 0 Number of PRB = BWP size           QCL info         TCI state #0           First subcarrier index in the PRB used for CSI-RS (k0)         0           CSI-RS resource 1: 8 used for CSI-RS (l0)         CSI-RS resource 2: 9           NZP CSI-RS for beam management         Number of CSI-RS ports (X)         1           Number of CSI-RS ports (X)         1           CDM Type         No CDM           Density (ρ)         3           120 kHz SCS: 160
CSI-RS offset         Slots         80 for CSI-RS resource 1 and 2 81 for CSI-RS resource 3 and 4 Start PRB 0 Number of PRB = BWP size           QCL info         TCI state #0           First subcarrier index in the PRB used for CSI-RS (k0)         0           NZP CSI-RS for beam management         Number of CSI-RS ports (X)         1           NZP CSI-RS for beam management         Number of CSI-RS ports (X)         1           Number of CSI-RS ports (X)         1           CDM Type         No CDM           Density (ρ)         3
CSI-RS offset
CSI-RS offset   Slots   81 for CSI-RS resource 3 and 4   Start PRB 0   Number of PRB = BWP size
resource 3 and 4   Start PRB 0   Number of PRB = BWP size
Frequency Occupation
BWP size
QCL info         TCI state #0           First subcarrier index in the PRB used for CSI-RS (k0)         0           CSI-RS resource 1: First OFDM symbol in the PRB used for CSI-RS (l0)         CSI-RS resource 2: 9           NZP CSI-RS for beam management         Number of CSI-RS ports (X)         1           CDM Type Density (ρ)         No CDM Type Density (ρ)           Density (ρ)         3
First subcarrier index in the PRB used for CSI-RS (k0)
used for CSI-RS (k0)           CSI-RS resource 1:           First OFDM symbol in the PRB used for CSI-RS (l0)         CSI-RS resource 2:           9         Number of CSI-RS ports (X)         1           CDM Type         No CDM           Density (ρ)         3           120 kHz SCS: 160
NZP CSI-RS for beam management   First OFDM symbol in the PRB used for CSI-RS (I0)   CSI-RS resource 1: 8   CSI-RS resource 2: 9
First OFDM symbol in the PRB used for CSI-RS (I0)   CSI-RS resource 2:   NZP CSI-RS for beam management   Number of CSI-RS ports (X)   1   CDM Type   No CDM     Density (ρ)   3   120 kHz SCS: 160
NZP CSI-RS for beam management         Used for CSI-RS (I0)         CSI-RS resource 2: 9           Number of CSI-RS ports (X)         1           CDM Type         No CDM           Density (ρ)         3           120 kHz SCS: 160
NZP CSI-RS for beam management         Number of CSI-RS ports (X)         1           CDM Type         No CDM           Density (ρ)         3           120 kHz SCS: 160
NZP CSI-RS for beam managementCDM TypeNo CDMDensity (ρ)3120 kHz SCS: 160
beam management Density (ρ) 3  120 kHz SCS: 160
management Density (ρ) 3 120 kHz SCS: 160
120 KHZ SCS: 160
USI-KS periodicity   Slots   for USI-KS resource
1,2
0 for CSLPS
CSI-RS offset Slots resource 1,2
Repetition ON
QCL info TCl state #1
Single Panel Type I,
Random per slot
with equal
probability of each
PDCCH & PDCCH DMRS Precoding configuration applicable i <sub>1</sub> , i <sub>2</sub> combination, and
with REG bundling
granularity for
number of Tx larger
than 1
Type 1 QCL SSB index SSB #0
TCI state #0 information QCL Type Type C
Type 2 QCL   SSB index   SSB #0

	Type 1 QCL information	CSI-RS resource	CSI-RS resource 1 from 'CSI-RS for tracking' configuration					
TCI state #1		QCL Type	Type A					
TOI State #1	Type 2 QCL information	CSI-RS resource	CSI-RS resource 1 from 'CSI-RS for tracking' configuration					
		QCL Type	Type D					
Symbols for all un	used 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 buildle size		6 for test 1-2	2	
Interleaver size		3 for test 1-1	2	
Interieaver 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	-	erence alue
num ber	(MHz)	ET RB	duration	Aggregation level	Channel	Propagation Condition	and correlation Matrix	Pm- dsg (%)	SNR <sub>BB</sub> (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	Dan duridéh	CORESE	CORESET	Aggregation	Deference	Dranagation	Antenna configuration	-	erence alue
num ber	Bandwidth (MHz)	CORESE T RB	CORESET duration	Aggregation level	Reference Channel	Propagation Condition	and correlation Matrix	Pm- dsg (%)	SNR <sub>BB</sub> (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	Reference value		
number	Subcarrier spacing (kHz)	channel	condition	and correlation matrix	Pm- bch (%)	SNR <sub>BB</sub> (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	Reference value		
number	Subcarrier spacing (kHz)	channel	condition	and correlation matrix	Pm- bch (%)	PBCH 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.

$$DataRate = 10^{-3} \sum_{j=1}^{J} TBS_{j} 2^{\mu_{j}}$$

where

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

TBS<sub>j</sub> 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<sub>i</sub> 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
configuration	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		Symbols #0 Table 7.5A.1-2
			1/8
BDCCH	CCE-to-REG mapping type		Non-interleaved
PDCCH configuration	DCI format		1-1
	TCI State		TCI state #1
	PDCCH &PDCCH DMRS Precoding configuration		Single Panel Type I, Random per slot with equal probability of precoder index 0 and 2, and with REG bundling granularity for number of Tx larger than 1
	Mapping type		Type A
	k0		0
			1
			Static
PDSCH			WB Type 0
configuration			Config2
	DCI format  TCI State  PDCCH &PDCCH DMRS Precoding configuration  Mapping type k0 PDSCH aggregation factor PRB bundling type PRB bundling size Resource allocation type	Non-interleaved	
	VRB-to-PRB mapping interleaver bundle	) RBs   kHz     kHz     kHz     kHz     kHz   kH	N/A
			1
	Length (L)		13
			Type 1
			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> <sub>PT-RS</sub> ) Time density ( <i>L</i> <sub>PT-RS</sub> )		2
Comigaration	Subcarrier indexes in the PRB used for		$k_0 = 3$ for CSI-RS resource 1,2,3,4
CSI-RS for tracking	CSI-RS  OFDM symbols in the PRB used for CSI-		l <sub>0</sub> = 6 for CSI-RS resource 1 and 3
	RS		$I_0 = 10$ for CSI-RS resource 2 and 4
	Number of CSI-RS ports (X)		1 for CSI-RS resource 1,2,3,4 'No CDM' for CSI-RS resource
	CDM Type		1,2,3,4
	Density (ρ)		3 for CSI-RS resource 1,2,3,4

	•			
				60 kHz SCS: 80 for CSI-RS resource
	CSI-RS periodicity		Slots	1,2,3,4
				120 kHz SCS: 160 for CSI-RS
				resource 1,2,3,4 60 kHz SCS:
				40 for CSI-RS resource 1 and 2
				41 for CSI-RS resource 3 and 4
	CSI-RS offset		Slots	41 for COLING resource 5 and 4
			0.010	120 kHz SCS:
				80 for CSI-RS resource 1 and 2
				81 for CSI-RS resource 3 and 4
	Fraguency Occupa	tion		Start PRB 0
	гтечиенсу Оссира	Frequency Occupation		Number of PRB = BWP size
	QCL info			TCI state #0
	Subcarrier indexes in the PRB used for			$k_0 = 4$
	CSI-RS			
	OFDM symbols in the PRB used for CSI-RS			$I_0 = 13$
	Number of CSI-RS	norte (V)		Same as number of transmit antenna
	CDM Type	ports (x)		'FD-CDM2'
NZP CSI-RS for	Density (p)			1 D-CDIVIZ
CSI acquisition	- 11			60 kHz SCS: 80
	CSI-RS periodicity		Slots	120 kHz SCS: 160
	CSI-RS offset			0
				Start PRB 0
	Frequency Occupa	tion		Number of PRB = BWP size
	QCL info			TCI state #1
	Subcarrier indexes	in the PRB used for		$k_0 = 0$
	CSI-RS			K <sub>0</sub> = U
	OFDM symbols in the PRB used for CSI-			lo = 12
	RS			10 - 12
	Number of CSI-RS	ports (X)		4
ZP CSI-RS for CSI	CDM Type			'FD-CDM2'
acquisition	Density (ρ)			1
	CSI-RS periodicity		Slots	60 kHz SCS: 80 120 kHz SCS: 160
	CSI-RS offset			0
	CSI-RS offset			Start PRB 0
	Frequency Occupa	tion		Number of PRB = BWP size
	First subcarrier index in the PRB used for			
	CSI-RS			k <sub>0</sub> =0 for CSI-RS resource 1,2
	First OFDM symbol in the PRB used for			l <sub>0</sub> = 8 for CSI-RS resource 1
	CSI-RS			l <sub>0</sub> = 9 for CSI-RS resource 2
	Number of CSI-RS ports (X)			1 for CSI-RS resource 1,2
	CDM Type			'No CDM' for CSI-RS resource 1,2
CSI-RS for beam	Density (ρ)			3 for CSI-RS resource 1,2
refinement	CSI-RS periodicity			60 kHz SCS: 80 for CSI-RS resource
			Slots	1,2 120 kHz SCS: 160 for CSI-RS
				resource 1,2
	CSI-RS offset		Slots	0 for CSI-RS resource 1,2
	Repetition		01013	ON
	QCL info			TCI state #1
	Tyoe 1 QCL	SSB index		SSB #0
TOL -4: 4 #2	information	QCL Type		Type C
TCI state #0	Tyoe 2 QCL	SSB index		SSB #0
	information	QCL Type		Type D
TCI state #1	Tyoe 1 QCL	CSI-RS resource		CSI-RS resource 1 from 'CSI-RS for
	information			tracking' configuration
	omadon	QCL Type		Type A
	Tyoe 2 QCL	CSI-RS resource		CSI-RS resource 1 from 'CSI-RS for
	information			tracking' configuration
		QCL Type		Type D
feedback	Maximum number of code block groups for ACK/NACK feedback			1
Number of HARQ Pr	ocesses			10 for FR2.60-1 and 8 for FR2.120-1
K1 value				Specific to each UL-DL pattern

Maximum number	of HARQ transmission	4
HARQ ACK/NAC	Standling	Multiplexed
Redundancy version	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 un	used 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	2 layers CCs	2x2 or 2x4
Physical signals, of	channels mapping and precoding	As specified in Annex B.4.1
Note 1: PDSCH	His 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 <sub>BB</sub> (dB) for maximum number of PDSCH MIMO Layers = 1	SNR <sub>BB</sub> (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	ype	Test list	Applicability notes	
Supported maximum number of PDSCH MIMO layers (maxNumberMIMO-	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	
LayersPDSCH)		RI	Clause 8.4.2.2	PDSCH MIMO layers capability	
Support of 1 port DTDS	FR2 TDD	CQI	Clause 8.2		
Support of 1 port PTRS (onePortsPTRS)		PMI	Clause 8.3		
(Oner Orisi 1113)		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 transmis	esion schama		Transmission
	SSION SCHEME		scheme 1
Duplex Mode			TDD
PTRS epre-Ration			0
Actual carrier configuration	Offset between Point A and the lowest usable subcarrier on this carrier (Note 3)	RBs	0
	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 i			1
Common	Physical Cell ID		0
serving cell	SSB position in burst	1	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 Multi-path fading
PDCCH configuration	PDCCH & PDCCH DMRS Precoding configuration		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 2, selection updated per slot  Not configured
Cross carrier scr			
	Mapping type k0		Type A 0
	Starting symbol (S)		2
	Length (L)	1	12
	PDSCH aggregation factor		12
PDSCH	PRB bundling type		Static
configuration	PRB bundling type		2
Comiguration	Resource allocation type	1	Type 0
	RBG size	+	Config2
		+	Non-interleaved
	VRB-to-PRB mapping type VRB-to-PRB mapping interleaver		N/A
DD0011 D1125	bundle size	-	
PDSCH DMRS configuration	DMRS Type Number of additional DMRS		Type 1
comiguration	INUITIBET OF AUGILIOHAL DIVING	1	<u> </u>

	1		1	T
	DMRS ports i	indexes		{1000} for Rank1 {1000,1001} for Rank2
	Maximum number of OFDM symbols for DL front loaded DMRS			1
	Number of Pl group(s) with	DSCH DMRS CDM out data		2
	Frequency de			2
PTRS	Time density			1
configuration	Resource Element Offset			2
		er index in the PRB		0 for CSI-RS
	used for CSI-			resource 1,2,3,4
		(1.0)		4 for CSI-RS
	First OFDM s	symbol in the PRB		resource 1 and 3
	used for CSI-			8 for CSI-RS
		(10)		resource 2 and 4
				1 for CSI-RS
	Number of C	SI-RS ports (X)		resource 1,2,3,4
				No CDM for CSI-RS
	CDM Type			resource 1,2,3,4
				3 for CSI-RS
CSI-RS for	Density $(\rho)$			resource 1,2,3,4
tracking				120kHz SCS: 160 for
g	CSI-RS perio	dicity	slot	CSI-RS resource
				1,2,3,4
				120 kHz SCS:
	CSI-RS offset			80 for CSI-RS
			slot	resource 1 and 2
				81 for CSI-RS
				resource 3 and 4
	Frequency Occupation			Start PRB 0
				Number of PRB =
				BWP size
	QCL info			TCI state #0
NZP CSI-RS				Start PRB 0
for CSI	Frequency O	ccupation		Number of PRB =
acquisition	OOL into			BWP size
	QCL info			TCI state #1
ZP CSI-RS for	F			Start PRB 0
CSI acquisition	Frequency O	ccupation		Number of PRB = BWP size
	First subservi	er index in the PRB		
	used for CSI-			k <sub>0</sub> =0 for CSI-RS resource 1,2
	useu 101 001	110		I <sub>0</sub> = 8 for CSI-RS
	First OFDM s	symbol in the PRB		resource 1
	used for CSI-			I <sub>0</sub> = 9 for CSI-RS
	used for CSI-ICS			resource 2
				1 for CSI-RS
	Number of C	SI-RS ports (X)		resource 1,2
CSI-RS for	CDM Tune			'No CDM' for CSI-RS
beam	CDM Type			resource 1,2
refinement	Density (ρ)			3 for CSI-RS
	Density (p)			resource 1,2
				120 kHz SCS: 160
	CSI-RS perio	dicity	Slots	for CSI-RS resource
				1,2
	CSI-RS offse	t	Slots	0 for CSI-RS
				resource 1,2
	Repetition QCL info			ON TCI state #1
-	Type 1	SSB index		SSB #0
	QCL			
	information	QCL Type		Type C
TCI state #0	Type 2	SSB index		SSB #0
	QCL			
	information	QCL Type		Type D

TCI state #1	Type 1 QCL information Type 2 QCL	CSI-RS resource  QCL Type  CSI-RS resource		CSI-RS resource 1 from 'CSI-RS for tracking' configuration Type A CSI-RS resource 1 from 'CSI-RS for tracking'
	information	OCL Type		configuration
Niveshau of LIADO	) Drassass	QCL Type		Type D
Number of HARC				8
HARQ ACK/NAC				Multiplexed
Redundancy vers	sion coding sec	quence		{0,2,3,1}
K1 value (PDSCH-to-HARQ-timing-indicator)			For FR2.120-1: 3 if mod (i.5) = 0, 6 if mod(i,5) = 2 For FR2.120-2: 11 if mod(i,8) = 0, 7]if mod(i,8) = 4, 6]if mod(i,8) = 5, where i is slot index per radio fame with values 0-79.	
Symbols for 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: PDSCH is not scheduled on slots containing CSI-RS or slots which are not				

full DL.

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.

#### 8.2 Reporting of Channel Quality Indicator (CQI)

#### 1RX requirements 8.2.1

(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  $\pm 1$  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	100	
Subcarrier sp		kHz	120	
Duplex Mode			TDD	
TDD Slot Cor	nfiguration	-ID	FR2.120-2 Annex A.1.3	
SNR <sub>BB</sub> Propagation of	hannal	dB	8 9 14 15 AWGN	
Propagation C	channel		2x2 with static channel	
Antenna conf	iguration		specified in Annex B.1	
D f i	Mandal		As specified in Annex	
Beamforming	Model		B.4.1	
	CSI-RS resource Type		Periodic	
	Number of CSI-RS ports (X)		4	
	CDM Type		FD-CDM2	
ZP CSI-RS	Density (ρ)		1	
configuratio	First subcarrier index in the		8	
n	PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )			
	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		13	
	CSI-RS			
	periodicity and offset	slot	8/1	
	CSI-RS resource Type		Periodic	
	Number of CSI-RS ports (X)		2	
	CDM Type		fd-CDM2	
NZP CSI-	Density (ρ)		1	
RS for CSI	First subcarrier index in the		6	
acquisition	PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		в	
	First OFDM symbol in the PRB		13	
	used for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		10	
	NZP CSI-RS-timeConfig	slot	8/1	
	periodicity and offset		Davis dia	
	CSI-IM RE patters		Periodic 1	
CSI-IM	CSI-IM RE pattern CSI-IM Resource Mapping		1	
configuratio	(kcsi-im,lcsi-im)		(8, 13)	
n	CSI-IM timeConfig	_		
	periodicity and offset	slot	8/1	
ReportConfig			Periodic	
CQI-table			Table 1	
reportQuantity			cri-RI-PMI-CQI	
timeRestrictio	nForChannelMeasurements		Not configured	
	nForInterferenceMeasurements		Not configured	
cqi-FormatInd			Wideband	
pmi-Formatin			Wideband	
Sub-band Siz		RB	8	
csi-Reporting	eriodicity and offset	olo+	111111111 8/3	
aperiodicTrigg		slot	Not configured	
apendulcing	Codebook Type	-	typel-SinglePanel	
	Codebook Mode		1	
Codebook	(CodebookConfig-		•	
configuration	N1,CodebookConfig-N2)	1	Not configured	
	CodebookSubsetRestriction		010000	
	RI Restriction		N/A	
Physical char	nnel for CSI report		PUCCH	
	CQI/RI/PMI delay	ms	8.375	
Maximum nur	mber of HARQ transmission		1	
Measurement	t channel		As specified in Table	
		l	A.4-1, 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  $\alpha$  % of the time, where  $\alpha$ % 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 RE pattern  CSI-IM REsource Mapping (kosi-Msi-Lssi-Ms)  CSI-IM resource Mapping (kosi-Msi-Lssi-Msi-		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 R				
Density (p)   Tirst subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )   First oFDM symbol in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )   First oFDM symbol in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )   First oFDM symbol in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )   Density (p)   Aperiodic				
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 ReportConfigType Aperiodic CQI-table ReportConfigType CQI-table ReportConfigType Aperiodic CQI-table ReportConfigType Aperiodic CQI-table ReportConfigType Aperiodic COI-IM imeConfig interval and offset Not configured timeRestrictionForChannelMeasurements Not configured timeRestrictionForChannelMeasurements Not configured timeRestrictionForInterferenceMeasurements Not configured TimeRestrictionForChannelMeasurements Not configu	_	PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		8
interval and offset		used for CSI-RS (l <sub>0</sub> , l <sub>1</sub> )		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 <sub>0</sub> , k <sub>1</sub> )   First OFDM symbol in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )   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 <sub>CSI-IM-LCSI-IM</sub> )   CSI-IM Resource Mapping (k <sub>CSI-IM-LCSI-IM</sub> )   (SSI-IM timeConfig interval and offset   Aperiodic CQI-table   Table 1   Table 1				fd-CDM2
RS for CSI acquisition    PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )	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 <sub>0</sub> , k <sub>1</sub> )		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 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 (RCSI-IM ImeConfigured)  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 111111111  CSI-Report periodicity and offset slot Not configured Aperiodic Report Slot Offset 6  CSI request Slot Offset 1 in slots i, where mod(i, 8) = 1, otherwise it is equal to  reportTriggerSize 1 1  CSI-AperiodicTriggerStateList Associated Report Configuration  CSI-AperiodicTriggerStateList Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM COdebook Configuration (CodebookConfig-				Aperiodic
configuration N	CSI-IM			1
ReportConfigType ReportConfigUred ReportConfigUred ReportConfigUred ReportConfigUred ReportConfigUred ReportConfigUred ReportInterferenceMeasurements Repo	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	-71		
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  timeRestrictionForChannelMeasurements Not configured Wideband Wideband Saba RB 8 1111111111 CINAMINATION CONTIGENTAL Solution Wideband Wideband Saba Saba Saba Saba Saba Saba Saba Sab		У		
cqi-FormatIndicator       Wideband         pmi-FormatIndicator       Wideband         Sub-band Size       RB       8         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 Mode CodebookConfig-       Not configured	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.:	Cino.		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	reportifigger	OIZE	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	711199010tate=10t		
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 comigured

	CodebookSubsetRestriction		000001
	RI Restriction		N/A
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	1.375
Maximum number 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  $\gamma$ , 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 <sub>0</sub> , k <sub>1</sub> )		Row 4, (8,-)	Row 4, (8,-)
	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		(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 <sub>0</sub> , k <sub>1</sub> )		Row 3, (6,-)	Row 3, (6,-)
	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		(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-FormatIndicator			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-AperiodicTriggerStateList			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	nannel		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 spacing		kHz	120	120	120
Duplex Mode			TDD	TDD	TDD
TDD Slot Cor			FR1.120-2	FR1.120-2	FR1.120-2
SNR	3	dB	0	16	16
Propagation of	channel		TDLA30-35	TDLA30-35	TDLA30-35
Antenna conf			ULA Low 2x2	ULA Low 2x2	XP 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 (ρ)		1	1	1
configuratio	First subcarrier index in the				
n	PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 4, (8,-)	Row 4, (8,-)	Row 4, (8,-)
	First OFDM symbol in the PRB		4 )	4 \	4
	used for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		(13,-)	(13,-)	(13,-)
	CSI-RS	_	8/1	8/1	8/1
	interval and offset	slot	0,1	<i>37</i> 1	G/ 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
	Density (ρ)		1	1	1
NZP CSI-	First subcarrier index in the			·	·
RS for CSI	PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 3 (6,-)	Row 3 (6,-)	Row 3 (6,-)
acquisition	First OFDM symbol in the PRB				
	used for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		(13,-)	(13,-)	(13,-)
	NZP CSI-RS-timeConfig		Not configured	Not	Not
	interval and offset	slot	140t configured	configured	configured
	aperiodicTriggeringOffset		0	0	0
	CSI-IM resource Type		Periodic	Periodic	Periodic
	CSI-IM RE pattern		Pattern 1	Pattern 1	Pattern 1
CSI-IM	CSI-IM Resource Mapping				
configuratio	(kcsi-im,lcsi-im)		(8,13)	(8,13)	(8,13)
n	CSI-IM timeConfig		Not configured	Not	Not
	interval and offset	slot	110t oormgaroa	configured	configured
ReportConfig			Aperiodic	Aperiodic	Aperiodic
CQI-table	.,,,,		Table 1	Table 1	Table 1
				cri-RI-PMI-	cri-RI-PMI-
reportQuantit	у		cri-RI-PMI-CQI	CQI	CQI
				not	not
timeRestriction	nForChannelMeasurements		not configured	configured	configured
				not	not
timeRestriction	nForInterferenceMeasurements		not configured	configured	configured
cqi-FormatInd	dicator		Wideband	Wideband	Wideband
pmi-FormatIndicator			Wideband	Wideband	Wideband
Sub-band Size		RB	8	8	8
csi-ReportingBand			111111111	111111111	111111111
<u> </u>				Not	Not
CSI-Report interval and offset		slot	Not configured	configured	configured
Aperiodic Res	port Slot Offset		7	7	7
Aponodic INE	Jon Giot Gridet		1 in slots i,	1 in slots i,	1 in slots i,
			where mod(i,	where mod(i,	where mod(i,
CSI request			8) = 1,	8) = 1,	8) = 1,
CSI request			otherwise it is	otherwise it is	otherwise it is
			equal to 0	equal to 0	equal to 0
reportTrigger	Siza		1	1	1
reportTriggerSize			<u> </u>	l I	<u>'</u>

CSI-AperiodicTriggerStateList			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 number of HARQ transmission			1	1	1
RI Configuration			Fixed RI = 2 and follow RI	Fixed RI = 1 and follow RI	Fixed RI = 1 and follow RI

Table 8.4.2.2-2: Minimum requirement (TDD)

	Test 1	Test 2	Test 3
71	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.
- For UEs supporting FR1 intra-band contiguous and non-contiguous EN-DC, the requirements applicability is specified in Table 9.1.1-3.

Table 9.1.1-3: Requirements applicability for UE supporting FR1 intra-band and inter-band EN-DC

	Inter-band	UE indicates	UE does not indicate	
	scenarios are not	"interBandContiguousMRDC"	"interBandContiguousMRDC"	
	supported			
Intra-band	N/A	Clause 9.5B.1.1 for inter-band	Clause 9.5B.1.2 for inter-band	
scenarios are not		scenarios	scenarios	
supported				
UE does not	Clause 9.5B.1.1 for	Clause 9.5B.1.1 for intra-band	Clause 9.5B.1.1 for intra-band	
indicate	intra-band	and inter-band scenarios	scenarios	
"intraBandENDC-	scenarios			
Support"				
UE indicates	Clause 9.5B.1.1 for	Clause 9.5B.1.1 for intra-band	Clause 9.5B.1.1 for intra-band	
"both" in	intra-band	and inter-band scenarios	scenarios	
"intraBandENDC-	scenarios			
Support"				
UE indicates "non-	Clause 9.5B.1.2 for	Clause 9.5B.1.1 for inter-band	Clause 9.5B.1.2 for intra-band	
contiguous" in	intra-band	scenarios	and inter-band scenarios	
"intraBandENDC-	scenarios			
Support"				
Note 4. Descriptions and are applicable to intro hand according and only inter hand according from Table 5.50.4.4				

Note 1: Requirements are applicable to intra-band scenarios and only inter-band scenarios from Table 5.5B.4.1-1 of TS 38.101-3 [8] for which Note 4 is applied.

#### 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].

Table 9.1.2.1-1: Common Test Parameters (FDD)

Parameter	Unit	Value	
Cyclic prefix		Normal	
Physical Cell ID		0	
Number of PDCCH symbols	symbols	1	
PHICH Ng (Note 1)		1	
PHICH duration		Normal	
Number of HARQ processes per component carrier	Processes	8	
Maximum number of HARQ transmission		4	
Redundancy version coding sequence		{0,0,1,2} for 64QAM	
Propagation condition		Static propagation condition  No external noise sources are applied	
Transmission mode		1	
Transmission time difference between E- UTRA cell and NR cell(s)	μs	0	
Antenna configuration		All NR cells are in FR1: 1x2 Any NR cell is in FR2: 1 Tx <sup>Note 1</sup>	
Codebook subset restriction		10	
Symbols for all unused REs		OCNG in Annex A.5	
Note 1: As the link can be provided over the air, the LIF Ry antenna configuration is not			

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)		ownlir power cation	•
•	, ,	$ 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 configuration		7
Number of PDCCH symbols	symbols	1
PHICH Ng (Note 3)		1
PHICH duration		Normal
Cyclic prefix		Normal
Cell ID		0
Maximum number of HARQ transmission		4
Redundancy version coding sequence		{0,0,1,2} for 64QAM
Propagation condition		Static propagation condition  No external noise sources are applied
Transmission mode		1
Transmission time difference between E- UTRA cell and NR cell(s)	μs	0
Antenna configuration		All NR cells are in FR1: 1x2 Any NR cell is in FR2: 1 Tx <sup>Note 2</sup>
Codebook subset restriction		10
Symbols for all unused REs		OCNG in Annex A.5

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		nlink p cation	
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.

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

Parameter	Unit	Value
Inter-TTI Distance		1
Number of OFDM		
symbols for PDCCH per	OFDM symbols	1
component carrier		
Cross carrier scheduling		Not configured
Propagation condition		Static propagation condition
Fropagation condition		No external noise sources are applied
$\hat{E}_{\scriptscriptstyle s}$ at antenna port	dBm/15kHz	-85
Antonno configuration	2 layer CC	2x2 or 2x4
Antenna configuration	4 layer CC	4x4
Codebook subset	2 layer CC	10
restriction	4 layer CC	1000
Downlink power	2 layer CC	$\rho_A = -3dB, \ \rho_B = -3dB, \ \sigma = 0dB$
allocation	4 layer CC	$\rho_A = -6$ dB, $\rho_B = -6$ dB, $\sigma = 3$ dB

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

MIMO layer	Bandwidth	Reference channel			
Willwio layer	Danuwium	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 lover	10	R.PDSCH.4-2.2 FDD	R.PDSCH.4-4.2 FDD	R.PDSCH.4-6.2 FDD	
4 layer	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 layer	Bandwidth	Reference channel			
		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.

# 9.5B PDSCH demodulation for DC with power imbalance

#### 9.5B.1 EN-DC

#### 9.5B.1.1 Intra-band contiguous EN-DC within FR1

#### 9.5B.1.1.1 PDSCH

The requirements in this section verify the ability of intra-band contiguous EN-DC UE to demodulate the signal transmitted by the NR SCG in the presence of a stronger E-UTRA MCG. The parameters specified in Table 5.2A.2.2-2 and Table 5.2A.3.2-2 are valid for all intra-band contiguous EN-DC power imbalance tests unless otherwise stated. The test setup for each E-UTRA MCG CC is specified in Clause 9.1.2. During the test, only the PDSCH performance on the NR SCG CC shall be verified.

The test parameters of channel bandwidth and allocated resource blocks are determined by the following procedure:

- Step 1: First select the CBW combinations with the same BWs between E-UTRA MCG carrier(s) and NR SCG carrier. If there is no such CBW combination, go to Step 1a. Otherwise go to step 2.
  - Step 1a: Select the CBW combinations that the BW of NR SCG carrier is smaller than the BW of E-UTRA MCG carrier(s). If there is no such CBW combination, go to Step 1c.
  - Step 1b: Among the CBW combinations selected from Step 1a, select the CBW combinations with the smallest CBW difference between NR SCG carrier and E-UTRA MCG carrier(s). Go to step 2.
  - Step 1c: Select the EN-DC combinations with smallest CBW difference between the NR SCG carrier and E-UTRA MCG carrier(s). Go to step 2.
- Step 2: Among the CBW combinations selected from Step 1, select the EN-DC combination with the largest aggregated CBW.

- When the BW of NR SCG carrier is smaller than or equal to the BW of E-UTRA MCG carrier(s), test full allocated PRBs
- When the BW of NR SCG carrier is larger than the BW of E-UTRA MCG carrier(s), test partial allocated PRBs, and the PRB number for testing equals to the PRB number in the full bandwidth of E-UTRA MCG carrier(s).
  - If frequency of NR SCG carrier is higher than E-UTRA MCG carrier, then the test RBs will be allocated on the highest part of NR SCG carrier.
  - If frequency of NR SCG carrier is lower than E-UTRA MCG carrier, then the test RBs will be allocated on the lowest part of NR SCG carrier.

The performance requirements are specified in Table 9.5B.1.1.1-1 and Table 9.5B.1.1.1-2. The downlink physical channel setup according to Annex C.3.1.

Table 9.5B.1.1.1-1: Minimum performance for FDD EN-DC with 15kHz SCS

Test Number	Bandwidth (MHz)	Reference channel		Power at antenna port (dBm/Hz)		Reference value Fraction of Maximum Throughput (%)	
	NR SCG CC	E-UTRA MCG CC (Note 1)	NR SCG CC	E-UTRA MCG CC	NR SCG CC	E-UTRA MCG CC (Note 1)	NR SCG CC
1	Selected EN-DC combination as per the test procedure	NA	Derived as per section 5.1.3.2 of TS 38.214 [12]	-106	-112	NA	85
Note 1:	The number of E-UTRA MCG carriers depend on the intra-band and inter-band contiguous EN-DC configuration and bandwidth combination set						

Table 9.5B.1.1.1-2: Minimum performance for TDD EN-DC with 30kHz SCS

Test Number	Bandwidth (MHz)	Reference channel		Power at antenna port (dBm/Hz)		Reference value Fraction of Maximum Throughput (%)	
	NR SCG CC	E-UTRA MCG CC (Note 1)	NR SCG CC	E-UTRA MCG CC	NR SCG CC	E-UTRA MCG CC (Note 1)	NR SCG CC
1	Selected EN-DC combination as per the test procedure	NA	Derived as per section 5.1.3.2 of TS 38.214 [12]	-106	-112	NA	85
Note 1:	The number of E-UTRA MCG carriers depend on the intra-band and inter-band contiguous EN-DC configuration and bandwidth combination set						

#### 9.5B.1.2 Intra-band non-contiguous EN-DC within FR1

#### 9.5B.1.2.1 PDSCH

The requirements in this section verify the ability of intra-band non-contiguous EN-DC UE to demodulate the signal transmitted by the NR SCG in the presence of a stronger E-UTRA MCG. The parameters specified in Table 5.2A.2.2-2 and Table 5.2A.3.2-2 are valid for all intra-band non-contiguous EN-DC power imbalance tests unless otherwise stated. The test setup for each E-UTRA MCG CC is specified in Clause 9.1.2. During the test, only the PDSCH performance on the NR SCG CC shall be verified.

The test parameters of channel bandwidth and allocated resource blocks are determined by the following procedure:

- Step 1: First select the CBW combinations with the same BWs between E-UTRA MCG carrier(s) and NR SCG carrier. If there is no such CBW combination, go to Step 1a. Otherwise go to step 2.
  - Step 1a: Select the CBW combinations that the BW of NR SCG carrier is smaller than the BW of E-UTRA MCG carrier(s). If there is no such CBW combination, go to Step 1c.
  - Step 1b: Among the CBW combinations selected from Step 1a, select the CBW combinations with the smallest CBW difference between NR SCG carrier and E-UTRA MCG carrier(s). Go to step 2.
  - Step 1c: Select the EN-DC combinations with smallest CBW difference between the NR SCG carrier and E-UTRA MCG carrier(s). Go to step 2.
- Step 2: Among the CBW combinations selected from Step 1, select the EN-DC combination with the largest aggregated CBW.
  - When the BW of NR SCG carrier is smaller than or equal to the BW of E-UTRA MCG carrier(s), test full allocated PRBs
  - When the BW of NR SCG carrier is larger than the BW of E-UTRA MCG carrier(s), test partial allocated PRBs, and the PRB number for testing equals to the PRB number in the full bandwidth of E-UTRA MCG carrier(s).
    - If frequency of NR SCG carrier is higher than E-UTRA MCG carrier, then the test RBs will be allocated on the highest part of NR SCG carrier.
    - If frequency of NR SCG carrier is lower than E-UTRA MCG carrier, then the test RBs will be allocated on the lowest part of NR SCG carrier.

The performance requirements are specified in Table 9.5B.1.2.1-1 and Table 9.5B.1.2.1-2. The downlink physical channel setup according to Annex C.3.1.

Table 9.5B.1.2.1-1: Minimum performance for FDD EN-DC with 15kHz SCS

Test Number	Bandwidth (MHz)	Reference channel					Reference value Fraction of Maximum Throughput (%)	
	NR SCG CC	E-UTRA MCG CC (Note 1)	NR SCG CC	E-UTRA MCG CC	NR SCG CC	E-UTRA MCG CC (Note 1)	NR SCG CC	
1	Selected EN-DC combination as per the test procedure	NA	Derived as per section 5.1.3.2 of TS 38.214 [12]	-106	-112	NA	85	
Note 1:	The number of E-U	The number of E-UTRA MCG carriers depend on the intra-band and inter-band non-contiguous						

Note 1: The number of E-UTRA MCG carriers depend on the intra-band and inter-band non-contiguous EN-DC configuration and bandwidth combination set

Test Bandwidth Reference channel Power at antenna Reference value Number (MHz) port (dBm/Hz) Fraction of Maximum Throughput (%) NR SCG NR SCG CC E-UTRA NR SCG E-UTRA NR SCG E-UTRA MCG CC MCG CC CC MCG CC CC CC (Note 1) (Note 1) Selected EN-DC -106 -112 85 1 NA Derived as NA combination as per per section the test procedure 5.1.3.2 of TS 38.214 [12] Note 1: The number of E-UTRA MCG carriers depend on the intra-band and inter-band non-contiguous EN-DC configuration and bandwidth combination set

Table 9.5B.1.2.1-2: Minimum performance for TDD EN-DC with 30kHz SCS

# 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.

#### TDD UL-DL configurations for FR1 A.1.2

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		
		Unit	FR1.15-1		
TDD Slot Configuration pattern (Note 1)			DDDSU		
Special Slot Configuration	on (Note 2)		10D+2G+2U		
referenceSubcarrierSpa	cing	kHz	15		
pattern1	dl-UL-TransmissionPeriodicity	ms	5		
	nrofDownlinkSlots		3		
	nrofDownlinkSymbols		10		
nrofUplinkSlot			1		
	nrofUplinkSymbols		2		
The number of slots between PDSCH and corresponding			4 if $mod(i,5) = 0$		
HARQ-ACK information		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.

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

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

Parameter		1	UL-DL pattern					
Param	neter	Unit	FR1.30-1	FR1.30-2	FR1.30-3	FR1.30-4	FR1.30-5	FR1.30-6
TDD Slot Configuration pattern	(Note 1)		7DS2U	DDDSU	DDDSUDDSUU	DDDSUUDDDD	DSUU	DS₁S₂U
Special Slot Configuration (Note	e 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
	nrofÚplinkSymbols		N/A	N/A	2	0	N/A	0
The number of slots between P HARQ-ACK information (Note 3			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
		Oilit	FR1.30-1A
TDD Slot Configuration pattern (N			7DS2U
Special Slot Configuration (Note 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
T			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 $mod(i, 10) = 0$
Note 1: D denotes a slot with a	all DL symbols; S denotes a slo	t with a	
	otes a slot with all UL symbols		
information.	otos a siot with all OL symbols	. 1116 116	NG 13 101
	, guard and UL symbols, respe	ectively.	The field is for
information.	, , ,	,	
Note 3: i is the slot index per fr	rame; $i = \{0,, 19\}$		
Note 4: Do not configure tdd-L	/L-DL-ConfigurationCommon ເ	using 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

D <sub>c</sub>	arameter	Unit	UL-DL pattern
Fa	arameter	Ollit _	FR2.60-1
TDD Slot Configuration patt	tern (Note 1)		DDSU
Special Slot Configuration (	Note 2)		11D+3G+0U
referenceSubcarrierSpacing	g	kHz	60
pattern1	dl-UL-	ms	4
	TransmissionPeriodicity		ı
	nrofDownlinkSlots		2
	nrofDownlinkSymbols		11
	nrofUplinkSlot		1
	nrofUplinkSymbols		0
The number of slots between	en PDSCH and corresponding		3 if $mod(i,4) = 0$
HARQ-ACK information (No	ote 3)		2 if $mod(i,4) = 1$
			5 if $mod(i,4) = 2$

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

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

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

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

	Parameter	Unit	UL-DL	pattern
rarameter		Ollit	FR2.120-1	FR2.120-2
TDD Slot Configuration	pattern (Note 1)		DDDSU	DDSU
Special Slot Configuration	on (Note 2)		10D+2G+2U	11D+3G+0U
referenceSubcarrierSpa	acing	kHz	120	120
pattern1	dl-UL-	ms	0.625	0.5
	TransmissionPeriodicity		0.625	0.5
	nrofDownlinkSlots		3	2
	nrofDownlinkSymbols		10	11
	nrofUplinkSlot		1	1
	nrofUplinkSymbols		2	0
The number of slots bet	ween PDSCH 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 $mod(i.5) = 3$	

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 1:

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

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

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

Parameter			UL-DL pattern FR2.120-1A
TDD Slot Configuration pattern (I	Note 1)		DDDSU
Special Slot Configuration (Note			10D+2G+2U
referenceSubcarrierSpacing		kHz	N/A
pattern1 (Note 4)	dl-UL-	ms	
pattern (Note 4)	TransmissionPeriodicity	1113	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,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 PD	SCH and corresponding		4 if $mod(i,5) = 0$
HARQ-ACK information(Note 3)			3 if $mod(i,5) = 1$
			2 if $mod(i,5) = 2$
			6 if $mod(i,5) = 3$
	all DL symbols; S denotes a slo		
	denotes a slot with all UL syml	bols. Ir	ne field is for
information.			The field in fee
Note 2: D, G and U denote DL information.	., guard and UL symbols, respe	ectively.	ine field is for
Note 3: i is the slot index per f	rame; i = {0,,79}		
Note 4: Do not configure tdd-l	JL-DL-ConfigurationCommon ເ	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-	R.PDSCH.1-		
Reference channel		1.1 FDD	1.2 FDD	1.3 FDD	1.4 FDD		
Channel bandwidth	MHz	10	10	10	10		
Subcarrier spacing	kHz	15	15	15	15		
Number of allocated resource blocks	PRBs	52	6	52	52		
Number of consecutive PDSCH symbols		12	12	7	12		
Allocated slots per 2 frames	Slots	19	19	19	19		
MCS table		64QAM	64QAM	64QAM	64QAMLowSE		
MCS index		4	4	4	14		
Modulation		QPSK	QPSK	QPSK	QPSK		
Target Coding Rate		0.30	0.30	0.30	0.59		
Number of MIMO layers		1	1	1	1		
Number of DMRS REs		18	12	12	12		
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	3904	480	2280	8064		
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	16	16	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	1	1	1	1		
Binary Channel Bits Per Slot							
For Slot i = 0	Bits	N/A	N/A	N/A	N/A		
For Slots i = 10, 11	Bits	12480	1512	6864	13104		
For Slots i =1,, 9, 12,, 19	Bits	13104	1584	7488	13728		
Max. Throughput averaged over 2 frames	Mbps	3.709	0.456	2.166	7.661		
Note 1: SS/PBCH block is transm	Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 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	Mhnc	42.841	
frames	Mbps	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	DIIS	34812	
Max. Throughput averaged over 2	Mbps	24.814	
frames	•		

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	
Deference channel		R.PDSCH.1-	R.PDSCH.1-	R.PDSCH.1-	
Reference channel		6.1 FDD	6.2 FDD	6.3 FDD	
Channel bandwidth	MHz	10	10	10	
Subcarrier spacing	kHz	15	15	15	
Number of allocated resource	555	50	50		
blocks	PRBs	52	52	52	
Number of consecutive PDSCH		40	40	40	
symbols		12	12	12	
Allocated slots per 2 frames	Slots	15	15	15	
MCS table		64QAM	64QAM	64QAM	
MCS index		13	13	20	
Modulation		16QAM	16QAM	64QAM	
Target Coding Rate		0.48	0.48	0.55	
Number of MIMO layer		1	2	2	
Number of DMRS REs (Note 3)		24	24	24	
Overhead for TBS determination		0	0	0	
Information Bit Payload per Slot		-	-	-	
For Slot i = 0	Bits	N/A	N/A	N/A	
For CSI Slots i, if mod (i,5) =1,					
i={0,,19}		N/A	N/A	N/A	
For Non CSI-RS Slot i, if mod (i,5)	5	10010	0.4070	10070	
={0,2,3,4}, i={1,19}	Bits	12040	24072	40976	
Transport block CRC per Slot					
For Slot i = 0	Bits	N/A	N/A	N/A	
For CSI Slots i, if mod (i,5) =1,		NI/A	NI/A	N1/A	
i={0,,19}		N/A	N/A	N/A	
For Non CSI-RS Slot i, if mod (i,5)	D:4-	24	24	24	
={0,2,3,4}, i={1,19}	Bits	24	24	24	
Number of Code Blocks per Slot					
For Slot i = 0	CBs	N/A	N/A	N/A	
For CSI Slots i, if mod (i,5) =1,		N/A	N/A	N/A	
i={0,,19}		IN/A	IN/A	IN/A	
For Non CSI-RS Slot i, if mod (i,5)	CBs	2	3	5	
={0,2,3,4}, i={1,,19}	CDS	2	3	5	
Binary Channel Bits Per Slot					
For Slot i = 0	Bits	N/A	N/A	N/A	
For CSI Slots i, if mod (i,5) =1,		N/A	N/A	N/A	
i={0,,19}					
For Slots i = 10	Bits	23712	47424	71136	
For Non CSI-RS Slot i, if mod (i,5)	Bits	24960	49920	74880	
={0,2,3,4}, i={1,9,11,,19}	סונס	24300	43320	14000	
Max. Throughput averaged over 2	Mbps	9.030	18.054	30.732	
frames	·			30.732	

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

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

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

Parameter	Unit			Value	
Reference channel		R.PDSCH.1-	R.PDSCH.1-		
Reference charmer		7.1 FDD	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		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		
Deference channel		R.PDSCH.1-	R.PDSCH.1-	R.PDSCH.1-	R.PDSCH.1-	
Reference channel		8.1 FDD	8.2 FDD	8.3 FDD	8.4 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	0.010	64QAM	64QAM	64QAM	64QAM	
MCS index		13	17	13	17	
Modulation		16QAM	64QAM	16QAM	64QAM	
Target Coding Rate		0.48	0.43	0.48	0.43	
Number of MIMO layers		1	1	2	2	
Number of DMRS REs		18	18	18	18	
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	12552	16896	25104	28680	
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	3	3	4	
Binary Channel Bits Per Slot						
For Slot i = 0	Bits	N/A	N/A	N/A	N/A	
For Slots i = 1,2,11,12	Bits	24960	37440	51168	76752	
For Slots i = 3,, 10, 13,, 19	Bits	26208	39312	52416	78624	
Max. Throughput averaged over 2 frames	Mbps	11.924	16.0512	23.8488	27.246	

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

Table A.3.2.1.1-9: PDSCH Reference Channel for FDD CC and CA scenario

Parameter	Unit			Value		
Deference channel		R.PDSCH.1-	R.PDSCH.1-	R.PDSCH.1-	R.PDSCH.1-	R.PDSCH.1-
Reference channel		9.1 FDD	9.2 FDD	9.3 FDD	9.4 FDD	9.5 FDD
Channel bandwidth	MHz	5	15	20	25	30
Subcarrier spacing	kHz	15	15	15	15	15
Number of allocated resource blocks	PRBs	25	79	106	133	160
Number of consecutive PDSCH symbols		12	12	12	12	12
Allocated slots per 2 frames	Slots	19	19	19	19	19
MCS table		64QAM	64QAM	64QAM	64QAM	64QAM
MCS index		13	13	13	13	13
Modulation		16QAM	16QAM	16QAM	16QAM	16QAM
Target Coding Rate		0.48	0.48	0.48	0.48	0.48
Number of MIMO layers		2	2	2	2	2
Number of DMRS REs		12	12	12	12	12
Overhead for TBS		0	0	0	0	0
determination		0	0	0	0	U
Information Bit Payload per Slot						
For Slot i = 0	Bits	N/A	N/A	N/A	N/A	N/A
For Slots i = 1,, 19	Bits	12552	39936	53288	67584	79896
Transport block CRC per Slot						
For Slot i = 0	Bits	N/A	N/A	N/A	N/A	N/A
For Slots i = 1,, 19	Bits	24	24	24	24	24
Number of Code Blocks per Slot						
For Slot i = 0	CBs	N/A	N/A	N/A	N/A	N/A
For Slots i = 1,, 19	CBs	2	5	7	9	10
Binary Channel Bits Per Slot						
For Slot i = 0	Bits	N/A	N/A	N/A	N/A	N/A
For Slots i = 10, 11	Bits	25200	79632	106848	134064	161280
For Slots i =1,, 9, 12,, 19	Bits	26400	83424	111936	140448	168960
Max. Throughput averaged over 2 frames	Mbps	11.924	37.939	50.624	64.205	75.901

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

Note 2:

Table A.3.2.1.1-10: PDSCH Reference Channel for FDD CC and CA scenario

MHz kHz PRBs	R.PDSCH.1- 10.1 FDD 40 15	R.PDSCH.1- 10.2 FDD 50 15			
kHz	40 15	50			
kHz	15				
		15			
PRBs	216				
1 1/02		270			
	210	210			
	12	12			
Slots	19	19			
Oloto					
	0	0			
Bits	N/A	N/A			
Bits	108552	135296			
Bits	N/A	N/A			
Bits	24	24			
CBs	N/A	N/A			
CBs	13	17			
Bits	N/A	N/A			
Bits	217728	272160			
Bits	228096	285120			
Mbps	103.124	128.531			
	Bits Bits Bits CBs CBs CBs Bits Bits Bits	12  Slots 19 64QAM 13 16QAM 0.48 2 12 0 Bits N/A Bits 108552  Bits N/A Bits 24  CBs N/A CBs 13  Bits N/A Bits 217728 Bits 228096	12	12	12

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

Note 2:

Table A.3.2.1.1-11: PDSCH Reference Channel for FDD

Parameter	Unit		Value
Deference channel		R.PDSCH.1-	
Reference channel		11.1 FDD	
Channel bandwidth	MHz	10	
Subcarrier spacing	kHz	15	
Number of allocated resource	PRBs	52	
blocks	PRDS	52	
Number of consecutive PDSCH		12	
symbols		12	
Allocated slots per 2 frames	Slots	18	
MCS table		64QAMLowSE	
MCS index		19	
Modulation		16QAM	
Target Coding Rate		0.54	
Number of MIMO layers		1	
Number of DMRS REs		12	
Overhead for TBS determination		0	
Information Bit Payload per Slot			
For Slot $i = 0,1$	Bits	N/A	
For Slots i = 2,, 19	Bits	14856	
Transport block CRC per Slot			
For Slot $i = 0,1$	Bits	N/A	
For Slots i = 2,, 19	Bits	24	
Number of Code Blocks per Slot			
For Slot $i = 0,1$	CBs	N/A	
For Slots i = 2,, 19	CBs	2	
Binary Channel Bits Per Slot			
For Slot i = 0,1	Bits	N/A	
For Slots i = 10, 11	Bits	26208	
For Slots i =2,, 9, 12,, 19	Bits	27456	
Max. Throughput averaged over 2	Mbps	6.685	
frames	Micho	(NOTE 3)	

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

Note 2:

Slot i is slot index per 2 frames
Throughput is calculated under assumption of aggregation factor 2. Note 3:

Table A.3.2.1.1-12: PDSCH Reference Channel for FDD

Parameter	Unit		Value
Reference channel		R.PDSCH.1-	
Reference channel		12.1 FDD	
Channel bandwidth	MHz	10	
Subcarrier spacing	kHz	15	
Number of allocated resource	PRBs	52	
blocks	FKD5	52	
Number of consecutive PDSCH		2	
symbols		2	
Allocated slots per 2 frames	Slots	19	
MCS table		64QAM	
MCS index		4	
Modulation		QPSK	
Target Coding Rate		0.3	
Number of MIMO layers		1	
Number of DMRS REs		6	
Overhead for TBS determination		0	
Information Bit Payload per Slot			
For Slot i = 0	Bits	N/A	
For Slots i = 1,, 19	Bits	576	
Transport block CRC per Slot			
For Slot i = 0	Bits	N/A	
For Slots i = 1,, 19	Bits	16	
Number of Code Blocks per Slot			
For Slot i = 0	CBs	N/A	
For Slots i = 1,, 19	CBs	1	
Binary Channel Bits Per Slot			
For Slot i = 0	Bits	N/A	
For Slots i = 10, 11	Bits	1872	
For Slots i =1,, 9, 12,, 19	Bits	1872	
Max. Throughput averaged over 2 frames	Mbps	0.547	

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.3.2.1.2 Reference measurement channels for SCS 30 kHz FR1

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	ity 20 ms

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

#### 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	Value				
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<sub>PRB</sub> = 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	Value				
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<sub>PRB</sub> = 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<sub>PRB</sub> = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n<sub>PRB</sub> = 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<sub>PRB</sub> = 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<sub>PRB</sub> = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n<sub>PRB</sub> = 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<sub>PRB</sub> = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n<sub>PRB</sub> = 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<sub>PRB</sub> = 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<sub>PRB</sub> = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n<sub>PRB</sub> = 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<sub>PRB</sub> = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n<sub>PRB</sub> = 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<sub>PRB</sub> = 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<sub>PRB</sub> = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n<sub>PRB</sub> = 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<sub>PRB</sub> = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n<sub>PRB</sub> = 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<sub>PRB</sub> = 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<sub>PRB</sub> = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n<sub>PRB</sub> = 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<sub>PRB</sub> = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n<sub>PRB</sub> = 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

Table A.3.2.2.1-1: PDSCH Reference Channel for TDD UL-DL pattern FR1.15-1 and LTE-NR coexistence scenario

Parameter	Unit			Value
Reference channel		R.PDSCH.1-	R.PDSCH.1-	
Neierence channel		1.1 TDD	1.2 TDD	
Channel bandwidth	MHz	10	10	
Subcarrier spacing	kHz	15	15	
Allocated resource blocks	PRBs	52	52	
Number of consecutive PDSCH				
symbols				
For Slot i, if $mod(i, 5) = 3$ for i from		N/A	N/A	
{0,,19}		14/71	14// (	
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i		9	11	
from {1,,19}				
Allocated slots per 2 frames		7	7	
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				
For Slot i, if $mod(i, 5) = 3$ for i from		N/A	N/A	
{0,,19}		IN/A	IN/A	
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i		12	12	
from {1,,19}		12	12	
Overhead for TBS determination		18	18	
Information Bit Payload per Slot				
For Slot 0 and Slot i, if mod(i, 5) =	Bits	N/A	N/A	
{2,3,4} for i from {0,,19}	DIIS	IN/A	IN/A	
For Slot i, if $mod(i, 5) = \{0,1\}$ for i from	Bits	2472	3240	
{1,,19}	DIIS	2412	3240	
Transport block CRC per Slot				
For Slot 0 and Slot i, if mod(i, 5) =	Bits	N/A	N/A	
{2,3,4} for i from {0,,19}	Dita	IN/A	IN/A	
For Slot i, if $mod(i, 5) = \{0,1\}$ for i from	Bits	16	16	
{1,,19}	Dita	10	10	
Number of Code Blocks per Slot				
For Slot 0 and Slot i, if $mod(i, 5) =$	CBs	N/A	N/A	
{2,3,4} for i from {0,,19}	ODS	TN//A	TN//A	
For Slot i, if $mod(i, 5) = \{0,1\}$ for i from	CBs	1	1	
{1,,19}	ODS	'	'	
Binary Channel Bits Per Slot				
For Slot 0 and Slot i, if mod(i, 5) =	Bits	N/A	N/A	
{2,3,4} for i from {0,,19}			18/7	
For Slots i = 10, 11	Bits	7760	10256	
For Slot i, if $mod(i, 5) = \{0,1\}$ for i from	Bits	8384	10880	
{1,,9,12,,19}	סווט	0304	10000	
Max. Throughput averaged over 2	Mbps	0.865	1.134	
frames		with periodicity 3		

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: No user data is scheduled on slots with LTE PBCH/PSS/SSS

Table A.3.2.2.1-2: PDSCH Reference Channel for TDD CC with UL-DL pattern FR1.15-1 and CA scenario

Parameter	Unit			Value				
Deference showed		R.PDSCH.1-	R.PDSCH.1-	R.PDSCH.1-	R.PDSCH.1-	R.PDSCH.1-		
Reference channel		2.1 TDD	2.2 TDD	2.3 TDD	2.4 TDD	2.5 TDD		
Channel bandwidth	MHz	5	10	15	20	25		
Subcarrier spacing	kHz	15	15	15	15	15		
Number of allocated resource	PRBs	25	52	70	106	122		
blocks	PKDS	25	52	79	106	133		
Number of consecutive PDSCH								
symbols								
For Slot i, if mod(i, 5) = 3 for i		8	8	8	8	8		
from {0,,19}		0	0	0	0	0		
For Slot i, if $mod(i, 5) = \{0,1,2\}$		12	12	12	12	12		
for i from {1,,19}			12			12		
Allocated slots per 2 frames	Slots	15	15	15	15	15		
MCS table		64QAM	64QAM	64QAM	64QAM	64QAM		
MCS index		13	13	13	13	13		
Modulation		16QAM	16QAM	16QAM	16QAM	16QAM		
Target Coding Rate		0.48	0.48	0.48	0.48	0.48		
Number of MIMO layers		2	2	2	2	2		
Number of DMRS REs								
For Slot i, if $mod(i, 5) = 3$ for i		40	40	40	40	40		
from {0,,19}		12	12	12	12	12		
For Slot i, if $mod(i, 5) = \{0,1,2\}$		40	40	40	40	40		
for i from {1,,19}		12	12	12	12	12		
Overhead for TBS		0	0	0	0	0		
determination		U	U	U	U	U		
Information Bit Payload per Slot								
For Slot i = 0	Bits	N/A	N/A	N/A	N/A	N/A		
For Slot i, if $mod(i, 5) = 3$ for i	Bits	8064	16896	25608	22016	43032		
from {0,,19}	Dita	0004	10090	23000	33816	43032		
For Slot i, if $mod(i, 5) = \{0,1,2\}$	Bits	12552	26120	39936	53288	67584		
for i from {1,,19}	Dita	12552	20120	39930	55266	07304		
Transport block CRC per Slot								
For Slot i = 0	Bits	N/A	N/A	N/A	N/A	N/A		
For Slot i, if $mod(i, 5) = 3$ for i	Bits	24	24	24	24	24		
from {0,,19}	DIIS	24	24	24	24	24		
For Slot i, if $mod(i, 5) = \{0,1,2\}$	Bits	24	24	24	24	24		
for i from {1,,19}	DIIS	24	24	24	24	24		
Number of Code Blocks per								
Slot								
For Slot i = 0	CBs	N/A	N/A	N/A	N/A	N/A		
For Slot i, if mod(i, 5) = 3 for i	CBs	1	3	4	5	6		
from {0,,19}	CDS	1	3	4	J	υ		
For Slot i, if $mod(i, 5) = \{0,1,2\}$	CBs	2	4	5	7	9		
for i from {1,,19}	CDS	۷	4	J	′	<i>9</i>		
Binary Channel Bits Per Slot								
For Slot i = 0	Bits	N/A	N/A	N/A	N/A	N/A		
For Slots i = 10, 11	Bits	25200	52416	79632	106848	134064		
For Slot i, if mod(i, 5) = 3 for i	Bits	16800	34944	53088	71232	89376		
from {0,,19}	DIIS	10000	34944	55066	11232	093/0		
For Slot i, if $mod(i, 5) = \{0,1,2\}$	Dito	26400	54012	92/2/	111026	140449		
for i from {1,,9,12,,19}	Bits	26400	54912	83424	111936	140448		
Max. Throughput averaged	Mbps	8.516	17.745	27.086	36.072	45.778		
over 2 frames	•			21.000	36.072	45.770		
Note 1: SS/PBCH block is tran			eriodicity 20 ms					
Note 2: Slot i is slot index per 2 frames								

Table A.3.2.2.1-3: PDSCH Reference Channel for TDD CC with UL-DL pattern FR1.15-1 and CA scenario

Parameter	Unit			Value	
Reference channel		R.PDSCH.1-	R.PDSCH.1-	R.PDSCH.1-	
Reference channel		3.1 TDD	3.2 TDD	3.3 TDD	
Channel bandwidth	MHz	30	40	50	
Subcarrier spacing	kHz	15	15	15	
Number of allocated resource	PRBs	160	246	270	
blocks	PRDS	160	216	270	
Number of consecutive PDSCH					
symbols					
For Slot i, if $mod(i, 5) = 3$ for i		8	8	8	
from {0,,19}		0	0	0	
For Slot i, if $mod(i, 5) = \{0,1,2\}$		12	12	12	
for i from {1,,19}			12		
Allocated slots per 2 frames	Slots	15	15	15	
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		2	2	2	
Number of DMRS REs					
For Slot i, if $mod(i, 5) = 3$ for i		12	12	12	
from {0,,19}		12	12	12	
For Slot i, if $mod(i, 5) = \{0,1,2\}$		12	12	12	
for i from {1,,19}		12	12	12	
Overhead for TBS		0	0	0	
determination		U	U	U	
Information Bit Payload per Slot					
For Slot i = 0	Bits	N/A	N/A	N/A	
For Slot i, if $mod(i, 5) = 3$ for i	Bits	51216	69672	86040	
from {0,,19}	Dita	31210	03072	00040	
For Slot i, if $mod(i, 5) = \{0,1,2\}$	Bits	79896	108552	135296	
for i from {1,,19}	Dita	73030	100332	100200	
Transport block CRC per Slot					
For Slot i = 0	Bits	N/A	N/A	N/A	
For Slot i, if $mod(i, 5) = 3$ for i	Bits	24	24	24	
from {0,,19}	Ditto	۷.		- 1	
For Slot i, if $mod(i, 5) = \{0,1,2\}$	Bits	24	24	24	
for i from {1,,19}	5.1.0	- '			
Number of Code Blocks per					
Slot	0.0	21/2	N1/A	<b>N</b> 1/A	
For Slot i = 0	CBs	N/A	N/A	N/A	
For Slot i, if $mod(i, 5) = 3$ for i	CBs	7	9	11	
from {0,,19}			_		
For Slot i, if $mod(i, 5) = \{0,1,2\}$	CBs	10	13	17	
for i from {1,,19}		_			
Binary Channel Bits Per Slot	5	21/2	21/2	<b>N</b> 1/A	
For Slots is 40,44	Bits	N/A	N/A	N/A	<del></del>
For Slots i = 10, 11	Bits	161280	217728	272160	<del></del>
For Slot i, if $mod(i, 5) = 3$ for i	Bits	107520	145152	181440	
from {0,,19}	-				<del></del>
For Slot i, if $mod(i, 5) = \{0, 1, 2\}$	Bits	168960	228096	285120	
for i from {1,,9,12,,19}	1				<del></del>
Max. Throughput averaged	Mbps	54.186	73.638	91.621	
over 2 frames					
Note 1: SS/PBCH block is tran		•	enouldity 20 ms		

#### 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		
Deference channel		R.PDSCH.2-	R.PDSCH.2-	R.PDSCH.2-	R.PDSCH.2-	
Reference channel		1.1 TDD	1.2 TDD	1.3 TDD	1.4 TDD	
Channel bandwidth	MHz	40	40	40	40	
Subcarrier spacing	kHz	30	30	30	30	
Allocated resource blocks	PRBs	106	6	106	106	
Number of consecutive PDSCH						
symbols						
For Slot i, if mod(i, 10) = 7 for i from		4	4	N/A	N/A	
{0,,39}			'	14/71	14/71	
For Slot i, if mod(i, 10) =		12	12	7	12	
{0,1,2,3,4,5,6} for i from {1,,39}						
Allocated slots per 2 frames		31	31	27	27	
MCS table		64QAM	64QAM	64QAM	64QAMLowSE	
MCS index		4	4	4	14	
Modulation		QPSK	QPSK	QPSK	QPSK	
Target Coding Rate		0.30	0.30	0.30	0.59	
Number of MIMO layers		1	1	1	1	
Number of DMRS REs						
For Slot i, if $mod(i, 10) = 7$ for i from		6	6	N/A	N/A	
{0,,39} For Slot i, if mod(i, 10) =						
$\{0,1,2,3,4,5,6\}$ for i from $\{1,,39\}$		18	12	12	12	
Overhead for TBS determination		0	0	0	0	
Information Bit Payload per Slot		U	0	U	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	2664	144	N/A	N/A	
For Slot i, if mod(i, 10) =						
{0,1,2,3,4,5,6} for i from {1,,39}	Bits	8064	480	4608	16392	
Transport block CRC per Slot						
For Slots 0 and Slot i, if mod(i, 10)	D:4-	NI/A	NI/A	NI/A	NI/A	
$= \{8,9\}$ 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	16	16	N/A	N/A	
{0,,39}	DIIS	10	10	IN/A	IN/A	
For Slot i, if mod(i, 10) =	Bits	24	16	24	24	
{0,1,2,3,4,5,6} for i from {1,,39}	Dito	2-7	10	24	27	
Number of Code Blocks per Slot						
For Slots 0 and Slot i, if mod(i, 10)	CBs	N/A	N/A	N/A	N/A	
$= \{8,9\}$ for i from $\{0,,39\}$	020	14/71	14/7	1471	14/71	
For Slot i, if $mod(i, 10) = 7$ for i from	CBs	1	1	N/A	N/A	
{0,,39}						
For Slot i, if mod(i, 10) =	CBs	1	1	1	2	
{0,1,2,3,4,5,6} for i from {1,,39}						
Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10)						
$= \{8,9\}$ for i from $\{0,,39\}$	Bits	N/A	N/A	N/A	N/A	
For Slots i = 20, 21	Bits	25440	1512	13992	26712	
For Slots i = 20, 21  For Slot i, if mod(i, 10) = 7 for i from						
$\{0,,39\}$	Bits	8904	504	N/A	N/A	
For Slot i, if mod(i, 10) =						
{0,1,2,3,4,5,6} for i from	Bits	26712	1584	15264	27984	
{1,,19,22,,39}	210	20/12	1004	10207	2,004	
Max. Throughput averaged over 2		44	0.5==	0.55.	44.65-	
frames	Mbps	11.419	0.677	6.221	11.065	
Note 1: SS/PBCH block is transmitt	ed in slot	#0 with periodi	city 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-
Reference channel		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		4	4	4	4
{0,,39}					
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39}		12	12	12	12
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			_	- J	
For Slot i, if $mod(i, 10) = 7$ for i from	<u> </u>			4.5	10
{0,,39}		6	6	12	12
For Slot i, if mod(i, 10) =		40	40	0.4	0.4
{0,1,2,3,4,5,6} for i from {1,,39}		12	12	24	24
Overhead for TBS determination		0	0	0	0
Information Bit Payload per Slot					
For Slots 0 and Slot i, if mod(i, 10) =	Bits	N/A	N/A	N/A	N/A
{8,9} for i from {0,,39}	Dita	IN//A	IN//A	IN/A	IN//A
For Slot i, if $mod(i, 10) = 7$ for i from	Bits	8456	16896	22032	29192
{0,,39}	Dito	0.100	10000	22002	20102
For Slot i, if $mod(i, 10) =$	Bits	26632	53288	73776	98376
{0,1,2,3,4,5,6} for i from {1,,39}					
Transport block CRC 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 Slot i, if mod(i, 10) = 7 for i from	1				
{0,,39}	Bits	24	24	24	24
For Slot i, if mod(i, 10) =					
{0,1,2,3,4,5,6}for i from {1,,39}	Bits	24	24	24	24
Number of Code Blocks per Slot					
For Slots 0 and Slot i, if mod(i, 10) =	CD-	NI/A	NI/A	NI/A	NI/A
{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	7
For Slot i, if mod(i, 10) =	CBs	4	7	9	12
{0,1,2,3,4,5,6} for i from {1,,39}	050	•	'	Ŭ	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	Bits	17808	35616	45792	61056
{0,,39} For Slot i, if mod(i, 10) =	+				
{0,1,2,3,4,5,6} for i from	Bits	55968	111936	152640	203520
{0,1,2,3,4,3,0} for Filem {1,,19,22,,39}	טונס	33300	111930	102040	200020
Max. Throughput averaged over 2	† <u> </u>				
frames	Mbps	37.644	75.318	104.004	138.646
Note 1: SS/PBCH block is transmitt	ed in slot	#0 with periodic	city 20 ms		<u> </u>
Note 2: Slot i is slot index per 2 fran			•		

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-	
Reference charmer		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		4	
{0,,39}		-	
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$		12	
for i from {1,,39}		0.4	
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		6	
$\{0,,39\}$ For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,6\}$			
For Slot I, If $\text{mod}(1, 10) = \{0, 1, 2, 3, 4, 5, 6\}$ for i from $\{1,, 39\}$		12	
Overhead for TBS determination		0	
Information Bit Payload per Slot		U	
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 $mod(i, 10) = \{0,1,2,3,4,5,6\}$			
for i from $\{1,,39\}$	Bits	83976	
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	<b>5</b> :	0.4	
{0,,39}	Bits	24	
For Slot i, if mod(i, 10) =	D:4-	0.4	
{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) =	CBs	N/A	
{8,9} for i from {0,,39}	0	IN/A	
For Slot i, if mod(i, 10) = 7 for i from	CBs	4	
{0,,39}	ومان	7	
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$	CBs	10	
for i from {1,,39}	003	10	
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 Slots i = 20, 21	Bits	160272	
For Slot i, if $mod(i, 10) = 7$ for i from	Bits	53424	
{0,,39}		55.12.	
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$	Bits	167904	
for i from {1,,19,22,,39}			+ + + + + + + + + + + + + + + + + + + +
Max. Throughput averaged over 2	Mbps	118.796	
frames   Note 1: SS/PBCH block is transmitted i		ith poriodicity Of	00 mc
Note 1: SS/PBCH block is transmitted i Note 2: Slot i is slot index per 2 frames	II SIUL #U W	nur periodicity 2	cill 0:
Trote 2. Siot its siot index per 2 Italites			

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 $mod(i, 10) = \{0,1,2,3,4,5,6\}$	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	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	Mbps	130.308		
frames  Note 1: SS/PBCH block is transmitted i			) mc	
Note 1: SS/PBCH block is transmitted i Note 2: Slot i is slot index per 2 frames	11 210t #U V	vitir periodicity 20	) IIIS	

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	<del>                                     </del>	
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 i	n siot #U W	ntn periodicity 20	zu 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 channel		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 $mod(i, 10) = \{0,1,2,3,4,5,6\}$				
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		6		
$\{0,,39\}$ For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,6\}$				
For Slot 1, if find(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		0		
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	Bits	16896		
{0,,39}	DILS	10090		
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$	Bits	53288		
for i from {1,,39}	Dito	00200		
Transport block CRC per Slot				
For Slots 0 and Slot i, if mod(i, 10) =	Bits	N/A		
$\{8,9\}$ for i from $\{0,,39\}$ 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) =	CBs	N/A		
{8,9} for i from {0,,39}	CDS	IN/A		
For Slot i, if $mod(i, 10) = 7$ for i from	CBs	3		
{0,,39}				
For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,6\}$	CBs	7		
for i from {1,,39} Binary Channel Bits Per Slot				
For Slots 0 and Slot i, if mod(i, 10) =	_	<u> </u>		
{8,9} for i from {0,,39}	Bits	N/A		
For Slot i, if $mod(i, 10) = \{0,5\}$ for i from	D.:	400450		
{1,,19,22,,39}	Bits	103456		
For Slots i = 20	Bits	98368		
For Slots i = 21	Bits	106848		
For Slot i, if $mod(i, 10) = 7$ for i from	Bits	35616		
{0,,39}	2	555.0		
For Slot i, if mod(i, 10) = $\{1,2,3,4,6\}$ for	Bits	111936		
i from {1,,19,22,,39} Max. Throughput averaged over 2				
frames	Mbps	75.318		
Note 1: SS/PBCH block is transmitted i	n slot #0 w	vith periodicity 20	) ms	
Note 2: Slot i is slot index per 2 frames	5.51 // 6	pooaioity 20	- ··· <del>··</del>	

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

Parameter	Unit			Value	
Deference channel		R.PDSCH.2-	R.PDSCH.2-	R.PDSCH.2-	
Reference channel		8.1 TDD	8.2 TDD	8.3 TDD	
Channel bandwidth	MHz	40	40	40	
Subcarrier spacing	kHz	30	30	30	
Allocated resource blocks	PRBs	106	106	106	
Number of consecutive PDSCH		12	12	12	
symbols					
Allocated slots per 2 frames		23	23	23	
MCS table		64QAM	64QAM	64QAM	
MCS index		13	13	20	
Modulation		16QAM	16QAM	64QAM	
Target Coding Rate		0.48	0.48	0.55	
Number of MIMO layers		1	2	2	
Number of DMRS REs (Note 3)		24	24	24	
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	
{7,8,9} for i from {0,,39}	סווט	111/7	1 1/7	1 1/7	
For CSI-RS Slot i, if mod(i,10) =1 for i	Bits	N/A	N/A	N/A	
from {0,,39}					
For Slot i = 20	Bits	24576	49176	83976	
For Slot i, if $mod(i, 10) = \{0,2,3,4,5,6\}$	Bits	24576	49176	83976	
for i from {1,,19,22,,39}	Dito	21070	10170	00070	
Transport block CRC per Slot					
For Slots 0 and Slot i, if mod(i, 10) =	Bits	N/A	N/A	N/A	
{7,8,9} for i from {0,,39}	5.10	14/71	14//	1471	
For CSI-RS Slot i, if mod(i,10) =1 for i	Bits	N/A	N/A	N/A	
from {0,,39}	D.,				
For Slot i = 20	Bits	24	24	24	
For Slot i, if $mod(i, 10) = \{0,2,3,4,5,6\}$	Bits	24	24	24	
for i from {1,,19,22,,39}					
Number of Code Blocks per Slot					
For Slots 0 and Slot i, if mod(i, 10) =	CBs	N/A	N/A	N/A	
{7,8,9} for i from {0,,39} For CSI-RS Slot i, if mod(i,10) =1 for i					
	CBs	N/A	N/A	N/A	
from {0,,39} For Slot i = 20	CBs	3	6	10	
For Slot i = $20$ For Slot i, if mod(i, $10$ ) = $\{0,2,3,4,5,6\}$					
for i from $\{1,,19,22,,39\}$	CBs	3	6	10	
Binary Channel Bits Per Slot					
For Slots 0 and Slot i, if mod(i, 10) =					
$\{7,8,9\}$ for i from $\{0,,39\}$	Bits	N/A	N/A	N/A	
For CSI-RS Slot i, if mod(i,10) =1 for i	_			+	
from {0,,39}	Bits	N/A	N/A	N/A	
For Slot i = 20	Bits	48336	96672	145008	
For Slot i, if mod(i, 10) = $\{0,2,3,4,5,6\}$					
for i from {1,,19,22,,39}	Bits	50880	101760	152640	
Max. Throughput averaged over 2	<b>.</b>			<b>1</b>	
frames	Mbps	28.2624	56.5524	96.5724	
Note 1: SS/PBCH block is transmitted	in clot #C	with poriodicity	, 20 mg	L	

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.3.2.2.9: 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 $\{0,,39\}$		4				
For Slot i, if mod(i, 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		6				
{0,,39}		<u> </u>				
For Slot i, if $mod(i, 10) = \{0,1,2,6,7,8,9\}$		12				
for i from {1,,39}						
Overhead for TBS determination		0				
Information Bit Payload 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	13064				
$\{0,,39\}$ For Slot i, if mod(i, 10) = $\{0,1,2,6,7,8,9\}$						
For Slot 1, if find(i, $10) = \{0, 1, 2, 6, 7, 8, 9\}$ for i from $\{1,, 39\}$	Bits	40976				
Transport block CRC per Slot						
For Slots 0 and Slot i, if mod(i, 10) =						
{4,5} for i from {0,,39}	Bits	N/A				
For Slot i, if $mod(i, 10) = 3$ for i from						
{0,,39}	Bits	24				
For Slot i, if $mod(i, 10) = \{0,1,2,6,7,8,9\}$	D::	0.4				
for i from {1,,39}	Bits	24				
Number of Code Blocks per Slot						
For Slots 0 and Slot i, if mod(i, 10) =	CBs	N/A				
{4,5} for i from {0,,39}	CDS	IN/A				
For Slot i, if $mod(i, 10) = 3$ for i from $\{0,,39\}$	CBs	2				
For Slot i, if $mod(i, 10) = \{0,1,2,6,7,8,9\}$	CD	_				
for i from {1,,39}	CBs	5				
Binary Channel Bits Per Slot						
For Slots 0 and Slot i, if mod(i, 10) =	Dito	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 $\{0,,39\}$	Bits	25704				
For Slot i, if $mod(i, 10) = \{0,1,2,6,7,8,9\}$ for i from $\{1,,19,22,,39\}$	Bits	80784				
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			Value		
Reference channel		R.PDSCH.2-	R.PDSCH.2-	R.PDSCH.2-	R.PDSCH.2-	R.PDSCH.2
	N 41 I-	10.1 TDD	10.2 TDD	10.3 TDD	10.4 TDD	10.5 TDD
Channel bandwidth	MHz kHz	40 30	40 30	40 30	40 30	40 30
Subcarrier spacing  Allocated resource blocks	PRBs	106	106	106	106	106
Number of consecutive PDSCH	PRDS	106	106	106	106	106
symbols						
For Slot i, if $mod(i, 10) = 7$ for i						
from {0,,39}		4	N/A	4	N/A	4
For Slot i, if mod(i, 10) =						
{0,1,2,3,4,5,6} for i from		12	12	12	12	12
(1,,39)						
Allocated slots per 2 frames		31	27	31	27	31
MCS table		64QAM	64QAM	64QAM	64QAM	64QAM
MCS index		13	13	17	13	17
Modulation		16QAM	16QAM	64QAM	16QAM	64QAM
Target Coding Rate		0.48	0.48	0.43	0.48	0.43
Number of MIMO layers		1	1	1	2	2
Number of DMRS REs						
For Slot i, if $mod(i, 10) = 7$ for i		6	N/A	6	N/A	6
from {0,,39} For Slot i, if mod(i, 10) =						
		18	18	18	18	18
{0,1,2,3,4,5,6} for i from {1,,39}		10	10	10	10	10
Overhead for TBS						
determination		0	0	0	0	0
Information Bit Payload per Slot						
For Slots 0 and Slot i, if mod(i,						
	Bits	N/A	N/A	N/A	N/A	N/A
$10) = \{8,9\}$ for i from $\{0,,39\}$ For Slot i, if mod(i, 10) = 7 for i	D:40	0.450	NI/A	44500	NI/A	10101
from {0,,39}	Bits	8456	N/A	11528	N/A	19464
For Slot i, if mod(i, 10) =						
(0,1,2,3,4,5,6) for i from	Bits	25608	25608	33816	51216	58384
{1,,39}						
Transport block CRC per Slot						
For Slots 0 and Slot i, if mod(i,	Bits	N/A	N/A	N/A	N/A	N/A
$10) = \{8,9\}$ for i from $\{0,,39\}$						
For Slot i, if $mod(i, 10) = 7$ for i	Bits	24	N/A	24	N/A	24
from {0,,39} For Slot i, if mod(i, 10) =						
{0,1,2,3,4,5,6} for i from	Bits	24	24	24	24	24
{1,,39}	Dita	24	24	24	24	24
Number of Code Blocks per						
Slot						
For Slots 0 and Slot i, if mod(i,	OD-	NI/A	NI/A	N1/A	N1/A	N1/A
$10) = \{8,9\}$ for i from $\{0,,39\}$	CBs	N/A	N/A	N/A	N/A	N/A
For Slot i, if $mod(i, 10) = 7$ for i	CBs	2	N/A	2	N/A	3
from {0,,39}	CDS	2	IN/A	2	IN/A	3
For Slot i, if mod(i, 10) =						
(0,1,2,3,4,5,6) for i from	CBs	4	4	5	7	7
{1,,39}						
Binary Channel Bits Per Slot	-					
For Slots 0 and Slot i, if mod(i,	Bits	N/A	N/A	N/A	N/A	N/A
$\frac{10) = \{8,9\} \text{ for i from } \{0,,39\}}{\text{For Slote i} = 1,2,31,33}$						
For Slots $i = 1,2,21,22$	Bits	52176	50880	76320	104304	156456
For Slot i, if mod(i, 10) = 7 for i from $\{0,,39\}$	Bits	17808	N/A	26712	N/A	53424
For Slot i, if mod(i, 10) =	1					
{0,1,2,3,4,5,6} for i from	Bits	53424	53424	80136	106848	160272
{3,,20,23,,39}	טונס	00724	00724	50150	1000+0	100212
Max. Throughput averaged	1					
	1 N/Ib	26 262	34.5708	47.9572	69.1416	82.7112
over 2 frames	Mbps	36.262	34.3700	41.3312	03.1710	02.7 1 12

**ETSI** 

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		18	
{1,,39}		10	
For Slot i, if $mod(i, 4) = 1$ for i from		18	
{0,,39}			
Overhead for TBS determination		0	
Information Bit Payload per Slot			
For Slot 0 and Slot i, if $mod(i, 4) = \{2,3\}$	Bits	N/A	
for i from $\{0,,39\}$ 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 $mod(i, 4) = \{2,3\}$	D:4-	NI/A	
for i from {0,,39}	Bits	N/A	
For Slot i, if $mod(i, 4) = 0$ for i from	Bits	24	
{1,,39}	DIG	24	
For Slot i, if $mod(i, 4) = 1$ for i from	Bits	24	
{0,,39}			
Number of Code Blocks per Slot			
For Slot 0 and Slot i, if $mod(i, 4) = \{2,3\}$	CBs	N/A	
for i from {0,,39}			
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			
{0,,39}	CBs	1	
Binary Channel Bits Per Slot			
For Slot 0 and Slot i, if $mod(i, 4) = \{2,3\}$	D.:	N1/A	
for i from {0,,39}	Bits	N/A	
For Slot i = 20	Bits	25440	
For Slot i = 21	Bits	20352	
For Slot i, if $mod(i, 4) = 0$ for i from	Bits	26712	
{1,,19,22,,39}	סונס	20112	
For Slot i, if $mod(i, 4) = 1$ for i from	Bits	21624	
{0,,19,22,,39}	2.10	2.021	
Max. Throughput averaged over 2	Mbps	6.893	
frames	•		<u> </u>
Note 1: SS/PBCH block is transmitted i Note 2: Slot i is slot index per 2 frames		viin periodicity 20	U IIIS

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-			
Channel bandwidth	MHz	12.1 TDD 40			
Subcarrier spacing	kHz	30			
Allocated resource blocks	PRBs	106			
Number of consecutive PDSCH		,,,,,			
symbols			<u> </u>		
For Slot i, if mod(i, 4) = 0 for i from		12			
{1,,39}		12			
For Slot i, if $mod(i, 4) = 1$ for i from		8			
$\{0,,39\}$ For Slot i, if mod(i, 4) = 2 for i from				1	
$\{0,,39\}$		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				1	
For Slot i, if $mod(i, 4) = 0$ for i from		18			
{0,,39}		18			
For Slot i, if $mod(i, 4) = 2$ for i from					
{0,,39}		18			
Overhead for TBS determination		0			
Information Bit Payload per Slot					
For Slot 0 and Slot i, if $mod(i, 4) = 3$ for	Bits	N/A			
i from {0,,39}	Dito	1471			
For Slot i, if $mod(i, 4) = 0$ for i from	Bits	8064			
$\frac{\{1,,39\}}{\text{For Slot i, if mod(i, 4)} = 1 \text{ for i from}}$					
{0,,39}	Bits	4992			
For Slot i, if $mod(i, 4) = 2$ for i from	Bits	0500			
{0,,39}	DIIS	6528			
Transport block CRC per Slot					
For Slot 0 and Slot i, if $mod(i, 4) = 3$ for	Bits	N/A			
i from $\{0,,39\}$ 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			
For Slot i, if $mod(i, 4) = 2$ for i from	Bits	24			
{0,,39}	טוט	24			
Number of Code Blocks per Slot					
For Slot 0 and Slot i, if $mod(i, 4) = 3$ for	CBs	N/A			
i from $\{0,,39\}$ For Slot i, if mod(i, 4) = 0 for i from				1	
{1,,39}	CBs	1			
For Slot i, if $mod(i, 4) = 1$ for i from	0.0	4			
{0,,39}	CBs	1			
For Slot i, if $mod(i, 4) = 2$ for i from	CBs	1			
{0,,39}	555	<u>'</u>			
Binary Channel Bits Per Slot					
For Slot 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,39\}$	Bits	N/A			
For Slot i = 20	Bits	25440		1	
For Slot i = 21	Bits	15264		1	
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	Bits	16536			
{1,,19,22,,39}	2,10	10000			
For Slot i, if $mod(i, 4) = 2$ for i from	Bits	21624			
{0,,39}					

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Max. Thre	oughput averaged over 2	Mbps	9.389				
Note 1:	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.3.2.2.13: PDSCH Reference Channel for TDD CC with UL-DL pattern FR1.30-1 and CA scenario

13.1 TDD		Value		
Channel bandwidth	DSCH.2-	R.PDSCH.2-	R.PDSCH.2-	R.PDSCH.2-
Subcarrier spacing	.2 TDD	13.3 TDD	13.4 TDD	13.5 TDD
Allocated resource blocks	10	15	20	25
Number of consecutive PDSCH symbols	30	30	30	30
Symbols	24	38	51	65
For Slot i, if mod(i, 10) = 7 for i from (0,,39) For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {12} {1,,39} Allocated slots per 2 frames MCS table MCS index MCS index MCS index MCS index Modulation Target Coding Rate Number of MIMO layers Number of DMRS RES For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} F				
from {0,,39}         4           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,1,,39}         12           Allocated slots per 2 frames         31           MCS table         64QAM         64           MCS index         13         64           MCS index         13         13           Modulation         16QAM         16           Target Coding Rate         0.48         0           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 {0,,39}         12           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits         N/A           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits         18           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits         N/A           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         Bits         16           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         Bits         16           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits         16           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         CBs         1           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i f				
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,2,3,4,5,6} for i from {1,2,3,4,5,6} for i from {1,2,3,4,5,6} for i from {1,2,3,4,5,6} for i from {1,3} MCS table	4	4	4	4
\$\langle (0,1,2,3,4,5,6) \text{ for i from } \				
Allocated slots per 2 frames	12	12	12	12
MCS table         64QAM         64           MCS index         13         16QAM         16           Modulation         16QAM         16           Target Coding Rate         0.48         0.48           Number of MIMO layers         2           Number of DMRS REs         2           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 {12         12           {1,,39}         0         12           For Slots 0 and Slot i, if mod(i, 10) = 8,9} for i from {0,,39}         0           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         8           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         8           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         8           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         8           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         8           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         6           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         6           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         6           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         6           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         6				
MCS index         13           Modulation         16QAM         16           Target Coding Rate         0.48         0           Number of MIMO layers         2           Number of DMRS REs         2           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 {12,1,,39}         12           Verhead 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           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         Bits         1800           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39}         Bits         N/A           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         Bits         16           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         Bits         16           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         Bits         16           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         CBs         1           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         CBs         1           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         CBs         1           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         CBs	31	31	31	31
Modulation   Target Coding Rate   0.48   0	4QAM	64QAM	64QAM	64QAM
Target Coding Rate         0.48         0           Number of MIMO layers         2           Number of DMRS RES         6           For Slot i, if mod(i, 10) = {0,,39}         6           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {12         12           {1,,39}         0           Overhead for TBS determination         0           Information Bit Payload per Slot         Bits           For Slots 0 and Slot i, if mod(i, 10) = {7 for i from {0,,39}         Bits           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits           For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits           For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         CBs           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         CBs           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         CBs           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         CBs           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39	13	13	13	13
Number of MIMO layers         2           Number of DMRS REs         6           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) = 7 for i from {0,,39}           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         Bits           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits           For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         Bits           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         CBs           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         CBs           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         CBs           For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits           For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits           For Slots i = 20, 21         Bits         N/A           For Slot, if mod(i, 10) = 7 for i from {0,,39}         Bits         1	6QAM	16QAM	16QAM	16QAM
Number of DMRS RES	0.48	0.48	0.48	0.48
For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39}  Overhead for TBS determination  Information Bit Payload per Slot  For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 8,9} for i from {0,,39}  Binary Channel Bits Per Slot  For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}  Bits 11088 2  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slots i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 8 for i from {0,,39}  For Slot i, if mod(i, 10) = 8 for i from {0,,39}  For Slot i, if mod(i, 10) = 8 for i from {0,,39}  For Slot i, if mod(i, 10) = 8 for i from {0,,39}	2	2	2	2
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) = 7 for i from {0,,39}         Bits           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         Bits         1800           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits         N/A           For Slots 0 and Slot i, if mod(i, 10) = 7 for i from {0,,39}         Bits         N/A           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         Bits         16           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits         24           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         CBs         N/A           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         CBs         1           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         CBs         1           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         CBs         1           For Slots 0 and Slot i, if mod(i, 10) = 7 for i from {0,,39}         Bits         N/A           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         Bits         N/A           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         Bits </td <td></td> <td></td> <td></td> <td></td>				
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {12} {1,,39}  Overhead for TBS determination  Information Bit Payload per Slot  For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}  For Slot i, if mod(i, 10) = {12} {13} {14} {15} {15} {15} {15} {15} {15} {15} {15	6	6	6	6
{0,1,2,3,4,5,6} for i from       12         {1,,39}       0         Overhead for TBS determination       0         Information Bit Payload per Slot       0         For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}       Bits         For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}       Bits         For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}       Bits         For Slot, i, if mod(i, 10) = 7 for i from {0,,39}       Bits         For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}       Bits         For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}       CBs         For Slot, i, if mod(i, 10) = 7 for i from {0,,39}       CBs         For Slot, i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}       CBs         For Slot, i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}       CBs         For Slots 0 and Slot, i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}       Bits         For Slots 0 and Slot, i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}       Bits         For Slot, i, if mod(i, 10) = 7 for i from {0,,39}       Bits         For Slot, i, if mod(i, 10) = 7 for i from {0,,39}       Bits         For Slot, i, if mod(i, 10) = 7 for i from {0,,39}       Bits           For Slot, i, if mod(i, 10) = 7 for	-	-	-	
(1,,39)	12	40	40	40
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) = {0,,39}         Bits         1800         3           For Slot i, if mod(i, 10) = {0,,39}         Bits         5504         1           For Slot i, if mod(i, 10) = {0,,39}         Bits         N/A           For Slots 0 and Slot i, if mod(i, 10) = {0,,39}         Bits         N/A           For Slot i, if mod(i, 10) = {0,,39}         Bits         16           For Slot i, if mod(i, 10) = {0,,39}         Bits         24           For Slots 0 and Slot i, if mod(i, 10) = {0,,39}         CBs         N/A           For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         CBs         1           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         CBs         1           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits         N/A           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits         1           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         Bits         1           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         Bits         1           For Slot i,	12	12	12	12
Information   Bit Payload per Slot				
Information Bit Payload per Slot	0	0	0	0
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from 8 Bits 5504 11 {1,,39}  Transport block CRC per Slot For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}  Number of Code Blocks per Slot For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}  Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}  For Slots i = 20, 21  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 8 Bits 11088 2  For Slot i, if mod(i, 10) = 8 Bits 11088 2  For Slot i, if mod(i, 10) = 8 Bits 11088 2  For Slot i, if mod(i, 10) = 8 Bits 11088 2				
10) = {8,9} for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from 8 Bits 5504 1. {1,,39}  Transport block CRC per Slot  For Slots 0 and Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}  Number of Code Blocks per Slot  For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}  Binary Channel Bits Per Slot  For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 8 Bits 11088 2  For Slot i, if mod(i, 10) = 8 Bits 11616 2				
For Slot i, if mod(i, $10$ ) = 7 for i from $\{0,,39\}$ For Slot i, if mod(i, $10$ ) = $\{0,1,2,3,4,5,6\}$ for i from $\{1,,39\}$ Transport block CRC per Slot  For Slots 0 and Slot i, if mod(i, $10$ ) = $10$ Bits  For Slot i, if mod(i, $10$ ) = $10$ For Slot i, if mod(i, $10$ ) = $10$ For Slot i, if mod(i, $10$ ) = $10$ Bits  For Slot i, if mod(i, $10$ ) = $10$ Bits  For Slot i, if mod(i, $10$ ) = $10$ Bits  For Slot i, if mod(i, $10$ ) = $10$ Bits  For Slot i, if mod(i, $10$ ) = $10$ Bits  For Slot i, if mod(i, $10$ ) = $10$ CBs  For Slot i, if mod(i, $10$ ) = $10$ CBs  Tor Slot i, if mod(i, $10$ ) = $10$ CBs  For Slot i, if mod(i, $10$ ) = $10$ CBs  For Slot i, if mod(i, $10$ ) = $10$ CBs  For Slot i, if mod(i, $10$ ) = $10$ Bits  For Slots 0 and Slot i, if mod(i, $10$ ) = $10$ Bits  For Slots 0 and Slot i, if mod(i, $10$ ) = $10$ Bits  For Slots 0 and Slot i, if mod(i, $10$ ) = $10$ Bits  For Slots 0 and Slot i, if mod(i, $10$ ) = $10$ Bits  For Slot i, if mod(i, $10$ ) = $10$ Bits  For Slot i, if mod(i, $10$ ) = $10$ Bits  For Slot i, if mod(i, $10$ ) = $10$ Bits  For Slot i, if mod(i, $10$ ) = $10$ Bits  For Slot i, if mod(i, $10$ ) = $10$ Bits  For Slot i, if mod(i, $10$ ) = $10$ Bits  For Slot i, if mod(i, $10$ ) = $10$ Bits  For Slot i, if mod(i, $10$ ) = $10$ Bits  For Slot i, if mod(i, $10$ ) = $10$ Bits  For Slot i, if mod(i, $10$ ) = $10$ Bits  For Slot i, if mod(i, $10$ ) = $10$ Bits  For Slot i, if mod(i, $10$ ) = $10$ Bits  For Slot i, if mod(i, $10$ ) = $10$ Bits  For Slot i, if mod(i, $10$ ) = $10$ Bits  For Slot i, if mod(i, $10$ ) = $10$ Bits  For Slot i, if mod(i, $10$ ) = $10$ Bits	N/A	N/A	N/A	N/A
from {0,,39}         Bits         1600           For Slot i, if mod(i, 10) =         {0,1,2,3,4,5,6} for i from         Bits         5504         1           {1,,39}         Transport block CRC per Slot         Bits         N/A           For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}         Bits         16           For Slot i, if mod(i, 10) =         Bits         24           {1,,39}         Bits         24           For Slots 0 and Slot i, if mod(i, 10) =         CBs         N/A           For Slot i, if mod(i, 10) = {8,9} for i from {0,,39}         CBs         1           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         CBs         1           For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits         N/A           For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits         1088         2           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits         1086         8           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits         11616         2				
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} 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}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}  Number of Code Blocks per Slot  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  Number of Code Blocks per Slot  For Slots 0 and Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  Binary Channel Bits Per Slot  For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}  For Slots i = 20, 21  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 8	3840	6144	8192	10504
{0,1,2,3,4,5,6} 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}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}  Number of Code Blocks per Slot  For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}  For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}  Binary Channel Bits Per Slot  For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}  For Slots i = 20, 21  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 8 for Slot i,				
Transport block CRC per Slot  For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 8 lits  For Slot i, if mod(i, 10) = 8 lits  Tor Slot i, if mod(i, 10) = 8 lits  For Slots 0 and Slot i, if mod(i, 10) = 8 lits  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 8 lits  For Slot i, if mod(i, 10) = 8 lits  For Slot i, if mod(i, 10) = 8 lits  For Slot i, if mod(i, 10) = 8 lits  For Slot i, if mod(i, 10) = 8 lits  For Slots 0 and Slot i, if mod(i, 10) = 8 lits  For Slots 0 and Slot i, if mod(i, 10) = 8 lits  For Slots 0 and Slot i, if mod(i, 10) = 8 lits  For Slots i = 20, 21  For Slot i, if mod(i, 10) = 8 lits  For Slot i, if mod(i, 10) = 8 lits  For Slot i, if mod(i, 10) = 8 lits  For Slot i, if mod(i, 10) = 8 lits  For Slot i, if mod(i, 10) = 8 lits  For Slot i, if mod(i, 10) = 8 lits  For Slot i, if mod(i, 10) = 8 lits  For Slot i, if mod(i, 10) = 8 lits  For Slot i, if mod(i, 10) = 8 lits  For Slot i, if mod(i, 10) = 8 lits  For Slot i, if mod(i, 10) = 8 lits  For Slot i, if mod(i, 10) = 8 lits  For Slot i, if mod(i, 10) = 8 lits  For Slot i, if mod(i, 10) = 8 lits  For Slot i, if mod(i, 10) = 8 lits  For Slot i, if mod(i, 10) = 8 lits	2040	18960	25608	32776
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}  Number of Code Blocks per Slot  For Slots 0 and Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}  Binary Channel Bits Per Slot  For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 8 for Slot i, if				
10) = {8,9} for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = {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) = {1,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39}  Binary Channel Bits Per Slot  For Slots 0 and Slot i, if mod(i, 10) = {1,,39}  Binary Channel Bits Per Slot  For Slots 0 and Slot i, if mod(i, 10) = {1,,39}  Binary Channel Bits Per Slot  For Slots 0 and Slot i, if mod(i, 10) = {1,,39}  For Slots i = 20, 21  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 8 lits  For Slot i, if mod(i, 10) = 8 lits  For Slot i, if mod(i, 10) = 8 lits  Bits  11616				
For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = {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) = {1,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39}  Binary Channel Bits Per Slot  For Slots 0 and Slot i, if mod(i, 10) = {1,,39}  Binary Channel Bits Per Slot  For Slots 0 and Slot i, if mod(i, 10) = {1,,39}  For Slots i = 20, 21  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 8 lits  For Slot i, if mod(i, 10) = 8 lits  For Slot i, if mod(i, 10) = 8 lits  Bits  11616	N/A	N/A	N/A	N/A
from {0,,39}         Bits         16           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         Slot         CBs         N/A           For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}         CBs         1           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         CBs         1           For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits         N/A           For Slots i = 20, 21         Bits         11088         2           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits         3696         8           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits         11088         2	14/71	14/7 (	14// (	14/7 (
For Slot i, if mod(i, 10) = {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}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39}  Binary Channel Bits Per Slot  For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}  For Slots i = 20, 21  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from Bits  11616 2	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}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39}  Binary Channel Bits Per Slot  For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}  For Slots i = 20, 21  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 8 lits  For Slot i, if mod(i, 10) = 8 lits  For Slot i, if mod(i, 10) = 8 lits  Bits  Bits  3696				
Number of Code Blocks per   Slot	24	24	24	0.4
Number of Code Blocks per Slot  For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from Channel Bits Per Slot  For Slots 0 and Slot i, if mod(i, 10) = {1,,39}  Binary Channel Bits Per Slot  For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}  For Slots i = 20, 21  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = {1,2,3,4,5,6} for i from Bits  Bits  11616  2	24	24	24	24
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) = {0,1,2,3,4,5,6} for i from {1,,39}       CBs 1       1         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       11088       2         For Slot i, if mod(i, 10) = 7 for i from $\{0,,39\}$ For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from       Bits       11616       2				
For Slots 0 and Slot i, if mod(i, $10$ ) = $\{8,9\}$ for i from $\{0,,39\}$ For Slot i, if mod(i, $10$ ) = 7 for i from $\{0,,39\}$ For Slot i, if mod(i, $10$ ) = $\{0,1,2,3,4,5,6\}$ for i from CBs 1 $\{1,,39\}$ Binary Channel Bits Per Slot  For Slots 0 and Slot i, if mod(i, $10$ ) = $10$ Bits 11088 2  For Slot i, if mod(i, $10$ ) = $10$ For Slot i, if mod(i, $10$ ) = $10$ For Slot i, if mod(i, $10$ ) = $10$ For Slot i, if mod(i, $10$ ) = $10$ Bits 11616 2				
10) = {8,9} for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from CBs 1  {1,,39}  Binary Channel Bits Per Slot  For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}  For Slots i = 20, 21 Bits 11088 2  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 8  For Slot i, if mod(i, 10) = 8  {0,1,2,3,4,5,6} for i from Bits 11616 2				
For Slot i, if mod(i, 10) = 7 for i from $\{0,,39\}$ For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,6\}$ for i from CBs 1 $\{1,,39\}$ Binary Channel Bits Per Slot  For Slots 0 and Slot i, if mod(i, 10) = $\{8,9\}$ for i from $\{0,,39\}$ For Slots i = 20, 21 Bits 11088 2  For Slot i, if mod(i, 10) = 7 for i from $\{0,,39\}$ For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,6\}$ for i from Bits 11616 2	N/A	N/A	N/A	N/A
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			,	_
For Slot i, if mod(i, 10) = $ \{0,1,2,3,4,5,6\} \text{ for i from} \qquad \text{CBs} \qquad 1 \\ \{1,,39\} \qquad \qquad \\ \text{Binary Channel Bits Per Slot} \qquad \qquad \\ \text{For Slots 0 and Slot i, if mod(i, } \\ 10) = \{8,9\} \text{ for i from } \{0,,39\} \qquad \qquad \\ \text{For Slots i} = 20, 21 \qquad \qquad \\ \text{Bits} \qquad \qquad 11088 \qquad 2 \\ \text{For Slot i, if mod(i, } 10) = 7 \text{ for i from } \{0,,39\} \qquad \qquad \\ \text{For Slot i, if mod(i, } 10) = \\ \text{For Slot i, if mod(i, } 10) = \\ \{0,1,2,3,4,5,6\} \text{ for i from} \qquad \qquad \\ \text{Bits} \qquad \qquad 11616 \qquad 2 \\ \text{Bits} \qquad 11616$	1	1	1	2
Binary Channel Bits Per Slot         For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}         Bits       N/A         For Slots i = 20, 21       Bits       11088       2         For Slot i, if mod(i, 10) = 7 for i from {0,,39}       Bits       3696       8         For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from       Bits       11616       2	2	3	4	4
For Slots 0 and Slot i, if mod(i, 10) = $\{8,9\}$ for i from $\{0,,39\}$ For Slots i = 20, 21  For Slot i, if mod(i, 10) = 7 for i from $\{0,,39\}$ Bits 11088 2  For Slot i, if mod(i, 10) = 7 for i from $\{0,,39\}$ For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,6\}$ for i from Bits 11616 2				
10) = {8,9} for i from {0,,39}  For Slots i = 20, 21  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 8  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from Bits Bits Bits Bits Bits Bits Bits Bits				
For Slots i = 20, 21 Bits 11088 2  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 8  For Slot i, if mod(i, 10) = 8  {0,1,2,3,4,5,6} for i from Bits 11616 2	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 10) = 7 for i from $\{0,,39\}$ Bits 3696 8  For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,6\}$ for i from Bits 11616 2				
from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from Bits 11616 2	24192	38304	51408	65520
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from Bits 11616 2	8064	12768	17136	21840
{0,1,2,3,4,5,6} for i from Bits 11616 2				
	05244	40400	E2052	60040
	25344	40128	53856	68640
May Throughput averaged				
over 2 frames Mbps 7.790	7.022	26.825	36.209	46.348
Note 1: SS/PBCH block is transmitted in slot #0 with periodic	city 20 me			
Note 2: Slot i is slot index per 2 frames	only 20 1113			

Table A.3.2.2.14: PDSCH Reference Channel for TDD CC with UL-DL pattern FR1.30-1 and CA scenario

Parameter	Unit			Value		
	- Cinc	R.PDSCH.2-	R.PDSCH.2-	R.PDSCH.2-	R.PDSCH.2-	R.PDSCH.2-
Reference channel		14.1 TDD	14.2 TDD	14.3 TDD	14.4 TDD	14.5 TDD
Channel bandwidth	MHz	30	50	60	80	90
Subcarrier spacing	kHz	30	30	30	30	30
Allocated resource blocks	PRBs	78	133	162	217	245
Number of consecutive PDSCH						
symbols						
For Slot i, if $mod(i, 10) = 7$ for i		4	4	4	4	4
from {0,,39}			7	7	7	7
For Slot i, if mod(i, 10) =						
{0,1,2,3,4,5,6} for i from		12	12	12	12	12
{1,,39}		04	0.4	0.4	0.4	0.4
Allocated slots per 2 frames		31 64QAM	31 64QAM	31 64QAM	31 64QAM	31 64QAM
MCS table MCS index		13	13	13	13	13
Modulation		16QAM	16QAM	16QAM	16QAM	16QAM
Target Coding Rate		0.48	0.48	0.48	0.48	0.48
Number of MIMO layers		2	2	2	2	2
Number of DMRS REs						
For Slot i, if $mod(i, 10) = 7$ for i						
from {0,,39}		6	6	6	6	6
For Slot i, if mod(i, 10) =						
{0,1,2,3,4,5,6} for i from		12	12	12	12	12
{1,,39}						
Overhead for TBS		0	0	0	0	0
determination		U	U	U	U	U
Information Bit Payload per Slot						
For Slots 0 and Slot i, if mod(i,	Bits	N/A	N/A	N/A	N/A	N/A
$10) = \{8,9\}$ for i from $\{0,,39\}$	Ditto	14/71	14/73	14// (	14/7	1471
For Slot i, if $mod(i, 10) = 7$ for i	Bits	12552	21504	26120	34816	38936
from {0,,39}						
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from	Bits	38936	67584	81976	110632	122976
{0,1,2,3,4,3,6} for Fifting {1,,39}	DIIS	30930	07304	01970	110032	122970
Transport block CRC per Slot						
For Slots 0 and Slot i, if mod(i,						
10) = $\{8,9\}$ for i from $\{0,,39\}$	Bits	N/A	N/A	N/A	N/A	N/A
For Slot i, if $mod(i, 10) = 7$ for i	D:40	24	0.4	24	0.4	0.4
from {0,,39}	Bits	24	24	24	24	24
For Slot i, if mod(i, 10) =						
{0,1,2,3,4,5,6} for i from	Bits	24	24	24	24	24
{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	N/A
For Slot i, if mod(i, 10) = 7 for i						
from {0,,39}	CBs	2	3	4	5	5
For Slot i, if mod(i, 10) =						
{0,1,2,3,4,5,6} for i from	CBs	5	9	10	14	15
{1,,39}						
Binary Channel Bits Per Slot						
For Slots 0 and Slot i, if mod(i,	Bits	N/A	N/A	N/A	N/A	N/A
$10) = \{8,9\}$ for i from $\{0,,39\}$						
For Slots i = 20, 21	Bits	78624	134064	163296	218736	246960
For Slot i, if $mod(i, 10) = 7$ for i	Bits	26208	44688	54432	72912	82320
from {0,,39}	ļ	_		<del> </del>	1	_
For Slot i, if mod(i, 10) =	Bits	82368	140448	171072	229152	258720
{0,1,2,3,4,5,6} for i from {1,,19,22,,39}	DIIS	02300	140446	171072	229102	200720
Max. Throughput averaged	-					
over 2 frames	Mbps	55.074	95.539	115.892	156.316	173.805
Note 1: SS/PBCH block is tran	smitted i	n slot #0 with p	eriodicity 20 ms	1	1	1

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.3.2.2.2-15: PDSCH Reference Channel for TDD CC with UL-DL pattern FR1.30-1 and CA scenario

Reference channel	Parameter	Unit		Value	<b>)</b>	
15,1   DU			R.PDSCH.2-			
Subcarrier spacing						
Allocated resource blocks   PRBS   273						
Number of consecutive PDSCH symbols						
Symbols   For Slot i, if mod(i, 10) = 7 for i from (0,39)		PRBs	273			
For Slot i, if mod(i, 10) = 7 for i from (039)						
from (0,, 39)	symbols					
For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39)			4			
(0,1,2,3,4,5,6) for i from (1,39)						
Allocated slots per 2 frames   31			12			
Allocated slots per 2 frames   31			12			
MCS table         640AM           MCS index         13           Modulation         16QAM           Target Coding Rate         0.48           Number of MIMO layers         2           Number of MIMO layers         2           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 (1,2,3,4,5,6) for i from			31			
MCS index         13           Modulation         16QAM           Target Coding Rate         0.48           Number of MIMO layers         2           Number of DMRS REs         5           For Slott i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (1,,39)         6           For Slott i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (1,,39)         12           Verhead for TBS determination         0           Information Bit Payload per Slot         0           For Slots and Slott i, if mod(i, 10) = (8,9) for i from (0,,39)         6           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 (0,,39)         8           For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39)         8           For Slot i, if mod(i, 10) = 7 for i from (0,,39)         6           For Slot i, if mod(i, 10) = 7 for i from (0,,39)         6           For Slot i, if mod(i, 10) = 7 for i from (0,,39)         6           For Slot i, if mod(i, 10) = 7 for i from (0,,39)         6           For Slot i, if mod(i, 10) = 7 for i from (0,,39)         6           For Slot i, if mod(i, 10) = 7 for i from (0,,39)         6           For Slot i, if mod(i, 10) = 7 for i from (0,,39)         6           For Slot i, if mod(i						
Modulation						
Target Coding Rate						
Number of MIMO layers						
For Slot i, if mod(i, 10) = 7 for i from (039)			2			
from (0,,39)         0           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39}         12           (1,1,2,3,4,5,6) for i from {1,,39}         0           Overhead for TBS determination         0           Information Bit Payload per Slot For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39}         Bits           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         CBs           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         CBs           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         CBs           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,1,,39}         Bits           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6} for i from {0,1,2,3,						
From (U39)   Too (U	For Slot i, if $mod(i, 10) = 7$ for i		6			
12   12   13   14   15   15   16   16   16   16   16   16	from {0,,39}		U			
139  Overhead for TBS						
Overhead for TBS determination         0           Information Bit Payload per Slot         For Slots 0 and Slot i, if mod(i, 10) = for i from {0,,39}           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         Bits           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39}         Bits           Transport block CRC per Slot         Bits           For Slots 0 and Slot i, if mod(i, 10) = 7 for i from {0,,39}         Bits           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         Bits           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         Bits           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from Bits         24           {1,,39}         Number of Code Blocks per Slot           Slot         Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}           For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         CBs           For Slot, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         CBs           For Slot 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits           For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6} for i from {0,1,2,3			12			
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	{1,,39}					
Information Bit Payload per Slot   For Slots 0 and Slot i, if mod(i, 10) = (8,9) for i from (0,,38)   Bits   N/A			0			
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 8 lits						
10   = (8,9) for i from (0,,39)   Bits   N/A						
For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,39376} {1,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,0  = {8,9} for i from {0,,39}} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Number of Code Blocks per Slot For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Binary Channel Bits Per Slot For Slots i and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Binary Channel Bits Per Slot For Slots i = 20, 21 Bits For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 8 lits For Slot i, if	,	Bits	N/A			
from {0,,39}	For Slot i if mod/i 10) = 7 for i					
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39}  Transport block CRC per Slot  For Slots 0 and Slot i, if mod(i, 10) = 7 for i from {0,,39}.  For Slot 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}.  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}.  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}.  For Slot i, if mod(i, 10) = 7 for i from {0,,39}.  For Slot i, if mod(i, 10) = 7 for i from {0,,39}.  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}.  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}.  Binary Channel Bits Per Slot  For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}.  Binary Channel Bits Per Slot  For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}.  For Slots i = 20, 21 Bits 275184  For Slot i, if mod(i, 10) = 7 for i from {0,,39}.  For Slot i, if mod(i, 10) = 7 for i from {0,,39}.  For Slot i, if mod(i, 10) = 8 Bits 288288  {1,,9,22,,39}.  Max. Throughput averaged over 2 frames		Bits	44040			
(0,1,2,3,4,5,6) for i from {1,,39}	For Slot i, if mod(i, 10) =					
(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		Bits	139376			
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}    For Slot i, if mod(i, 10) = 7 for i from {0,,39}    For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}    For Slot i, if mod(i, 10) = {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) = 7 for i from {0,,39}    For Slot i, if mod(i, 10) = 7 for i from {0,,39}    For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}    For Slot i, if mod(i, 10) = {1,,39}    Bits    Observable    N/A    Observable    N/A    Observable    N/A    Observable    Observabl	{1,,39}					
10) = {8,9} for i from {0,,39}   Bits   N/A						
10   = {8,9}   for   from {0,,39}   For Slot i, if mod(i, 10) = 7 for i from {0,,39}   For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6}   for i from {0,,39}   Sits   24		Rits	N/A			
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         N/A         N/A           For Slots 0 and Slot i, if mod(i, 10) = {0,,39}         CBs         N/A           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         CBs         6           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39}         CBs         17           Binary Channel Bits Per Slot         Bits         N/A           For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits         N/A           For Slots i = 20, 21         Bits         275184           For Slot i, if mod(i, 10) = 7 for i from {0,,39}         Bits         91728           For Slot i, if mod(i, 10) = 80 for i from {0,,39}         Bits         288288           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits         288288           For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}         Bits         288288           {1,,19,22,,39}         Mbps         196.966	$10) = \{8,9\}$ for i from $\{0,,39\}$	Dito	14// (			
For Slot i, if mod(i, 10) = {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) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {1,,39}  Binary Channel Bits Per Slot  For Slots 0 and Slot i, if mod(i, 10) = 7 for i from {1,,39}  Binary Channel Bits Per Slot  For Slots 0 and Slot i, if mod(i, 10) = {1,,39} for i from {1,,39}  Binary Channel Bits Per Slot  For Slots 0 and Slot i, if mod(i, 10) = {1,,39} for i from {1,,39} for i from {1,,39} for i from {1,,39} for i from {1,,39} for Slot i, if mod(i, 10) = 7 for i from {1,,39} for Slot i, if mod(i, 10) = 7 for i from {1,,39} for Slot i, if mod(i, 10) = 7 for i from {1,,39} for Slot i, if mod(i, 10) = {1,,39} for i from {1,,39} fo		Bits	24			
{0,1,2,3,4,5,6} for i from {1,,39}       Bits       24         Number of Code Blocks per Slot       Slot       N/A         For Slots 0 and Slot i, if mod(i, 10) = {6,9} for i from {0,,39}       CBs       N/A         For Slot i, if mod(i, 10) = 7 for i from {0,,39}       CBs       6         For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39}       CBs       17         Binary Channel Bits Per Slot       Bits       N/A         For Slots 0 and Slot i, if mod(i, 10) = {0,,39}       Bits       N/A         For Slots i = 20, 21       Bits       275184         For Slot i, if mod(i, 10) = 7 for i from {0,,39}       Bits       91728         For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}       Bits       288288         4],,19,22,,39}       Mbps       196.966						
\{1,,39\} \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \		Dito	24			
Number of Code Blocks per   Slot		DIIS	24			
Slot   For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}   CBs   N/A   CBs   For Slot i, if mod(i, 10) = 7 for i from {0,,39}   CBs   6   CBs   C	Number of Code Blocks per					
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = CBs  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39}  Binary Channel Bits Per Slot  For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}  For Slots i = 20, 21  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 8 for Slot i, if mod(i, 10) = 7 for i from {1,,39}  For Slot i, if mod(i, 10) = 8 for Slot i, if mod(i, 10) = 10 for Slot	•					
10) = {8,9} for i from {0,,39}       CBS         For Slot i, if mod(i, 10) = {0,,39}       CBS         For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39}       CBS         Binary Channel Bits Per Slot       Bits         For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}       Bits         For Slots i = 20, 21       Bits         For Slot i, if mod(i, 10) = 7 for i from {0,,39}       Bits         For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6} for i from {1,2,2,,39}       Bits         Max. Throughput averaged over 2 frames       Mbps		05	N/A			
For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39}  Binary Channel Bits Per Slot  For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}  For Slots i = 20, 21  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,19,22,,39}  Max. Throughput averaged over 2 frames		CBs				
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39}  Binary Channel Bits Per Slot  For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}  For Slots i = 20, 21  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 8 lits  For Slot i, if mod(i, 10) = 8 lits  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}  Max. Throughput averaged over 2 frames		CDo	6			
{0,1,2,3,4,5,6} for i from {1,,39}  Binary Channel Bits Per Slot  For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}  For Slots i = 20, 21  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 8	from {0,,39}	CDS	О			
{1,,39}         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       275184         For Slot i, if mod(i, 10) = 7 for i from {0,,39}       Bits       91728         For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,19,22,,39}       Bits       288288         Max. Throughput averaged over 2 frames       Mbps       196.966	For Slot i, if mod(i, 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       275184         For Slot i, if mod(i, 10) = 7 for i from {0,,39}       Bits       91728         For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,19,22,,39}       Bits       288288         Max. Throughput averaged over 2 frames       Mbps       196.966	{0,1,2,3,4,5,6} for i from	CBs	17			
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}  For Slots i = 20, 21  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6} for i from {1,,19,22,,39}  Max. Throughput averaged over 2 frames						
10) = {8,9} for i from {0,,39}  For Slots i = 20, 21  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6} for i from {1,,19,22,,39}  Max. Throughput averaged over 2 frames						
For Slots i = 20, 21 Bits 275184  For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6} for i from {1,,19,22,,39}  Max. Throughput averaged over 2 frames  Bits 288288		Bits	N/A			
For Slot i, if mod(i, 10) = 7 for i from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6} for i from {1,,19,22,,39}  Max. Throughput averaged over 2 frames  Bits 91728  91728		Dito				
from {0,,39}  For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,19,22,,39}  Max. Throughput averaged over 2 frames  Bits 91728  91728  91728  91728		טונט				
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from	$from \{0, 30\}$	Bits	91728			
{0,1,2,3,4,5,6} for i from Bits 288288 {1,,19,22,,39} Max. Throughput averaged over 2 frames Mbps 196.966	For Slot i if mod(i 10) –					
{1,,19,22,,39}  Max. Throughput averaged over 2 frames  Mbps 196.966	{0.1.2.3.4.5.6} for i from	Bits	288288			
Max. Throughput averaged over 2 frames  Mbps 196.966						
over 2 frames		N #1	400.000			
		ivibps	196.966			
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms		smitted i	n slot #0 with pe	riodicity 20 ms	· · · · · · · · · · · · · · · · · · ·	
Note 2: Slot i is slot index per 2 frames				· 		

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

Parameter	Unit		Value
Deference channel		R.PDSCH.1-	
Reference channel		16.1 TDD	
Channel bandwidth	MHz	40	
Subcarrier spacing	kHz	30	
Allocated resource blocks	PRBs	106	
Number of consecutive PDSCH			
symbols			
For Slot i, if $mod(i, 10) = \{0, 7\}$ for i		N1/A	
from {0,,39}		N/A	
For Slot i, if mod(i, 10) =		40	
{1,2,3,4,5,6} for i from {1,,39}		12	
Allocated slots per 2 frames		24	
MCS table		64QAMLowSE	
MCS index		19	
Modulation		16QAM	
Target Coding Rate		0.54	
Number of MIMO layers		1	
Number of DMRS REs			
For Slot i, if $mod(i, 10) = \{0, 7\}$ for i		NI/A	
from {0,,39}		N/A	
For Slot i, if mod(i, 10) =		12	
{0,1,2,3,4,5,6} for i from {1,,39}		12	
Overhead for TBS determination		0	
Information Bit Payload per Slot			
For Slot i, if $mod(i, 10) = \{0,7,8,9\}$	Bits	N/A	
for i from {0,,39}	DIIS	IN/A	
For Slot i, if mod(i, 10) =	Bits	30216	
{1,2,3,4,5,6} for i from {1,,39}	Dito	00210	
Transport block CRC per Slot			
For Slot i, if $mod(i, 10) = \{0,7,8,9\}$	Bits	N/A	
for i from {0,,39}	Ditto	14/71	
For Slot i, if $mod(i, 10) =$	Bits	24	
{1,2,3,4,5,6} for i from {1,,39}			
Number of Code Blocks per Slot			
For Slot i, if $mod(i, 10) = \{0,7,8,9\}$	CBs	N/A	
for i from {0,,39}			
For Slot i, if mod(i, 10) =	CBs	2	
{1,2,3,4,5,6} for i from {1,,39}			
Binary Channel Bits Per Slot			<del>                                     </del>
For Slot i, if $mod(i, 10) = \{0,7,8,9\}$	Bits	N/A	
for i from {0,,39}	Dita	50404	
For Slot i if mod/i 10)	Bits	53424	
For Slot i, if mod(i, 10) = {1,2,3,4,5,6} for i from	Bits	55968	
{1,2,3,4,5,6} for Firom {1,,19,22,,39}	סווס	55900	
Max. Throughput averaged over 2	<del>                                     </del>	18.130	
frames	Mbps	(NOTE 3)	
Note 1: SS/PBCH block is transmit	tod in clo		ity 20 mc

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

Note 2:

Throughput is calculated under assumption of aggregation factor 2. Note 3:

Table A.3.2.2.2-17: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-2

Parameter	Unit		Value					
Reference channel		R.PDSCH.1- 17.1 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 $\{0,,39\}$		2						
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,39\}$		N/A						
Allocated slots per 2 frames		8						
MCS table								
MCS index		4						
Modulation		QPSK						
Target Coding Rate		0.3						
Number of MIMO layers		1						
Number of DMRS REs								
For Slot i, if $mod(i, 5) = 3$ for i from		•						
{0,,39}		6						
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,39\}$		N/A						
Overhead for TBS determination		0						
Information Bit Payload per Slot		•						
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$	Bits	1160						
For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i from $\{1,,39\}$	Bits	N/A						
Transport block CRC per Slot								
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$	Bits	16						
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,39\}$	Bits	N/A						
Number of Code Blocks per Slot								
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$	CBs	1						
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,39\}$	CBs	N/A						
Binary Channel Bits Per Slot								
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$	Bits	3816						
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,39\}$	Bits	N/A						
Max. Throughput averaged over 2 frames	Mbps	0.464						
Note 1: SS/PBCH block is transmitted in slot #0 with 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

#### 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)

Parameter	Unit		Value	
Reference channel		R.PDSCH.4-		
		1.1 TDD		
Channel bandwidth	MHz	50		
Subcarrier spacing	kHz	60		
Allocated resource blocks	PRBs	66		
Number of consecutive PDSCH				
symbols				
For Slot i, if $mod(i, 4) = 2$ for i from		10		
$\{1,, 79\}$ For Slot i, if mod(i, 4) = $\{0,1\}$ for i from				
		13		
{1,,79}		50		
Allocated slots per 2 frames		59		
MCS table		64QAM		
MCS index		13		
Modulation		16QAM		
Target Coding Rate Number of MIMO layers		0.48		
Number of DMRS REs				
For Slot i, if mod(i, 4) = 2 for i from				
{1,, 79}		12		
For Slot i, if $mod(i, 4) = \{0,1\}$ for i from				
{1,,79}		12		
Overhead for TBS determination		6		
Information Bit Payload per Slot		<u> </u>		
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	D.,	05000		
{1,, 79}	Bits	25608		
For Slot i, if $mod(i, 4) = \{0,1\}$ for i from	D:4-	0.404.0		
{1,,79}	Bits	34816		
Transport block CRC per Slot				
For Slots 0 and Slot i, if mod(i, 4) = 3	Bits	N/A		
for i from {0,,79}	Dita	14/74		
For Slot i, if mod(i, 4) = 2 for i from	Bits	24		
{1,, 79}	Dito			
For Slot i, if $mod(i, 4) = \{0,1\}$ for i from	Bits	24		
{1,,79}				
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	CBs	4		
$\{1,,79\}$ For Slot i, if mod(i, 4) = $\{0,1\}$ for i from			+ + + + + + + + + + + + + + + + + + + +	
$\{1,,79\}$	CBs	5		
Binary Channel Bits Per Slot			+ + + + + + + + + + + + + + + + + + + +	
For Slots 0 and Slot i, if $mod(i, 4) = 3$			+ + + + + + + + + + + + + + + + + + + +	
for i from $\{0,,79\}$	Bits	N/A		
For Slot i = 40, 41	Bits	69960		
For Slot i, if $mod(i, 4) = 2$ for i from				
{4,, 79}	Bits	54912		
For Slot i, if $mod(i, 4) = \{0,1\}$ for i from	D:+=	72400		
{1,,39,42,,79}	Bits	73128		
Max. Throughput averaged over 2	Mbps	93.499		
frames	•			
Note 1: SS/PBCH block is transmitted	in slot #0 v	vith periodicity 2	20 ms	

#### 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		0					
{0,, 159}		9					
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i		40					
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		4.0					
{0,, 159}		12					
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i		4.0					
from {1,,159}		12					
Overhead for TBS determination		6					
Information Bit Payload per Slot							
For Slots 0 and Slot i, if $mod(i, 5) = 4$	5	21/2					
for i from {0,,159}	Bits	N/A					
For Slot i, if mod(i, 5) = 3 for i from	5	2224					
{0,, 159}	Bits	3624					
For Slot i, if $mod(i, 5) = \{0, 1, 2\}$ for i	D::	5504					
from {1,,159}	Bits	5504					
Transport block CRC per Slot							
For Slots 0 and Slot i, if mod(i, 5) = 4	D::	N1/A					
for i from {0,,159}	Bits	N/A					
For Slot i, if $mod(i, 5) = 3$ for i from	D:4-	40					
{0,, 159}	Bits	16					
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i	Dita	0.4					
from {1,,159}	Bits	24					
Number of Code Blocks per Slot							
For Slots 0 and Slot i, if mod(i, 5) = 4	CDa	NI/A					
for i from {0,,159}	CBs	N/A					
For Slot i, if mod(i, 5) = 3 for i from	CBs	1					
{0,, 159}	CDS	<u> </u>					
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i	CBs	1					
from {1,,159}	CDS	ı					
Binary Channel Bits Per Slot							
For Slots 0 and Slot i, if mod(i, 5) = 4	Bits	N/A					
for i from {0,,159}							
For Slots i = 80, 81	Bits	17490					
For Slot i, if $mod(i, 5) = 3$ for i from	Bits	12210					
{0,, 159}	סונס	12210					
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i	Bits	18282					
from {1,,79,82,,159}	טונס	10202					
Max. Throughput averaged over 2	Mbps	31.942					
frames	·						
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms							

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			

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

Parameter	Unit		Value
Reference channel		R.PDSCH.5- 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		40	
{0,, 159}		12	
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i		40	
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	Dito	N/A	
for i from {0,,159}	Bits		
For Slot i, if $mod(i, 5) = 3$ for i from	Bits	16136	
{0,, 159}	DIIS	10130	
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i	Bits	25104	
from {1,,159}			
Transport block CRC per Slot		N1/A	
For Slots 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,159\}$	Bits	N/A	
For Slot i, if $mod(i, 5) = 3$ for i from			
{0,, 159}	Bits	24	
For Slot i, if $mod(i, 5) = \{0, 1, 2\}$ for i			
from {1,,159}	Bits	24	
Number of Code Blocks per Slot			
For Slots 0 and Slot i, if mod(i, 5) = 4	OD-	N1/A	
for i from {0,,159}	CBs	N/A	
For Slot i, if mod(i, 5) = 3 for i from	CBs	2	
{0,, 159}	ODS		
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i	CBs	3	
from {1,,159}			
Binary Channel Bits Per Slot		N1/2	
For Slots 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,159\}$	Bits	N/A	
For Slots i = 80, 81	Bits	52470	
For Slot i, if $mod(i, 5) = 3$ for i from			
{0,, 159}	Bits	36630	
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i	Bits	54846	
from {1,,79,82,,159}	סונס		
Max. Throughput averaged over 2	Mbps	145.062	
frames	-		
Note 1: SS/PBCH block is transmitted		ith periodicity 20	0 ms
Note 2: Slot i is slot index per 2 frames			

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 $\{1,, 159\}$		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		4		
Modulation		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 $\{1,, 159\}$		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	Dita	NI/A		
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 $mod(i, 4) = 3$ for i from $\{0,,159\}$	Bits	N/A		
For Slot i, if mod(i, 4) = 2 for i from {1,, 159}	Bits	16		
For Slot i, if $mod(i, 4) = \{0,1\}$ for i from	Bits	16		
{1,,159}				
Number of Code Blocks per Slot  For Slots 0 and Slot i, if mod(i, 4) = 3	CBs	N/A		
for i from $\{0,,159\}$ For Slot i, if mod(i, 4) = 2 for i from	CBs	1		
$\{1,, 159\}$ For Slot i, if mod(i, 4) = $\{0,1\}$ for i from				
{1,,159} Binary Channel Bits Per Slot	CBs	1		
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	3180		
For Slot i, if mod(i, 4) = 2 for i from $\{4,, 159\}$	Bits	2496		
For Slot i, if $mod(i, 4) = \{0,1\}$ for i from $\{1,,79,82,,159\}$	Bits	3324		
Max. Throughput averaged over 2 frames	Mbps	5.548		
Note 1: SS/PBCH block is transmitted	in slot #0 w	ith periodicity 20	1	
Note 2: Slot i is slot index per 2 frames		porrodionly 20	· · · · ·	

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-		
		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				1	
For Slot i, if mod(i, 4) = 2 for i from $\{1,, 159\}$		10	10		
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 Date		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 $\{1,, 159\}$		12	12		
For Slot i, if $mod(i, 4) = \{0,1\}$ for i from $\{1,,159\}$		12	12		
Overhead for TBS determination		6	6		
Information Bit Payload per Slot		Ü	Ŭ	1	
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	D.,	05000	40550		
{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 $mod(i, 4) = 3$					
for i from {0,,159}	Bits	N/A	N/A		
For Slot i, if mod(i, 4) = 2 for i from {1,, 159}	Bits	24	24		
For Slot i, if $mod(i, 4) = \{0, 1\}$ for i from	Bits	24	24		
{1,,159}	Dita	27	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}			,		
For Slot i, if $mod(i, 4) = 2$ for i from $\{1,, 159\}$	CBs	4	2		
For Slot i, if $mod(i, 4) = \{0,1\}$ for i from	CBs	5	3		
{1,,159} Binary Channel Bits Per Slot					
For Slots 0 and Slot i, if $mod(i, 4) = 3$					
for i from $\{0,,159\}$	Bits	N/A	N/A		
For Slot i = 80, 81	Bits	69960	33920		
For Slot i, if mod(i, 4) = 2 for i from {4,, 159}	Bits	54912	26624		
For Slot i, if $mod(i, 4) = \{0, 1\}$ for i from	D:4-	70400	25.450	+ +	
{1,,79,82,,159}	Bits	73128	35456	<u>                                     </u>	
Max. Throughput averaged over 2	Mbps	188.739	91.843		
frames	-				
Note 1: SS/PBCH block is transmitted		with periodicity 2	20 ms		,
Note 2: Slot i is slot index per 2 frames	3				

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	Bits	34816						
$\{1,, 159\}$ For Slot i, if mod(i, 4) = $\{0,1\}$ for i from	Bits	47112						
{1,,159}								
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	Mbps	255.724						
frames	-		0 mg					
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.3.2.2.5-7: PDSCH Reference Channel for TDD PMI reporting requirements with UL-DL pattern FR2.120-1 (16QAM)

Parameter	Unit		Value
Reference channel		R.PDSCH.5- 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) = {3,4} for i from {0,,159}	Bits	N/A	
For CSI-RS Slot i, if $mod(i,5) = 1$ for i from $\{0,,159\}$	Bits	N/A	
For Slot i = 80	Bits	14344	
For Slot i, if $mod(i, 5) = \{0,2\}$ for i from $\{1,,79,82,,159\}$	Bits	14344	
Transport block CRC per Slot			
For Slots 0 and Slot i, if $mod(i, 5) = {3,4}$ for i from ${0,,159}$	Bits	N/A	
For CSI-RS Slot i, if mod(i,5) =1 for i from {0,,159}	Bits	N/A	
For Slot i = 80	Bits	24	
For Slot i, if $mod(i, 5) = \{0,2\}$ for i from $\{1,,79,82,,159\}$	Bits	24	
Number of Code Blocks per Slot			
For Slots 0 and Slot i, if mod(i, 5) = {3,4} for i from {0,,159}	CBs	N/A	
For CSI-RS Slot i, if $mod(i,5) = 1$ for i from $\{0,,159\}$	CBs	N/A	
For Slot i = 80	CBs	2	
For Slot i, if $mod(i, 5) = \{0,2\}$ for i from $\{1,,79,82,,159\}$	CBs	2	
Binary Channel Bits Per Slot			
For Slots 0 and Slot i, if $mod(i, 5) = {3,4}$ for i from ${0,,159}$	Bits	N/A	
For CSI-RS Slot i, if mod(i,5) =1 for i from {0,,159}	Bits	N/A	
For Slot i = 80	Bits	28776	
For Slot i, if $mod(i, 5) = \{0,2\}$ for i from $\{1,,79,82,,159\}$	Bits	30360	
Max. Throughput averaged over 2 frames  Note 1: SS/PBCH block is transmitted in	Mbps	45.1836	

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:

Table A.3.2.2.5-9: PDSCH Reference Channel for TDD CC with UL-DL pattern FR2.120-1 and CA scenario

Parameter	Unit			Value			
Reference channel		R.PDSCH.5-	R.PDSCH.5-	R.PDSCH.5-	R.PDSCH.5-		
Reference channel		9.1 TDD	9.2 TDD	9.3 TDD	9.4 TDD		
Channel bandwidth	MHz	50	100	200	400		
Subcarrier spacing	kHz	120	120	120	120		
Allocated resource blocks	PRBs	32	66	132	264		
Number of consecutive PDSCH							
symbols							
For Slot i, if $mod(i, 5) = 3$ for i from		9	9	9	9		
{0,, 159}							
For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i		13	13	13	13		
from {1,,159} Allocated slots per 2 frames		127	127	127	127		
MCS table		64QAM	64QAM	64QAM	64QAM		
MCS index		10	10	10	10		
Modulation		16QAM	16QAM	16QAM	16QAM		
Target Coding Rate		0.33	0.33	0.33	0.33		
Number of MIMO layers		2	2	2	2		
Number of DMRS REs		_			_		
For Slot i, if $mod(i, 5) = 3$ for i from		40	40	40	40		
{0,, 159}		12	12	12	12		
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i		10	10	10	10		
from {1,,159}		12	12	12	12		
Overhead for TBS determination		6	6	6	6		
Information Bit Payload per Slot							
For Slots 0 and Slot i, if mod(i, 5) =	Bits	N/A	N/A	N/A	N/A		
4 for i from {0,,159}	Dito	14/71	14/73	14//	14/71		
For Slot i, if $mod(i, 5) = 3$ for i from	Bits	7680	15880	31752	63528		
{0,, 159}							
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,159\}$	Bits	11784	24072	48168	96264		
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	N/A		
For Slot i, if $mod(i, 5) = 3$ for i from	5	0.4	0.4	0.4	2.4		
{0,, 159}	Bits	24	24	24	24		
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i	Bits	24	24	24	24		
from {1,,159}	DIIS	24	24	24	24		
Number of Code Blocks per Slot							
For Slots 0 and Slot i, if mod(i, 5) =	CBs	N/A	N/A	N/A	N/A		
4 for i from {0,,159}	020	1471	1471	1471	1471		
For Slot i, if $mod(i, 5) = 3$ for i from	CBs	1	2	4	8		
$\{0,, 159\}$ For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i							
For Slot 1, if fried(1, 5) = $\{0, 1, 2\}$ for 1 from $\{1,, 159\}$	CBs	2	3	6	12		
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	N/A		
For Slots i = 80, 81	Bits	33920	69960	139920	279840		
For Slot i, if $mod(i, 5) = 3$ for i from							
{0,, 159}	Bits	23680	48840	97680	195360		
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i	Bits	35456	73128	146256	292512		
from {1,,79,84,,159}	טונט	00400	70120	140200	202012		
Max. Throughput averaged over 2	Mbps	68.262	139.750	279.601	558.899		
frames							
Note 1: SS/PBCH block is transmitte		#U with periodic	city 20 ms				
Note 2: Slot i is slot index per 2 frames							

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#### 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<sub>PRB</sub> = 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<sub>PRB</sub> = 4..74 are allocated for the user data in sub-frame 5, and resource blocks n<sub>PRB</sub> = 0..74 in sub-frames 0,3,4,8,9.
- Note 9: Resource blocks n<sub>PRB</sub> = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n<sub>PRB</sub> = 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<sub>PRB</sub> = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 7: Resource blocks n<sub>PRB</sub> = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n<sub>PRB</sub> = 0..49 in sub-frames 0,3,4,8,9.
- Note 8: Resource blocks n<sub>PRB</sub> = 4..74 are allocated for the user data in sub-frame 5, and resource blocks n<sub>PRB</sub> = 0..74 in sub-frames 0,3,4,8,9.
- Note 9: Resource blocks n<sub>PRB</sub> = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n<sub>PRB</sub> = 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	57600	86400	115200	
For Sub-Frames 8,9	Bits	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<sub>PRB</sub> = 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<sub>PRB</sub> = 4..74 are allocated for the user data in sub-frame 5, and resource blocks n<sub>PRB</sub> = 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<sub>PRB</sub> = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 7: Resource blocks n<sub>PRB</sub> = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n<sub>PRB</sub> = 0..49 in sub-frames 0,3,4,8,9.
- Note 8: Resource blocks n<sub>PRB</sub> = 4..74 are allocated for the user data in sub-frame 5, and resource blocks n<sub>PRB</sub> = 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		Valu	e	
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	Bits	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<sub>PRB</sub> = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 7: Resource blocks n<sub>PRB</sub> = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n<sub>PRB</sub> = 0..49 in sub-frames 0,3,4,8,9.
- Note 8: Resource blocks n<sub>PRB</sub> = 4..74 are allocated for the user data in sub-frame 5, and resource blocks n<sub>PRB</sub> = 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<sub>PRB</sub> = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 7: Resource blocks n<sub>PRB</sub> = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n<sub>PRB</sub> = 0..49 in sub-frames 0,3,4,8,9.
- Note 8: Resource blocks n<sub>PRB</sub> = 4..74 are allocated for the user data in sub-frame 5, and resource blocks n<sub>PRB</sub> = 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 channel		R.PDCCH.1- 2.1 FDD	R.PDCCH.1- 2.2 FDD	R.PDCCH.1- 2.3 FDD	R.PDCCH.1- 2.4 FDD	R.PDCCH.1- 2.5 FDD	R.PDCCH.1- 2.6 FDD
Subcarrier spacing	kHz	15	15	15	15	15	15
CORESET frequency domain allocation		24	24	24	48	48	48
CORESET time domain allocation		2	2	2	2	2	2
Aggregation level		2	4	2	4	8	16
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		Val	ue	
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	Bits	41	53	53					
CRC)									

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		Value						
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		Va	lue	
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	Value		
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	bits	24	24	
related PBCH payload bits)				

#### A.3.4.2 Reference measurement channels for FR2

Table A.3.4.2-1: PBCH Reference Channel

Parameter	Unit	Value		
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			64QAM						
Number of allocated PDSCH resource blocks			66	66					
Number of consecutive PDSCH symbols			12	12					
Number of F	PDSCH MIMO	layers		1	2				
Number of D	OMRS REs (N	ote 1)		24	24				
Overhead for TBS determination			6	6					
Available RE-s			7920	7920					
CQI index			Information Bit Payload per Slot						
	efficiency	index	n						
0	OOR	OOR	OOR	N/A	N/A				
1	0.1523	0	QPSK	1800	3624				
2	0.2344	0		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: Number of DMRS REs includes the overhead of the DM-RS CDM groups without data									

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)

TBS Scheme			TBS.2-1	TBS.2-2	TBS.2-3	TBS.2-4	TBS.2-5	TBS.2-6	
MCS table			256QAM						
Number of allocated PDSCH resource blocks			52	52	106	106	8	16	
Number of consecutive PDSCH symbols			12	12	12	12	12	12	
Number of PDSCH MIMO layers			1	2	1	2	1	1	
Number of DMRS REs (Note 1)			24	24	24	24	24	24	
Overhead for TBS determination			0	0	0	0	0	0	
Available RE	-s for PDSCH	1		6240	6240	12720	12720	960	1920
CQI index	Spectral	MCS	Modulatio	Information Bit Payload per 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	1	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	256QAM	38936	77896	79896	159880	6016	12040
14	6.9141	25	ZOOWAIVI	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: 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									

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

#### A.5.1 OCNG 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.

Note 2: Unused available REs refer to REs in PRBs not allocated for any physical channels, CORESETs, 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

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

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

Note 2: Unused available REs refer to REs in PRBs not allocated for any physical channels, CORESETs, 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

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

### 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
TDLC300-600	TDLC300	600 Hz
TDLC300-1200	TDLC300	1200 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	$R_{UE} = \begin{pmatrix} 1 & \beta \\ \beta^* & 1 \end{pmatrix}$	$R_{UE} = \begin{pmatrix} 1 & \beta^{1/9} & \beta^{4/9} & \beta \\ \beta^{1/9} & 1 & \beta^{1/9} & \beta^{4/9} \\ \beta^{4/9} & \beta^{1/9} & 1 & \beta^{1/9} \\ \beta^* & \beta^{4/9} & \beta^{1/9} & 1 \end{pmatrix}$

Table B.2.3.1.1-3 defines the channel spatial correlation matrix  $R_{spat}$ . The parameters,  $\alpha$  and  $\beta$  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	$R_{spat} = R_{UE} = \begin{bmatrix} 1 & \beta \\ \beta^* & 1 \end{bmatrix}$ $R_{spat} = R_{UE} = \begin{bmatrix} 1 & \beta^{1/9} & \beta^{4/9} & \beta \\ \beta^{1/9} & 1 & \beta^{1/9} & \beta^{4/9} \\ \beta^{4/9} & \beta^{1/9} & 1 & \beta^{1/9} \\ \beta^* & \beta^{4/9} & \beta^{1/9} & 1 \end{bmatrix}$ $R_{spat} = R_{gNB} = \begin{bmatrix} 1 & \alpha \\ \alpha^* & 1 \end{bmatrix}$
2x1 case	$R_{spat} = R_{gNB} = egin{bmatrix} 1 & \pmb{lpha} \ \pmb{lpha}^* & 1 \end{bmatrix}$
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	$R_{spat} = R_{gNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha \\ \alpha^* & 1 \end{bmatrix} \otimes \begin{bmatrix} 1 & \beta \\ \beta^* & 1 \end{bmatrix} = \begin{bmatrix} 1 & \beta & \alpha & \alpha\beta \\ \beta^* & 1 & \alpha\beta^* & \alpha \\ \alpha^* & \alpha^*\beta & 1 & \beta \\ \alpha^*\beta^* & \alpha^* & \beta^* & 1 \end{bmatrix}$ $R_{spat} = R_{gNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha \\ \alpha^* & 1 \end{bmatrix} \otimes \begin{bmatrix} 1 & \beta^{1/9} & \beta^{4/9} & \beta \\ \beta^{1/9*} & 1 & \beta^{1/9} & \beta^{4/9} \\ \beta^* & \beta^{1/9*} & 1 & \beta^{1/9} \\ \beta^* & \beta^{1/9*} & \beta^{1/9*} & 1 \end{bmatrix}$ $R_{spat} = R_{gNB} = \begin{bmatrix} 1 & \alpha^{1/9} & \alpha^{4/9} & \alpha \\ \alpha^{1/9} & \alpha^{1/9} & \alpha^{4/9} & \alpha \\ \alpha^{1/9} & \alpha^{1/9} & \alpha^{1/9} & 1 \end{bmatrix}$ $R_{spat} = R_{gNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha^{1/9} & \alpha^{4/9} & \alpha \\ \alpha^{1/9} & \alpha^{1/9} & \alpha^{1/9} & \alpha \\ \alpha^{1/9} & 1 & \alpha^{1/9} & \alpha^{4/9} \\ \alpha^{1/9} & \alpha^{1/9} & 1 & \alpha^{1/9} \end{bmatrix} \otimes \begin{bmatrix} 1 & \beta \\ \beta^* & 1 \end{bmatrix}$ $R_{spat} = R_{gNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha^{1/9} & \alpha^{4/9} & \alpha \\ \alpha^{1/9} & \alpha^{1/9} & 1 & \alpha^{1/9} \\ \alpha^{1/9} & \alpha^{1/9} & 1 & \alpha^{1/9} \end{bmatrix} \otimes \begin{bmatrix} 1 & \beta \\ \beta^* & 1 \end{bmatrix}$
4x2 case	
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  $\alpha$  and  $\beta$  for different correlation types are given in Table B.2.3.1.2-1.

Table B.2.3.1.2-1: The  $\alpha$  and  $\beta$  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 & 0.8099 \\ 0.9882 & 1.0000 & 0.9882 & 0.9541 & 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9541 & 0.9430 & 0.9105 & 0.8894 & 0.8999 & 0.8894 & 0.8587 \\ 0.9541 & 0.9882 & 1.0000 & 0.9882 & 0.9430 & 0.9767 & 0.9882 & 0.9767 & 0.9105 & 0.9430 & 0.9541 & 0.8099 & 0.8587 & 0.8894 & 0.8999 \\ 0.8999 & 0.9541 & 0.9882 & 1.0000 & 0.8894 & 0.9430 & 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9541 & 0.8099 & 0.8587 & 0.8894 & 0.8999 \\ 0.9882 & 0.9767 & 0.9430 & 0.8894 & 1.0000 & 0.9882 & 0.9541 & 0.8999 & 0.9882 & 0.9767 & 0.9430 & 0.9430 & 0.9541 & 0.9430 & 0.9105 & 0.8587 \\ 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 1.0000 & 0.9882 & 0.9541 & 0.9767 & 0.9430 & 0.9430 & 0.9541 & 0.9430 & 0.9105 \\ 0.9430 & 0.9767 & 0.9882 & 0.9767 & 0.9541 & 0.9882 & 1.0000 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9105 & 0.9430 & 0.9541 \\ 0.9541 & 0.9430 & 0.9105 & 0.8587 & 0.9882 & 0.9767 & 0.9430 & 0.8894 & 1.0000 & 0.9882 & 0.9541 & 0.8999 & 0.9882 & 0.9767 & 0.9430 \\ 0.9105 & 0.9430 & 0.9541 & 0.9430 & 0.9105 & 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9541 & 0.9767 & 0.9882 & 0.9767 & 0.9430 \\ 0.8587 & 0.9105 & 0.9430 & 0.9541 & 0.9430 & 0.9767 & 0.9882 & 0.9767 & 0.9541 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9882 \\ 0.8999 & 0.8894 & 0.8587 & 0.9430 & 0.9541 & 0.9430 & 0.9767 & 0.9882 & 0.8999 & 0.9541 & 0.9882 & 1.0000 & 0.8894 & 0.9430 & 0.9767 & 0.9882 \\ 0.8999 & 0.8894 & 0.8587 & 0.9430 & 0.9541 & 0.9430 & 0.9105 & 0.8587 & 0.9882 & 0.9767 & 0.9430 & 0.8894 & 1.0000 & 0.9882 & 0.9541 & 0.8999 \\ 0.8894 & 0.8999 & 0.8894 & 0.8587 & 0.9430 & 0.9541 & 0.9430 & 0.9105 & 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 1.0000 & 0.9882 & 0.9541 & 0.8999 & 0.8894 & 0.8999 & 0.8894 & 0.8999 & 0.8587 & 0.9430 & 0.9541 & 0.9430 & 0.9767 & 0.9882 & 0.9767 & 0.9541 & 0.9882 & 1.0000 & 0.9882 & 0.9541 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9541 & 0.9882 & 0.9541 & 0.9882 & 0.9567 & 0.9541 & 0.9882$								

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

1x2 case	N/A							
2x1	N/A							
case								
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							

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

1x4 case						R <sub>mediu</sub>	n A -	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				iium A =	1.0000 0.9000 0.6561 0.3874 0.3000 0.2700 0.1968 0.1162	1.00 1 0.90 1 0.65 1 0.65 1 0.27 0 0.30 3 0.27 2 0.19	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 58 0.2 52 0.1 50 0.9 50 1.0 51 0.9 74 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 0.1968 0.2700 0.3000 0.3874 0.656 0.9000 1.0000	3 0 0 4 1 0 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 0.5270	0.7873 0.8748 0.7873 0.6561 0.9000 1.0000 0.9000 3 0.5739 3 0.7873 3 0.8748 9 0.7873 0 0.3842 5 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	0.5856 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 0.6561 0.9000 0.9000 0.5739 0.7873 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 0.9000	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

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  $\pm 1.45$  degrees polarization slant angles are deployed at gNB and cross-polarized antenna elements with  $\pm 1.45$  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

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

The matrix  $\Gamma$  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,

$$R_{gNB\ Dim,i} = 1$$
.

- 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,

$$R_{gNB\_Dim,i} = \begin{pmatrix} 1 & \alpha_i^{1/4} & \alpha_i \\ \alpha_i^{1/4*} & 1 & \alpha_i^{1/4} \\ \alpha_i^* & \alpha_i^{1/4*} & 1 \end{pmatrix}.$$

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

$$R_{gNB\_Dim,i} = \begin{pmatrix} 1 & \alpha_{i}^{\frac{1}{9}} & \alpha_{i}^{\frac{4}{9}} & \alpha_{i} \\ \alpha_{i}^{\frac{1}{9}*} & 1 & \alpha_{i}^{\frac{1}{9}} & \alpha_{i}^{\frac{4}{9}} \\ \alpha_{i}^{\frac{4}{9}*} & \alpha_{i}^{\frac{1}{9}*} & 1 & \alpha_{i}^{\frac{1}{9}} \\ \alpha_{i}^{*} & \alpha_{i}^{\frac{4}{9}*} & \alpha_{i}^{\frac{1}{9}*} & 1 \end{pmatrix}.$$

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.,

$$R_{\scriptscriptstyle gNB}\!=\!R_{\scriptscriptstyle gNB\_Dim,1}$$

The spatial correlation matrices at UE side are as follows:

- For 1 antenna element with the same polarization,

$$R_{UF} = 1$$
.

- 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  $\alpha_1$ ,  $\alpha_2$ ,  $\beta$  and  $\gamma$  for the cross polarized antenna models are given in Table B.2.3.2.2-1.

Table B.2.3.2.2-1: The  $\alpha$  and  $\beta$  parameters for cross-polarized MIMO correlation matrices

Corr	elation Model	$\alpha_1$	02	β	γ			
Medi	um Correlation	0.3	0.3	0.6	0.2			
	h Correlation	0.9	0.9	0.9	0.3			
Note 1:	Note 1: Value of $\alpha_1$ applies when more than one pair of cross-polarized							
	antenna elements in first dimension at gNB side.							
Note 2:	e 2: Value of α <sub>2</sub> applies when more than one pair of cross-polarized							
	antenna elements in second dimension at gNB side.							
Note 3: Value of $\beta$ 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.

For the 2D cross polarized antenna array at gNB side, the correlation matrices for high spatial correlation are defined in Table B.2.3.2.2-4 as below.

The values in Table B.2.3.2.2-2, and Table B.2.3.2.2-4 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. For the  $16(4,2,2)x^2$  high spatial correlation case, a=0.00012.

The same method is used to adjust the 16(4,2,2)x4, 32(4,4,2)x2 and 32(4,4,2)x4 high correlation matrix to insure the correlation matrix is positive semi-definite after round-off to 4 digit precision with a =0.00012, a =0.00022, and a=0.00022 resoectively.

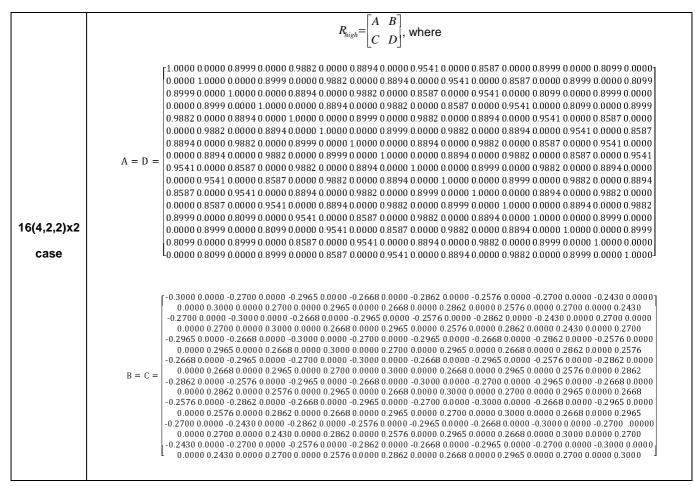
Table B.2.3.2.2-2: MIMO correlation matrices for high spatial correlation (1D cross polarized antenna array at gNB side)

				Г	0000	0.0000	0.00	200 4	2 0000	0.20	200 0		0.00	700 0		1	
				1	.0000	0.0000	0.90		0.0000	- 0.30		0.0000	-0.27		0.0000		
				0	.0000	1.0000	0.00	000	0.9000	0.00	000 (	0.3000	0.00	000	0.2700		
				0	.9000	0.0000	1.00	000	0.0000	-0.27	700 (	0.0000	-0.30	000	.0000		
4/2 4 2)×2				0	.0000	0.9000	0.0	000	1.0000	0.00	000 (	0.2700	0.00	000 (	.3000		
4(2,1,2)x2 case			$R_{high} =$	=						1.00					0.0000		
Cusc						0.0000			0.0000			0.0000	0.90				
				0	.0000	0.3000	0.0	0000	0.2700	0.00	000 1	.0000	0.00	000 (	0.9000		
				-0	.2700	0.0000	-0.3	000	0.0000	0.90	00 0	.0000	1.00	00 0	.0000		
				0	.0000	0.2700	0.0	0000	0.3000	0.00	00 0	.9000	0.00	000 1	.0000		
				<u> </u>	0000	0.9000	0.0	000	0.0000	-0.30	000 -	0.2700	0.00	00 0	0000	-	
					9000	1.0000			0.0000	-0.27		0.3000	0.00		0000		
					.0000	0.0000		000	0.9000			0.0000	0.300		2700		
2(1,1,2)x4			$R_{high}$	$=$ $\begin{vmatrix} 0 \end{vmatrix}$	0000	0.0000	0.9	000	1.0000	0.00	000 0	.0000	0.270	0.3	000		
case			high	-0	.3000	-0.270	0.0	000	0.0000	1.00	000 0	.9000	0.000	0.0	000		
				-0	.2700	-0.300	0.0	000	0.0000	0.90	000 1	.0000	0.000	0.0	000		
				0.	0000	0.0000	0.3	000	0.2700	0.00	000 (	0.0000	1.000	0.9	000		
				0	0000	0.0000		700	0.3000			0.0000	0.900		000		
		1.0000	0.9000		0.0000	0.9000	0.8100	0.0000		-0.3000	-0.2700	0.0000	0.0000	-0.2700	-0.2430	0.0000	0.0000
		0.9000		0.0000		0.8100	0.9000	0.0000	0.0000	-0.2700	-0.3000	0.0000	0.0000	-0.2430	-0.2700	0.0000	0.0000
		0.0000	0.0000	1.0000	0.9000	0.0000	0.0000	0.9000	0.8100	0.0000	0.0000	0.3000	0.2700	0.0000	0.0000	0.2700	0.2430
		0.0000	0.0000	0.9000	1.0000	0.0000	0.0000	0.8100	0.9000	0.0000	0.0000	0.2700	0.3000	0.0000	0.0000	0.2430	0.2700
		0.9000		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 $0.9000$		0.9000 0.0000	1.0000 0.0000	0.0000 1.0000	0.0000 0.9000	-0.2430 0.0000	-0.2700 0.0000	0.0000 0.2700	0.0000 0.2430	-0.2700 0.0000	-0.3000 0.0000	0.0000	0.0000 0.2700
4(2,1,2)x4		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
case	$R_{\rm high} =$	-0.3000	-0.2700	0.0000		-0.2700	-0.2430	0.0000	0.0000	1.0000	0.9000	0.0000	0.0000	0.9000	0.8100	0.0000	0.0000
		-0.2700		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		0.0000	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 $0.0000$		0.0000	0.0000	0.2430 0.0000	0.2700 0.0000	0.0000 0.9000	0.0000 0.8100	0.9000	1.0000	0.0000 1.0000	0.0000	0.8100	0.9000
		-0.2430		0.0000	0.0000	-0.2700	-0.3000	0.0000	0.0000	0.8100	0.9000	0.0000	0.0000	0.9000	1.0000	0.0000	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 0.000	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	0.988	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
		0.9883	0.0000	1.000	0.000	0 0.9883	0.0000	0.9542	0.0000	-0.2965	0.0000	-0.3000	0.0000	-0.2965	0.0000	-0.2862	0.0000
		0.0000	0.9883	0.000	0 1.000	0.0000	0.9883	0.0000	0.9542	0.0000	0.2965	0.0000	0.3000	0.0000	0.2965	0.0000	0.2862
		0.9542	0.0000	0.988	3 0.000	0 1.0000	0.0000	0.9883	0.0000	-0.2862	0.0000	-0.2965	0.0000	-0.3000	0.0000	-0.2965	0.0000
		0.0000	0.9542	0.000	0.988	3 0.0000	1.0000	0.0000	0.9883	0.0000	0.2862	0.0000	0.2965	0.0000	0.3000	0.0000	0.2965
		0.8999				0.9883											
8(4,1,2)x2	$R_{high} =$	0.0000	0.8999	0.000	0.954	2 0.0000	0.9883	0.0000	1.0000	0.0000	0.2700	0.0000	0.2862	0.0000	0.2965	0.0000	0.3000
case	nign	-0.3000	0.0000	-0.290	55 0.000	0 -0.2862	0.0000	-0.2700	0.0000	1.0000	0.0000	0.9883	0.0000	0.9542	0.0000	0.8999	0.0000
		0.0000				5 0.0000											
		-0.2965				0 -0.2965								0.9883			
		0.0000				0.0000							1.0000			0.0000	
		-0.2862				0 -0.3000							0.0000			0.9883	
		0.0000				5 0.0000								0.0000			
						0 -0.2965											
		0.0000	0.2700	0.000	0 0.286	2 0.0000	0.2965	0.0000	0.3000	0.0000	0.8999	0.0000	0.9542	0.0000	0.9883	0.0000	1.0000

Table B.2.3.2.2-3: MIMO correlation matrices for medium spatial correlation (1D cross polarized antenna array at gNB side)

	[ 1.000	0	0.0000	-0.2000	0.0000	
2(1,1,2)x2	$_{ m D}$ $_{ m D}$ $_{ m D}$ 0.00	00	1.0000	0.0000	0.2000	
case	$\frac{\kappa_{medium} 0.20}{\kappa_{medium}}$	00	0.0000	1.0000	0.0000	
	0,00	00	0.2000	0.0000	1.0000	

Table 1 B.2.3.2.2-4: MIMO correlation matices for high spatial correlation (2D cross polarized antenna array at gNB side)



#### 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,

- $D_{\theta_{k,1}}(N_1)$  is the steering matrix in first dimension with same polarization,
- $D_{\theta_{k,2}}(N_2)$  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,

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

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.
- $\mu$  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)
$\Delta  heta$	1.2566×10 <sup>-3</sup>

## B.2.4 Two-tap propagation conditions for CQI tests

For Channel Quality Indication (CQI) tests, the following additional multi-path profile is used:

$$h(t,\tau) = \delta(\tau) + a \exp(-i2\tau f_D t)\delta(\tau - \tau_d)$$

in continuous time  $(t, \tau)$  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 Figures B.3.1-1, B.3.1-2, B.3.1-3, B.3.1-4 are applied for all frequency bands.

Table B.3.1-1: High speed train scenario

Doromotor	Value									
Parameter	HST-750	HST-972	HST-1000	HST-1667						
$D_s$	300 m	300 m	300 m	300 m						
$D_{\mathrm{min}}$	2 m	2 m	2 m	2 m						
ν	300 km/h	500 km/h	300 km/h	500 km/h						
f.	750 Hz for 15 kHz SCS	972 Hz for 15 kHz SCS	1000 Hz for 30 kHz	1667 Hz for 30 kHz						
Jd	test	test	SCS test	SCS test						

NOTE 1: Parameters for HST conditions in table B.3.1-1 including  $f_d$  and Doppler shift trajectories presented on figures B.3.1-1 for 750 Hz and B.3.1-3 for 972 Hz for 15 kHz SCS and figures B.3.1-2 for 1000 Hz and B.3.1-4 for 1667 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) .

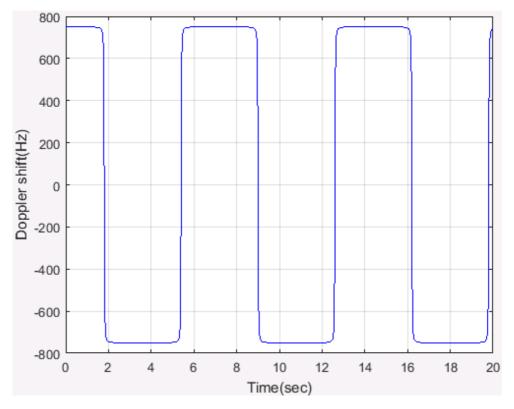


Figure B.3.1-1: Doppler shift trajectory (  $f_d$  = 750 Hz)

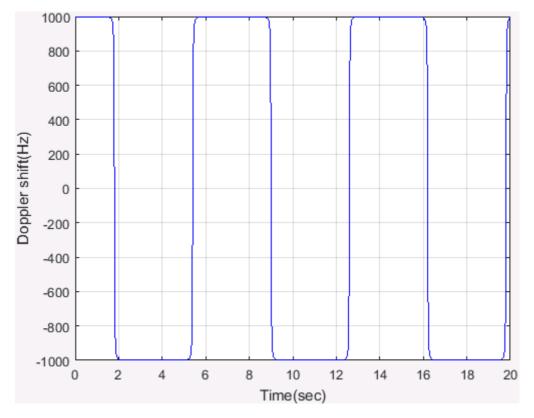


Figure B.3.1-2: Doppler shift trajectory (  $f_{\scriptscriptstyle d}$  = 1000 Hz)

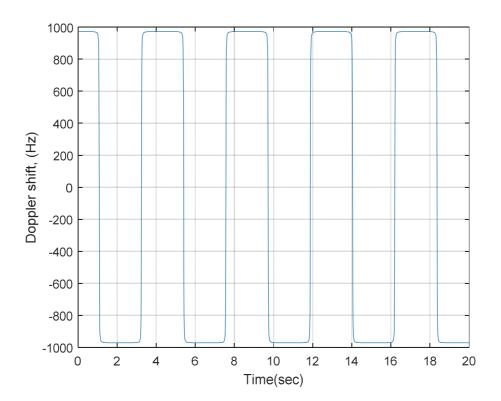


Figure B.3.1-3: Doppler shift trajectory (  $f_{\scriptscriptstyle d}$  = 972 Hz)

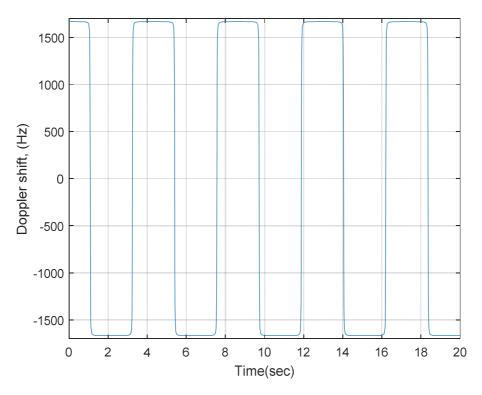


Figure B.3.1-4: Doppler shift trajectory (  $f_d$  = 1667 Hz)

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.3.2 HST-SFN Channel Profile

There is an infinite number of RRHs distributed equidistantly along the track with the same Cell ID as depicted in figure B.3.2-1.

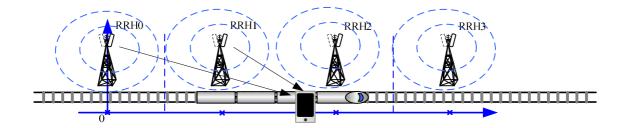


Figure B.3.2-1: Deployment of HST-SFN

The location of RRH k is given as:

$$x_k = k * D_s + j * D_{\min}$$
 (B.3.2.1)

where:  $k \in [-\infty, \infty]$ , j = sqrt(-1) and  $D_{mir}$  is the distance between the RRHs and railway track, while  $D_s$  is the distance of two RRHs, both in meters.

The train location is denoted as:

$$y = a + j * 0 (B.3.2.2)$$

where:  $a \in [0, \infty]$  and a means distance in meters, which means the train is right on the track.

The HST-SFN scenario for the test of the baseband performance is a non fading propagation channel with four taps, namely the four nearest RRHs. Thus, RRH *k* is visible for the train only in the range:

$$k*D_s - 2*D_s \le a < k*D_s + 2*D_s$$
 (B.3.2.3)

Power level  $P_k$  (dB) for the signal from  $k^{th}$  RRH, normalized to the total power received from all visible RRHs, is given by:

$$P_{k} = -20 \lg \left( \left| y - x_{k} \right| \right) - 10 \lg \left( \sum_{i \in \{i \mid i * D_{S} - 2 * D_{S} \le a < i * D_{S} + 2 * D_{S} \}} \frac{1}{\left| y - x_{i} \right|^{2}} \right) \text{ for } k * D_{s} - 2 * D_{s} \le a < k * D_{s} + 2 * D_{s}$$
(B.3.2.4)

Doppler shift  $F_{D,k}$ (Hz) from  $k^{th}$  RRH is given by:

$$F_{D,k} = f_C \times real \left[ -v \times \frac{y - x_k}{|y - x_k| \times C} \right] \text{ for } k * D_s - 2 * D_s \le a < k * D_s + 2 * D_s$$
 (B.3.2.5)

The relative delay  $T_k$  (s) for the signal from  $k^{\mathrm{th}}$  RRH can be derived as:

$$T_{k} = \frac{|y - x_{k}|}{C} \text{ for } k * D_{s} - 2 * D_{s} \le a < k * D_{s} + 2 * D_{s}$$
(B.3.2.6)

In the above v (m/s) is the moving speed of the train,  $f_C$  (Hz) is the center frequency, and C (m/s) is the velocity of light.

Power level, Doppler shift and relative delay are given by equations B.3.2.4 ~ B.3.2.6 respectively, where the required input parameters listed in table B.3.2-1 and the resulting Doppler shift shown in Figures B.3.2-3 and B.3.2-4 are applied for all requency bands.

Table B.3.2-1: HST-SFN scenario

Parameter	Value
$D_s$	700 m
$D_{ m min}$	150 m
ν	500 km/h
$f_d$	870 Hz for 15 kHz SCS test; 1667 Hz for 30 kHz SCS test

NOTE 1: The trajectories of ralative power, Doppler shifts and absolute delays presented in Figures B.3.2-2, B.3.2-3, B.3.2-4 and B.3.2-5 are derived from the equations B.3.2.4 ~ B.3.2.6 respectively.

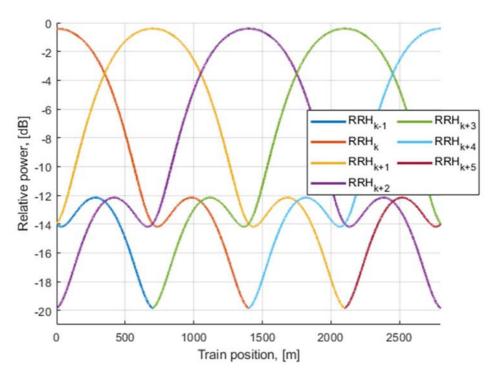


Figure B.3.2-2 Relative power level trajectories

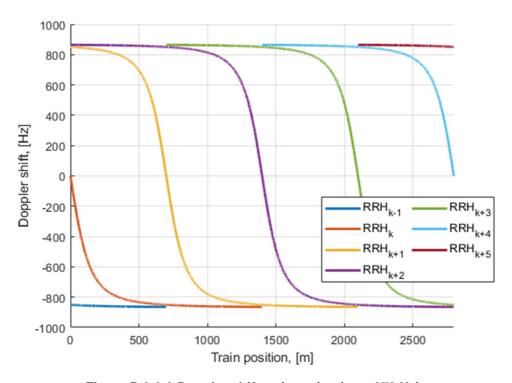


Figure B.3.2-3 Doppler shift trajectories (  $f_{\scriptscriptstyle d}$  = 870 Hz)

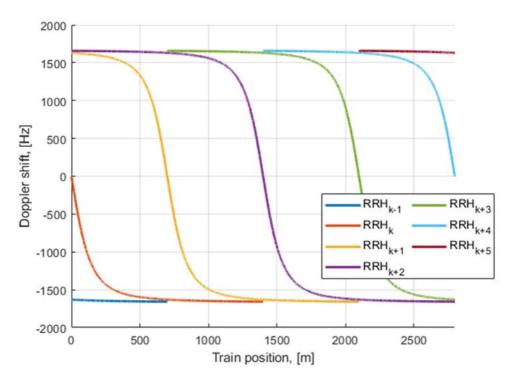


Figure B.3.2-4 Doppler shift trajectories (  $f_{\scriptscriptstyle d}$  = 1667 Hz)

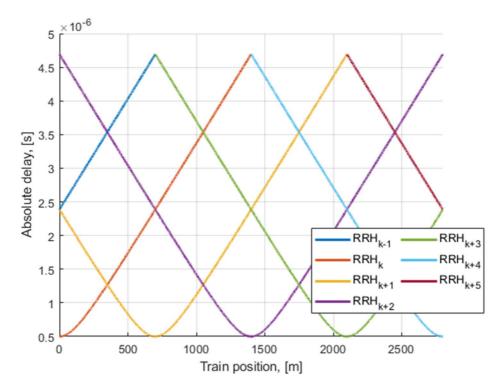


Figure B.3.2-5 Absolute delay trajectories

Static channel matrix will be used as defined in Annex B.1.

#### B.3.3 HST-DPS Channel Profile

There is an infinite number of RRHs distributed equidistantly along the railway track with the same Cell ID as illustrated in Figure B.3.3-1.

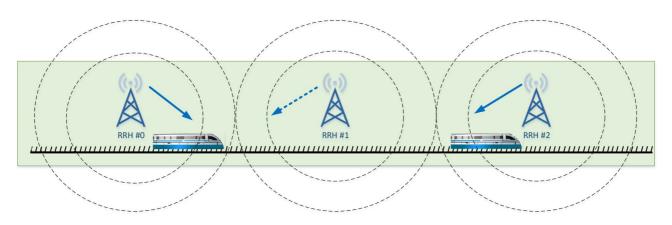


Figure B.3.3-1: Deployment of HST-DPS

The location of RRH k is given as:

$$x_k = k * D_s + j * D_{\min}$$
 (B.3.3.1)

where:  $k \in [-\infty, \infty]$ , j = sqrt(-1) and  $D_{\min}$  is the distance between the RRHs and railway track, while  $D_s$  is the distance of two RRHs, both in meters.

The train location is denoted as:

$$y = a + j * 0 (B.3.3.2)$$

where:  $a \in [0, \infty]$  and a means distance in meters, which means the train is right on the track.

The HST DPS multi-RRH scenario for the test of the baseband performance is a single tap propagation channel at each time with switching of transmission point in the middle point between two RRHs. Thus, RRH k is visible for the train only in the range:

$$k * D_s - \frac{D_s}{2} \le a < k * D_s + \frac{D_s}{2}$$
 (B.3.3.3)

Power level  $P_k$  (dB) for the signal from  $k^{\text{th}}$  RRH equals to 0. Doppler shift  $F_{D,k}$  (Hz) from  $k^{\text{th}}$  RRH is given by:

$$F_{D,k} = f_C \times real \left[ -v \times \frac{y - x_k}{\left| y - x_k \right| \times C} \right] \text{ for } k * D_s - \frac{D_s}{2} \le a < k * D_s + \frac{D_s}{2}$$
 (B.3.3.4)

In the above v (m/s) is the moving speed of the train, f<sub>C</sub> (Hz) is the centre frequency, and C (m/s) is the velocity of light.

Doppler shift is given by equation B.3.3.4, where the required input parameters listed in table B.3.3-1 and the resulting Doppler shift shown in Figures B.3.3-2 and B.3.3-3 are applied for all requency bands.

Table B.3.2-1: HST-DPS scenario

Parameter	Value
$D_s$	700 m
$D_{ m min}$	150 m
v	500 km/h
$f_d$	870 Hz for 15 kHz SCS test; 1667 Hz for 30 kHz SCS test

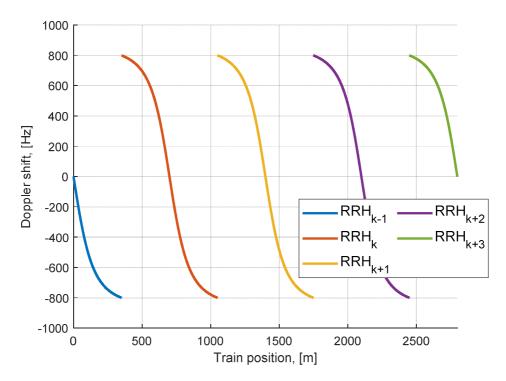


Figure B.3.3-2 Doppler shift trajectory (  $f_{\scriptscriptstyle d}$  = 870 Hz)

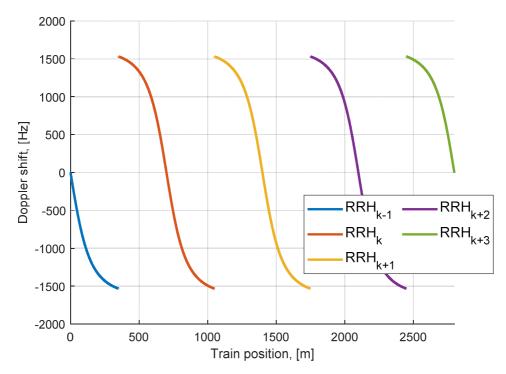


Figure B.3.3-3 Doppler shift trajectory (  $f_{\scriptscriptstyle d}$  = 1667 Hz)

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)  $p = p_0, p_0 + 1, \dots, p_0 + N_p - 1$  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)  $p = p_0, p_0 + 1, \dots, p_0 + N_p - 1, y^{(p)}(i) =$ 

 $\begin{bmatrix} y^{(p_0)}(i) \ y^{(p_0+1)}(i) \ \dots \ y^{(p_0+N_p-1)}(i) \end{bmatrix}^T, \ i=0,1,\dots, M_{\text{symb}}^{\text{ap}}-1, \ \text{with} \ M_{\text{symb}}^{\text{ap}} \ \text{being the number of modulation}$  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	dB	0
EPRE ratio of PDSCH to PDSCH DMRS	dB	Test specific (Note 1)
EPRE ratio of CSI-RS to SSS	dB	-10*log10(L) (Note 3)
EPRE ratio of 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.

#### **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 CSI-RS to SSS	dB	-10*log10(L) (Note 3)
EPRE ratio of PTRS to PDSCH	dB	Test specific
EPRE ratio of OCNG to SSS	dB	0
EPRE ratio of PDCCH OCNG to SSS	dB	0
		3 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.

 $L \in \{1,2,4,8\}$  is the CDM group size of NZP CSI-RS specified for each test. Note 3:

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 %)
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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	$0.96 \text{ m}^2/\text{s}^3$
20 Hz to 500 Hz	0,96 m <sup>2</sup> /s <sup>3</sup> 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	OIX	itev	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 RA	RAN4#88 bis	R4- 1814237				Approved Text Proposal in RAN4#88bis: R4-1814053, "TP on performance specification 38.101-4 Chapter 4 general part"	0.1.0
						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 conditions"	
2018-11	RAN4#89	R4- 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	RAN#82	RP-182408	ļ			V1.0.0 is submitted to RAN for 1-step approval	1.0.0
2018-12	RAN#82	RP-182704				V1.0.1 with editorial changes  Approved by plenary – Rel-15 spec under change control	1.0.1 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)	
					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	
					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  P4.4003448 Proft CB on FB3 CSI Reporting Toots (Overloam)	
					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)	
					R4-1900370, 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.	

2019-06	RAN#84	RP-191240	0002	B CR to TS 38.101-4: Implementation of endorsed draft CRs from RAN4#90bis and RAN4#91	15.2.0
				endorsed draft CRs from RAN4#90bis	
				R4-1902885, Draft CR on DL power allocation for TS 38.101-4	
				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 RMC 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	
				R4-1904758, Draft CR on EN-DC SDR requirements R4-1904759, Addition of alternative TDD configuration for UE	
				demodulation requirements	
				R4-1904765, Draft CR on FR2 PDCCH demodulation requirements	
				R4-1904766, draftCR: Updates to FR1 PDCCH demodulation	
				requirements	
				R4-1904767, Draft CR for Beamforming model: Annex B.4.1	
				R4-1904768, Draft CR for modification on CSI test cases: 6, 8, 10	
				R4-1904776, Draft CR on FR1 SDR requirements R4-1904777, Draft CR on FR2 SDR Requirements	
				R4-1904777, Draft CR on PDSCH DL RMC	
				R4-1904779, 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	
				R4-1904796, Draft CR to 38.101-4 on applicable SNR level for FR2	
				R4-1904833, Draft CR to TS 38.101-4 on SNR, Es and Noc setup	
				endorsed draft CRs from RAN4#91	
				R4-1906069, Draft CR on PBCH requirements	
				R4-1906706, Editorial corrections for 38.101-4 PBCH tables	
				R4-1907194, Draft CR on Noc and Es setup	
				R4-1907293, Draft CR to TS38.101-4 for FR2 SDR test cases	
				R4-1907294, draftCR: Introduce single-tap HST channel model in TS 38.101-4	
				R4-1907295, draftCR: updates to FR2 PDSCH test parameters	
				R4-1907296, draftCR: updates to FRC for demodulation	
				performance	
				R4-1907297, draftCR: updates to FR1 CQI reporting test cases in	
				section 6.2	
				R4-1907298, Draft CR to 38.101-4 on Applicability of requirements R4-1907299, Draft CR to 38.101-4 on Demodulation requirements	
				for interworking	
				R4-1907300, Draft CR to 38.101-4 on CSI requirements for	
				interworking	
				R4-1907301, Draft CR on FR1 normal PDSCH demodulation	
				requirements	
				R4-1907302, Draft CR on PDSCH FRC	
				R4-1907303, Draft CR on FR2 CSI Reporting tests R4-1907304, Editorial corrections for 38.101-4 PDCCH tables	
				R4-1907304, Editorial corrections for 36.101-4 FDCCH tables R4-1907307, draftCR: updates to FR1 PDSCH test parameters	
				R4-1907308, Draft CR on EN-DC SDR requirements	
				R4-1907309, Draft CR to TS38.101-4 on adding FRC for sub-band	
				CQI test cases	
				R4-1907310, Draft CR to TS38.101-4: Environmental conditions	
				(Annex E)  P4 1007315 Draft CP on SDP requirements for NP CA between	
				R4-1907315, Draft CR on SDR requirements for NR CA between FR1 and FR2	
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2019-09	RAN#85	RP-192022	0008		F	CR to TS 38.101-4: Implementation of endorsed draft CRs from	15.3.0
2019-09	KAN#03	KF-192022	0008		ı	RAN4#92 (Rel-15)	13.3.0
						R4-1907978, Update of Noc values for Power class 2 demodulation test	
						R4-1908202, Draft CR to TS 38.101-4: Environmental conditions R4-1908215, Draft CR to TS 38.101-4: Clarification of PTRS	
						configuration for FR2 tests R4-1908217, Draft CR to TS 38.101-4: DL power configuration in	
						radiated tests	
						R4-1908517, Draft CR to TS 38.101-4: Corrections of FRC for FR2 PMI tests	
						R4-1909250, Editorial change to correct TDD measurement channels	
						R4-1909252, Editorial correction to PBCH requirements R4-1909253, Editorial correction to PDSCH reference channels	
						R4-1909862, draft CR: updates to FR2 PDSCH test parameters	
						R4-1909864, draftCR: Introduce single-tap HST channel model in TS 38.101-4	
						R4-1910020, Antenna configuration for LTE cell in EN-DC 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 R4-1910024, draftCR: addition of test applicability for features with	
						UE capability	
						R4-1910053, Draft CR on corrections and missing parameters for PDSCH demodulation performance tests	
						R4-1910054, Draft CR to TS 38.101-4: NR FR1 PDSCH requirements finalization	
						R4-1910055, Draft CR to TS 38.101-4: Corrections for SDR requirements	
						R4-1910056, Editorial correction to formatting on SDR table R4-1910057, draft CR: updates to FR1 PDSCH test parameters	
						R4-1910058, Draft CR on corrections for PDCCH demodulation	
						performance tests R4-1910060, Draft CR on corrections for CSI Reporting performance	
						tests R4-1910061, Draft CR on updates to FR1 CSI reporting test	
						R4-1910062, Draft CR on updates to FR2 CSI reporting test R4-1910129, Draft CR to TS 38.101-4: Applicability of minimum	
						requirements R4-1910563, Updates to NR PDCCH test parameters	
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 2019-12	RAN#86	RP-192998	0010		F B	CR to TS 38.101-4: Editorial corrections for PDSCH RMC (R15) CR to TS 38.101-4: Introduction of NE-DC and NR-DC SDR	15.4.0
	RAN#86	RP-192998	0011		Ь	requirements (R15)	15.4.0
2019-12 2019-12	RAN#86 RAN#86	RP-192998 RP-192998	0014 0015	1	F	CR on corrections for MIMO Correlation Matrices CR on corrections for FR1 PDSCH demodulation performance tests	15.4.0 15.4.0
2019-12	RAN#86	RP-192998	0016	1	F	CR on corrections for FR2 PDSCH demodulation performance tests	15.4.0
2019-12	RAN#86	RP-192998	0017	1	F	CR on corrections for FR1 CSI Reporting performance tests	15.4.0
2019-12 2019-12	RAN#86	RP-192998	0018	1	F	CR on corrections for FR2 CSI Reporting performance tests	15.4.0 15.4.0
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
2019-12	RAN#86	RP-192998	0023	1	F	CR for TS38.101-4: Angle of arrival for radiated UE demodulation	15.4.0
2019-12	RAN#86	RP-192998	0024		F	testing 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
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2019-12	RAN#86	RP-192998	0030	1	F	CR: Updates to NR EN-DC SDR tests	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	RAN#87	RP-200397	0033	1	F	CR on corrections for FR1 PDSCH demodulation performance tests	15.5.0
2020-03 2020-03	RAN#87 RAN#87	RP-200397 RP-200397	0034 0037	1	F	CR to TS 38.101-4: Editorial corrections (R15) CR on number of NZP CSI-RS ports for RI reporting test in a TDD	15.5.0 15.5.0
						4Rx test case	
2020-03	RAN#87	RP-200397	0038		F	CR: Updates to NR PDSCH test parameters (Rel-15)	15.5.0

2020-03	RAN#87	RP-200379	0035		В	CR to TS 38.101-4: LTE-NR coexistence requirements for TDD mode (R16)	16.0.0
2020-06	RAN#88	RP-200985	0040		Α	CR to Aperiodic Report Slot Offset for CQI report	16.1.0
2020-06	RAN#88	RP-200985			A	CR to TS 38.101-4: Beamforming clarification (R16)	16.1.0
2020-06	RAN#88	RP-201043	0045		F	CR to TS 38.101-4: CR on TDD LTE-NR coexistence requirements finalization	16.1.0
2020-06	RAN#88	RP-200985	0047		Α	CR to TS 38.101-4: MIMO correlation matrices definition (R16)	16.1.0
2020-06	RAN#88	RP-200985	0054		Α	CR for correction of Angle of Arrival for Radiated Requirements in section 4	16.1.0
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2020-06	RAN#88	RP-201048	0042	1	F	CR on max MIMO layer assumption in TS38.101-4	16.1.0
2020-06	RAN#88	RP-200985	0056		Α	Update of DL physical channels definitions	16.1.0
2020-06	RAN#88	RP-200985	0057		Α	CR: clarification on EPRE ratio definition	16.1.0
2020-09	RAN#89	RP-201512	0059		Α	CR to ZP-CSI-RS configuration	16.2.0
2020-09	RAN#89	RP-201512	0061		Α	CR to 2Rx PDSCH mapping type B	16.2.0
2020-09	RAN#89	RP-201499	0074		В	CR for TS 38.101-4: Applicability for NR PMI requirements with Tx ports larger than 8 and up to 32	16.2.0
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2020-09	RAN#89	RP-201512	0078		Α	CR on Corrections in 38.101-4	16.2.0
2020-12	RAN#90	RP-202489	0800		Α	Update of Noc for NR operating bands in FR2	16.3.0
2020-12	RAN#90	RP-202489	0082		Α	Correction to FR1 Aperiodic CSI Reporting	16.3.0
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2020-12	RAN#90	RP-202416	0085	1	В	CR on requirements with slot aggregation in FR2	16.3.0
2020-12	RAN#90	RP-202423	8800		В	Draft CR on FRC for Normal NR CA demodulation requirements	16.3.0
2020-12	RAN#90	RP-202422	0090	1	В	CR to TS 38.101-4: HST-SFN FDD performance requirements	16.3.0
2020-12	RAN#90	RP-202422	0091	1	В	CR to TS 38.101-4: Propagation conditions for HST scenarios	16.3.0
2020-12	RAN#90	RP-202422	0092	1	В	CR on HST-SFN requirements for TDD	16.3.0
2020-12	RAN#90	RP-202423	0093	1	В	Introduction of NR PDSCH FR1 CA 2Rx performance requirements	16.3.0
2020-12	RAN#90	RP-202423	0094	1	В	CR: FR1 EN-DC power imbalance requirements	16.3.0
2020-12	RAN#90	RP-202422	0097	1	В	CR on HST DPS requirements	16.3.0
2020-12	RAN#90	RP-202422	0098	1	В	CR on HST single-tap and HST multi-path fading requirements	16.3.0
2020-12	RAN#90	RP-202422	0099	1	В	CR on applicability rules for HST scenarios	16.3.0
2020-12	RAN#90	RP-202416	0100	1	В	CR to TS 38.101-4: Addition of UE performance requirements for FR1 URLLC PDSCH repetitions over multiple slots	16.3.0
2020-12	RAN#90	RP-202416	0102	1	В	CR to TS 38.101-4: Applicability rules for URLLC UE demodulation requirements	16.3.0
2020-12	RAN#90	RP-202423	0103	1	В	CR: Introduction of performance requirements for NR FR1 PDSCH CA with 4Rx	16.3.0
2020-12	RAN#90	RP-202423	0105	1	В	CR: Addition of power imbalance requirements for intra-band contiguous CA and intra-band EN-DC	16.3.0
2020-12	RAN#90	RP-202423	0108	1	В	CR on Applicability rules for Normal NR CA demodulation requirements	16.3.0
2020-12	RAN#90	RP-202416	0109		В	CR on FRC for UE Ultra-low BLER requirements	16.3.0
2020-12	RAN#90	RP-202416	0110	1	В	CR on FRC for UE Higher BLER requirements	16.3.0
2020-12	RAN#90	RP-202416	0111	1	В	CR to TS 38.101-4: Performance requirements for URLLC High BLER feature tests	16.3.0
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2020-12	RAN#90	RP-202489	0117		Α	CR: Updates OCNG pattern reference (Rel-16)	16.3.0
2020-12	RAN#90	RP-202489	0119	1	Α	CR: Correction on OCNG pattern	16.3.0
2020-12	RAN#90	RP-202422		2	В	CR on FDD HST Single-Tap and Multipath Fading Requirements	16.3.0
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2020-12	RAN#90	RP-202423	0122		В	CR on FR2 PDSCH CA Requirements	16.3.0
2020-12	RAN#90		0123		F	CR to TS 38.101-4: on gamma values for SP Type I PMI	16.3.0
	<u> </u>				<u> </u>	requirements	<u> </u>

## History

Document history						
V16.1.0	July 2020	Publication				
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