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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".
- [9] 3GPP TS 38.211: "NR; Physical channels and modulation".
- [10] 3GPP TS 38.212: "NR; Multiplexing and channel coding".
- [11] 3GPP TS 38.213: "NR; Physical layer procedures for control".
- [12] 3GPP TS 38.214: "NR; Physical layer procedures for data".
- [13] 3GPP TS 37.340: "Evolved Universal Terrestrial Radio Access (E-UTRA) and NR; Multi-connectivity", Stage 2.
- [14] 3GPP TS 38.306: "NR; User Equipment (UE) radio access capabilities".
- [15] 3GPP TS 36.211: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation".
- [16] 3GPP TS38.521-4, "User Equipment (UE) conformance specification; Radio transmission and reception; Part 4: Performance"
- [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:

E_s The averaged received energy per Hz of the wanted signal during the useful part of the symbol, i.e. excluding the cyclic prefix, at the UE antenna connector; average power is computed within a set

of REs used for the transmission of physical, divided transmission bandwidth within the set

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

 N_{oc} The power spectral density of a white noise source with average power per Hz as defined in Clause

4.4.3 for conducted requirements and Clause 4.5.3 for radiated requirements

3.3 Abbreviations

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

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

CP Cyclic Prefix

CSI Channel-State Information
CSI-IM CSI Interference Measurement

CSI-RS CSI Reference Signal

CW Codeword

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

DC Dual Connectivity

DCI Downlink Control Information

DL Downlink

DMRS Demodulation Reference Signal
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
TRxP Transmission and Reception Point
TTI Transmission Time Interval

UL Uplink

VRB Virtual Resource Block

4 General

4.1 Relationship between minimum requirements and test requirements

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

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

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

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

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

4.2 Applicability of minimum requirements

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

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

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

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

4.3 Specification suffix information

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

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_{RX} denotes the number of receiver antenna connectors and the superscript receiver antenna connector *j*.
- The above SNR definition assumes that the REs are not precoded, and does not account for any gain which can be associated to the precoding operation.
- Unless otherwise stated, the SNR refers to the SSS wanted signal.
- The downlink SSS transmit power is defined as the linear average over the power contributions in [W] of all resource elements that carry the SSS within the operating system bandwidth.
- The power ratio of other wanted signals to the SSS is defined in clause C.3.1.

4.4.3 Noc

4.4.3.1 Introduction

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

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

4.4.3.2 Noc for NR operating bands in FR1

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

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

4.4.3.2.1 Derivation of Noc values for NR operating bands in FR1

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

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

where

- REFSENS_{Band_X, SCS_Y, CBW_Z} is the REFSENS value in dBm for Band X, SCS Y and CBW Z specified in Table 7.3.2-1 of TS 38.101-1 [6]
- 12 is the number of subcarriers in a PRB
- SCS Y is the subcarrier spacing associated with the REFSENS value
- nPRB is the maximum number of PRB for SCS Y and CBW Z associated with the REFSENS value, and is specified in Table 5.3.2-1 of TS 38.101-1 [6]
- D is diversity gain equal to 3 dB
- SNR_{REFSENS} = -1 dB is the SNR used for simulation of REFSENS
- Δ_{thermal} is the amount of dB that the wanted noise is set above UE thermal noise, giving a defined rise in total noise. $\Delta_{\text{thermal}} = 16$ dB, giving a rise in total noise of 0.1dB, regarded as insignificant.

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

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

4.4.4 Es

where:

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:

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

- REFSENS_{Band_X, SCS_Y, CBW_Z} is the REFSENS value in dBm for Band X, SCS Y and CBW Z specified in Table 7.3.2-1 of TS 38.101-1 [6]
- 12 is the number of subcarriers in a PRB
- SCS Y is the subcarrier spacing associated with the REFSENS value
- nPRB is the maximum number of PRB for SCS Y and CBW Z associated with the REFSENS value, and is specified in Table 5.3.2-1 of TS 38.101-1 [6]
- D is diversity gain equal to 3 dB
- SNR_{REFSENS} = -1 dB is the SNR used for simulation of REFSENS

- dB_{EVM} is the SNR of the applied signal due to EVM impairment on the wanted Es. An allowed EVM of 3% gives a dB_{EVM} of 30.5dB, derived as 20*log10(1/0.03).
- $\Delta_{thermal}$ is the amount of dB that the impairment due to EVM on the wanted Es is set above UE thermal noise, giving a defined rise in total impairment. $\Delta_{thermal} = 7.6 dB$, giving a rise in total impairment of 0.7dB, regarded as acceptable.

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

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

4.5 Radiated requirements

4.5.0 Introduction

The requirements are defined for the following modes:

- Mode 1: conditions with external noise source
 - Wanted signal with power level Es is transmitted.
 - External white noise source with power spectral density Noc is used.
 - Es and Noc levels are selected to achieve target SNR as described in Clause 4.5.2.
- Mode 2: Noise free conditions
 - Wanted signal with power level Es is transmitted.
 - No external noise transmitted.

4.5.1 Reference point

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

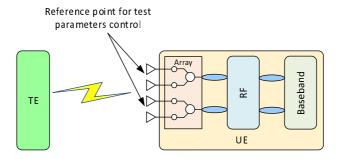


Figure 4.5.1-1: Reference point for radiated Demodulation and CSI requirements

4.5.2 SNR definition

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

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

where Δ_{BB} is specified in clause 4.5.3.

The reference point SNR is defined as:

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

- N_{RX} denotes the number of receiver reference points, and the super script receiver reference point j.
- The above SNR definition assumes that the REs are not precoded, and does not account for any gain which can be associated to the precoding operation.
- Unless otherwise stated, the SNR refers to the SSS wanted signal.
- The downlink SSS transmit power is defined as the linear average over the power contributions in [W] of all resource elements that carry the SSS within the operating system bandwidth.
- The power ratio of other wanted signals to the SSS is defined in Clause C.3.1.

4.5.3 Noc

4.5.3.1 Introduction

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

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	-167.3	-161. 8	-158.1	-166. 8
n258	-167.3	-161. 8	-158.1	-166. 8
n259			-154. 5	
n260	-164.3		-155. 5	-164. 8
n261	-167.3	-161. 8	-158.1	-166. 8
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_{SB} 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_{SC} is derived by assuming UE supports single carrier.
- ΔR_{IB} values are specified in TS 38.101-2 [7].

4.5.3.3 Derivation of Noc values for NR operating bands in FR2

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

 $Noc_{PC_P, Band_X} = REFSENS_{PC_P, Band_X, 50MHz} - 10Log_{10}(12 \times 120kHz \times PRB_{REFSENS}) - SNR_{REFSENS} + \Delta_{thermal} + \Delta$

where:

- REFSENS_{PC_P, Band X, 50MHz} is the REFSENS value in dBm specified for the Power Class P of UE in Band X for 50MHz Channel bandwidth in clause 7.3.2 of TS 38.101-2 [7].
- 12 is the number of subcarriers in a PRB
- 120 kHz is chosen as a subcarrier spacing to select PRB_{REFSENS}.
- PRB_{REFSENS} is N_{RB} associated with subcarrier spacing 120 kHz for 50MHz in Table 5.3.2-1 of TS 38.101-2 [7] and is 32.
- SNR_{REFSENS} = -1 dB is the SNR used for simulation of REFSENS
- Δ_{thermal} is the amount of dB that the wanted noise is set above UE thermal noise, giving a rise in total noise of Δ_{BB} . $\Delta_{\text{thermal}} = -10\text{Log}_{10}(10^{(\Delta_{\text{BB}}/10)-1}) = 5.87\text{dB}$, giving a rise in total noise Δ_{BB} of 1 dB.

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

4.5.4 Angle of arrival

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

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

4.5.5 Es

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

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

5 Demodulation performance requirements (Conducted requirements)

5.1 General

5.1.1 Applicability of requirements

5.1.1.1 General

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

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

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

5.1.1.2 Applicability of requirements for different number of RX antenna ports

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

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

Table 5.1.1.2-1: Requirements applicability

Supported RX antenna ports	• • • • • • • • • • • • • • • • • • • •	
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			Clause 5.2.3.1.1 (Test 5-1)	
	FR1 TDD	PDSCH	Clause 5.2.2.2.1 (Test 3-1)	
			Clause F 2 2 2 4 /Test F 4)	
Alternative additional DMRS	FR1 FDD	PDSCH	Clause 5.2.3.2.1 (Test 5-1) Clause 5.2.2.1.4 (Test 1-2)	
position for co-existence with		. 200	, ,	
LTE CRS (additionalDMRS-DL-			Clause 5.2.3.1.4 (Test 1-2)	
Alt)	FR1 TDD	PDSCH	Clause 5.2.2.2.4 (Test 1-2)	
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)	INIC OA	ODIC	Olause S.SA. I	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			Clause 5.2.3.1.9 (Test 1-1)	
velocity up to 500km/h			, ,	
	FR1 TDD	PDSCH	Clause 5.2.2.2.9 (Test 1-1)	
			Clause 5.2.3.2.9 (Test 1-1)	
Alternative 64QAM MCS table	FR1 FDD	PDSCH	Clause 5.2.2.1.5	
for PDSCHNew 64QAM MCS			Clause 5.2.3.1.5	
table for PDSCH (dl-64QAM- MCS-TableAlt)			Clause 5.2.2.1.6 Clause 5.2.3.1.6	
in the state of th	FR1 TDD	PDSCH	Clause 5.2.2.2.5	_
			Clause 5.2.3.2.5	
			Clause 5.2.2.2.6 Clause 5.2.3.2.6	
CQI table with target BLER of	FR1 FDD	PDSCH	Clause 5.2.3.1.5	
10^-5New CQI table (cqi-			Clause 5.2.3.1.5	
TableAlt)	FR1 TDD	PDSCH	Clause 5.2.2.2.5	_
	TRITOD	I DOCIT	Clause 5.2.3.2.5	
PDSCH repetitions over multiple	FR1 FDD	PDSCH	Clause 5.2.2.1.6	
slots (pdsch- RepetitionMultiSlots)			Clause 5.2.3.1.6	
Tropoundaminate of the state of	FR1 TDD	PDSCH	Clause 5.2.2.2.6	
LIE BROOM	ED4 EDD	PPOOL	Clause 5.2.3.2.6	
UE PDSCH processing capability #2 (pdsch-	FR1 FDD	PDSCH	Clause 5.2.2.1.7 Clause 5.2.3.1.7	
ProcessingType2)]
	FR1 TDD	PDSCH	Clause 5.2.2.2.7	
Pre-emption indication for DL	FR1 FDD	PDSCH	Clause 5.2.3.2.7 Clause 5.2.2.1.8	
(pre-EmptIndication-DL)			Clause 5.2.3.1.8	
	FR1 TDD	PDSCH	Clause 5.2.2.2.8	
Single DCI based SDM	FR1 FDD	PDSCH	Clause 5.2.3.2.8 Clause 5.2.2.1.11	
transmission for multi-TRxP			Clause 5.2.3.1.11	
(singleDCI-SDM-scheme-r16)	FR1 TDD	PDSCH	Clause 5.2.2.2.11 Clause 5.2.3.2.11	
Multi DCI based multi-TRxP	FR1 FDD	PDSCH	Clause 5.2.3.2.11 Clause 5.2.2.1.12	
support (multiDCI-MultiTRP-r16)			Clause 5.2.3.1.12	
	FR1 TDD	PDSCH	Clause 5.2.2.2.12	
Single DCI based FDM Scheme-	FR1 FDD	PDSCH	Clause 5.2.3.2.12 Clause 5.2.2.1.13	
A for multi-TRxP(supportFDM-			Clause 5.2.3.1.13	
SchemeA-r16)	FR1 TDD	PDSCH	Clause 5.2.2.2.13	
			Clause 5.2.3.2.13	

Single DCI based inter-slot TDM	FR1 FDD	PDSCH	Clause 5.2.2.1.14	
for multi-TRxP (supportInter-			Clause 5.2.3.1.14	
slotTDM-r16)	FR1 TDD	PDSCH	Clause 5.2.2.2.14	
			Clause 5.2.3.2.14	
DRX Adaptation (<i>drx-Adaptation-r16</i>)	FR1 FDD	PDCCH	Clause 5.3.2.1.3	If the Test 1 in Clause 5.3.2.1.3 is passed, the test coverage can be considered fulfilled without executing Test 3 in clause 5.3.2.1.1.
	FR1 TDD	PDCCH	Clause 5.3.2.2.3	If the Test 1 in Clause 5.3.2.2.3 is passed, the test coverage can be considered fulfilled without executing Test 2 in clause 5.3.2.2.1.
	FR1 FDD	PDCCH	Clause 5.3.3.1.3	If the Test 1 in Clause 5.3.3.1.3 is passed, the test coverage can be considered fulfilled without executing Test 3 in clause 5.3.3.1.1.
	FR1 TDD	PDCCH	Clause 5.3.3.2.3	If the Test 1 in Clause 5.3.3.2.3 is passed, the test coverage can be considered fulfilled without executing Test 2 in clause 5.3.3.2.1.
Validating P/SP-CSI-RS reception (periodicAndSemi-PersistentCSI-RS-r16)	FR1 TDD	PDSCH	Clause 5.2.2.2.15 Clause 5.2.3.2.15 Clause 5.2A.2.3 Clause 5.2A.3.3	The requirements apply only in case tested UE supporting operations in shared spectrum access and validation of P/SP-CSI-RS reception based on DCI
Supported UL channels for dynamic channel access mode (<i>ul-DynamicChAccess-r16</i>) or UL channel access for semistatic channel access mode (ul-Semi-StaticChAccess-r16) or both	FR1 TDD	PDSCH	Clause 5.2.2.2.15 Clause 5.2.3.2.15	The requirements apply only in case tested UE supports one of UL channels for dynamic channel access mode and UL channel access for semi- static channel access mode

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
	FR1 TDD	PDSCH	Clause 5.2.2.2.4 Clause 5.2.3.2.4	considered fulfilled without executing Test 1-1. Otherwise, only Test 1-1 is tested.
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)	TIEL GOLLIG POLIC
Supported maximum number of PDSCH MIMO layers (maxNumberMIMO-LayersPDSCH)	FR1 FDD	PDSCH	Clause 5.2.2.1.1 (Tests 2-1, 2-2, 3-1) Clause 5.2.2.1.2 Clause 5.2.3.1.1 (Tests 2-1, 2-2, 3-1, 4-1, 5-1) Clause 5.2.3.1.2	The requirements apply only in case the PDSCH MIMO rank in the test case does not exceed UE PDSCH MIMO layers capability
	FR1 TDD	PDSCH	Clause 5.2.2.2.1 (Tests 2-1, 2-2, 3-1) Clause 5.2.2.2.2 Clause 5.2.3.2.1 (Tests 2-1, 2-2, 3-1, 4-1, 5-1) Clause 5.2.3.2.2	
Support number of active TCI states per BWP per CC, including control and data (maxNumberActiveTCI-PerBWP)	FR1 FDD	PDSCH	Clause 5.2.2.1.10 (Test 1-2) Clause 5.2.3.1.10 (Test 1-2)	The requirements apply only when maxNumberActiveTC I-PerBWP is other than n1.
Ý	FR1 TDD	PDSCH	Clause 5.2.2.2.10 (Test 1-2) Clause 5.2.3.2.10 (Test 1-2)	

Support for maximum number of TRS resource sets per CC which the UE can track simultaneously (maxSimultaneousResourceSe tsPerCC)	FR1 FDD	PDSCH	Clause 5.2.2.1.10 (Test 1-2) Clause 5.2.3.1.10 (Test 1-2) Clause 5.2.2.1.11 Clause 5.2.2.1.12 Clause 5.2.2.1.13 Clause 5.2.2.1.14 Clause 5.2.3.1.11 Clause 5.2.3.1.12 Clause 5.2.3.1.13 Clause 5.2.3.1.13 Clause 5.2.3.1.14	The requirements apply only when maxSimultaneousRe sourceSetsPerCC ≥ 2
	FR1 TDD	PDSCH	Clause 5.2.2.2.10 (Test 1-2) Clause 5.2.3.2.10 (Test 1-2) Clause 5.2.2.2.11 Clause 5.2.2.2.12 Clause 5.2.2.2.13 Clause 5.2.2.2.14 Clause 5.2.3.2.11 Clause 5.2.3.2.12 Clause 5.2.3.2.13 Clause 5.2.3.2.14	

5.1.1.5 Applicability of different requirements for HST

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

Table 5.1.1.5-1: Applicability of requirements for HST

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

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

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

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

- First select the bandwidth combinations with the same bandwidth in each carrier.
 - If there is no such bandwidth combination, select the bandwidth combinations with smallest bandwidth difference between the two carriers, and the carrier with <u>smaller bandwidth</u> 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)				
	_C corresponds to NR CA configurations and bandwidth combination				
sets defined in Clause 5.5A.1 of TS 38.101-1 [6].					
CA_N corresponds to NR CA configurations and bandwidth combination					
sets defined in Clause 5.5A.2 of TS 38.101-1 [6].					
CA_AX corresponds to NR CA configurations and bandwidth combination					
sets	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.

NOTE 1: For CA_AX capability, if CA configuration from step 2 is CA configuration with the largest number of bands then Step 3 and Step 4 are skipped. Otherwise, the two CA configurations selected from Step 2 and Step 4 are used for testing.

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

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

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

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

Within the CA configuration if any of the PCell and/or the SCells is a 4Rx supported RF band, all 4Rx should be connected with data source from system simulator. Requirements from Clause 5.2A.3.1 are applied.

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

5.1.1.8 Applicability of different requirements with Multi-TRxP

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

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

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

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

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

5.2 PDSCH demodulation requirements

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

Table 5.2-1: Common test parameters

	Parameter	Unit	Value
PDSCH transmission	scheme		Transmission scheme 1
Carrier configuration	Offset between Point A and the lowest usable subcarrier on this carrier (Note 2)	RBs	0
· ·	Subcarrier spacing	kHz	15 or 30
DL BWP configuration #1	Cyclic prefix		Normal
ŭ	RB offset	RBs	0
	Number of contiguous PRB	PRBs	Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-1 [6] for tested channel bandwidth and subcarrier spacing
Common serving cell parameters	Physical Cell ID		0
	SSB position in burst		First SSB in Slot #0
	SSB periodicity	ms	20
PDCCH configuration	Slots for PDCCH monitoring		Each slot
ooga.ao	Symbols with PDCCH	Symbols	0, 1
	Number of PRBs in CORESET	Symmotic .	Table 5.2-2 for tested channel bandwidth and subcarrier spacing
	Number of PDCCH candidates and aggregation levels		1/AL8
	CCE-to-REG mapping type		Non-interleaved
	DCI format		1 1
	TCI state		TCI state #1
	PDCCH & PDCCH DMRS Precoding configuration		Single Panel Type I, Random per slot with equal probability of each applicable i ₁ , i ₂ combination, and with REG bundling granularity for number
			of Tx larger than 1
Cross carrier schedu	ling		Not configured
CSI-RS for tracking	First subcarrier index in the PRB used for CSI-RS		k ₀ =0 for CSI-RS resource 1,2,3,4
	First OFDM symbol in the PRB used for CSI-RS		$l_0 = 6$ 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
	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
	Francisco Occurration		21 for CSI-RS resource 3 and 4
	Frequency Occupation		Start PRB 0 Number of PRB = ceil(BWP size/4)*4
N7D 00: 50 :	QCL info		TCI state #0
NZP CSI-RS for CSI acquisition	First subcarrier index in the PRB used for CSI-RS		k ₀ = 0
	First OFDM symbol in the PRB used for CSI-RS		I ₀ = 12
	Number of CSI-RS ports (X)		Same as number of transmit antenna
	CDM Type		'No CDM' for 1 transmit antenna 'FD-CDM2' for 2 and 4 transmit antenna
	Density (ρ)		1
	CSI-RS periodicity	Slots	15 kHz SCS: 20 30 kHz SCS: 40
	CSI-RS offset	Slots	0

1				
	Frequency Occ	cupation		Start PRB 0
	20111			Number of PRB = ceil(BWP size/4)*4
	QCL info			TCI state #1
ZP CSI-RS for CSI acquisition	First subcarrier CSI-RS	index in the PRB used for		$k_0 = 4$
	First OFDM syr	mbol in the PRB used for		I ₀ = 12
	Number of CSI	-RS ports (X)		4
	CDM Type			'FD-CDM2'
	Density (ρ)			1
	CSI-RS periodi	city	Slots	15 kHz SCS: 20
			0.000	30 kHz SCS: 40
	CSI-RS offset		Slots	0
	Frequency Occ	cupation		Start PRB 0
				Number of PRB = ceil(BWP size/4)*4
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	A		
		SCH DMRS CDM group(s)		1 for Rank 1 and Rank 2 tests
	without data	3 1, 7		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	SSB index		N/A
	information			
		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	CSI-RS resource		N/A
	information			
		QCL Type		N/A
PT-RS configuration				PT-RS is not configured
		ps for ACK/NACK feedback		1
Maximum number of		sion		4
HARQ ACK/NACK b	undling			Multiplexed
Redundancy version	coding sequence	9		{0,2,3,1}
PDSCH & PDSCH D	MRS Precoding	configuration		Single Panel Type I, Random
	•	-		precoder selection updated per slot,
				with equal probability of each
				applicable i ₁ , i ₂ combination, and with
				PRB bundling granularity
Symbols for all unus	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				As specified in Annex B.4.1
NI=4= 4	41 4 41 TOL -	tata familia DDOOLLIA Islandia	- I 4 - 4 T/	Cliatata applied for the DDCCH

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		Туре А
· ·	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
J	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.
		1	Other tests: Table 5.2-1.
	CSI-RS offset	Slots	Test 1-5, 1-6, 1-7:
			1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4.
			Other tests: Table 5.2-1.
Number of HARQ Processes			8 for Test 1-4
			4 for other tests
The number of slots 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	[9.9]
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.	Reference channel	Bandwidth (MHz)/	Modulation format and	Propagation condition	Correlation matrix and	Reference	value
num.	Chamer	Subcarrier spacing (kHz)	code rate	Condition	antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
2-1	R.PDSCH.1-3.1 FDD	10 / 15	64QAM, 0.50	TDLA30-10	2x2, ULA Low	70	19.4
2-2	R.PDSCH.2-1.1 FDD	20 / 30	64QAM, 0.50	TDLA30-10	2x2, ULA Low	70	19.7

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

Test num.	Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	Correlation matrix and antenna configuration	Reference va	alue
						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	X		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 ₀ = 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 ACK information	between PDSCH and corresponding HARQ-		2

Table 5.2.2.1.2-3: Minimum performance for Rank 2

		Bandwidth			Correlation	Reference value	
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-5.1 FDD	10 / 15	16QAM, 0.48	TDLC300- 100	2x2, ULA Low	70	14.8

5.2.2.1.3 Minimum requirements for PDSCH Mapping Type B

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

The test purposes are specified in Table 5.2.2.1.3-1.

Table 5.2.2.1.3-1: Tests purpose

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

Table 5.2.2.1.3-2: Test parameters

	Parameter	Unit	Value
Duplex mode			FDD
Active DL BWP inde	x		1
PDSCH configuration	Mapping type		Type B
	k0		0
	Starting symbol (S)		5
	Length (L)		7
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS configuration	DMRS Type		Type 1
	Number of additional DMRS		1
	Maximum number of OFDM symbols for DL front loaded DMRS		1
Number of HARQ Pr	ocesses		4
The number of slots ACK information	between PDSCH and corresponding HARQ-		2

Table 5.2.2.1.3-3: Minimum performance for Rank 1

		Bandwidth			Correlation	Reference value	
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-1.3 FDD	10 / 15	QPSK, 0.30	TDLA30-10	2x2, ULA Low	70	-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	1-1, 1-2
under 2 receive antenna conditions with CRS rate	
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		Propagation condition	Correlation	Reference value	
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate		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 index	X		1
PDSCH configuration	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		12
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS configuration	DMRS Type		Type 1
	Number of additional DMRS		1
	Maximum number of OFDM symbols for DL front loaded DMRS		1
Maximum number of HARQ transmission			1
Number of HARQ Pr	ocesses		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	Deference	Bandwidth (MHz) /	Modulation	Propagation	Correlation	Reference va	lue
num.	Reference channel	Subcarrier spacing (kHz)	format and code rate		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%	2.7

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			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 corresponding HARO	between final repetition of PDSCH and Q-ACK information		2

Table 5.2.2.1.6-3: Minimum performance for Rank 1

Toot	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.1-11.1 FDD	10 / 15	16QAM, 0.54	TDLA30-10	2x2, ULA Low	1% (Note 1)	1.6
Note 1	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	1-1
conditions	

Table 5.2.2.1.7-2: Test parameters

	Parameter	Unit	Value
Duplex mode			FDD
Active DL BWP inde	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 Pr	ocesses		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	[8.0]

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
3	Number of additional DMRS		1
	Maximum number of OFDM symbols for DL front loaded DMRS		1
Pre-emption configuration (Note 2)	Starting symbol (S)		3
	Length (L)		2
	Pre-emption periodicity and offset (Note 3)	Slots	10/1
Number of HARQ Pro	ocesses		4
ACK information	petween PDSCH and corresponding HARQ-		2
Note 1: Void	eo modellod as random data en pro empted Pl	Ec	

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

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

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

Table 5.2.2.1.8-3: Minimum performance for Rank 1

		Bandwidth (MHz) /	Madadatian		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. 1-2.5 FDD	10 / 15	16QAM 0.64	TDLA30-10	2x2, ULA Low	70	10.5

5.2.2.1.9 Minimum requirements for PDSCH HST-SFN

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

The test purposes are specified in Table 5.2.2.1.9-1.

Table 5.2.2.1.9-1: Tests purpose

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
3	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 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	2x2	70	13.0	

5.2.2.1.10 Minimum requirements for HST-DPS

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

The test purposes are specified in Table 5.2.2.1.10-1.

Table 5.2.2.1.10-1: Tests purpose

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

Table 5.2.2.1.10-2: Test parameters

	Parameter		Unit	Value
Duplex mode			<u> </u>	FDD
Active DL BWP index				1
PDCCH configuration	TCI state			Note 1
PDSCH configuration	Mapping type			Type A
1 Door Cornigulation	k0			0
		1		2
	Starting symbol (S) Length (L)			12
	PDSCH aggregation factor			
	PRB bundling type			1
	PRB bundling type PRB bundling size			Static
				2
	Resource allocatio	n type		Type 0
	RBG size			Config2
	VRB-to-PRB mapping type			Non-interleaved
		ing interleaver bundle size		N/A
	TCI state			Note 1
PDSCH DMRS configuration	DMRS Type			Type 1
Configuration	Number of addition	od DMPC		2
		of OFDM symbols for DL		1
	front loaded DMRS			I
	HOIR IOAUEU DIVIRS	First OFDM symbol in		l ₀ = 5 for CSI-RS resource 1 and 3
CSI_PS for tracking	Resource set #1	the PRB used for CSI-		$l_0 = 5$ for CSI-RS resource 1 and 3 $l_0 = 9$ for CSI-RS resource 2 and 4
CSI-RS for tracking	ivesonice set #1	RS		10 = 9 101 Col-Ro resource 2 and 4
		_	Cloto	10 for CCL BC resource 1 2 2 4
		CSI-RS periodicity	Slots Slots	10 for CSI-RS resource 1,2,3,4. 1 for CSI-RS resource 1 and 2
		CSI-RS offset	Siots	2 for CSI-RS resource 1 and 2
		OOL into		
		QCL info		TCI state #2
	December 224 #0	First OFDM symbol in		$I_0 = 6$ for CSI-RS resource 5 and 6
	Resource set #2	the PRB used for CSI-		$I_0 = 10$ for CSI-RS resource 7 and 8
		RS : I' '	01.1	40.4 001.00
		CSI-RS periodicity	Slots	10 for CSI-RS resource 5,6,7,8.
		CSI-RS offset	Slots	1 for CSI-RS resource 5 and 6 2 for CSI-RS resource 7 and 8
		QCL info		TCI state #3
		First OFDM symbol in		lo = 12
NZP CSI-RS for CSI	Resource set #3	the PRB used for CSI-		10 – 12
acquisition	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	RS		
		CSI-RS periodicity	Slots	20
		CSI-RS offset	Slots	0
		QCL info	Cioto	TCI state #0
		First OFDM symbol in		I ₀ = 13
	Resource set #4	the PRB used for CSI-		10 = 13
	Tresource set #4	RS		
		CSI-RS periodicity	Slots	20
		CSI-RS offset	Slots	0
		QCL info	OIUIS	TCI state #1
		QUE IIIIU		CSI-RS resource 1 from 'CSI-RS for
TCI state #0	Type 1 QCL	CSI-RS resource		tracking Resource set #1'
101 State #U	information	COI-NO TESOUICE		configuration
		QCL Type		Type A
	Type 2 QCL			N/A
	information	CSI-RS resource		I W/A
		QCL Type		N/A
	Type 1 QCL			CSI-RS resource 5 from 'CSI-RS for
TCI state #1	information	CSI-RS resource		tracking Resource set #2'
	om	001.7		configuration
	Type 2 OC	QCL Type		Type A
	Type 2 QCL information	CSI-RS resource		N/A
	ioiiiladoii	QCL Type		N/A
TCI otota #0	Type 1 QCL			SSB #0
TCI state #2	information	SSB index		
		QCL Type		Type C
	Type 2 QCL	SSB index		N/A
1	information	=		

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

Note 1: SSB # (k mod 2), CSI-RS (for tracking) resource set # ((k mod 2) + 1) and CSI-RS (for CSI acquisition) resource set # ((k mod 2) + 3) are transmitted by kth RRH.

For Test 1-1, 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 kth 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 kth 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 5.2.2.1.10-3: 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 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	2x2	70	13.4
1-2	R.PDSCH.1- 8.4 FDD	10 / 15	64QAM, 0.43	HST-DPS	2	2x2	70	13.4

5.2.2.1.11 Minimum requirements for PDSCH Single-DCI based SDM scheme

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

The test purposes are specified in Table 5.2.2.1.11-1.

Table 5.2.2.1.11-1: Tests purpose

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

Table 5.2.2.1.11-2: Test parameters

Parameter					Value		
				Unit	TRxP #1(Note 1) TRxP #2(Note 1)		
Transmit TRxP of SS					TRx		
PDCCH configuration		TCI state				ate #1	
-	,	CORESET)	
			rrier index in the		k0=0 for CSI-RS	k0=1 for CSI-RS	
	<u> </u>	PRB usea	for CSI-RS		resources 1,2,3,4	resources 5,6,7,8	
					10 = 6 for CSI-RS	10 = 6 for CSI-RS	
		First OFDN	I symbol in the PRB		resources 1 and 3 10 = 10 for CSI-	resources 5 and 7 10 = 10 for CSI-	
	1	used for CS	SI-RS		RS resources 2	RS resources 6	
					and 4	and 8	
					1 for CSI-RS	1 for CSI-RS	
		Number of	CSI-RS ports (X)		resource 1,2,3,4		
CSI-RS for tracking						SI-RS resource	
	'	CDM Type				,5,6,7,8	
		Density				3	
		CSI-RS pe	riodicity	Slots		:0	
		•	•		10 for CSI-RS	10 for CSI-RS	
		CCL DC -#		Class	resources 1 and 2	resources 5 and 6	
	'	CSI-RS off	set	Slots	11 for CSI-RS	11 for CSI-RS	
					resources 3 and 4		
	(QCL info				ate #0	
Duplex mode						DD	
Active DL BWP index	Active DL BWP index					1	
	Mapping typ	oe				e A	
	kO				0		
	Starting symbol (S)				2		
	Length (L)				12		
PDSCH	PRB bundling type				Static 2		
configuration	PRB bundling size				<u> </u>	_	
	Resource allocation type					e 1	
		RBG size			Config2 Non-interleaved		
		/RB-to-PRB mapping type /RB-to-PRB mapping interleaver bundle			Non-interieaved		
	size	Б парріпу	inteneaver bundle		N	/A	
		port indexes			1000	1002	
	TCI state				TCI State #1	TCI State #2	
PDSCH DMRS	DMRS Type					pe 1	
configuration	Number of a		OMRS			1	
		n number of OFDM symbols for			·		
	DL front load				1		
					CSI-RS resource		
	Type 1 QCL		CSI-RS resource		1 from 'CSI-RS	N/A	
	information	-	COI-IXO TESOUICE		for tracking'	IN/A	
TCI State #1	Illionnation				configuration		
			QCL Type		Type A	N/A	
	Type 2 QCL	-	CSI-RS resource		N/A	N/A	
	information	+	QCL Type		N/A	N/A	
						CSI-RS resource	
	Type 1 QCL	_	CSI-RS resource		N/A	5 from 'CSI-RS for tracking'	
TCI State #2	information			1		configuration	
101 State #2		-	QCL Type	1	N/A	Type A	
	Type 2 QCL		CSI-RS resource		N/A	N/A	
information QCL Type				N/A	N/A		
Resource allocation	71				Full-ove	·	
	Timing offset of the second TRxP from the first TRxP				-0.5 for	test 1-1	
inning offset of the s	econa i RXP f	nom the fir	SUIRXP	us		est 1-2	
Eroguenov offeet of th	ho cocord TD	vD from 44	o firet TDvD	⊔-	200 for	test 1-1	
Frequency offset of the		XE HOITI (N	e iiist irxr	Hz	0 for to	est 1-2	
Number of HARQ Pro					4	4	
The number of slots	between PDS	CH and co	rresponding HARQ-			2	
ACK information					<u> </u>		

Precodin	g configuration	SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity				
Note 1:	J ,					

Table 5.2.2.1.11-3: Minimum performance

		Bandwidt	Modulatio		Correlation matrix	Reference value	
Test num	Reference channel	h (MHz) / Subcarrier spacing (kHz)	n format and code rate	Propagation condition(Not e 1)	and antenna configuration(Not e 2)	Fraction of maximum throughpu t (%)	SNR (dB)(Not e 3)
1-1	R.PDSCH.1 -3.2 FDD	10 / 15	64QAM, 0.50	TDLA30-10	2x2, ULA Low	70	20.7
1-2	R.PDSCH.1 -3.2 FDD	10 / 15	64QAM, 0.50	TDLA30-10	2x2, ULA Low	70	20.1
Note 1	The propag	nation condition	ns annly to eac	h of TRyP #1 and	TRyP #2 and are statis	tically independ	dent

Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent

Note 2: Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2

Note 3: SNR corresponds to SNR of TRxP #1 and TRxP #2 as defined in 4.4.2 with scaling factor as 1/sqrt(2) for transmitted signal from each TRxP

5.2.2.1.12 Minimum requirements for PDSCH Multi-DCI based transmission scheme

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

The test purposes are specified in Table 5.2.2.1.12-1.

Table 5.2.2.1.12-1: Tests purpose

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

Table 5.2.2.1.12-2: Test parameters

	Parar	meter	Unit		lue		
T		110101	Onit	TRxP #1(Note 1)	TRxP #2(Note 1)		
Transmit TRxP of SS	iB I	TCI state		TCI State #1	P #1 TCI State #2		
PDCCH configuration	n		TPoolIndex		1	.1	
			arrier index in the		k0=0 for CSI-RS	k0=1 for CSI-RS	
			for CSI-RS		resources 1,2,3,4	resources 5,6,7,8	
					I0 = 6 for CSI-RS	I0 = 6 for CSI-RS	
		First OFD	M symbol in the PRB		resources 1 and 3	resources 5 and 7	
		used for 0			10 = 10 for CSI-	10 = 10 for CSI-	
					RS resources 2 and 4	RS resources 6 and 8	
					1 for CSI-RS	1 for CSI-RS	
		Number c	of CSI-RS ports (X)			resource 5,6,7,8	
CSI-RS for tracking		CDM Typ	^			SI-RS resource	
		• •				,5,6,7,8	
		Density	. p,	01.1		3	
		CSI-RS p	eriodicity	Slots	10 for CSI-RS	10 for CSI-RS	
					resources 1 and 2	resources 5 and 6	
		CSI-RS o	ffset	Slots	11 for CSI-RS	11 for CSI-RS	
						resources 7 and 8	
		QCL info				ate #0	
Duplex mode						DD .	
Active DL BWP index						1	
	Mapping ty	ype				ne A	
	Starting symbol (S)				0 2		
	Length (L)				12		
PDSCH	PRB bundling type				Static		
configuration	PRB bundling size				2		
Comiguration	Resource allocation type					oe 1	
	RBG size					nfig2	
	VRB-to-PRB mapping type				Non-inte	erleaved	
	VRB-to-PRB mapping interleaver bundle size				N/A		
		Antenna port indexes			{1000,1001}	{1002,1003}	
	TCI state				TCI State #1	TCI State #2	
PDSCH DMRS	DMRS Typ				Тур	oe 1	
configuration		f additional			,	1	
	Maximum number of OFDM symbols for					1	
	DL front loaded DMRS				CSI-RS resource		
					1 from 'CSI-RS		
	Type 1 QCL		CSI-RS resource		for tracking'	N/A	
TCI State #1	information	n			configuration		
			QCL Type		Type A	N/A	
	Type 2 QC		CSI-RS resource		N/A	N/A	
	information	[]	QCL Type		N/A	N/A CSI-RS resource	
	_		201.75			5 from 'CSI-RS	
	Type 1 QC		CSI-RS resource		N/A	for tracking'	
TCI State #2	information	n				configuration	
			QCL Type		N/A	Type A	
	Type 2 QC		CSI-RS resource		N/A	N/A	
information QCL Type Resource allocation					N/A	N/A	
Timing offset of the second TRxP from the first TRxP					Non-overlapping -0.5		
Frequency offset of the second TRxP from the first TRxP						00	
Number of HARQ Processes						4	
The number of slots between PDSCH and corresponding HARQ-					,	2	
ACK information	ACK information						
						endent precoding	
Precoding configurati	ion					ed for both TRxPs, vith PRB bundling	
						ularity	
					, g/a//	- ·- ·- ·- ·	

Note 1: PDSCH transmission is done from both TRxPs. Transmission from TRxP #1 uses CORESETPoolIndex 0 and transmission from TRxP #2 uses CORESETPoolIndex 1

Table 5.2.2.1.12-3: Minimum performance

Tes t nu m.	Reference	e channel	Bandwid th (MHz) / Subcarri er spacing (kHz)	Modulati on format and code rate	Propagation condition(N ote 1)	Correlation matrix and antenna configuration(N ote 2)	Reference Fraction of maximu m throughp ut (%)	SNR (dB)(No te 3)
	TRxP #1	TRxP #2						
1-1	R.PDSCH. 1-3.3 FDD	R.PDSCH. 1-3.4 FDD	10 / 15	64QAM, 0.50	TDLA30-10	2x2, ULA Low	70	20.6

Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2

Note 3: SNR corresponds to SNR of TRxP #1 and TRxP #2 as defined in 4.4.2

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

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

The test purposes are specified in Table 5.2.2.1.13-1.

Table 5.2.2.1.13-1: Tests purpose

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

Table 5.2.2.1.13-2: Test parameters

Transmit TRXP of SSB		Paran	neter		Unit		lue	
PDCCH configuration	Transmit TDvD of CC			-	TRxP #1 (Note 1)			
CORESETPOOIIndex			TCI state					
First subcarrier index in the PRB used for CSI-RS PRB used for CSI-RS PRB used for CSI-RS PRB used for CSI-RS First OFDM symbol in the PRB used for CSI-RS First OFDM symbol in the PRB used for CSI-RS First OFDM symbol in the PRB used for CSI-RS First OFDM symbol in the PRB used for CSI-RS First OFDM symbol in the PRB used for CSI-RS First OFDM symbol in the PRB used for CSI-RS First OFDM symbol in the PRB used for CSI-RS First OFDM symbol in the PRB used for CSI-RS First OFDM symbol in the PRB used for CSI-RS First OFDM symbol								
PRB used for CSI-RS								
First OFDM symbol in the PRB used for CSI-RS								
Prist Or Dispress Prist Or Dispress Security Se								
Used for CSI-RS Used for CSI-RS Used for CSI-RS RS resources 2 and 4			First OFD	M symbol in the PRB				
CSI-RS for tracking								
Number of CSI-RS ports (X)								
CDM Type		-	Number o	f CSI-RS ports (X)		1 for CSI-RS	1 for CSI-RS	
Density	CSI-RS for tracking	-	CDM Type	e		'No CDM' for C	SI-RS resource	
CSI-RS periodicity		-						
CSI-RS offset				eriodicity	Slots			
CSI-RS offset Slots resources 1 and 2 11 for CSI-RS resources 3 and 4 resources 5 and 6 11 for CSI-RS resources 3 and 4 resources 7 and 8 TCI state #0		-	ooi no p	criodicity	01013		_	
Duplex mode			CSI-RS of	ffset	Slots	resources 1 and 2	resources 5 and 6	
Duplex mode		_						
Mapping type			QCL info		ļ			
Mapping type		.,				F	טט	
FOR FOR	Active DL BVVP index	_	/DO			Tym	1 00 A	
Starting symbol (S)			/pe					
PDSCH Configuration						-		
PRB bundling type Static PRB bundling size wideband Resource allocation type Type 0 RBG size Config2 VRB-to-PRB mapping type Non-interleaved VRB-to-PRB mapping interleaver bundle size N/A Antenna port indexes 1000, 1001 1000, 1001 TCI state TCI State #1 TCI State #2 DMRS Type Type 1 TCI State #2 DMRS Type Type 1 Type 1 Number of additional DMRS 1 Type 1 Maximum number of OFDM symbols for DL front loaded DMRS 1 SCSI-RS resource Type 1 QCL information CSI-RS resource 1 from "CSI-RS" for tracking" configuration configuration N/A N/A TQP 2 QCL information CSI-RS resource N/A N/A N/A TVpp 1 QCL information CSI-RS resource N/A N/A N/A TCI State #2 Type 1 QCL information CSI-RS resource N/A N/A N/A TCI State #2 Type 1 QCL information CSI-RS resource N/A N/A								
PRB bundling size	DUSCH	PRB bundling type				Static		
Resource allocation type								
VRB-to-PRB mapping type	comigaration							
VRB-to-PRB mapping interleaver bundle size								
Size						inon-interieaved		
TCI state						N/A		
DMRS Type						1000, 1001	1000, 1001	
Number of additional DMRS 1 Maximum number of OFDM symbols for DL front loaded DMRS 1 TCI State #1 Type 1 QCL information CSI-RS resource 1 from 'CSI-RS for tracking' configuration N/A TVJpe 1 QCL information QCL Type Type A N/A Type 2 QCL information CSI-RS resource N/A N/A N/A Type 1 QCL information CSI-RS resource N/A N/A N/A Type 1 QCL information QCL Type N/A Type A Type 2 QCL information QCL Type N/A Type A Type 2 QCL information QCL Type N/A N/A Type 2 QCL information QCL Type N/A N/A Type A Type 2 QCL information QCL Type N/A N/A Type A Type 2 QCL information QCL Type N/A N/A Timing offset of the second TRXP from the first TRXP Use Type Information Use Type Information Number of HARQ Processes 4 The number of slots between PDSCH and corresponding HARQ-ACK information SP Type I, independent precoding generation is applied for both TRXPs, random per slot with PRB bundling granularity								
Maximum number of OFDM symbols for DL front loaded DMRS 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1						Тур	pe 1	
TCI State #1 Type 1 QCL information CSI-RS resource 1 from 'CSI-RS for tracking' configuration QCL Type Type A N/A N/A Type 2 QCL information CSI-RS resource 1 from 'CSI-RS for tracking' configuration QCL Type Type A N/A N/A Type 1 QCL Type N/A N/A Type 1 QCL Type N/A N/A CSI-RS resource 5 from 'CSI-RS for tracking' configuration CSI-RS resource N/A Type A N/A Type 1 QCL Type N/A Type A N/A Type 2 QCL information QCL Type N/A Type A N/A Type 2 QCL CSI-RS resource N/A N/A Type 2 QCL CSI-RS resource N/A N/A Timing offset of the second TRxP from the first TRxP US Frequency offset of the second TRxP from the first TRxP US Frequency offset of the second TRxP from the first TRxP Hz The number of slots between PDSCH and corresponding HARQ-ACK information Precoding configuration SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity.	configuration					,	1	
Type 1 QCL Information						•	1	
TCI State #1 Information						CSI-RS resource		
TCI State #1 Information		Type 1 OCI		CSLRS resource			N/A	
TCI State #1 Configuration Type A N/A Type 2 QCL information QCL Type N/A N/A Type 1 QCL CSI-RS resource N/A N/A Type 1 QCL information QCL Type N/A N/A Type 2 QCL information QCL Type N/A Type A Type 2 QCL information QCL Type N/A N/A Type 2 QCL information QCL Type N/A N/A Type A N/A N/A Type A N/A N/A Timing offset of the second TRxP from the first TRxP Us -0.5 Frequency offset of the second TRxP from the first TRxP Hz 200 Number of HARQ Processes 4 The number of slots between PDSCH and corresponding HARQ-ACK information 2 Precoding configuration SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity.				OOI-ING Tesource			IN/A	
Type 2 QCL information QCL Type N/A N/A Type 1 QCL information QCL Type N/A N/A Type 1 QCL information QCL Type N/A S for tracking' configuration QCL Type N/A Type A Type 2 QCL information QCL Type N/A Type A Type 2 QCL information QCL Type N/A N/A Type A Type 2 QCL information QCL Type N/A N/A Timing offset of the second TRxP from the first TRxP US Frequency offset of the second TRxP from the first TRxP Hz Number of HARQ Processes 4 The number of slots between PDSCH and corresponding HARQ-ACK information Precoding configuration SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity.	TCI State #1			OCL Turns			NI/A	
TCI State #2 TUPE 1 QCL information Type 1 QCL Type QCL Type Type 2 QCL QCL Type Type 2 QCL OCSI-RS resource Information QCL Type Type 2 QCL OCSI-RS resource Information QCL Type Type 2 QCL OCSI-RS resource Information QCL Type N/A Timing offset of the second TRxP from the first TRxP Trequency offset of the second TRxP from the first TRxP Number of HARQ Processes The number of slots between PDSCH and corresponding HARQ-ACK information Precoding configuration Precoding configuration Timing offset of the second TRxP from the first TRxP N/A Timing offset of the second TRxP from the first TRxP N/A Type A N/A N/A Type A N/A N/A N/A N/A N/A N/A N/A N		Type 2 00	<u>۱</u>					
TCI State #2 Type 1 QCL information CSI-RS resource Information QCL Type N/A Type 2 QCL CSI-RS resource Information QCL Type N/A Type 2 QCL OCL Type N/A N/A N/A Type A N/A Timing offset of the second TRxP from the first TRxP US Frequency offset of the second TRxP from the first TRxP Number of HARQ Processes The number of slots between PDSCH and corresponding HARQ-ACK information Precoding configuration SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity.								
TCI State #2 Type 1 QCL information QCL Type Type 2 QCL information QCL Type Type 2 QCL information QCL Type Type 2 QCL information QCL Type N/A Type A N/A Type A N/A N/A N/A Timing offset of the second TRxP from the first TRxP Vus Frequency offset of the second TRxP from the first TRxP Number of HARQ Processes The number of slots between PDSCH and corresponding HARQ-ACK information Precoding configuration SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity.		1		JF-				
TCI State #2 Information QCL Type Type 2 QCL Information QCL Type Type 2 QCL Information QCL Type N/A Type A N/A N/A N/A Timing offset of the second TRxP from the first TRxP Frequency offset of the second TRxP from the first TRxP Number of HARQ Processes The number of slots between PDSCH and corresponding HARQ-ACK information Precoding configuration SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity.		Type 1 OC	YI	CSI-RS resource		N/A	5 from 'CSI-RS	
Configuration QCL Type N/A Type 2 QCL information QCL Type N/A N/A N/A Timing offset of the second TRxP from the first TRxP Value of HARQ Processes The number of slots between PDSCH and corresponding HARQ-ACK information Precoding configuration CSI-RS resource N/A N/A N/A N/A -0.5 Hz 200 SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity.				JOI NO TESOUICE		IN/A		
Type 2 QCL information QCL Type N/A N/A Timing offset of the second TRxP from the first TRxP us -0.5 Frequency offset of the second TRxP from the first TRxP Hz 200 Number of HARQ Processes 4 The number of slots between PDSCH and corresponding HARQ-ACK information SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity.	ICI State #2			OCL Turns	1	NI/A		
information QCL Type N/A N/A Timing offset of the second TRxP from the first TRxP us -0.5 Frequency offset of the second TRxP from the first TRxP Hz 200 Number of HARQ Processes 4 The number of slots between PDSCH and corresponding HARQ-ACK information SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity.		Type 2.00	<u>'</u>					
Timing offset of the second TRxP from the first TRxP us -0.5 Frequency offset of the second TRxP from the first TRxP Hz 200 Number of HARQ Processes 4 The number of slots between PDSCH and corresponding HARQ-ACK information SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity.								
Frequency offset of the second TRxP from the first TRxP								
The number of slots between PDSCH and corresponding HARQ-ACK information 2 SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity.								
ACK information SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity.						4	4	
Precoding configuration generation is applied for both TRxPs, random per slot with PRB bundling granularity.								
	Precoding configuration					generation is appli random per slot v	ed for both TRxPs, vith PRB bundling	
	Note 1: PDSCH tr	ansmission is	s done fron	n both TRxPs		granu	ularity.	

Table 5.2.2.1.13-3: Minimum performance for Rank 2

		Bandwidth			Correlation	Reference value		
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition (Note 1)	matrix and antenna configuration (Note 2)	Fraction of maximum throughput (%)	SNR (dB) (Note 3)	
1-1	R.PDSCH.1-2.5 FDD	10 / 15	16QAM, 0.54	TDLA30-10	2x2, ULA Low	70	17. 3	

Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent.

Note 2: Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2.

Note 3: SNR corresponds to SNR of TRxP #1 and TRxP #2 as defined in 4.4.2

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

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

The test purposes are specified in Table 5.2.2.1.14-1.

Table 5.2.2.1.14-1: Tests purpose

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

Table 5.2.2.1.14-2: Test parameters

	Parai	meter	Unit	Value			
				TRxP #1 (Note 1)	TRxP #2 (Note 1)		
Transmit TRxP of SS	BB	T		TRx			
PDCCH configuration TCI state					TCI St		
- 20011 comigaration		CORESETPoolIndex				nfigured	
			arrier index in the		k0=0 for CSI-RS	k0=1 for CSI-RS	
		PRB used	I for CSI-RS		resources 1,2,3,4 I0 = 6 for CSI-RS	resources 5,6,7,8 10 = 6 for CSI-RS	
					resources 1 and 3	resources 5 and 7	
			M symbol in the PRB		10 = 10 for CSI-	10 = 10 for CSI-	
		used for C	CSI-RS		RS resources 2	RS resources 6	
					and 4	and 8	
		Number o	f CSI-RS ports (X)		1 for CSI-RS	1 for CSI-RS	
CSI-RS for tracking		Number o	T COI-ITO POITS (X)		resource 1,2,3,4	resource 5,6,7,8	
Correction tracking		CDM Type	е			SI-RS resource	
						,5,6,7,8	
		Density CSI-RS p	oriodicity	Slots	3	0	
		COI-KO p	enodicity	31013	10 for CSI-RS	10 for CSI-RS	
					resources 1 and 2	resources 5 and 6	
		CSI-RS of	ffset	Slots	11 for CSI-RS	11 for CSI-RS	
						resources 7 and 8	
		QCL info			TCI st		
Duplex mode		•			F[DD	
Active DL BWP index					•	1	
	Mapping t	уре			Тур	e A	
	k0)	
	Starting symbol (S)				2		
	Length (L)				12		
BBOOLL	Repetition number				2 Static		
PDSCH	PRB bundling type PRB bundling size				1		
configuration	Resource allocation type				_	2	
	RBG size					pe 0 nfig2	
	VRB-to-PRB mapping type				Non-interleaved		
	VRB-to-PRB mapping interleaver bundle						
	size	-11	,		N.	/A	
	Antenna p	port indexes			1000	1000	
	TCI state				TCI State #1	TCI State #2	
PDSCH DMRS	DMRS Ty				Тур	e 1	
configuration		f additional			,		
			OFDM symbols for			1	
	DL front ic	aded DMR	S		CCL DC reservings		
					CSI-RS resource 1 from 'CSI-RS		
	Type 1 QC		CSI-RS resource		for tracking'	N/A	
TCI State #1	informatio	n			configuration		
			QCL Type		Type A	N/A	
	Type 2 QC		CSI-RS resource		N/A	N/A	
	informatio	n	QCL Type		N/A	N/A	
						CSI-RS resource	
	Type 1 Q0	CL	CSI-RS resource		N/A	5 from 'CSI-RS	
TOL State #2	informatio			1		for tracking'	
TCI State #2			QCL Type	1	N/A	configuration Type A	
	Type 2 Q0	.i	CSI-RS resource		N/A N/A	N/A	
	information		QCL Type		N/A	N/A	
Timing offset of the second TRxP from the first TRxP						2	
Frequency offset of the second TRxP from the first TRxP				us Hz		00	
Number of HARQ Processes						1	
The number of slots between PDSCH and corresponding HARQ-					,	2	
ACK information	ACK information						
				1		endent precoding	
Precoding configurat	ion				generation is appli		
						vith PRB bundling	
				<u> </u>	<u>l</u> granu	ılarity.	

Note 1: PDSCH transmission is done from both TRxPs

Table 5.2.2.1.14-3: Minimum performance for Rank 1

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

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 5.2.2.1-1: 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	X		1
PDSCH	Mapping type		Type A
configuration			
	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
	December allocation to me		Total A.O. Toron A with start DD 50
	Resource allocation type		Test 1-2: Type 1 with start RB = 50,
			L _{RBs} = 6
	RBG size		Other tests: Type 0 Test 1-2: N/A
	RBG Size		Other tests: Config2
	VPR to DPR manning type		Non-interleaved
	VRB-to-PRB mapping type VRB-to-PRB mapping interleaver bundle		N/A
	size		IV/A
PDSCH DMRS	DMRS Type		Type 1
configuration	Divince Type		1,400 1
comigaration	Number of additional DMRS		2 for Tests 1-1, 1-7, 1-8, 1-9, 1-10, 1-
	Transor of additional Divince		11
			1 for other tests
	Maximum number of OFDM symbols for		1
	DL front loaded DMRS		·
CSI-RS for tracking	First OFDM symbol in the PRB used for		Tests 1-8, 1-9:
· ·	CSI-RS		$I_0 = 4$ for CSI-RS resource 1 and 3
			$I_0 = 8$ 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.
			0,1 , , , , , , , , , , , , , , , , , ,
	001.00 //	01.4	Other tests: Table 5.2-1.
	CSI-RS offset	Slots	Test 1-7, 1-10, 1-11:
			1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4.
			2 for CSI-RS resource 3 and 4.
			Other tests: Table 5.2-1.
	Frequency Occupation		Test 1-7, 1-10, 1-11:
	- 12 - 13 - 13 - 13 - 13 - 13 - 13 - 13		Start PRB 0
			Number of PRB = 52
			Other tests: Table 5.2-1.
Number of HARQ Pr	ocesses		16 for Test 1-4
			10 for Test 1-9
			8 for other tests
	between PDSCH and corresponding HARQ-		Specific to each TDD UL-DL pattern
ACK information			and as defined in Annex A.1.2

Table 5.2.2.2.1-3: Minimum performance for Rank 1

		Bandwidth				Correlation	Reference v	value
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	TDD UL- DL pattern	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.2- 1.1 TDD	40 / 30	QPSK, 0.30	FR1.30- 1A	TDLB100- 400	2x2, ULA Low	70	-1.1
1-2	R.PDSCH.2- 1.2 TDD	40 / 30	QPSK, 0.30	FR1.30-1	TDLC300- 100	2x2, ULA Low	70	0.2
1-3	R.PDSCH.2- 4.1 TDD	40 / 30	256QAM, 0.82	FR1.30-1	TDLA30-10	2x2, ULA Low	70	25.3
1-4	R.PDSCH.2- 2.1 TDD	40 / 30	16QAM, 0.48	FR1.30-1	TDLC300- 100	2x2, ULA Low	30	1.6
1-5	R.PDSCH.2- 5.1 TDD	40 / 30	QPSK, 0.30	FR1.30-2	TDLA30-10	2x2, ULA Low	70	-0.9
1-6	R.PDSCH.2- 6.1 TDD	40 / 30	QPSK, 0.30	FR1.30-3	TDLA30-10	2x2, ULA Low	70	-0.8
1-7	R.PDSCH.2- 10.1 TDD	40 / 30	16QAM, 0.48	FR1.30-1	HST-1000	1x2	70	6.4
1-8	R.PDSCH.2- 11.1 TDD	40 / 30	QPSK, 0.30	FR1.30-5	TDLB100- 400	2x2, ULA Low	70	-1.0
1-9	R.PDSCH.2- 12.1 TDD	40 / 30	QPSK, 0.30	FR1.30-6	TDLB100- 400	2x2, ULA Low	70	-1.1
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 5.2.2.1-4: Minimum performance for Rank 2

Test num.	Reference channel	Bandwidth (MHz) / Subcarrier spacing	Modulation format and code rate	TDD UL-DL pattern	Propagation condition	Correlation matrix and antenna	Reference Fraction of maximum throughput	value SNR (dB)
		(kHz)		•		configuration	(%)	(GB)
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	Mandadatian	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)
	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	X		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		I ₀ = 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		8
	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	Madulation	TDD III		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		Type B
	k0		0
	Starting symbol (S)		5
	Length (L)		7
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS configuration	DMRS Type		Type 1
· ·	Number of additional DMRS		1
	Maximum number of OFDM symbols for DL front loaded DMRS		1
Number of HARQ P	rocesses		8
The number of slots ACK information	s 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	Meduletien	TDD		Correlation	Reference va	lue
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	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 Pro			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				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	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 5.2.2.5-3: Minimum performance for Rank 1

Test num.	Reference channel Subcarr spacin	Bandwidth (MHz) /	Modulation	TDD III DI	Dranagation	Correlation	Reference value	
		Subcarrier spacing (kHz) format and code rate	format and code rate	TDD UL-DL 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	1x2, ULA Low	0.001%	2.8

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 ind	ex		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		2	
	Resource allocation type		Type 0	
	RBG size		Config2	
	VRB-to-PRB mapping type		Non-interleaved	
			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 F	Processes		4	
The number of slot	s between final repetition of PDSCH and		Specific to each TDD UL-DL pattern	
corresponding HAF	RQ-ACK information		and as defined in Annex A.1.2 (Note 1)	
Note 1: ACK/NA	CK feedback is generated for PDSCH on slot i,	where mo	$d(i,10) = \{2, 4, 6\}.$	

Table 5.2.2.2.6-3: Minimum performance for Rank 1

Toot	Poforonoo	Bandwidth (MHz) /	Modulation	TDD UL-DL	Propagation	Correlation	Reference va	lue
Test num.	channel	Subcarrier termat and	pattern	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)	1.4

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

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

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

The test purposes are specified in Table 5.2.2.2.7-1.

Table 5.2.2.2.7-1: Tests purpose

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

Table 5.2.2.2.7-2: Test parameters

	Parameter	Unit	Value
Duplex mode			TDD
Active DL BWP index	X		1
PDSCH	Mapping type		Туре В
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	Meduletien	TDD		Correlation	Reference va	ılue
Test num.	Reference channel		format and code rate		Propagation condition	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	2x2, ULA Low	70	[0.6]

5.2.2.2.8 Minimum requirements for PDSCH pre-emption

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

The test purposes are specified in Table 5.2.2.2.8-1.

Table 5.2.2.2.8-1: Tests purpose

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

Table 5.2.2.2.8-2: Test parameters

Duplex mode			Value		
			TDD		
Active DL BWP index			1 0, 1 2_1 14x1 Type A 0 2 12 12 1 Static 2 Type 0		
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		
2)			40/(1,12,23,34) (Note 3)		
Number of HARQ Pro			8		
The number of slots b ACK information	netween PDSCH and corresponding HARQ-		FR1.30-1		

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

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

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

Table 5.2.2.2.8-3: Minimum performance for Rank 1

Test num.		Bandwidth (MHz) /	Meduletien			Correlation	Reference	value
	Reference channel	Subcarrier format a	format and code rate	TDD UL-DL pattern	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH. 2-2.5 TDD	40 / 30	16QAM 0.48	FR1.30-1	TDLA30-10	2x2, ULA Low	70	[12.5]

5.2.2.2.9 Minimum requirements for HST-SFN

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

The test purposes are specified in Table 5.2.2.2.9-1.

Table 5.2.2.2.9-1: Tests purpose

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

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

Table 5.2.2.2.9-3: Minimum performance for Rank 2

Test num.	Reference Su	Bandwidth			Propagation condition	Correlation matrix and antenna configuration	Reference value	
		Subcarrier f	Modulation format and code rate	TDD UL- DL pattern			Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.2- 10.4 TDD	40 / 30	16QAM, 0.48	FR1.30-1	HST-SFN	2x2	70	14.2

5.2.2.2.10 Minimum requirements for HST-DPS

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

The test purposes are specified in Table 5.2.2.2.10-1.

Table 5.2.2.2.10-1: Tests purpose

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

Table 5.2.2.2.10-2: Test parameters

	Parameter		Unit	Value
Duplex mode			TDD	
Active DL BWP index				1
PDCCH configuration	TCI state		Note 1	
	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		$I_0 = 6$ for CSI-RS resource 5 and 6
		PRB used for CSI-RS		l ₀ = 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
	Nesource set #2		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 + //O	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 iii T	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 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 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), CSI-RS (for tracking) resource set # ((k mod 2) + 1) and CSI-RS (for CSI acquisition) resource set # ((k mod 2) + 3) are transmitted by # 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^{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#

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

to slot#

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

Where k=0, 1, 2... is the RRH number, n = 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			of I		andwidth of Correlation		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			

5.2.2.2.11 Minimum requirements for PDSCH Single-DCI based SDM scheme

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

The test purposes are specified in Table 5.2.2.2.11-1.

Table 5.2.2.2.11-1: Tests purpose

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

Table 5.2.2.2.11-2: Test parameters

	Daramat		l lmi4	Va	lue	
	Paramet	ter	Unit	TRxP #1(Note 1)	TRxP #2(Note 1)	
Transmit TRxP of SS					P #1	
PDCCH configuration	1	CI state			tate #1	
	U	ORESETPoolIndex irst subcarrier index in the		k0=0 for CSI-RS)	
		RB used for CSI-RS		resources 1,2,3,4	k0=1 for CSI-RS resources 5,6,7,8	
	<u> </u>	NB used for CSI-NS		10 = 6 for CSI-RS	10 = 6 for CSI-RS	
				resources 1 and 3	resources 5 and 7	
		rst OFDM symbol in the PRB		10 = 10 for CSI-	10 = 10 for CSI-	
		sed for CSI-RS		RS resources 2	RS resources 6	
				and 4	and 8	
	N	umber of CSI-RS ports (X)		1 for CSI-RS	1 for CSI-RS	
CSI-RS for tracking	IN	uniber of Col-Ro ports (X)		resource 1,2,3,4		
CSI-IXS for tracking	C	DM Туре			SI-RS resource	
					,5,6,7,8	
		ensity	01.1		3	
	<u>C</u>	SI-RS periodicity	Slots		0	
				20 for CSI-RS resources 1 and 2	20 for CSI-RS resources 5 and 6	
	С	SI-RS offset	Slots	21 for CSI-RS	21 for CSI-RS	
					resources 7 and 8	
	0	CL info			ate #0	
Duplex mode					DD	
Active DL BWP index	Κ				1	
	Mapping type)		Тур	e A	
	k0			(0	
	Starting symb	ool (S)		2		
	Length (L)			12		
PDSCH	PRB bundling				atic	
configuration	PRB bundling				2	
	Resource allo	ocation type			<u>e 1</u>	
	RBG size	manning tune			nfig2	
		mapping type mapping interleaver bundle		Non-interleaved		
	size	mapping interleaver buridle		N	/A	
	Antenna port	indexes		1000	1002	
	TCI state			TCI State #1	TCI State #2	
PDSCH DMRS	DMRS Type				ne 1	
configuration		dditional DMRS		•	1	
	Maximum nu	mber of OFDM symbols for			1	
	DL front load	ed DMRS			! 	
				CSI-RS resource		
	Type 1 QCL	CSI-RS resource		1 from 'CSI-RS for tracking'	N/A	
TCI State #1	information			configuration		
101 State #1		QCL Type		Type A	N/A	
	Type 2 QCL	CSI-RS resource		N/A	N/A	
	information	QCL Type		N/A	N/A	
		<u> </u>			CSI-RS resource	
	Type 1 QCL	CSI-RS resource		N/A	5 from 'CSI-RS	
	information	COI NO resource		14/71	for tracking'	
TCI State #2	omation	001 7			configuration	
	T 2. 2. 2. 2.	QCL Type		N/A	Type A	
Type 2 QCL information		CSI-RS resource QCL Type		N/A N/A	N/A N/A	
Resource allocation	I IIIOIIIIalioiI	QOL Type			erlapping	
				-0.25 for	r test 1-1	
Timing offset of the s	econd TRxP from	om the first TRxP	us		est 1-2	
Frague and all all all all all all all all all al	he energy TD	D from the first TDvD	11-		test 1-1	
Frequency offset of the		r nom the first TRXP	Hz		est 1-2	
Number of HARQ Pro					3	
	between PDSC	H and corresponding HARQ-			DD UL-DL pattern	
ACK information				and as defined	in Annex A.1.2	

Precoding configuration	SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity.
Note 1: PDSCH transmission is done from both TRxPs (PDSCH La layer 1 is transmitted from TRxP #2)	yer 0 is transmitted from TRxP #1 and PDSCH

Table 5.2.2.2.11-3: Minimum performance

		Bandwidt			Correlation	Reference	e value	
Test num	Reference channel	h (MHz) / Subcarri er spacing (kHz)	Modulatio n format and code rate	TDD UL-DL patter n	Propagation condition(No te 1)	matrix and antenna configuration(N ote 2)	Fraction of maximum throughp ut (%)	SNR (dB)(Not e 3)
1-1	R.PDSCH. 2-3.2 TDD	40 / 30	64QAM, 0.50	FR1.3 0-1	TDLA30-10	2x2, ULA Low	70	20.2
1-2	R.PDSCH. 2-3.2 TDD	40 / 30	64QAM, 0.50	FR1.3 0-1	TDLA30-10	2x2, ULA Low	70	20.0
Note 1	Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent							

Note 1: The propagation conditions apply to each of TRXP #1 and TRXP #2 and are statistically independent

Note 2: Correlation matrix and antenna configuration parameters apply to each of TRXP #1 and TRXP #2

Note 3: SNR corresponds to SNR of TRXP #1 and TRXP #2 as defined in 4.4.2 with scaling factor as 1/sqrt(2) for transmitted signal from each TRXP

5.2.2.2.12 Minimum requirements for PDSCH Multi-DCI based transmission scheme

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

The test purposes are specified in Table 5.2.2.2.12-1.

Table 5.2.2.2.12-1: Tests purpose

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

Table 5.2.2.2.12-2: Test parameters

	Parar	neter	Unit		lue		
T		110101	Onit	TRxP #1(Note 1)	TRxP #2(Note 1)		
Transmit TRxP of SS	SB	TCI state		TCI State #1	P #1 TCI State #2		
PDCCH configuration CORESETPoolIndex						.1	
			arrier index in the		k0=0 for CSI-RS	k0=1 for CSI-RS	
			for CSI-RS		resources 1,2,3,4	resources 5,6,7,8	
					I0 = 6 for CSI-RS	I0 = 6 for CSI-RS	
		Eirct OED	M symbol in the PRB		resources 1 and 3	resources 5 and 7	
		used for 0			10 = 10 for CSI-	10 = 10 for CSI-	
		4004.0.			RS resources 2	RS resources 6	
					and 4 1 for CSI-RS	and 8 1 for CSI-RS	
		Number of	of CSI-RS ports (X)			resource 5,6,7,8	
CSI-RS for tracking		CDM Tun	•			SI-RS resource	
		CDM Typ	e 		1,2,3,4	,5,6,7,8	
		Density		61		3	
		CSI-RS p	eriodicity	Slots		0	
					20 for CSI-RS resources 1 and 2	20 for CSI-RS resources 5 and 6	
		CSI-RS o	ffset	Slots	21 for CSI-RS	21 for CSI-RS	
						resources 7 and 8	
		QCL info				ate #0	
Duplex mode	-					DD	
Active DL BWP index						1	
	Mapping ty	ype				e A	
	k0	l L (O)				<u>) </u>	
	Starting sy Length (L)	/mbol (S)				<u>2</u> 2	
	PRB bund	ling type			Static		
PDSCH	PRB bund				2		
configuration	Resource allocation type				Type 1		
	RBG size					nfig2	
		VRB-to-PRB mapping type			Non-inte	erleaved	
		RB mapping	g interleaver bundle		N/A		
		ort indexes			{1000,1001}	{1002,1003}	
	TCI state				TCI State #1	TCI State #2	
PDSCH DMRS	DMRS Typ	ре			Тур	ne 1	
configuration		f additional			,	1	
			OFDM symbols for			1	
	DL front lo	aded DMR	S 		CSI-RS resource	<u> </u>	
					1 from 'CSI-RS		
	Type 1 QCL information		CSI-RS resource		for tracking'	N/A	
TCI State #1					configuration		
			QCL Type		Type A	N/A	
	Type 2 QC		CSI-RS resource		N/A	N/A	
	informatio	n	QCL Type		N/A	N/A	
						CSI-RS resource	
	Type 1 QC		CSI-RS resource		N/A	5 from 'CSI-RS for tracking'	
TCI State #2	information					configuration	
101 State #2			QCL Type		N/A	Type A	
	Type 2 QC	CL	CSI-RS resource		N/A	N/A	
information QCL Type				N/A	N/A		
Resource allocation						erlapping	
Timing offset of the second TRxP from the first TRxP				us		.25	
Frequency offset of the second TRxP from the first TRxP				Hz		00 3	
Number of HARQ Processes The number of slots between PDSCH and corresponding HARQ-						DD UL-DL pattern	
ACK information	DOLWICOITT D	COLL ALIU C	oncoponding HAING			in Annex A.1.2	
						endent precoding	
Precoding configurat	ion				generation is appli	ed for both TRxPs,	
. recountly configurat	.011					vith PRB bundling	
					j grani	ularity	

Note 1: PDSCH transmission is done from both TRxPs. Transmission from TRxP #1 uses CORESETPoolIndex 0 and transmission from TRxP #2 uses CORESETPoolIndex 1

Table 5.2.2.2.12-3: Minimum performance

			Bandwid Modula					Reference value	
Test num.	Referenc	ce channel	th (MHz) / Subcarri er spacing (kHz)	tion format and code rate	TDD UL-DL pattern	Propagati on condition(Note 1)	Correlation matrix and antenna configurati on(Note 2)	Fraction of maximu m through put (%)	SNR (dB)(N ote 3)
	TRxP #1	TRxP #2							
1-1	R.PDSC H.2-3.3 TDD	R.PDSCH. 2-3.4 TDD	40 / 30	64QAM , 0.50	FR1.30 -1	TDLA30- 10	2x2, ULA Low	70	20.4
Note 1:	The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent								
Note 2:	Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2								
Note 3:	SNR corr	responds to SN	NR of TRxP#	#1 and TRx	P #2 as de	fined in 4.4.2			

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

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

The test purposes are specified in Table 5.2.2.2.13-1.

Table 5.2.2.2.13-1: Tests purpose

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

Table 5.2.2.1.13-2: Test parameters

Transmit TraxP of SSB		Param	neter		Unit	Va	lue
PDCCH configuration							
CORESETPOolIndex							
First subcarrier index in the PRB used for CSI-RS PRB used for CSI-RS PRB used for CSI-RS First OFDM symbol in the PRB symbol in the PRB undiing year of Sich Selection of Sich S							
PRB used for CSI-RS							
CSI-RS for tracking							
CSI-RS for tracking							
Used for CSI-RS With the content of the content			First OFD	M symbol in the PRR			
CSI-RS for tracking			used for C	SI-RS			
Number of CSI-RS ports (X)							
CDM Type			Number o	f CSI-RS ports (X)		1 for CSI-RS	1 for CSI-RS
Density	CSI-RS for tracking	_	CDM Type	9		'No CDM' for C	SI-RS resource
CSI-RS periodicity		_					
CSI-RS offset		-		eriodicity	Slots		
CSI-RS offset		-	COI-IXO PI	enodicity	01013		_
Duplex mode			CSI-RS of	ffset	Slots	resources 1 and 2	resources 5 and 6
Duplex mode							
Mapping type	Duploy mode		QCL info				
Mapping type		y				I L	טע 1
PDSCH	Active DL BVVF IIIde		ne			Tyr	ne A
Length (L)			P-0				
PRB bundling type		Starting symbol (S)					
PRB bundling size							
Resource allocation type	PDSCH						
RBG size	configuration						
VRB-to-PRB mapping type							
VRB-to-PRB mapping interleaver bundle size							
Antenna port indexes		VRB-to-PRB mapping interleaver bundle				N/A	
TCI state			port indexes			1000, 1001	1000, 1001
Number of additional DMRS		TCI state					
Maximum number of OFDM symbols for DL front loaded DMRS						Тур	e 1
DL front loaded DMRS	configuration					,	1
Type 1 QCL Information				_ '		,	1
TCI State #1 Type 1 QCL Information QCL Type Type A N/A			DE HOIR loaded Divino			CSI-RS resource	
TCI State #1 Information		Type 1 OC	l	CSI-RS resource			N/A
TCI State #2 TUPE 1 QCL information QCL Type N/A	T01.0:			OCI NO TODOGIOO			14/73
Type 2 QCL information QCL Type N/A N/A Type 1 QCL information QCL Type N/A N/A Type 1 QCL information QCL Type N/A Type A Type 2 QCL information QCL Type N/A Type A Type 2 QCL information QCL Type N/A Type A Type 2 QCL information QCL Type N/A N/A Timing offset of the second TRxP from the first TRxP US Frequency offset the second TrxP from the first TRxP Hz 300 Number of HARQ Processes The number of slots between PDSCH and corresponding HARQ-ACK information Precoding configuration Timing offset of the second TrxP from the first TRxP Specific to each TDD UL-DL pattern and as defined in Annex A.1.2 SP Type I, independent precoding generation is applied for both TrxPs, random per slot with PRB bundling granularity.	TCI State #1			OCL Type			NI/A
TCI State #2 TO STATE TAXE TO STATE TAXE		Type 2 QC	L				
TCI State #2 Type 1 QCL information CSI-RS resource Information QCL Type Type 2 QCL CSI-RS resource Information QCL Type Type 2 QCL CSI-RS resource Information QCL Type N/A Type A N/A N/A N/A Timing offset of the second TRxP from the first TRxP QCL Type N/A N/A N/A Timing offset of the second TRxP from the first TRxP Number of HARQ Processes The number of slots between PDSCH and corresponding HARQ- ACK information Precoding configuration CSI-RS resource N/A N/A N/A N/A N/A N/A Specific to each TDD UL-DL pattern and as defined in Annex A.1.2 SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity.							
TCI State #2 Tope 1 QCL Information QCL Type N/A Type A							CSI-RS resource
TCI State #2 Information QCL Type Type 2 QCL Information QCL Type Type 2 QCL Information QCL Type N/A Type A N/A N/A Timing offset of the second TRxP from the first TRxP Frequency offset the second TRxP from the first TRxP Number of HARQ Processes The number of slots between PDSCH and corresponding HARQ- ACK information Precoding configuration Information QCL Type N/A N/A N/A N/A 10 N/A N/A N/A 10 N/A N/A N/A Specific to each TDD Number of slots between PDSCH and corresponding HARQ- ACK information Precoding configuration SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity.		Type 1 QC	L	CSI-RS resource		N/A	
QCL Type	TOI State #2						
Type 2 QCL information QCL Type N/A N/A Timing offset of the second TRxP from the first TRxP us -0.25 Frequency offset the second TRxP from the first TRxP Hz 300 Number of HARQ Processes 8 The number of slots between PDSCH and corresponding HARQ-ACK information SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity.	TOT State #2			QCL Type		N/A	
Information QCL Type N/A N/A Timing offset of the second TRxP from the first TRxP us -0.25 Frequency offset the second TRxP from the first TRxP Hz 300 Number of HARQ Processes 8 The number of slots between PDSCH and corresponding HARQ-ACK information Specific to each TDD UL-DL pattern and as defined in Annex A.1.2 Precoding configuration SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity.		Type 2 QC	L				
Frequency offset the second TRxP from the first TRxP Hz 300 Number of HARQ Processes 8 The number of slots between PDSCH and corresponding HARQ- ACK information Specific to each TDD UL-DL pattern and as defined in Annex A.1.2 SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity.		information		QCL Type			
Number of HARQ Processes The number of slots between PDSCH and corresponding HARQ- ACK information Precoding configuration Specific to each TDD UL-DL pattern and as defined in Annex A.1.2 SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity.							
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 SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity.			from the	tirst TRxP	Hz		
ACK information and as defined in Annex A.1.2 SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity.			CH and a	orresponding HADO			
Precoding configuration generation is applied for both TRxPs, random per slot with PRB bundling granularity.						and as defined	in Annex A.1.2
random per slot with PRB bundling granularity.							
	Precoding configurat	Precoding configuration				random per slot v	vith PRB bundling
	Note 1: PDSCH tr	ansmission is	done fron	n both TRxPs	1	grand	

Table 5.2.2.2.13-3: Minimum performance for Rank 2

		Bandwidth		700	5	Correlation	Reference value		
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	TDD UL-DL pattern	Propagation condition (Note 1)	matrix and antenna configuration (Note 2)	Fraction of maximum throughput (%)	SNR (dB) (Note 3)	
1-1	R.PDSCH.2- 2.5 TDD	40 / 30	16QAM, 0.54	FR1.30- 1	TDLA30-10	2x2, ULA Low	70	17.6	
	Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent. Note 2: Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2.								

Note 3: SNR corresponds to SNR of TRxP #1 and TRxP #2 as defined in 4.4.2

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

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

The test purposes are specified in Table 5.2.2.2.14-1.

Table 5.2.2.2.14-1: Tests purpose

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

Table 5.2.2.2.14-2: Test parameters

Parameter					Va	lue
					TRxP #1 (Note 1)	TRxP #2 (Note 1)
Transmit TRxP of SSB TCl state						P #1
PDCCH configuration	า	TCI state CORESETPoolIndex				tate #1
			arrier index in the		k0=0 for CSI-RS	nfigured k0=1 for CSI-RS
			for CSI-RS		resources 1,2,3,4	resources 5,6,7,8
					10 = 6 for CSI-RS	10 = 6 for CSI-RS
		Firet OFD	M symbol in the PRB		resources 1 and 3	resources 5 and 7
		used for 0			10 = 10 for CSI-	10 = 10 for CSI-
					RS resources 2 and 4	RS resources 6 and 8
		Number o	of CSI-RS ports (X)		1 for CSI-RS	1 for CSI-RS resource 5,6,7,8
CSI-RS for tracking		CDM Typ	e		'No CDM' for C	SI-RS resource
						,5,6,7,8
		Density CSI-RS p	eriodicity	Slots		3 .0
		σοι-ινο μ	onodioity	Jiota	20 for CSI-RS	20 for CSI-RS
		CSI-RS o	ffset	Slots	resources 1 and 2 21 for CSI-RS	resources 5 and 6 21 for CSI-RS
		001 : (resources 7 and 8
Dunley mode		QCL info				ate #0 DD
Active DL BWP index	Duplex mode Active DL BWP index					<u>טט</u> 1
sa.re zz zvir maoz	Mapping t	уре				e A
	k0					0
	Starting symbol (S)				2	
	Length (L)				12	
PDSCH	Repetition PRB bund				Static	
configuration	PRB bund					2
		Resource allocation type				pe 0
	RBG size				Cor	nfig2
	VRB-to-PRB mapping type				Non-inte	erleaved
	VRB-to-PF size	/RB-to-PRB mapping interleaver bundle			N	/A
		na port indexes			1000	1000
	TCI state				TCI State #1	TCI State #2
PDSCH DMRS	DMRS Ty					e 1
configuration		f additional				1
		number of aded DMR	OFDM symbols for S		·	1
					CSI-RS resource	
	Type 1 QC	CL	CSI-RS resource		1 from 'CSI-RS	N/A
TCI State #1	information				for tracking' configuration	
101 State #1			QCL Type		Type A	N/A
	Type 2 QC	CL	CSI-RS resource		N/A	N/A
	information		QCL Type		N/A	N/A
						CSI-RS resource
	Type 1 QC		CSI-RS resource		N/A	5 from 'CSI-RS for tracking'
TCI State #2	information					configuration
1 οι οιαιο π2			QCL Type		N/A	Type A
	Type 2 QC		CSI-RS resource		N/A	N/A
· · · · · · · · · · · · · · · · · ·	information		QCL Type		N/A	N/A
Timing offset of the s				us Hz	1 300	
Frequency offset of the second TRxP from the first TRxP Number of HARQ Processes				172		4
	The number of slots between PDSCH and corresponding HARQ-					DD UL-DL pattern
ACK information					and as defined in A	nnex A.1.2 (Note 2)
Precoding configuration					SP Type I, indep generation is appli random per slot v	endent precoding ed for both TRxPs, vith PRB bundling larity.
				•		-

Note 1:	PDSCH transmission is done from both TRxPs	l
Note 2:	ACK/NACK feedback is generated for PDSCH on slot i, where $mod(i,10) = \{2, 4, 6\}$.	l

Table 5.2.2.2.14-3: Minimum performance for Rank 1

		Bandwidth		700 III		Correlation	Reference value	
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	TDD UL- DL pattern	Propagation condition (Note 1)	matrix and antenna configuration (Note 2)	BLER (%)	SNR (dB) (Note 4)
1-1	R.PDSCH.2- 16.2 TDD	40 / 30	16QAM, 0.54	FR1.30- 1	TDLA30-10	2x2, ULA Low	1 (Note 3)	2. 8
Note 1	: The propagat	ion conditions	apply to each o	of TRxP #1 a	and TRxP #2 and	d are statistically i	independent.	
Note 2	: Correlation m	atrix and anter	nna configuration	on paramete	rs apply to each	of TRxP #1 and	TRxP #2.	
Note 3	3: BLER is defined as residual BLER; i.e. ratio of incorrectly received transport blocks / sent transport blocks,							
	independently	of the numbe	r HARQ transm	nission(s) for	each transport	block.		
Note 4	: SNR correspo	onds to SNR of	f TRxP #1 and	TRxP #2 as	defined in 4.4.2			

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

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

The test purposes are specified in Table 5.2.2.2.15-1.

Table 5.2.2.2.15-1: Tests purpose

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

Table 5.2.2.2.15-2: Test parameters

	Parameter	Unit	Value
Duplex mode			TDD
Active DL BWP inde	x		1
DL transmission mod	del		As specified in B.5
Downlink Model	SSB Q factor		8
Parameters	Downlink transmission duration values	Slots	{2,4,6,7}
	Occupied OFDM symbols in slot other	Symbols	14
	than the last slot of the downlink duration		14
	Occupied OFDM symbols in the last slot	Symbols	{6,9,12,14} (Note 1)
	of the downlink duration		[0,0,12,14]
	Downlink period	ms	5
	LBT failure probability (plbt)		0.25
PDSCH	Mapping type		Type A
configuration	k0		0
	Starting symbol (S)		2
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS	DMRS Type		Type 1
configuration	dmrs-AdditionalPosition		pos1
	Maximum number of OFDM symbols for DL front loaded DMRS		1
Number of HARQ Pr	ocesses		8
The number of slots	between PDSCH and corresponding HARQ-		Specific to each TDD UL-DL pattern
ACK information			and as defined in Annex A.1.2
Note 1: If DL Tran	smission duration is 2 Slot, the occupied OFD	M symbols i	n the last slot of the downlink duration
is 14.			

Table 5.2.2.2.15-3: Minimum performance for Rank 2

		Bandwidth				Correlation	Reference value	
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation TDD UL- format and DL code rate pattern		Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1- 18.1 TDD	20 / 30	16QAM, 0.48	FR1.30-7	TDLA30-10	2x2, ULA Low	70	[13.8]
1-2	R.PDSCH.1- 18.2 TDD	40 / 30	16QAM, 0.48	FR1.30-7	TDLA30-10	2x2, ULA Low	70	[14.0]
1-3	R.PDSCH.1- 18.3 TDD	60 / 30	16QAM, 0.48	FR1.30-7	TDLA30-10	2x2, ULA Low	70	[14.2]
1-4	R.PDSCH.1- 18.4 TDD	80 / 30	16QAM, 0.48	FR1.30-7	TDLA30-10	2x2, ULA Low	70	[14.5]

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			Value
Duplex mode			FDD
Active DL BWP index			1
	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		12
	PDSCH aggregation factor		1
	PRB bundling type		Static
PDSCH configuration	PRB bundling size		4 for Test 1-1 wideband 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 Processes			8 for Test 1-4, 2-1 4 for other tests
The number of slots between PDSCH and corresponding HARQ-ACK information			2

Table 5.2.3.1.1-3: Minimum performance for Rank 1

		Bandwidth			Correlation	Reference value	
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-1.1 FDD	10 / 15	QPSK, 0.30	TDLB100-400	2x4, ULA Low	70	-3.5
1-2	R.PDSCH.1-1.2 FDD	10 / 15	QPSK, 0.30	TDLC300-100	2x4, ULA Low	70	-2.9
1-3	R.PDSCH.1-4.1 FDD	10 / 15	256QAM, 0.82	TDLA30-10	2x4, ULA Low	70	21.0
1-4	R.PDSCH.1-2.1 FDD	10 / 15	16QAM, 0.48	TDLC300-100	2x4, ULA Low	30	-1.5
1-5	R.PDSCH.1-8.1 FDD	10 / 15	16QAM, 0.48	HST-750	1x4	70	3.3
1-6	R.PDSCH.1-8.2 FDD	10 / 15	64QAM, 0.43	HST-972	1x4	70	[7.0]
1-7	R.PDSCH.1-8.1 FDD	10 / 15	16QAM, 0.48	TDLC300-600	2x4	70	[5.0]

Table 5.2.3.1.1-4: Minimum performance for Rank 2

		Bandwidth		Propagation condition	Correlation	Reference value	
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate		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	Meduletien		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)	
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	Madalatian		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)	
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 ₀ = 13
CSI acquisition	CSI-RS periodicity	Slots	5
ZP CSI-RS for CSI	Subcarrier index in the PRB used for CSI-RS		$(k_0, k_1, k_2, k_3)=(2, 4, 6, 8)$
acquisition	Number of CSI-RS ports (X)		8
•	CSI-RS periodicity	Slots	5
Number of HARQ Pr	ocesses		4
The number of slots ACK information	between PDSCH and corresponding HARQ-		2

Table 5.2.3.1.2-3: Minimum performance for Rank 2

Test	Reference	Bandwidth (MHz) / Subcarrier spacing	Modulation format and	Propagation condition	Correlation matrix and antenna configuration	Reference va	ilue
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 Pr	ocesses		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	Correlation			lue	
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-1.3 FDD	10 / 15	QPSK, 0.30	TDLA30-10	2x4, ULA Low	70	-3.8

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

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

The test purposes are specified in Table 5.2.3.1.4-1.

Table 5.2.3.1.4-1: Tests purpose

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

Table 5.2.3.1.4-2: Test parameters

	Parameter	Unit	Value
Duplex mode			FDD
Active DL BWP index	X		1
NR UL transmission	with a 7.5 kHz shift to the LTE raster		true
PDCCH configuration	Symbols with PDCCH		Symbol# 2
	Mapping type		Type A
	k0		0
	Starting symbol (S)		3
	Length (L)		9 for Test 1-1 11 for Test 1-2
DDCCH	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
DD0011 D14D0	Position of the first DM-RS for downlink		3
PDSCH DMRS	Number of additional DMRS		1
configuration	Maximum number of OFDM symbols for DL front loaded DMRS		1
	LTE carrier centre subcarrier location		Same as NR carrier centre subcarrier location
CRS for rate	LTE carrier BW	MHz	10
matching (Note 1)	Number of antenna ports		4
	v-shift		0
Number of HARQ Processes			4
The number of slots between PDSCH and corresponding HARQ-ACK information			2
Note 1: No MBSF	N is configured on LTE carrier		

Table 5.2.3.1.4-3: Minimum performance for Rank 1

		Bandwidth (MHz) /	Mandadatian		Correlation	Reference va	
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		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			!
Maximum number of HARQ transmission			1
Number of HARQ Pr	ocesses		4
The number of slots	between PDSCH and corresponding HARQ-		2
ACK information			۷

Table 5.2.3.1.5-3: Minimum performance for Rank 1

Test	Reference	Bandwidth (MHz) /	Modulation	Propagation	Correlation matrix and	Reference value	
num.	channel	Subcarrier spacing (kHz)	format and code rate	Propagation condition	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%	0.2

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	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 P	rocesses		4
The number of slots corresponding HAR	between final repetition of PDSCH and Q-ACK information		2

Table 5.2.3.1.6-3: Minimum performance for Rank 1

Toot	Deference	Bandwidth (MHz) /	Modulation	Dramanation	Correlation	Reference value	
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)	-2.3

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

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

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

The test purposes are specified in Table 5.2.3.1.7-1.

Table 5.2.3.1.7-1: Tests purpose

Purpose	Test index
PDSCH mapping Type B performance and UE processing capability 2 under four receive antenna	1-1
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		IN/A
	DMRS Type		Type 1
PDSCH DMRS	Number of additional DMRS		0
configuration	Maximum number of OFDM symbols for		1
DL front loaded DMRS			ı
Maximum number of HARQ transmission			1
Number of HARQ Processes			2
	between PDSCH and corresponding HARQ-		0
ACK information			

Table 5.2.3.1.7-3: 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.1-12.1 FDD	10 / 15	QPSK, 0.30	TDLA30-10	2x4, ULA Low	70	[- 2.3]

5.2.3.1.8 Minimum requirements for PDSCH pre-emption

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

The test purposes are specified in Table 5.2.3.1.8-1.

Table 5.2.3.1.8-1: Tests purpose

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

Table 5.2.3.1.8-2: Test parameters

	Parameter	Unit	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		N/A
	Size		Tuno 4
PDSCH DMRS	DMRS Type		Type 1
	Number of additional DMRS		<u> </u>
configuration	Maximum number of OFDM symbols for DL front loaded DMRS		1
Pre-emption	Starting symbol (S)		3
configuration (Note	Length (L)		2
2)	Pre-emption periodicity and offset (Note 3)	Slots	10/1
Number of HARQ Pro			4
The number of slots I ACK information	between PDSCH and corresponding HARQ-		2
Note 1: Void			

Note 1: Void

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

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

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

Table 5.2.3.1.8-3: Minimum performance for Rank 1

		Bandwidth (MHz) /	(MHz) /		Correlation	Reference value	
Test num.	Reference channel	Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH. 1-2.5 FDD	10 / 15	16QAM 0.64	TDLA30-10	2x4, ULA Low	70	6. 6

5.2.3.1.9 Minimum requirements for PDSCH HST-SFN

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

The test purposes are specified in Table 5.2.3.1.9-1.

Table 5.2.3.1.9-1: Tests purpose

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

Table 5.2.3.1.9-2: Test parameters

	Parameter	Unit	Value
Duplex mode			FDD
Active DL BWP index	(1
	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		12
	PDSCH aggregation factor		1
PDSCH	PRB bundling type		Static
configuration	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle		N/A
	size		
	DMRS Type		Type 1
PDSCH DMRS	Number of additional DMRS		2
configuration	Maximum number of OFDM symbols for		1
	DL front loaded DMRS		•
	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
		0.0.0	2 for CSI-RS resource 3 and 4.
Number of HARQ Processes			4
The number of slots I ACK information	petween PDSCH and corresponding HARQ-		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				1
PDCCH configuration	TCI state			Note 1
	Mapping type			Type A
	k0	\		0 2
	Starting symbol (S Length (L))		12
	PDSCH aggregation factor			12
PDSCH configuration	PRB bundling type			Static
	PRB bundling size			2
	Resource allocatio			Type 0
	RBG size			Config2
	VRB-to-PRB mapp			Non-interleaved
		oing interleaver bundle size		N/A
	TCI state			Note 1
DD00H DMD0	DMRS Type	- L DMDO		Type 1
PDSCH DMRS configuration	Number of addition	of OFDM symbols for DL		2
Comiguration	front loaded DMRS			1
		First OFDM symbol in		I ₀ = 5 for CSI-RS resource 1 and 3
		the PRB used for CSI-		$I_0 = 9$ for CSI-RS resource 2 and 4
		RS		
	Resource set #1	CSI-RS periodicity	Slots	10 for CSI-RS resource 1,2,3,4.
		CSI-RS offset	Slots	1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4
		QCL info		TCI state #2
CSI-RS for tracking		First OFDM symbol in		l ₀ = 6 for CSI-RS resource 5 and 6
		the PRB used for CSI-		$I_0 = 10$ for CSI-RS resource 7 and 8
		RS		
	Resource set #2	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
			01010	2 for CSI-RS resource 7 and 8
		QCL info First OFDM symbol in		TCI state #3 I ₀ = 12
	Resource set #3	the PRB used for CSI-		10 = 12
		RS		
		CSI-RS periodicity	Slots	20
		CSI-RS offset	Slots	0
NZP CSI-RS for CSI		QCL info		TCI state #0
acquisition		First OFDM symbol in		$I_0 = 13$
		the PRB used for CSI-		
	Resource set #4	RS CSI-RS periodicity	Slots	20
		CSI-RS offset	Slots	0
		QCL info	01010	TCI state #1
		, , <u>-</u> -		CSI-RS resource 1 from 'CSI-RS for
	Type 1 QCL	CSI-RS resource		tracking Resource set #1'
TCI state #0	information			configuration
. Or orato #0	T - 200:	QCL Type		Type A
	Type 2 QCL	CSI-RS resource		N/A
	information	QCL Type		N/A CSI-RS resource 5 from 'CSI-RS for
	Type 1 QCL	CSI-RS resource		tracking Resource set #2'
	information	COLINO 10000106		configuration
TCI state #1		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
	Type 2 QCL information	SSB index QCL Type		N/A N/A
	Type 1 QCL	SSB index		SSB #1
TOL 1 115	information	QCL Type		Type C
TCI state #3	Type 2 QCL	SSB index		N/A
	information	QCL Type		N/A

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

Note 1: SSB # (k mod 2), CSI-RS (for tracking) resource set # ((k mod 2) + 1) and CSI-RS (for CSI acquisition) resource set # ((k mod 2) + 3) are transmitted by k^{th} 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 kth 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, 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#

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

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 5.2.3.1.10-3: Minimum performance for HST-DPS

		Bandwidth			Number of	Correlation	Reference v	alue
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

5.2.3.1.11 Minimum requirements for PDSCH Single-DCI based SDM scheme

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

The test purposes are specified in Table 5.2.3.1.11-1.

Table 5.2.3.1.11-1: Tests purpose

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

Table 5.2.3.1.11-2: Test parameters

	Paramet	or	Unit		lue	
		lei	Offic	TRxP #1(Note 1)	TRxP #2(Note 1)	
Transmit TRxP of SS				TRxP #1		
PDCCH configuration		CI state			tate #1	
	C	ORESETPoolIndex			0	
		rst subcarrier index in the		k0=0 for CSI-RS	k0=1 for CSI-RS	
	P	RB used for CSI-RS		resources 1,2,3,4	resources 5,6,7,8	
				10 = 6 for CSI-RS	I0 = 6 for CSI-RS	
	Fi	rst OFDM symbol in the PRB		resources 1 and 3 10 = 10 for CSI-	resources 5 and 7 I0 = 10 for CSI-	
	us	sed for CSI-RS		RS resources 2	RS resources 6	
				and 4	and 8	
				1 for CSI-RS	1 for CSI-RS	
	N	Number of CSI-RS ports (X)		resource 1,2,3,4		
CSI-RS for tracking		DM T			SI-RS resource	
	C	DM Туре			,5,6,7,8	
		ensity			3	
		SI-RS periodicity	Slots	2	20	
				10 for CSI-RS	10 for CSI-RS	
	C	SI-RS offset	Slots	resources 1 and 2	resources 5 and 6	
		COI NO Oliset		11 for CSI-RS	11 for CSI-RS	
				resources 3 and 4		
	Q	CL info			ate #0	
Duplex mode					DD .	
Active DL BWP index					1	
	Mapping type				oe A	
	k0	-1 (0)		0		
	Starting symb	001 (5)		2 12		
	Length (L)	1 truno		Static		
PDSCH configuration	PRB bundling				auc 2	
	Resource allo				ze 1	
	RBG size	ocation type				
		mapping type		Config2 Non-interleaved		
		mapping type mapping interleaver bundle				
	size	mapping interiouver buriale		N	/A	
	Antenna port	indexes		1000	1002	
	TCI state			TCI State #1	TCI State #2	
PDSCH DMRS	DMRS Type				pe 1	
configuration	Number of ac	Iditional DMRS		,	1	
	Maximum nui	mber of OFDM symbols for		1		
	DL front loade	ed DMRS			1	
				CSI-RS resource		
	Type 1 QCL	CSI-RS resource		1 from 'CSI-RS	N/A	
TOLO: 4 #4	information			for tracking'		
TCI State #1		OCL Turns		configuration	NI/A	
	Type 2 OCL	QCL Type		Type A	N/A	
	Type 2 QCL information	CSI-RS resource QCL Type	+	N/A N/A	N/A N/A	
	iiiioiiiialioii	QUL Type	+	IN/A	CSI-RS resource	
					5 from 'CSI-RS	
	Type 1 QCL	CSI-RS resource		N/A	for tracking'	
TCI State #2	information				configuration	
		QCL Type		N/A	Type A	
	Type 2 QCL	CSI-RS resource		N/A	N/A	
	information	QCL Type		N/A	N/A	
Resource allocation	Resource allocation			Full-ove	erlapping	
Timing offset of the second TRxP from the first TRxP			us		test 1-1	
g onoor or tile s	John HAI III	310 11100	4.5		est 1-2	
Frequency offset of the	he second TRx	P from the first TRxP	Hz		test 1-1	
<u> </u>			+		est 1-2	
Number of HARQ Pro		H and correct and in a LADO	1	1	4	
ACK information	between PDSC	H and corresponding HARQ-			2	
			1			

Precoding configuration		SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity.
Note 1:	PDSCH transmission is done from both TRxPs (PDSCH La layer 1 is transmitted from TRxP #2)	ayer 0 is transmitted from TRxP #1 and PDSCH

Table 5.2.3.1.11-3: Minimum performance

		Bandwidt	Modulatio		Correlation matrix	Referenc	e value
Test num	Reference channel	h (MHz) / Subcarrier spacing (kHz)	n format and code rate	Propagation condition(Not e 1)	and antenna configuration(Not e 2)	Fraction of maximum throughpu t (%)	SNR (dB)(Not e 3)
1-1	R.PDSCH.1 -3.2 FDD	10 / 15	64QAM, 0.50	TDLA30-10	2x4, ULA Low	70	14.6
1-2	R.PDSCH.1 -3.2 FDD	10 / 15	64QAM, 0.50	TDLA30-10	2x4, ULA Low	70	13.9
Note 1	. The propag	ation condition	s annly to eac	h of TRyP #1 and	TRyP #2 and are statis	tically independ	dent

Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent

Note 2: Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2

Note 3: SNR corresponds to SNR of TRxP #1 and TRxP #2 as defined in 4.4.2 with scaling factor as 1/sqrt(2) for transmitted signal from each TRxP

5.2.3.1.12 Minimum requirements for PDSCH Multi-DCI based transmission scheme

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

The test purposes are specified in Table 5.2.3.1.12-1.

Table 5.2.3.1.12-1: Tests purpose

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

Table 5.2.3.1.12-2: Test parameters

December					Va	lue	
Parameter			Unit	TRxP #1(Note 1) TRxP #2(Note 1)			
Transmit TRxP of SSB				TRx			
PDCCH configuration		TCI state			TCI State #1	TCI State #2	
- 2 con connigarance		CORESETPoolIndex			0		
			arrier index in the		k0=0 for CSI-RS	k0=1 for CSI-RS	
		PRB used for CSI-RS			resources 1,2,3,4 I0 = 6 for CSI-RS	resources 5,6,7,8 10 = 6 for CSI-RS	
					resources 1 and 3	resources 5 and 7	
			M symbol in the PRB		10 = 10 for CSI-	10 = 10 for CSI-	
		used for CSI-RS			RS resources 2	RS resources 6	
					and 4	and 8	
		Number of CCL BC norte (V)			1 for CSI-RS	1 for CSI-RS	
CSI-RS for tracking		Number of CSI-RS ports (X)			resource 1,2,3,4	resource 5,6,7,8	
CSI-KS for tracking		CDM Type				SI-RS resource	
					1,2,3,4,5,6,7,8		
		Density		01.4	3		
		CSI-RS periodicity		Slots	20		
					10 for CSI-RS resources 1 and 2	10 for CSI-RS resources 5 and 6	
		CSI-RS of	ffset	Slots	11 for CSI-RS	11 for CSI-RS	
						resources 7 and 8	
		QCL info			TCI st		
Duplex mode	l				F		
Active DL BWP index	X					1	
	Mapping ty	уре			Type A		
	k0)	
	Starting sy	mbol (S)			2		
	Length (L)				12		
PDSCH	PRB bund				Static		
configuration	PRB bund				2		
garanen.		allocation ty	ype		Type 1		
	RBG size				Config2		
		/RB-to-PRB mapping type /RB-to-PRB mapping interleaver bundle			Non-interleaved		
	VRB-to-PF	RB mapping	j interleaver bundle		N.	/A	
		Antenna port indexes			{1000,1001}	{1002,1003}	
	TCI state	•			TCI State #1	TCI State #2	
PDSCH DMRS	DMRS Typ	ne .			Type 1		
configuration		f additional	DMRS		1		
			OFDM symbols for		1		
		DL front loaded DMRS					
					CSI-RS resource		
	Type 1 QC	CI.	CSI-RS resource		1 from 'CSI-RS	N/A	
	information				for tracking'	14/71	
TCI State #1			OCL Tuno		configuration Type A	NI/A	
			QCL Type CSI-RS resource		N/A	N/A N/A	
	Type 2 QC information		QCL Type		N/A N/A	N/A	
	omatioi		QOL TYPE	<u> </u>	IN/A	CSI-RS resource	
		.,	001.00		N1/4	5 from 'CSI-RS	
	Type 1 QC		CSI-RS resource		N/A	for tracking'	
TCI State #2	information					configuration	
			QCL Type		N/A	Type A	
	Type 2 QC		CSI-RS resource		N/A	N/A	
	information	nformation QCL Type		ļ	N/A N/A		
Resource allocation					Non-overlapping		
Timing offset of the second TRxP from the first TRxP			US LI-7	-0.5 200			
Frequency offset of the second TRxP from the first TRxP			Hz	200			
Number of HARQ Processes The number of slots between PDSCH and corresponding HARQ-			1				
ACK information				2			
			<u> </u>	SP Type I, independent precoding			
				generation is appli			
Precoding configurat	Precoding configuration					vith PRB bundling	
						ularity	

Note 1: PDSCH transmission is done from both TRxPs. Transmission from TRxP #1 uses CORESETPoolIndex 0 and transmission from TRxP #2 uses CORESETPoolIndex 1

Table 5.2.3.1.12-3: Minimum performance

			5	Modula		0	Reference value	
Test num.			Bandwidt h (MHz) / Subcarrier spacing (kHz)	tion format and code rate	Propagati on condition(Note 1)	Correlation matrix and antenna configuratio n(Note 2)	Fraction of maximu m throughp ut (%)	SNR (dB)(No te 3)
1-1	R.PDSCH. 1-3.3 FDD	R.PDSCH.1- 3.4 FDD	10 / 15	64QAM , 0.50	TDLA30- 10	2x4, ULA Low	70	14.6
Note 1	Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent							

Note 1: The propagation conditions apply to each of TRXP #1 and TRXP #2 and are statistically independent Note 2: Correlation matrix and antenna configuration parameters apply to each of TRXP #1 and TRXP #2 Note 3: SNR corresponds to SNR of TRXP #1 and TRXP #2 as defined in 4.4.2

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

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

The test purposes are specified in Table 5.2.3.1.13-1.

Table 5.2.3.1.13-1: Tests purpose

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

Table 5.2.3.1.13-2: Test parameters

	Paran	neter		Unit	Va	lue
						TRxP #2 (Note 1)
Transmit TRxP of SS	SB				TRx	
PDCCH configuration	n -	TCI state	TD 11 1			ate #1
3			TPoolIndex			nfigured
			arrier index in the I for CSI-RS		k0=0 for CSI-RS	k0=1 for CSI-RS
		FKD used	1101 C31-K3		resources 1,2,3,4 I0 = 6 for CSI-RS	resources 5,6,7,8 I0 = 6 for CSI-RS
					resources 1 and 3	resources 5 and 7
			M symbol in the PRB		10 = 10 for CSI-	10 = 10 for CSI-
		used for C	SI-RS		RS resources 2	RS resources 6
					and 4	and 8
		Numbero	f CSI-RS ports (X)		1 for CSI-RS	1 for CSI-RS
CSI-RS for tracking		Number 0	i Coi-No ports (A)		resource 1,2,3,4	
COI-NO for tracking		CDM Type	9			SI-RS resource
						,5,6,7,8
	-	Density	- vi - di -it	Slots		3
		CSI-RS p	enodicity	51015	10 for CSI-RS	10 for CSI-RS
					resources 1 and 2	resources 5 and 6
		CSI-RS of	ffset	Slots	11 for CSI-RS	11 for CSI-RS
					resources 3 and 4	
	-	QCL info				ate #0
Duplex mode						DD
Active DL BWP index	X				•	1
	Mapping ty	ре			Тур	e A
	k0)
	Starting sy	mbol (S)			2	
	Length (L)					2
PDSCH	PRB bundl					atic
configuration	PRB bundl					band
	Resource a	allocation ty	ype			pe 0 nfig2
		R manning	n type			iligz erleaved
		VRB-to-PRB mapping type VRB-to-PRB mapping interleaver bundle				
	size	Παρριτίς	g intericaver bariale		N.	/A
		port indexes			1000, 1001	1000, 1001
	TCI state	_			TCI State #1	TCI State #2
PDSCH DMRS	DMRS Typ				Тур	e 1
configuration	Number of				,	1
			OFDM symbols for		,	1
	DL front loa	aded DMR	S			·
					CSI-RS resource	
	Type 1 QC	L	CSI-RS resource		1 from 'CSI-RS for tracking'	N/A
TCI State #1	information	1			configuration	
			QCL Type		Type A	N/A
	Type 2 QC	L	CSI-RS resource		N/A	N/A
	information		QCL Type		N/A	N/A
						CSI-RS resource
	Type 1 QC	1	CSI-RS resource		N/A	5 from 'CSI-RS
	information		33.1.3 10000100		13//	for tracking'
TCI State #2			001 7		N1/A	configuration
	Tune 2.00	1	QCL Type		N/A N/A	Type A N/A
Type 2 Q0 informatio			CSI-RS resource QCL Type		N/A N/A	N/A N/A
Timing offset of the second TRxP from the first TRxP			us			
Frequency offset of the second TRxP from the first TRxP			Hz	-0.5 200		
Number of HARQ Processes					4	
	The number of slots between PDSCH and corresponding HARQ-				,	2
ACK information			<u> </u>		2	
						endent precoding
Precoding configurat	ion					ed for both TRxPs,
J 22 Jan 20						vith PRB bundling
Note 1: PDSCH tra	anemiceion i	dona fron	n both TRxPs	<u> </u>	<u>granu</u>	ılarity.
INDIE I. FUSCH III	ariorilloolUII l	aurie IIUII	I DOUI I I IXE 2			

Table 5.2.3.1.13-3: Minimum performance for Rank 2

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

Note 2: Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2.

SNR corresponds to SNR of TRxP #1 and TRxP #2 as defined in 4.4.2 Note 3:

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

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

The test purposes are specified in Table 5.2.3.1.14-1.

Table 5.2.3.1.14-1: Tests purpose

Test index
1-1

Table 5.2.3.1.14-2: Test parameters

	Parai	meter		Unit	Va	lue	
					TRxP #1 (Note 1)	TRxP #2 (Note 1)	
Transmit TRxP of SS	B	T			TRx		
PDCCH configuration	า	TCI state			TCI St		
- 2001. comgarano.			TPoolIndex			nfigured	
			arrier index in the		k0=0 for CSI-RS	k0=1 for CSI-RS	
		PRB used	I for CSI-RS		resources 1,2,3,4 I0 = 6 for CSI-RS	resources 5,6,7,8 10 = 6 for CSI-RS	
					resources 1 and 3	resources 5 and 7	
			M symbol in the PRB		10 = 10 for CSI-	10 = 10 for CSI-	
		used for C	CSI-RS		RS resources 2	RS resources 6	
					and 4	and 8	
		Number of CSI-RS ports (X)			1 for CSI-RS	1 for CSI-RS	
CSI-RS for tracking		Number o	T COI-ITO POITS (X)		resource 1,2,3,4	resource 5,6,7,8	
COLITION INCOMING		CDM Type	е			SI-RS resource	
						,5,6,7,8	
		Density CSI-RS p	oriodicity	Slots		<u>3</u> 0	
		CSI-RS p	enodicity	Siois	10 for CSI-RS	10 for CSI-RS	
					resources 1 and 2	resources 5 and 6	
		CSI-RS of	ffset	Slots	11 for CSI-RS	11 for CSI-RS	
						resources 7 and 8	
		QCL info				ate #0	
Duplex mode		•			F	DD	
Active DL BWP index	Κ				,	1	
	Mapping t	уре			Тур	e A	
	k0				0		
	Starting sy				2		
	Length (L)					2	
550011	Repetition					2	
PDSCH configuration	PRB bund					atic	
	PRB bund				_	2	
	RBG size	allocation t	ype			pe 0 nfig2	
		VRB-to-PRB mapping type				erleaved	
		/RB-to-PRB mapping interleaver bundle					
	size	(D mapping			N.	/A	
		ort indexes			1000	1000	
	TCI state				TCI State #1	TCI State #2	
PDSCH DMRS	DMRS Ty	pe			Тур	e 1	
configuration		f additional			,	1	
			OFDM symbols for		,	1	
	DL front lo	aded DMR	<u>S</u>			•	
					CSI-RS resource		
	Type 1 Q0	CL	CSI-RS resource		1 from 'CSI-RS for tracking'	N/A	
TCI State #1	informatio	n			configuration		
101 State #1			QCL Type		Type A	N/A	
	Type 2 Q0	CL	CSI-RS resource	1	N/A	N/A	
	informatio		QCL Type		N/A	N/A	
						CSI-RS resource	
	Type 1 Q0	2.1	CSI-RS resource		N/A	5 from 'CSI-RS	
	informatio		33. 1.3 10000100		13//3	for tracking'	
TCI State #2			OOL Torre		N1/A	configuration	
	Tuna 2.00	N	QCL Type CSI-RS resource	-	N/A	Type A	
Type 2 QCL information			QCL Type	1	N/A N/A	N/A N/A	
Timing offset of the second TRxP from the first TRxP			us				
Frequency offset of the second TRXP from the first TRXP				Hz	2 200		
Number of HARQ Processes						1	
The number of slots between PDSCH and corresponding HARQ-				1		-	
ACK information					<u> </u>	2	
						endent precoding	
Precoding configurat	ion					ed for both TRxPs,	
. 1000anig oomigalat					-	vith PRB bundling	
					granu	ılarity.	

Note 1: PDSCH transmission is done from both TRxPs

Table 5.2.3.1.14-3: Minimum performance for Rank 1

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

5.2.3.2 TDD

Note 4:

5.2.3.2.1 Minimum requirements for PDSCH Mapping Type A

SNR corresponds to SNR of TRxP #1 and TRxP #2 as defined in 4.4.2

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
	9 71		4 for Tests 1-1, 1-8, 1-9
PDSCH	PRB bundling size		wideband for Test 3-1
			2 for other tests
configuration			Test 1-2: Type 1 with start RB = 50,
	Resource allocation type		L _{RBs} = 6
			Other tests: Type 0
	RBG size		Test 1-2: N/A
	RDG Size		Other tests: Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle		NI/A
	size		N/A
	DMRS Type		Type 1
PDSCH DMRS			2 for Tests 1-1, 1-7, 1-8, 1-9, 1-10, 1-
	Number of additional DMRS		11
configuration			1 for other tests
	Maximum number of OFDM symbols for		1
	DL front loaded DMRS		•
			Tests 1-8, 1-9:
	First OFDM symbol in the PRB used for		$I_0 = 4$ for CSI-RS resource 1 and 3
	CSI-RS		$I_0 = 8$ for CSI-RS resource 2 and 4
			Other tests; Table 5.2-1.
			Test 1-7, 1-10, 1-11:
	CSI-RS periodicity	Slots	20 for CSI-RS resource 1,2,3,4.
			Other tests. Table 5.0.4
CCI DC for two skips			Other tests: Table 5.2-1. Test 1-7, 1-10, 1-11:
CSI-RS for tracking			1 for CSI-RS resource 1 and 2
	CSI-RS offset	Slots	
	CSI-RS Oliset	Siols	2 for CSI-RS resource 3 and 4.
			Other tests: Table 5.2-1.
			Test 1-7, 1-10, 1-11:
			Start PRB 0
	Frequency Occupation		Number of PRB = 52
	1 Toquettoy Coodpation		14dinibol 611 115 = 62
			Other tests: Table 5.2-1.
	•		16 for Test 1-4
Number of HARQ Pro	ocesses		10 for Test 1-9
			8 for other tests
The number of slots b	petween PDSCH and corresponding HARQ-		Specific to each TDD UL-DL pattern
ACK information			and as defined in Annex A.1.2

Table 5.2.3.2.1-3: Minimum performance for Rank 1

		Bandwidth				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	Madulation	TDD	Propagation r	Correlation matrix and antenna configuration	Reference value	
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	TDD UL-DL pattern			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	Moduletien			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)
3-1	R.PDSCH.2- 2.3 TDD	40 / 30	16QAM, 0.48	FR1.30-1	TDLA30-10	4x4, ULA Low	70	11.1

Table 5.2.3.2.1-6: Minimum performance for Rank 4

		Bandwidth		TDD III	Propagation matrix ar condition antenna	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)
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 max configuration throu	Fraction of maximum throughput (%)	SNR (dB)
5-1	R.PDSCH.2- 2.3 TDD	40 / 30	16QAM, 0.48	FR1.30-1	TDLA30-10	4x4, ULA Medium A	70	22.9

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

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

The test purposes are specified in Table 5.2.3.2.2-1.

Table 5.2.3.2.2-1: Tests purpose

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

Table 5.2.3.2.2-2: Test parameters

	Parameter	Unit	Value
Duplex mode			TDD
Active DL BWP index	(1
	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		12
PDSCH	PDSCH aggregation factor		1
	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		l ₀ = 13
CSI acquisition	CSI-RS periodicity	Slots	5
ZP CSI-RS for CSI	Subcarrier index in the PRB used for CSI-RS		(k ₀ , k ₁ , k ₂ , k ₃)=(2, 4, 6, 8)
acquisition	Number of CSI-RS ports (X)		8
	CSI-RS periodicity	Slots	5
Number of HARQ Pr	ocesses		8
The number of slots ACK information	between PDSCH and corresponding HARQ-		Specific to each TDD UL-DL pattern and as defined in Annex A.1.2

Table 5.2.3.2.2-3: Minimum performance for Rank 2

	Bandwidth (MHz) / Modulation TDD UL-			Correlation		/alue		
Test num.	Reference channel	Subcarrier spacing (kHz)	format and code rate	DL DL pattern	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.2- 7.1 TDD	40 / 30	16QAM, 0.48	FR1.30-1	TDLC300- 100	2x4, ULA Low	70	9.0

5.2.3.2.3 Minimum requirements for PDSCH Mapping Type B

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

The test purposes are specified in Table 5.2.3.2.3-1.

Table 5.2.3.2.3-1: Tests purpose

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

Table 5.2.3.2.3-2: Test parameters

	Parameter	Unit	Value	
Duplex mode			TDD	
Active DL BWP inde	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 Pr	ocesses		8	
The number of slots ACK information	between PDSCH and corresponding HARQ-		Specific to each TDD UL-DL pattern and as defined in Annex A.1.2	

Table 5.2.3.2.3-3: Minimum performance for Rank 1

		Bandwidth Madulation	TDD !!!		Correlation	Reference value		
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	TDD UL- DL pattern	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
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
THE OL HARSHISSION	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
PDSCH DMRS	Position of the first DM-RS for downlink		3
	Number of additional DMRS		1
configuration	Maximum number of OFDM symbols for DL front loaded DMRS	g type Type A g symbol (S) (L) 4 aggregation factor Indling type Indling size In	1
CRS for rate	LTE carrier centre subcarrier location		Same as NR carrier centre subcarrier location
0.10.10.10.0	LTE carrier BW	MHz	10
matching (Note 1)	Number of antenna ports		4
	v-shift		0
Number of HARQ Processes			
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
Note 1: No MBSF	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 inde	X		1	
	Mapping type		Type A	
	k0		0	
	Starting symbol (S)		2	
	Length (L)		12	
	PDSCH aggregation factor		1	
PDSCH	PRB bundling type		Static	
configuration	PRB bundling size		2	
	Resource allocation type		Type 0	
	RBG size		Config2	
	VRB-to-PRB mapping type		Non-interleaved	
	VRB-to-PRB mapping interleaver bundle		N/A	
	size		IN/A	
	DMRS Type		Type 1	
PDSCH DMRS	Number of additional DMRS		1	
configuration	Maximum number of OFDM symbols for		1	
	DL front loaded DMRS		ı	
Maximum number of	f HARQ transmission		1	
Number of HARQ Pr	ocesses		8	
	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

Toot	Deference	Bandwidth (MHz) /	Modulation	TDD UL-DL	Dranagation	Correlation	Reference	value
num.	Test Reference num. channel	Subcarrier tormat and	pattern	L 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%	0.2

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 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 Processes			4
The number of slots	between final repetition of PDSCH and		Specific to each TDD UL-DL pattern
corresponding HARQ-ACK information			and as defined in Annex A.1.2 (Note 1)
Note 1: ACK/NAC	CK feedback is generated for PDSCH on slot i,	where mo	$d(i,10) = \{2, 4, 6\}.$

Table 5.2.3.2.6-3: Minimum performance for Rank 1

Test	Reference	Bandwidth (MHz) /	Modulation	TDD UL-DL	Propagation	Correlation matrix and	Reference va	lue
num.	channel	Subcarrier spacing (kHz)	format and code rate	pattern	Propagation condition	antenna configuration	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)	-2.6

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

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

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

The test purposes are specified in Table 5.2.3.2.7-1.

Table 5.2.3.2.7-1: Tests purpose

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

Table 5.2.3.2.7-2: Test parameters

Parameter			Value
Duplex mode			TDD
Active DL BWP index			1
DDCCH	Mapping type		Type B
PDSCH 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	of HARQ transmission	1
Number of HARQ F	Processes	2
The number of slots ACK information	s between PDSCH and corresponding HARQ-	0

Table 5.2.3.2.7-3: Minimum performance for Rank 1

		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.1- 17.1 TDD	40 / 30	QPSK, 0.30	FR1.30- 2	TDLA30-10	2x4, ULA Low	70	[- 2.5]

5.2.3.2.8 Minimum requirements for PDSCH pre-emption

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

The test purposes are specified in Table 5.2.3.2.8-1.

Table 5.2.3.2.8-1: Tests purpose

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

Table 5.2.3.2.8-2: 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
2) Pre-emption periodicity and offset		Slots	40/(1,12,23,34) (Note 3)
Number of HARQ Pr			8
The number of slots ACK information	between PDSCH and corresponding HARQ-		FR1.30-1

Note 1: Void

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

Note 3: Pre-emption is scheduled with with 10% probability with 20ms periodicity.

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

Table 5.2.3.2.8-3: Minimum performance for Rank 1

		Bandwidth (MHz) /	Modulation		Correlation Reference value			
Test num.	Reference channel	Subcarrier spacing (kHz)	format and code rate	TDD UL-DL pattern	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH. 2-2.5 TDD	40 / 30	16QAM 0.48	FR1.30-1	TDLA30-10	2x4, ULA Low	70	8.7

5.2.3.2.9 Minimum requirements for HST-SFN

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

The test purposes are specified in Table 5.2.3.2.9-1.

Table 5.2.3.2.9-1: Tests purpose

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

Table 5.2.3.2.9-2: Test parameters

	Parameter	Unit	Value
Duplex mode			TDD
Active DL BWP index	(1
	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 22 for CSI-RS resource 3 and 4.
	Frequency Occupation		Start PRB 0 Number of PRB = 52
Number of HARQ Processes			8
The number of slots between PDSCH and corresponding HARQ-ACK information			Specific to each TDD UL-DL pattern and as defined in Annex A.1.2

Table 5.2.3.2.9-3: 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	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	on factor		1
PDSCH configuration	PRB bundling type	•		Static
FD3CIT Configuration	PRB bundling size			2
	Resource allocation	n type		Type 0
	RBG size			Config2
	VRB-to-PRB mapp			Non-interleaved
		ping interleaver bundle size		N/A
	TCI state			Note 1
	DMRS Type			Type 1
PDSCH DMRS	Number of addition			2
configuration	Maximum number front loaded DMRS	of OFDM symbols for DL		1
	HOIR IDAGED 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
	Resource set #1	CSI-RS offset	Slots	1 for CSI-RS resource 1 and 2
	Resource set #1	CSI-RS dilset	Siois	2 for CSI-RS resource 3 and 4
		QCL info		TCI state #2
		Frequency Occupation		Start PRB 0
CSI-RS for tracking		. , , , ,		Number of PRB = 52
CSI-NS for tracking		First OFDM symbol in the		$I_0 = 6$ for CSI-RS resource 5 and 6
		PRB used for CSI-RS		$l_0 = 10$ 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
	Nesource set #2		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		10 = 12
		PRB used for CSI-RS		-
	Resource set #3	CSI-RS periodicity	Slots	40
NITE 001 E0 (001		CSI-RS offset	Slots	0
NZP CSI-RS for CSI		QCL info		TCI state #0
acquisition		First OFDM symbol in the PRB used for CSI-RS		10 = 13
	Resource set #4		Slots	40
	Resource set #4	CSI-RS periodicity CSI-RS offset	Slots	0
		QCL info	31013	TCI state #1
		QUE IIIIU		CSI-RS resource 1 from 'CSI-RS
	Type 1 QCL	CSI-RS resource		for tracking Resource set #1'
	information			configuration
TCI state #0		QCL Type		Type A
	Type 2 QCL	CSI-RS resource		N/A
	information	QCL Type		N/A
				CSI-RS resource 5 from 'CSI-RS
	Type 1 QCL	CSI-RS resource		for tracking Resource set #2'
TCI atata #4	information			configuration
TCI state #1		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		Туре С
TOT State #Z	Type 2 QCL	SSB index		N/A
	information	QCL Type		N/A
	Type 1 QCL	SSB index		SSB #1
TCI state #3	information	QCL Type		Type C
101 31410 #0	Type 2 QCL	SSB index		N/A
	information	QCL Type		N/A

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) , CSI-RS (for tracking) resource set # ((k mod 2) + 1) and CSI-RS (for CSI acquisition) resource set # ((k mod 2) + 3) are transmitted by k^{th} 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^{th} RRH from slot#

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

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#

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

to slot#

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

Where k=0, 1, 2... is the RRH number, n = 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

5.2.3.2.11 Minimum requirements for PDSCH Single-DCI based SDM scheme

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

The test purposes are specified in Table 5.2.3.2.11-1.

Table 5.2.3.2.11-1: Tests purpose

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

Table 5.2.3.2.11-2: Test parameters

	Doromo	to:	I Init	Va	lue	
	Parame	ter	Unit	TRxP #1(Note 1) TRxP #2(Note 1)		
Transmit TRxP of SSB				TRx		
PDCCH configuration	_	CI state			ate #1	
	U	CORESETPoolIndex First subcarrier index in the		k0=0 for CSI-RS) 	
		RB used for CSI-RS		resources 1,2,3,4	k0=1 for CSI-RS resources 5,6,7,8	
		KB used for CSI-KS		10 = 6 for CSI-RS	10 = 6 for CSI-RS	
				resources 1 and 3	resources 5 and 7	
		irst OFDM symbol in the PRB		10 = 10 for CSI-	10 = 10 for CSI-	
	u	sed for CSI-RS		RS resources 2	RS resources 6	
				and 4	and 8	
	N	umber of CSI-RS ports (X)		1 for CSI-RS	1 for CSI-RS	
CSI-RS for tracking	_ IN	uniber of CSI-KS ports (X)		resource 1,2,3,4		
CSI-IXS for tracking	C	DM Type			SI-RS resource	
					,5,6,7,8	
		ensity	01.1		3	
	<u> </u>	SI-RS periodicity	Slots		0	
				20 for CSI-RS resources 1 and 2	20 for CSI-RS resources 5 and 6	
	C	SI-RS offset	Slots	21 for CSI-RS	21 for CSI-RS	
					resources 7 and 8	
	C	CL info			ate #0	
Duplex mode					DD	
Active DL BWP index	K				1	
	Mapping type	9		Тур	e A	
	k0			0		
	Starting symb	ool (S)		2		
	Length (L)			12		
PDSCH	PRB bundling				atic	
configuration	PRB bundling				2	
	Resource allo	ocation type			<u>e 1</u>	
	RBG size	manning tune		Config2 Non-interleaved		
		mapping type mapping interleaver bundle		Non-interleaved		
	size	mapping interleaver buridle		N	/A	
	Antenna port	indexes		1000	1002	
	TCI state			TCI State #1	TCI State #2	
PDSCH DMRS	DMRS Type			Type 1		
configuration		dditional DMRS		•	1	
	Maximum nu	mber of OFDM symbols for			1	
	DL front load	ed DMRS			<u>'</u>	
				CSI-RS resource		
	Type 1 QCL	CSI-RS resource		1 from 'CSI-RS for tracking'	N/A	
TCI State #1	information			configuration		
101 State #1		QCL Type		Type A	N/A	
	Type 2 QCL	CSI-RS resource		N/A	N/A	
	information	QCL Type		N/A	N/A	
					CSI-RS resource	
	Type 1 QCL	CSI-RS resource		N/A	5 from 'CSI-RS	
	information	COI NO leaduide		13//3	for tracking'	
TCI State #2		001.7		N1/A	configuration	
	Turno 0.001	QCL Type	1	N/A	Type A	
	Type 2 QCL information	CSI-RS resource QCL Type	-	N/A N/A	N/A N/A	
Resource allocation	_ miornation	QOL Type	-		rlappling	
				-0.25 for	r test 1-1	
Timing offset of the s	econd TRxP fro	om the first TRxP	us		est 1-2	
Frequency offset of the second TRxP from the first TRxP					test 1-1	
		P HOTH THE HIST TRXP	Hz		est 1-2	
Number of HARQ Processes					3	
	between PDSC	H and corresponding HARQ-			DD UL-DL pattern	
ACK information				and as defined	in Annex A.1.2	

Precodin	g configuration	SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity.			
Note 1:	ote 1: PDSCH transmission is done from both TRxPs (PDSCH Layer 0 is transmitted from TRxP #1 and PDSCH layer 1 is transmitted from TRxP #2)				

Table 5.2.3.2.11-3: Minimum performance

		Bandwidt		·		Correlation	Reference value				
Test num	Reference channel	h (MHz) / Subcarri er spacing (kHz)	Modulatio n format and code rate	TDD UL-DL patter n	Propagation condition(No te 1)	matrix and antenna configuration(N ote 2)	Fraction of maximum throughp ut (%)	SNR (dB)(Not e 3)			
1-1	R.PDSCH. 2-3.2 TDD	40 / 30	64QAM, 0.50	FR1.3 0-1	TDLA30-10	2x4, ULA Low	70	14.5			
1-2	R.PDSCH. 2-3.2 TDD	40 / 30	64QAM, 0.50	FR1.3 0-1	TDLA30-10	2x4, ULA Low	70	13.9			
	Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent										

Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent

Note 2: Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2

Note 3: SNR corresponds to SNR of TRxP #1 and TRxP #2 as defined in 4.4.2 with scaling factor as 1/sqrt(2) for transmitted signal from each TRxP

5.2.3.2.12 Minimum requirements for PDSCH Multi-DCI based transmission scheme

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

The test purposes are specified in Table 5.2.3.2.12-1.

Table 5.2.3.2.12-1: Tests purpose

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

Table 5.2.3.2.12-2: Test parameters

	D		Unit	Va	lue		
Parameter					TRxP #1(Note 1)	TRxP #2(Note 1)	
Transmit TRxP of SS	SB				TRx		
PDCCH configuration	n	TCI state			TCI State #1	TCI State #2	
- 2 con connigations	-	CORESETPoolIndex			0.		
		First subcarrier index in the PRB used for CSI-RS			k0=0 for CSI-RS	k0=1 for CSI-RS resources 5,6,7,8	
		FIVE 0360	1101 031-103		resources 1,2,3,4 10 = 6 for CSI-RS	10 = 6 for CSI-RS	
					resources 1 and 3	resources 5 and 7	
			M symbol in the PRB		10 = 10 for CSI-	10 = 10 for CSI-	
		used for C	SI-RS		RS resources 2	RS resources 6	
					and 4	and 8	
		Number o	f CSI-RS ports (X)		1 for CSI-RS	1 for CSI-RS	
CSI-RS for tracking		Number o	T COI-ING POITS (X)		resource 1,2,3,4	resource 5,6,7,8	
Correction tracking		CDM Type	е		'No CDM' for C		
					1,2,3,4		
		Density CSI-RS po	ariodicity	Slots	3		
		COI-IXO PI	enodicity	31013	20 for CSI-RS	20 for CSI-RS	
					resources 1 and 2	resources 5 and 6	
		CSI-RS of	ffset	Slots	21 for CSI-RS	21 for CSI-RS	
					resources 3 and 4		
		QCL info			TCI st		
Duplex mode					TC)D	
Active DL BWP index					1		
	Mapping t	уре				e A	
	k0				0		
	Starting sy				2		
	Length (L)				12 Static		
PDSCH	PRB bundling type						
configuration	PRB bundling size				7		
	Resource allocation type RBG size				Тур		
	VRB-to-PRB mapping type				Con Non-inte		
	VRB-to-PRB mapping interleaver bundle						
	size				N/	/A	
	Antenna port indexes				{1000,1001}	{1002,1003}	
	TCI state				TCI State #1	TCI State #2	
PDSCH DMRS	DMRS Ty				Тур	e 1	
configuration		f additional			1		
			OFDM symbols for				
	DL front loaded DMRS				001.00		
					CSI-RS resource 1 from 'CSI-RS		
	Type 1 QC		CSI-RS resource		for tracking'	N/A	
TCI State #1	information	n			configuration		
101 State #1			QCL Type		Type A	N/A	
	Type 2 QC	CL	CSI-RS resource		N/A	N/A	
	information		QCL Type		N/A	N/A	
						CSI-RS resource	
	Type 1 QC	2.1	CSI-RS resource		N/A	5 from 'CSI-RS	
	information		JOI NO TOUGHTOE		13//3	for tracking'	
TCI State #2	i iii oii ii da					configuration	
	Tura 0.00	N .	QCL Type		N/A	Type A	
	Type 2 QC information		CSI-RS resource QCL Type		N/A N/A	N/A N/A	
Resource allocation	I IIIIOIIIIaliO	11	WOL TYPE		Non-ove		
	Timing offset of the second TRxP from the first TRxP					25	
Frequency offset of the second TRxP from the first TRxP					30		
Number of HARQ Processes					8		
The number of slots between PDSCH and corresponding HARQ-					Specific to each T	DD UL-DL pattern	
ACK information					and as defined	in Annex A.1.2	
						endent precoding	
Precoding configurat	Precoding configuration					ed for both TRxPs,	
. 1000anig ooningalat					random per slot w	_	
					granı	ılarity	

Note 1: PDSCH transmission is done from both TRxPs. Transmission from TRxP #1 uses CORESETPoolIndex 0 and transmission from TRxP #2 uses CORESETPoolIndex 1

Table 5.2.3.2.12-3: Minimum performance

Test num.	Reference channel		Bandwid th (MHz) / Subcarri er spacing (kHz)	Modulatio n format and code rate	TDD UL-DL pattern	Propaga tion conditio n(Note 1)	Correlation matrix and antenna configurati on(Note 2)	Reference Fraction of maximu m through put (%)	SNR (dB)(N ote 3)	
	TRxP #1	TRxP #2								
1-1	R.PDSC H.2-3.3 TDD	R.PDSC H.2-3.4 TDD	40 / 30	64QAM, 0.50	FR1.30 -1	TDLA30- 10	2x4, ULA Low	70	14. 6	
Note 1:	The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent									
Note 2:		Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2								
Note 3:	SNR corr	responds to S	SNR of TRxP	#1 and TRxP	#2 as defi	ned in 4.4.2				

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

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

The test purposes are specified in Table 5.2.3.2.13-1.

Table 5.2.3.2.13-1: Tests purpose

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

Table 5.2.3.1.13-2: Test parameters

Transmit TRxP of SSB PDCCH configuration	First su PRB us First Of used fo	EETPoolIndex bcarrier index in the ed for CSI-RS FDM symbol in the PRB r CSI-RS		TRxP #1 (Note 1) TRx TCI St Not cor k0=0 for CSI-RS resources 1,2,3,4 l0 = 6 for CSI-RS resources 1 and 3	P #1 ate #1 ifigured k0=1 for CSI-RS resources 5,6,7,8
PDCCH configuration	First Of used fo	ETPoolIndex bcarrier index in the ed for CSI-RS FDM symbol in the PRB		TCI St Not cor k0=0 for CSI-RS resources 1,2,3,4 I0 = 6 for CSI-RS	ate #1 figured k0=1 for CSI-RS resources 5,6,7,8
	First Of used fo	ETPoolIndex bcarrier index in the ed for CSI-RS FDM symbol in the PRB		Not cor k0=0 for CSI-RS resources 1,2,3,4 I0 = 6 for CSI-RS	figured k0=1 for CSI-RS resources 5,6,7,8
	First su PRB us First Of used fo	bcarrier index in the ed for CSI-RS FDM symbol in the PRB		k0=0 for CSI-RS resources 1,2,3,4 I0 = 6 for CSI-RS	k0=1 for CSI-RS resources 5,6,7,8
	PRB us First Of used fo	ed for CSI-RS FDM symbol in the PRB		resources 1,2,3,4 I0 = 6 for CSI-RS	resources 5,6,7,8
	First Of used fo	FDM symbol in the PRB		I0 = 6 for CSI-RS	
	used fo				10 = 6 for CSI-RS
	used fo			i igoualded i dilu 3	resources 5 and 7
		1 CSI-RS		10 = 10 for CSI-	10 = 10 for CSI-
	Numbe			RS resources 2	RS resources 6
	Numbe			and 4	and 8
		r of CSI-RS ports (X)		1 for CSI-RS	1 for CSI-RS
CSI-RS for tracking		1 (/		resource 1,2,3,4	resource 5,6,7,8 SI-RS resource
	CDM T	/pe		1,2,3,4	
	Density			1,2,0,4	
		periodicity	Slots	4	
		,		20 for CSI-RS	20 for CSI-RS
	CSI-RS	offoot	Slots	resources 1 and 2	resources 5 and 6
	Col-No	Oliset	31015	21 for CSI-RS	21 for CSI-RS
					resources 7 and 8
D l	QCL inf	0		TCI st	
Duplex mode Active DL BWP index				IL.	DD I
	Mapping type			· ·	e A
	(0			(
<u> </u>	Starting symbol (S)				<u>2</u>
	Length (L)			12	
PDSCH	PRB bundling type			Static	
configuration	PRB bundling size			wideband	
<u> </u>	Resource allocation type				e 0
	RBG size				fig2
	VRB-to-PRB mapp			Non-inte	erleaved
	v RB-to-PRB mapp size	RB mapping interleaver bundle		N/	/A
	Antenna port index	es		1000, 1001	1000, 1001
	TCI state			TCI State #1	TCI State #2
	DMRS Type			Тур	e 1
	Number of addition			1	
		of OFDM symbols for		1	1
L	DL front loaded DM	IRS		001 00	
				CSI-RS resource 1 from 'CSI-RS	
	Type 1 QCL	CSI-RS resource		for tracking'	N/A
TCI State #1	nformation			configuration	
		QCL Type		Type A	N/A
	Type 2 QCL	CSI-RS resource		N/A	N/A
ļ i	nformation	QCL Type		N/A	N/A
					CSI-RS resource
7	Type 1 QCL	CSI-RS resource		N/A	5 from 'CSI-RS for tracking'
	nformation				configuration
1 Of Oldie #2		QCL Type		N/A	Type A
	Type 2 QCL	CSI-RS resource		N/A	N/A
i	nformation	QCL Type		N/A	N/A
Timing offset of the sec			us		25
Frequency offset of the		the first TRxP	Hz	30	
Number of HARQ Proce		" !!! 50		0 : :: - t b T	
	The number of slots between PDSCH and corresponding HARQ-ACK information				DD UL-DL pattern
ACK IIIIOIIIIaliOff					in Annex A.1.2 endent precoding
.				generation is appli	
Precoding configuration	1			random per slot v	
				granu	
Note 1: PDSCH trans	<u>smission is done fr</u>	om both TRxPs			

Table 5.2.3.2.13-3: Minimum performance for Rank 2

Test num.	Reference channel	Bandwidth (MHz) / Subcarrier spacing	Modulation format and code rate	TDD UL-DL pattern	Propagation condition (Note 1)	Correlation matrix and antenna configuration	Reference Fraction of maximum	SNR (dB)
		(kHz)	code rate	pattern	(Note 1)	(Note 2)	throughput (%)	(Note 3)
1-1	R.PDSCH.2- 2.5 TDD	40 / 30	16QAM, 0.54	FR1.30- 1	TDLA30-10	2x4, ULA Low	70	10.5
Note 1	Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent.							
Note 2: Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2.								
Note 3	: SNR corresp	onds to SNR o	of TRxP #1 and	TRxP #2 a	as defined in 4.4	.2		

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

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

The test purposes are specified in Table 5.2.3.2.14-1.

Table 5.2.3.2.14-1: Tests purpose

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

Table 5.2.3.2.14-2: Test parameters

	Param	eter		Unit	Value		
					TRxP #1 (Note 1) TRxP #2 (Note 1)		
Transmit TRxP of SS					TRx		
PDCCH configuration		TCI state				ate #1	
J			TPoolIndex			nfigured	
		First subcarrier index in the PRB used for CSI-RS			k0=0 for CSI-RS	k0=1 for CSI-RS	
	-	PRD used	1 101 CSI-KS		resources 1,2,3,4 I0 = 6 for CSI-RS	resources 5,6,7,8 10 = 6 for CSI-RS	
					resources 1 and 3	resources 5 and 7	
			M symbol in the PRB		10 = 10 for CSI-	10 = 10 for CSI-	
		used for C	CSI-RS		RS resources 2	RS resources 6	
					and 4	and 8	
		Numbero	f CCL DC north (V)		1 for CSI-RS	1 for CSI-RS	
CSI-RS for tracking		Number o	f CSI-RS ports (X)		resource 1,2,3,4		
CSI-RS for tracking		CDM Type	Δ			SI-RS resource	
						,5,6,7,8	
		Density				3	
	_	CSI-RS p	eriodicity	Slots	-	0	
					20 for CSI-RS	20 for CSI-RS	
		CSI-RS of	ffset	Slots	resources 1 and 2	resources 5 and 6 21 for CSI-RS	
					21 for CSI-RS	resources 7 and 8	
	-	QCL info				ate #0	
Duplex mode		QOL IIIIO				DD	
Active DL BWP index	X					1	
7.10.1.10.2.2.2.1.1.1.1.0.2.	Mapping typ	oe .			Tvp	e A	
	k0	-)	
	Starting symbol (S)				2	2	
	Length (L)				12		
	Repetition number				2	2	
PDSCH	PRB bundling type				Static		
configuration	PRB bundling size					2	
	Resource allocation type					oe 0	
		RBG size				nfig2	
		/RB-to-PRB mapping type			Non-interleaved		
		B mapping	g interleaver bundle		N	/A	
	size	ort indoved					
	TCI state	port indexes			1000 TCI State #1	1000 TCI State #2	
PDSCH DMRS	DMRS Type	2			Typ		
configuration	Number of a		DMRS			1	
Johngaration		number of OFDM symbols for					
	DL front loa				·	1	
					CSI-RS resource		
	Type 1 001		CSI-RS resource		1 from 'CSI-RS	N/A	
	Type 1 QCL information	_	COI-NO TESUUICE		for tracking'	IN/A	
TCI State #1	IIIOIIIIalioII				configuration		
			QCL Type		Type A	N/A	
	Type 2 QCL	-	CSI-RS resource		N/A	N/A	
	information		QCL Type		N/A	N/A	
						CSI-RS resource 5 from 'CSI-RS	
	Type 1 QCL	_	CSI-RS resource		N/A	for tracking'	
TCI State #2	information					configuration	
101 Glate #2			QCL Type	1	N/A	Type A	
	Type 2 QCL		CSI-RS resource		N/A	N/A	
	information		QCL Type		N/A	N/A	
Timing offset of the s	Timing offset of the second TRxP from the first TRxP				,	1	
Frequency offset of the second TRxP from the first TRxP				Hz	30	00	
Number of HARQ Processes						4	
	between PDS	CH and c	orresponding HARQ-			DD UL-DL pattern	
ACK information						nnex A.1.2 (Note 2)	
						endent precoding	
Precoding configurat	tion					ed for both TRxPs,	
					Table	vith PRB bundling	
				i	ı yıanı	ılarity.	

Note 1: PDSCH transmission is done	from both TRxPs
------------------------------------	-----------------

Note 2: ACK/NACK feedback is generated for PDSCH on slot i, where mod(i,10) = {2, 4, 6}.

Table 5.2.3.2.14-3: Minimum performance for Rank 1

		Bandwidth			Madulation TDD III Drangation		TDD III Proposition		dulation TDD III Brown ration		Correlation	Reference	value
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	TDD UL- DL pattern	Propagation condition (Note 1)	matrix and antenna configuration (Note 2)	BLER (%)	SNR (dB) (Note 4)					
1-1	R.PDSCH.2- 16.2 TDD	40 / 30	16QAM, 0.54	FR1.30-1	TDLA30-10	2x4, ULA Low	1 (Note 3)	-0.5					
Note 2 Note 3	Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent. Note 2: Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2. Note 3: BLER is defined as residual BLER; i.e. ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block.												
Note 4	 SNR corresp 	onds to SNR	of TRxP #1 and	d TRxP #2 as	s defined in 4.4.2	2							

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

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

The test purposes are specified in Table 5.2.3.2.15-1.

Table 5.2.3.2.15-1: Tests purpose

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

Table 5.2.3.2.15-2: Test parameters

	Parameter	Unit	Value			
Duplex mode			TDD			
Active DL BWP inde	ex		1			
DL transmission mo	del		As specified in B.5			
Downlink Model	SSB Q factor		8			
Parameters	Downlink transmission duration values	Slots	{2,4,6,7}			
	Occupied OFDM symbols in slot other than the last slot of the downlink duration	Symbols	14			
	Occupied OFDM symbols in the last slot of the downlink duration	Symbols	{6,9,12,14} (Note 1)			
	Downlink period	ms	5			
	LBT failure probability (plbt)		0.25			
PDSCH	Mapping type		Type A			
configuration	k0		0			
	Starting symbol (S)		2			
	PDSCH aggregation factor		1			
	PRB bundling type		Static			
	PRB bundling size		2			
	Resource allocation type		Type 0			
	RBG size		Config2			
	VRB-to-PRB mapping type		Non-interleaved			
	VRB-to-PRB mapping interleaver bundle size		N/A			
PDSCH DMRS	DMRS Type		Type 1			
configuration	dmrs-AdditionalPosition		pos1			
-	Maximum number of OFDM symbols for DL front loaded DMRS		1			
Number of HARQ P	rocesses		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			
Note 1: If DL Transmission duration is 2 Slot, the occupied OFDM symbols in the last slot of the downlink duration is						

14.

Table 5.2.3.2.15-3: Minimum performance for Rank 2

		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.1- 18.1 TDD	20 / 30	16QAM, 0.48	FR1.30-7	TDLA30-10	2x4, ULA Low	70	[8.8]
1-2	R.PDSCH.1- 18.2 TDD	40 / 30	16QAM, 0.48	FR1.30-7	TDLA30-10	2x4, ULA Low	70	[8.8]
1-3	R.PDSCH.1- 18.3 TDD	60 / 30	16QAM, 0.48	FR1.30-7	TDLA30-10	2x4, ULA Low	70	[9.0]
1-4	R.PDSCH.1- 18.4 TDD	80 / 30	16QAM, 0.48	FR1.30-7	TDLA30-10	2x4, ULA Low	70	[9.2]

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	Unit	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
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	rocesses		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	1	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 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

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)	
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

Donahui déla	Deference	Modulation	Duamanation	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

B	Reference Modulation		D	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 number	er 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 Co					
4	FDD 15 kHz + TDD 15 kHz	As defined in Table 5.2A.2.1-1 and Table 5.2A.2.1-2 per CC					
5	TDD 15 kHz + TDD 30 kHz	As defined in Table 5.2A.2.1-2 and Table 5.2A.2.1-3 per CC					
Note 1: The applicability of requirements for different CA duplex modes, SCSs, CA configurations and bandwidth							
co	combination sets is defined in 5.1.1.5.						

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

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

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

Table 5.2A.2.2-1: Tests purpose

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

Table 5.2A.2.2-2: Test parameters

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

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

Test Number	Bandwidth (MHz)		Reference	e channel	Power at port (d		Referent Fraction of Through	f Maximum
	PCell	SCell	PCell	SCell	\hat{E}_{s_PCell} for PCell	\hat{E}_{s_SCell} for Scell	PCell	SCell
1	bandwid	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

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

Test Number	Bandwidth (MHz)		Reference	channel	Power at port (d		Referen Fraction of Through	
	PCell	SCell	PCell	SCell	\hat{E}_{s_PCell}	\hat{E}_{s_SCell}	PCell	SCell
					for PCell	for Scell		
1	bandwid	Channel of the as per of 5.1.1.6	Derived as per section 5.1.3.2 of TS 38.214 [12]	NA	-112	-106	85	NA

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

The performance requirements for SCell on band with shared spectrum access are specified in Table 5.2.2.2.15-3, with the additional test parameters for SCell in Table 5.2.2.2.15-2, the test parameters for PCell in Table 5.2.2.2.3-2 and the downlink physical channel setup according to Annex C.3.1.

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

Table 5.2A.2.3-1: Tests purpose

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

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

	Parameter	Unit	Value
Duplex mode			TDD
Bandwidth		MHz	20
Subcarrier spacing		kHz	30
Active DL BWP index	(1
PDSCH	Mapping type		Type A
configuration			
	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		N/A
	size		
PDSCH DMRS	DMRS Type		Type 1
configuration			
	Dmrs-AdditionalPosition		pos1
	Maximum number of OFDM symbols for		1
	DL front loaded DMRS		
CSI-RS for tracking	First OFDM symbol in the PRB used for CSI-RS		Table 5.2-1
	CSI-RS periodicity	Slots	Table 5.2-1
	CSI-RS offset	Slots	Table 5.2-1
	Frequency Occupation		Table 5.2-1
Number of HARQ Processes			8
The number of slots I	petween PDSCH and corresponding HARQ-	_	Specific to each TDD UL-DL pattern
ACK information			and as defined in Annex A.1.2

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

D I W.	Rendwidth Reference Modulation Properties		D	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

D	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. 1.181	D. C.	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 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	Hz + TDD 30 kHz As defined in Table 5.2A.3.1-2 and Table 5.2A.3.1-3 per CC				
Note 1: The applicability of requirements for different CA duplex modes, SCSs, CA configurations and bandwidth						
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 intra-band adjacent carrier	
aggregation UE to demodulate the signal transmitted by	
the PCell or SCell in the presence of a stronger SCell or	
PCell signal on an adjacent frequency. Throughput is	
measured on the PCell or SCell only	

Table 5.2A.3.2-2: Test parameters

Parameter			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	rate		64QAM, MCS 27
Number of HARQ Pr	ocesses		FDD: 4 TDD: 8
Maximum number of	HARQ transmission		1
Redundancy version	coding sequence		{0}
TDD UL-DL pattern			30kHz SCS: FR1.30-1
The number of slots 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 determination			0
SSB transmission			Slot#0 with periodicity 20ms
RB assignment			Full applicable test bandwidth as defined in Table 5.3.5-1 of TS 38.101-1 [6]

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

Test Number			Reference	channel		antenna Bm/Hz)	Fraction of	ce value f Maximum nput (%)
	PCell	SCell	PCell	SCell	\hat{E}_{s_PCell} for PCell	\hat{E}_{s_SCell} for Scell	PCell	SCell
1	bandwid	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

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

Test Number	Bandwi	dth (MHz)	Reference	channel	Power at port (d		Fraction of	ce value f Maximum hput (%)
	PCell	SCell	PCell	SCell	\hat{E}_{s_PCell}	\hat{E}_{s_SCell}	PCell	SCell
					for PCell	for Scell		
1	bandwid	Channel of the as per of 5.1.1.6	Derived as per section 5.1.3.2 of TS 38.214 [12]	NA	-112	-106	85	NA

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

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

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

Table 5.2A.3.3-1: Tests purpose

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

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

Parameter			Value
Duplex mode			TDD
Bandwidth		MHz	20
Subcarrier spacing		kHz	30
Active DL BWP index	(1
PDSCH	Mapping type		Type A
configuration			
	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		N/A
	size		
PDSCH DMRS	DMRS Type		Type 1
configuration			
	Dmrs-AdditionalPosition		pos1
	Maximum number of OFDM symbols for		1
	DL front loaded DMRS		
CSI-RS for tracking	First OFDM symbol in the PRB used for CSI-RS		Table 5.2-1
	CSI-RS periodicity	Slots	Table 5.2-1
	CSI-RS offset	Slots	Table 5.2-1
	Frequency Occupation		Table 5.2-1
Number of HARQ Processes			8
	petween PDSCH and corresponding HARQ-		Specific to each TDD UL-DL pattern
ACK information			and as defined in Annex A.1.2

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	Offset between	een Point A and the		0
configuration		le subcarrier on this		
	carrier (Note	,		
DL BWP	Cyclic prefix		- DD	Normal
configuration #1	RB offset	II ID	RBs	0
Common	Physical Ce			0
serving cell parameters	SSB position SSB periodi		ms	20
parameters		CCH monitoring	1113	Each slot
		PDCCH candidates		1
PDCCH				Start from RB = 0
configuration		domain resource r CORESET		with contiguous RB
		TOOKLOLI		allocation
	TCI state			TCI state #1
	used for CS	rier index in the PRB I-RS (k_0)		0
				CSI-RS resource 1:
				CSI-RS resource 2:
	First OFDM	symbol in the PRB		8
	used for CS	I-K5 (10)		CSI-RS resource 3:
				CSI-RS resource 4: 8
		CSI-RS ports (X)		1
	CDM Type			No CDM
	Density (ρ)			3
CSI-RS for	CSI-RS peri	odicity	Slots	15 kHz SCS: 20 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 =
				ceil(BWP size /4)*4
	QCL info			TCI state #0
	Type 1	SSB index		SSB #0
TCI state #0	QCL information	QCL Type		Type C
101 State #U	Type 2	SSB index		SSB #0
	QCL information	QCL Type		Type D
				CSI-RS resource 1
	Type 1	CSI-RS resource		from 'CSI-RS for
	QCL information			tracking' configuration
	Inionnation	QCL Type		Type A
TCI state #1				CSI-RS resource 1
	Type 2	CSI-RS resource		from 'CSI-RS for
	QCL	COI-IVO IESUUICE		tracking'
	information	001.7		configuration
		QCL Type	<u> </u>	Type D

	Single Panel Type I,
	Random precoder
	selection updated
	per slot, with equal
	probability of each
PDCCH & PDCCH DMRS Precoding configuration	applicable i ₁ , i ₂
	combination with
	REG bundling
	granularity for
	number of Tx larger
	than 1
Physical signals, channels mapping and precoding	As specified in
1 Trysteal signals, charmers mapping and precoding	Annex B.4.1
	OP.1 FDD as
	defined in Annex
Symbols for all unused REs	A.5.1.1
Symbols for all dridsed INES	OP.1 TDD as
	defined in Annex
	A.5.2.1
	2 for FDD.
	For TDD, specific to
The number of slots between PDSCH and	each TDD UL-DL
corresponding HARQ-ACK information	pattern and as
	defined in Annex
	A.1.2.
Note 1: Point A coincides with minimum guard band	as specified in Table 5.3.3-1
from TS 38 101-1 [6] for tested channel hand	width 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				

5.3.2.1.3 Minimum requirements for power saving

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

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

Table 5.3.2.1.3-1: Test Parameters

Parameter		Unit	1 Tx Antenna
CCE to REG mapping type			nonInterleaved
REG bundle size			6
Shift Index			0
DRX cycle		ms	10
ps-WakeUp-r16			absent
Wake-up indication bit in DCI format 2_	_6		1
	PS-offset		$(T_{minimumTimeGap} + 1)/2^{\mu}/0.125$
	Number of PDCCH candidates		1
PDCCH DCI format 2_6 configuration	Frequency domain resource allocation for CORESET		Start from RB = 0 with contiguous RB allocation
	TCI state		TCI state #1
PDCCH configuration	Slots for PDCCH monitoring	Fach slot during D	
Note: T _{minimumTimeGap} is signaled as	a part of drx-Adaptation-r1	6 UE car	pability.

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

Table 5.3.2.1.3-2: Minimum performance for PDCCH with 15 kHz SCS

		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	48	2	4	R.PDCCH.	TDLA30-10	1x2 Low	1	[5.5]
					1-2.4 FDD				
			2	8	R.PDCCH.				
					1-2.7 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. 2-1.1 TDD	TDLA30-10	1x2 Low	1	7.0
2	40	102	1	4	R.PDCCH. 2-1.2 TDD	TDLC300- 100	1x2 Low	1	3.0
3	40	48	2	16	R.PDCCH. 2-2.1 TDD	TDLC300- 100	1x2 Low	1	-3.8

5.3.2.2.2 2 Tx Antenna performances

For the parameters specified in Table 5.3.2.2-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 5.3.2.2.2-1. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.3.2.2.2-1: Minimum performance for PDCCH with 30 kHz SCS

			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-	2x2 Low	1	-1.2
					2-1.3 TDD	100			

5.3.2.2.3 Minimum requirements for power saving

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

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

Table 5.3.2.2.3-1: Test Parameters

Parameter		Unit	1 Tx Antenna		
TDD UL-DL pattern			FR1.30-1		
CCE to REG mapping type	CCE to REG mapping type				
Interleaver size		3			
REG bundle size			2		
Shift Index		0			
DRX cycle	ms	10			
ps-WakeUp-r16		absent			
Wake-up indication bit in DCI format 2_		1			
	PS-offset		$(T_{minimumTimeGap}+1)/2^{\mu}/0.125$		
	Number of PDCCH candidates		1		
PDCCH DCI format 2_6 configuration	Frequency domain resource allocation for CORESET		Start from RB = 0 with contiguous RB allocation		
	TCI state		TCI state #1		
PDCCH configuration	Slots for PDCCH monitoring		Each slot during DRX-on period		
Note: TminimumTimeGap is signaled as	a part of drx-Adaptation-r	16 UE ca	pability.		

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

Table 5.3.2.2.3-2: Minimum performance with 30 kHz SCS

		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)
4	40	400	4	4	R.PDCCH. 2-1.2 TDD	TDLC300-	4.40.1	4	2.0
1	40	102	1	8	R.PDCCH. 2-1.4 TDD	100	1x2 Low	1	3.0

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

5.3.3.1.2 2 Tx Antenna performances

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

Table 5.3.3.1.2-1: Minimum performance for PDCCH with 15 kHz SCS

			CORES	_{=S} 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					

5.3.3.1.3 Minimum requirements for power saving

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

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

Table 5.3.3.1.3-1: Test Parameters

Parameter		Unit	1 Tx Antenna
CCE to REG mapping type			nonInterleaved
REG bundle size			6
Shift Index			0
DRX cycle		ms	10
ps-WakeUp-r16			absent
Wake-up indication bit in DCI format 2_	6		1
	PS-offset		$(T_{minimumTimeGap} + 1)/2^{\mu}/0.125$
	Number of PDCCH candidates		1
PDCCH DCI format 2_6 configuration	Frequency domain resource allocation for CORESET		Start from RB = 0 with contiguous RB allocation
	TCI state		TCI state #1
Slots for PDCCH monitoring			Each slot during DRX-on period
Note: T _{minimumTimeGap} is signaled as	a part of <i>drx-Adaptation-r1</i>	6 UE cap	pability.

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

Table 5.3.3.1.3-2: Minimum performance for PDCCH with 15 kHz SCS

			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	48	2	4	R.PDCCH.	TDLA30-10	1x4 Low	1	0.2
					1-2.4 FDD				
			2	8	R.PDCCH.				
					1-2.7 FDD				

5.3.3.2 TDD

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

Table 5.3.3.2-1: Common Test Parameters

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

5.3.3.2.1 1 Tx Antenna performances

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

Table 5.3.3.2.1-1: Minimum performance for PDCCH with 30 kHz SCS

		CORE SET RB	CORES ET duratio n	Aggregati on level	Reference Channel		Antenna	Reference value	
Test numbe r	Bandw idth (MHz)					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			

5.3.3.2.3 Minimum requirements for power saving

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

For the parameters specified in Table 5.3.3.2.3-1, the average probability of a missed downlink scheduling grant (Pmdsg) observed on PDCCH during DRX on shall be below the specified value in Table 5.3.3.2.3-2. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.3.3.2.3-1: Test Parameters

Parameter		Unit	1 Tx Antenna
TDD UL-DL pattern			FR1.30-1
CCE to REG mapping type			interleaved
Interleaver size			3
REG bundle size			2
Shift Index			0
DRX cycle		ms	10
ps-WakeUp-r16		absent	
Wake-up indication bit in DCI format 2_		1	
	PS-offset		$(T_{minimumTimeGap}+1)/2^{\mu}/0.125$
	Number of PDCCH candidates		1
PDCCH DCI format 2_6 configuration	Frequency domain resource allocation for CORESET		Start from RB = 0 with contiguous RB allocation
	TCI state		TCI state #1
Slots for PDCCH monitoring			Each slot during DRX-on period
Note: T _{minimumTimeGap} is signaled as	a part of drx-Adaptation-r1	6 UE cap	pability.

Table 5.3.3.2.3-2: Minimum performance with 30 kHz SCS

			CORES				Antenna configurat ion and correlatio n Matrix	Reference value	
Test numbe r	Bandw idth (MHz)	CORE SET RB	ET duratio n	Aggregati on level	Reference Channel	Propagation Condition		Pm-dsg (%)	SNR (dB)
	40	102	4	4	R.PDCCH. 2-1.2 TDD	TDLC300- 100	1x4 Low	1	-0.9
1			1	8	R.PDCCH. 2-1.4 TDD				

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

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

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).

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

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

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

Test number	Bandwidth (MHz) / Subcarrier spacing	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	dB	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 PRB bundling size		Static
configuration	Resource allocation type		wideband Type 0
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle		N/A
	size DMRS Type		Type 1
	Number of additional DMRS		1 1 1
	Length		1
PDSCH DMRS configuration	Antenna ports indexes		{1000} for 1 Layer CCs {1000, 1001} for 2 Layers CCs {1000 – 1003} for 4 Layers CCs
	Number of PDSCH DMRS CDM group(s) without data		1 for 1 layer and 2 layers CCs 2 for 4 Layers CCs
PTRS configuration			PTRS is not configured
	Subcarrier indexes in the PRB used for CSI-RS		k ₀ = 3 for CSI-RS resource 1,2,3,4
CSI-RS for tracking	OFDM symbols in the PRB used for CSI-RS		$l_0 = 6$ for CSI-RS resource 1 and 3 $l_0 = 10$ for CSI-RS resource 2 and 4
	Number of CSI-RS ports (X)		1 for CSI-RS resource 1,2,3,4
		•	

	CDM Typo			'No CDM' for CSI-RS resource 1,2,3,4
	CDM Type Density (ρ)			3 for CSI-RS resource 1,2,3,4
	neugity (b)			15 kHz SCS: 20 for CSI-RS resource
	CSI-RS period	dicity	Slots	1,2,3,4 30 kHz SCS: 40 for CSI-RS resource 1,2,3,4
				15 kHz SCS: 10 for CSI-RS resource 1 and 2
	CSI-RS offset	:	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 = ceil(BWP size /4)*4
	QCL info			TCI state #0
	CSI-RS	dexes in the PRB used for		k ₀ = 4
	RS	ols in the PRB used for CSI-		I ₀ = 12
		SI-RS ports (X)		Same as number of transmit antenna
NZP CSI-RS for	CDM Type		ļ	'FD-CDM2'
CSI acquisition	Density (ρ)			1
2 2 2 3 4 4 3 3 1	CSI-RS perio	-		15 kHz SCS: 20 30 kHz SCS: 40
	CSI-RS offset	t		0
	Frequency Od	ccupation		Start PRB 0 Number of PRB = ceil(BWP size /4)*4
	QCL info			TCI state #1
		dexes in the PRB used for		k ₀ = 0
		ols in the PRB used for CSI-		I ₀ = 12
		SI-RS ports (X)		4
ZP CSI-RS for CSI	CDM Type	1		'FD-CDM2'
acquisition	Density (ρ)			1
	CSI-RS perio	dicity		15 kHz SCS: 20 30 kHz SCS: 40
	CSI-RS offset	!		0
	Frequency Oc			Start PRB 0 Number of PRB = ceil(BWP size/4)*4
	Type 1 QCL	SSB index		SSB #0
TOI -1-1 "0	information	QCL Type		Type C
TCI state #0	Type 2 QCL	SSB index		N/A
	information	QCL Type		N/A
	Type 1 QCL	CSI-RS resource		CSI-RS resource 1 from 'CSI-RS for tracking' configuration
TCI state #1	information	QCL Type		Type A
	Type 2 QCL	CSI-RS resource		N/A
	information	QCL Type		N/A
Maximum number of Maximum number of		ups for ACK/NACK feedback		1 4
		JOIUI I		4 Multiplexed
HARQ ACK/NACK bundling Redundancy version coding sequence			+	(0,2,3,1)
TOGGINGATION VEISION	Journa Schuell	 		Single Panel Type I, Random precoder
PDSCH & PDSCH DMRS Precoding configuration				selection updated per slot, with equal probability of each applicable i ₁ , i ₂ combination with PRB bundling
Symbols for all unused REs				granularity OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1
Propagation condition	า			Static propagation condition No external noise sources are applied
A .	1 layer CCs			1x2 or 1x4
Antenna	2 layers CCs			2x2 or 2x4
configuration	4 layers CCs			4x4
	•			

Physical	signals, channels mapping and precoding		As specified in Annex B.4.1
Note 1:	UE assumes that the TCI state for the PDSCH is identicated	I to the TO	CI state applied for the PDCCH
transmission			
Note 2:	Point A coincides with minimum guard band as specified	in Table 5	5.3.3-1 from TS 38.101-1 [6] for tested
	channel bandwidth and subcarrier spacing		

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

	Parameter	Unit	Value
Duplex mode			FDD
PDSCH	Starting symbol (S)		1
configuration Length (L)			13
Number of HARQ Processes			4
K1 value			2

Table 5.5A-3: Additional test parameters for TDD CC

	Parameter	Unit	Value
Duplex mode			TDD
PDSCH	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	TDD III DI		15 kHz SCS: FR1.15-1
TDD UL-DL pattern			30 kHz SCS: FR1.30-1
Note 1: PDSCI	H is scheduled only on full DL slots		

Table 5.5A-4: Number of PRBs in CORESET

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

Table 5.5A-5: MCS indexes for indicated UE capabilities

Maximum number of PDSCH MIMO layers	Maximum modulation format	Scaling factor	MCS
1	8	1	26
1	8	0.8	21
1	8	0.75	20
1	8	0.4	11
1	6	1	27
1	6	0.8	23
1	6	0.75	22
1	6	0.4	14
1	4	1	16
1	4	0.8	16
1	4	0.75	16
1	4	0.4	10
1	2	1	9
1	2	0.8	9
1	2	0.75	9
1	2	0.4	4
2	8	1	26
2	8	0.8	21
2	8	0.75	20
2	8	0.4	11
2	6	1	27
2	6	0.8	23
2	6	0.75	22
2	6	0.4	14
2	4	1	16
2	4	0.8	16
	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] except for test cases listed in Clause 6.2.2.2.1.4, Clause 6.2.3.2.1.4, Clause 6.2.A.3.1.2 and Clause 6.2.A.4.1.2 which are only applicable for FR1 bands restricted to operation with shared spectrum.

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

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

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

Table 6.1.1.2-1: Requirements applicability

6.1.1.3 Applicability of requirements for optional UE features

The performance requirements in Table 6.1.1.3-1 shall apply for UEs which support optional UE features with capability signalling only.

Table 6.1.1.3-1: Requirements applicability for optional features with UE capability signalling

UE feature/capability [14]	Test	type	Test list	Applicability notes
CQI table with target BLER of	FR1 FDD	CQI	Clause 6.2.2.1.1.2 Clause 6.2.3.1.1.2	
10^-5New CQI table (cqi- TableAlt)	FR1 TDD	CQI	Clause 6.2.2.2.1.2 Clause 6.2.3.2.1.2	
Alternative 64QAM MCS table for PDSCH New 64QAM MCS	FR1 FDD	CQI	Clause 6.2.2.1.1.2 Clause 6.2.3.1.1.2	
table for PDSCH (dl-64QAM- MCS-TableAlt)	FR1 TDD	CQI	Clause 6.2.2.2.1.2 Clause 6.2.3.2.1.2	
Validating P/SP-CSI-RS reception (periodicAndSemi-PersistentCSI-RS-r16)	FR1 TDD	CQI	Clause 6.2.2.2.1.4 Clause 6.2.3.2.1.4 Clause 6.2A.3.1.2 Clause 6.2A.4.1.1	The requirements apply only in case tested UE supporting operations in shared spectrum access and validation of P/SP-CSI-RS reception based on DCI
Supported UL channels for dynamic channel access mode (ul-DynamicChAccess-r16) or UL channel access for semistatic channel access mode (ul-Semi-StaticChAccess-r16) or both	FR1 TDD	CQI	Clause 6.2.2.2.1.4 Clause 6.2.3.2.1.4	The requirements apply only in case tested UE supports one of UL channels for dynamic channel access mode and UL channel access for semi-static channel access mode

The performance requirements in Table 6.1.1.3-2 shall apply for UEs which support optional UE features only.

Table 6.1.1.3-2: Requirements applicability for optional UE features

UE feature/capability [14]	Test	type	Test list	Applicability notes
Support of Type II codebook	FR1 FDD	PMI	Clause 6.3.2.1.5	
(CodebookParameters contains type2,			Clause 6.3.3.1.5	
supportedCSI-RS-ResourceList,	FR1 TDD	PMI	Clause 6.3.2.2.5	
parameterLx, amplitudeScalingType,			Clause 6.3.3.2.5	
amplitudeSubsetRestriction)				
Support of Enhanced Type II codebook	FR1 FDD	PMI	Clause 6.3.2.1.6	
with at least 16 ports per CSI-RS			Clause 6.3.3.1.6	
resource(codebookParametersAddition-	FR1 TDD	PMI	Cluase 6.3.2.2.6	
r16 contains etype2R1-r16,			Cluase 6.3.3.2.6	
supportedCSI-RS-ResourceListAdd-r16,				
maxNumberTxPortsPerResource)				

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 the
		RI	Clause 6.4.2.1	PDSCH MIMO rank in
			Clause 6.4.3.1	the test case does not
Supported maximum number of PDSCH MIMO layers (maxNumberMIMO-	FR1 TDD	CQI	Clause 6.2.3.2.1.1	exceed UE PDSCH MIMO layers capability
LayersPDSCH)		PMI	Clause 6.3.3.2.2	
		RI	Clause 6.4.2.2	
	ED / EDD	514	Clause 6.4.3.2	
Supported maximum number of	FR1 FDD	PMI	Clause 6.3.2.1.1	The requirements
ports across all configured NZP- CSI-RS resources per CC			Clause 6.3.2.1.2 Clause 6.3.2.1.3	apply only in case the number of NZP-CSI-
(maxConfigNumberPortsAcross			Clause 6.3.2.1.4	RS ports in the test
NZP-CSI-RS-PerCC)			Clause 6.3.2.1.4	case satisfies UE
1121 00111010100)			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)	

6.1.1.5 Applicability of Channel Quality Indicator (CQI) reporting requirements for CA

6.1.1.5.1 Applicability and test rules for different duplex modes and SCS combinations

The applicability and test rules for different duplex modes and SCS combinations are defined in Table 6.1.1.5.1-1.

Table 6.1.1.5.1-1: Applicability for different duplex modes and SCS combinations

Tests	PCell CC configuration	
Test 1 in Clause	TDD CC if supported, otherwise FDD CC	
6.2A.3.1.1	• •	
Test 2 in Clause		
6.2A.3.1.1	Any of CCs	
(NOTE 2)		
Test 3 in Clause	Any of CCo	
6.2A.3.1.1	Any of CCs	
NOTE 1: The tes	st coverage can be considered fulfilled if UE passes one of	
	as PCell in Test 1.	
NOTE 2: These	scenarios are only tested for UEs which are not verified with	
Test 1 i	n Clause 6.2A.3.1.1.	

6.1.1.5.2 Applicability and test rules for different CA configurations and bandwidth combination sets

The performance requirement for CA CQI tests in clause 6.2A are defined independent of CA configurations and bandwidth combination sets specified in clasue 5.5A in TS 38.101-1 [6].

For UEs supporting multiple CA capabilities, test any one of the supported CA capabilities with largest aggregated CA bandwidth combination. The categorization of CA capability is specified in clasue 5.1.1.7.1.

For UEs supporting multiple CA configurations from the selected CA capability, test any one of the supported CA configurations with largest aggregated CA bandwidth combination. For simplicity, the CA configuration refers to combination of CA configuration and bandwidth combination set.

A single uplink CC is configured for all tests.

6.1.1.5.3 Test coverage for different number of componenet carriers

For CA CQI tests specified in clause 6.2A, among all supported CA capabilities, if corresponding CA tests with the largest number of CCs supported by the UE are tested, the test coverage can be considered fulfilled without executing the CA tests with less than the largest number of CCs supported by the UE.

6.1.1.5.4 Applicability rule and antenna connection for CA tests with 4 RX

All the requirements specified in clause 6.2A for CA with 2 RX are applied for 4 RX capable UEs by connecting all 4 RX with data source from system simulator and reducing the signal power density by 3 dB compared to the signal power density for 2 RX in the test configurations.

6.1.2 Common test parameters

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

Table 6.1.2-1: Test parameters for CSI test cases

	Parameter	Unit	Value
PDSCH transmis	ssion scheme		Transmission
1 BOOT transmit			scheme 1
Actual carrier configuration	Offset between Point A and the lowest usable subcarrier on this carrier (Note 3)	RBs	0
	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
Additional PDCCH	Slots for PDCCH monitoring		Each slot
Configuration for Aperiodic	Symbols with PDCCH Number of PDCCH candidates and aggregation levels		0,1 1/AL8
Reporting	DCI format		0_1
(Note 4)	TCI state		TCI state #1
	PDCCH & PDCCH DMRS Precoding configuration		Multi-path fading propagation conditions: Single Panel Type I, Random per slot with equal probability of each applicable i1, i2 combination, and with REG bundling granularity for number of Tx larger than 1
Active DL BWP			1
Common	Physical Cell ID		0 First CCR in Clot #0
serving cell parameters	SSB position in burst SSB periodicity	ma	First SSB in Slot #0 20
parameters	Slots for PDCCH monitoring	ms	Each slot
	Symbols with PDCCH		0,1
PDCCH	Number of PDCCH candidates		
configuration	and aggregation levels		1/AL8
	DCI format		1_1
	TCI state		TCI state #1
Cross carrier sch	neduling		Not configured
	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		12
PDSCH	PDSCH aggregation factor		1
configuration	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		type 0
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A

	PDCCH & PDCCH DMRS Precoding configuration		Multi-path fading propagation conditions: Single Panel Type I, Random per slot with equal probability of each applicable i1, i2 combination, and with REG bundling granularity for number of Tx larger than 1 Static propagation
	DMRS Type		conditions: Single Panel Type I, Random precoder chosen from precoder index 0 an 2, selection updated per slot Type 1
	Number of additional DMRS		1
	Maximum number of OFDM symbols for DL front loaded DMRS		1
PDSCH DMRS configuration	DMRS ports indexes		{1000} for Rank1 {1000,1001} for Rank2 {1000,1001,1002} for Rank3 {1000,1001,1002,100 3} for Rank4
	Number of PDSCH DMRS CDM group(s) without data		2
PTRS	Frequency density (K _{PT-RS})		N/A
configuration	Time density (L _{PT-RS})		N/A
	First subcarrier index in the PRB used for CSI-RS (k_0)		0 for CSI-RS resource 1,2,3,4
	First OFDM symbol in the PRB used for CSI-RS (<i>lo</i>)		4 for CSI-RS resource 1 and 3 8 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	slot	15 kHz SCS: 20 for CSI-RS resource 1,2,3,4 30 kHz SCS: 40 for CSI-RS resource
	CSI-RS offset	slot	15 kHz SCS: 10 for CSI-RS resource 1 and 2 11 for CSI-RS resource 3 and 4 30 kHz SCS: 20 for CSI-RS resource 1 and 2 21 for CSI-RS resource 3 and 4
	Frequency Occupation		Start PRB 0 Number of PRB = ceil(BWP size /4)*4

QCL info TCl state #0				
	QOL IIIIO		Start PRB 0	
NZP CSI-RS for	Frequency Occupation		Number of PRB =	
CSI acquisition		·	ceil(BWP size /4)*4	
	QCL info		TCI state #1	
ZP CSI-RS for			Start PRB 0	
CSI acquisition	Frequency O	ccupation	Number of PRB =	
- Cor acquicition			ceil(BWP size /4)*4	
	Type 1 QCL information	SSB index	SSB #0	
TCI state #0	mormation	QCL Type	Type C	
TOI State #0	Type 2 QCL	SSB index	N/A	
	information	QCL Type	N/A	
			CSI-RS resource 1	
	Type 1 QCL	CSI-RS resource	from 'CSI-RS for	
	information	COI-ING Tesource	tracking'	
TCI state #1			configuration	
l or otato	T 000	QCL Type	Type A	
	Type 2 QCL	CSI-RS resource	N/A	
	information	QCL Type	N/A	
Number of HARC) Processes		4 For FDD	
HADO ACK/NAC	I/ bundling		8 for TDD	
HARQ ACK/NAC Redundancy vers		uonoo	Multiplexed {0,2,3,1}	
Redundancy vers	sion couling sequ	uerice	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	
K1 value			0~19	
(PDSCH-to-HAR	Q-timing-indicat	tor)	For FR1.30-7:	
			8 if mod(i,10) = 0	
			7 if mod(i,10) = 1	
			6 if $mod(i,10) = 2$	
			5 if mod(i,10) = 3	
			4 if mod(i,10) = 4	
			3 if $mod(i,10) = 5$	
			2 if mod(i,10) = 6	
			Where i is the slot	
			index of all slots in	
			every 5ms i = {0,,9} OP.1 FDD as defined	
			in Annex A.5.1.1	
Symbols for unus	ed REs		OP.1 TDD as defined	
			in Annex A.5.2.1	
			As specified in Annex	
Physical signals,	channels mapp	ing and precoding	B.4.1	
Note 1: PDSC	H is not schedu	led on slots containing CSI	-RS or slots which are not full	
DL.		_		
Note 2: LIE assumes that the TCI state for the PDSCH is identical to the TCI state				

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 38.101-1 [6] for tested channel bandwidth and subcarrier spacing. Additional PDCCH configuration for aperiodic reporting is only for test cases with aperiodic CSI reporting configured. Note 4:

6.2 Reporting of Channel Quality Indicator (CQI)

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

6.2.1 1RX requirements

(Void)

6.2.2 2RX requirements

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

6.2.2.1 FDD

6.2.2.1.1 CQI reporting definition under AWGN conditions

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

6.2.2.1.1.1 Minimum requirement for periodic CQI reporting

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

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

Table 6.2.2.1.1.1-1: CQI reporting definition test

Parameter		Unit	Te	est 1	Te	st 2	
Bandwidth		MHz		10			
Duplex Mode			FDD				
Subcarrier spacing		kHz		15			
SNR		dB	8	9	14	15	
Propagation channel				AW			
Antenna configuration			2x2 with static channel specified in Annex B.1				
Beamforming Mod	del		As	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		
comiguration	used for CSI-RS (k ₀)			NOW	J, 4		
	First OFDM symbol in the PRB used			9			
	for CSI-RS (I ₀)			3			
	CSI-RS	slot		5/	1		
	periodicity and offset	3101					
	CSI-RS resource Type			Perio	odic		
	Number of CSI-RS ports (X)			2			
	CDM Type			FD-CI	DM2		
NZP CSI-RS for CSI acquisition	Density (ρ)			1			
	First subcarrier index in the PRB			Row 3	(6 -)		
OOI doquioition	used for CSI-RS (k ₀ , k ₁)			10W 3	,(0,-)		
	First OFDM symbol in the PRB used			13	3		
	for CSI-RS (I ₀)				,		
	NZP CSI-RS-timeConfig	slot		5/	1		
	periodicity and offset	0.01					
	CSI-IM resource Type			Perio			
	CSI-IM RE pattern			0			
CSI-IM	CSI-IM Resource Mapping			(4,	9)		
configuration	(kcsi-im, lcsi-im)						
	CSI-IM timeConfig	slot		5/	1		
Donort ConfigType	periodicity and offset			Perio	ndi o		
ReportConfigType CQI-table				Tabl			
				cri-RI-PI			
reportQuantity	rChannelMeasurements			Not con			
	rInterferenceMeasurements			Not con			
				Widek			
cqi-FormatIndicate pmi-FormatIndicate				Widek			
	toi	RB		8			
Sub-band Size		KD		1111			
Csi-ReportingBand CSI-Report periodicity and offset		slot		5/0			
aperiodicTriggeringOffset		SIOL		Not con			
Codebook configuration	Codebook Type			typel-Sing			
	Codebook Type Codebook Mode			typer-Siriç 1	JICI AIICI		
	(Codebook Mode (CodebookConfig-						
	N1,CodebookConfig-N2)			Not con	figured		
	CodebookSubsetRestriction			0100	000		
	RI Restriction			N/2			
Physical channel for CSI report				PUC			
CQI/RI/PMI delay		ms		8			
Maximum number of HARQ transmission		1110		1			
Measurement channel			As sne	cified in Tal	ole A 4-2	TBS 2-	
			, 10 Spe	2		, 150.2	
		l	1				

6.2.2.1.1.2 Minimum requirement for periodic CQI reporting with Table 3

For the parameters specified in Table 6.2.2.1.1.2-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) The reported CQI value according to the reference channel shall be in the range of ± 1 of the reported median more than 90% of the time.
- b) If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 10⁻⁵, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 10⁻⁵. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 10⁻⁵, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 10⁻⁵.
- c) The reported CQI value according to the reference channel shall be ≥ 1 .

Table 6.2.2.1.1.2-1: CQI reporting test parameters

Parameter		Unit	Test 1	
Bandwidth		MHz	10	
Duplex Mode			FDD	
Subcarrier spacing		kHz	15	
SNR		dB	1 2	
Propagation channel			AWGN	
Antenna configuration			1x2 with static channel specified in Annex B.1	
Beamforming Mod	del		As specified in Annex B.4.1	
	CSI-RS resource Type		Periodic	
	Number of CSI-RS ports (X)		4	
	CDM Type		FD-CDM2	
	Density (p)		1	
ZP CSI-RS	First subcarrier index in the PRB		-	
configuration	used for CSI-RS (k ₀)		Row 5,4	
Comiguration	First OFDM symbol in the PRB used for CSI-RS (I ₀)		9	
	CSI-RS periodicity and offset	slot	5/1	
	CSI-RS resource Type		Periodic	
	Number of CSI-RS ports (X)		1	
NZP CSI-RS for CSI acquisition	CDM Type		No CDM	
	Density (ρ)		3	
	First subcarrier index in the PRB			
	used for CSI-RS (k ₀ , k ₁)		Row 1,(0,-)	
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		13	
	NZP CSI-RS-timeConfig periodicity and offset	slot	5/1	
	CSI-IM resource Type		Periodic	
	CSI-IM RE pattern		0	
CSI-IM	CSI-IM Resource Mapping			
configuration	(kcsi-im, lcsi-im)		(4, 9)	
comigaration	CSI-IM timeConfig		_,,	
	periodicity and offset	slot	5/1	
ReportConfigType			Periodic	
CQI-table			Table 3	
reportQuantity			cri-RI-PMI-CQI	
	rChannelMeasurements		Not configured	
	rInterferenceMeasurements		Not configured	
cqi-FormatIndicator			Wideband	
pmi-FormatIndicator			Wideband	
Sub-band Size		RB	8	
Csi-ReportingBand			111111	
CSI-Report periodicity and offset		slot	5/0	
aperiodicTriggeringOffset			Not configured	
aponouio i i ggoini	Codebook Type		typel-SinglePanel	
	Codebook Mode		1	
Codebook	(CodebookConfig-		Not an C	
configuration	N1,CodebookConfig-N2)		Not configured	
ū	CodebookSubsetRestriction		000001	
	RI Restriction		N/A	

Physical channel for CSI report		PUCCH
CQI/RI/PMI delay	ms	8
Maximum number of HARQ transmission		1
Measurement channel		As specified in Table A.4-4, TBS.4-1

6.2.2.1.2 CQI reporting under fading conditions

6.2.2.1.2.1 Minimum requirement for wideband CQI reporting

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

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

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

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

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

	Parameter	Unit	Test 1	Test 2
Bandwidth			1	0
Subcarrier spacing	g	kHz	1	5
Duplex Mode	-		FDD	
SNR		dB	6 7	12 13
Propagation chan	nel		TDLA	A30-5
Antenna configura				×2
Correlation config				high
Beamforming Mod				n Annex B.4.1
- C	CSI-RS resource Type			iodic
	Number of CSI-RS ports (X)		4	4
	CDM Type		FD-C	DM2
ZP CSI-RS	Density (ρ)			1
	First subcarrier index in the PRB		D	. 5. 4
configuration	used for CSI-RS (k ₀)		Row	v 5,4
	First OFDM symbol in the PRB used		,	<u> </u>
	for CSI-RS (I ₀)		`	9
	CSI-RS	slot	5	/1
	periodicity and offset	SIOL	3)	/ I
	CSI-RS resource Type		Peri	iodic
	Number of CSI-RS ports (X)		2	2
	CDM Type		FD-C	DM2
NZP CSI-RS for	Density (ρ)		•	1
CSI acquisition	First subcarrier index in the PRB		Dow !	2 (6)
CSI acquisition	used for CSI-RS (k ₀ , k ₁)		Kow .	3,(6,-)
	First OFDM symbol in the PRB used		1	2
	for CSI-RS (I ₀)		13	
	NZP CSI-RS-timeConfig	slot	5/1	
	periodicity and offset	SIOL	3/1	
	CSI-IM resource Type		Peri	iodic
	CSI-IM RE pattern		0	
CSI-IM	CSI-IM Resource Mapping			
configuration	(kcsi-im,lcsi-im)		(4, 9)	
J				
	CSI-IM timeConfig	slot	5,	/1
D + O + C T	periodicity and offset		D- ni	1: -
ReportConfigType	,			odic
CQI-table				ole 2
reportQuantity	rChannelMeasurements			PMI-CQI
				nfigured
	rInterferenceMeasurements			nfigured
cqi-Formatindicate				band
pmi-FormatIndicat	OF	DD		eband
Sub-band Size	-1	RB		8
Csi-ReportingBan		-1-4		1111
CSI-Report period		slot		/0
aperiodicTriggerin				nfigured
	Codebook Type			iglePanel
Cadaba-li	Codebook Mode			1
Codebook	(CodebookConfig-		Not cor	nfigured
configuration	N1,CodebookConfig-N2) CodebookSubsetRestriction			
			000001 N/A	
Dhygiaal altaur 15	RI Restriction			
Physical channel t	ior CSI report			CCH
CQI/RI/PMI delay	of LIADO transprincia	ms		8
iviaximum number	of HARQ transmission			1
Measurement cha	nnel			able A.4-2, TBS.2-
		<u> </u>	1	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 α % of the time but less than β % of the time for each sub-band, where α and β are specified in Table 6.2.2.1.2.2-2;
- b) The ratio of the throughput obtained when transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level and that obtained when transmitting the transport format indicated by the reported wideband CQI median on a randomly selected sub-band among all the sub-bands shall be $\geq \gamma$, where γ is specified in Table 6.2.2.1.2.2-2;
- c) When transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level, the average BLER for the indicated transport format shall be greater than or equal to 0.02.

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

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

Parameter		Unit	Test 1	Test 2	
Bandwidth		MHz	10		
Subcarrier spacing		kHz	1:	5	
Duplex Mode			FD	D	
SNR	SNR		8 9	14 15	
Propagation chan			Two tap model specified in Anne. B.2.4 with $a=1$, $f_D=5$ Hz, and $\tau_d=0.45\mu s$		
Antenna configura	ation		2×	2	
Correlation config			As per Ar		
Beamforming Mod			As specified in		
	CSI-RS resource Type		Perio		
	Number of CSI-RS ports (X)		4		
	CDM Type Density (ρ)		FD-C		
ZP CSI-RS configuration	First subcarrier index in the PRB used for CSI-RS (k ₀)		Row		
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		9		
	CSI-RS periodicity and offset	slot	5/	1	
	CSI-RS resource Type		Perio	odic	
	Number of CSI-RS ports (X)		2		
	CDM Type		FD-C	DM2	
NZP CSI-RS for	Density (ρ)		1		
CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁)		Row 3	3,(6,-)	
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		13		
	NZP CSI-RS-timeConfig periodicity and offset	slot	5/		
	CSI-IM resource Type		Perio		
	CSI-IM RE pattern		0		
CSI-IM configuration	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(4,	9)	
	CSI-IM timeConfig periodicity and offset	slot	ot 5/1		
ReportConfigType	9		Aperi		
CQI-table			Tabl		
reportQuantity			cri-RI-P		
	rChannelMeasurements		Not con		
cgi-FormatIndicate	rInterferenceMeasurements		Not con Subb		
pmi-FormatIndicat			Widel		
Sub-band Size	ioi	RB	8		
csi-ReportingBand	b		1111		
CSI-Report period		slot	Not con		
Aperiodic Report			5		
CSI request	·		1 in slots i, wher otherwise it i		
reportTriggerSize			1		
CSI-AperiodicTriggerStateList			One State with on Report Corrections and Associated Report contains a point or the state of the	nfiguration ort Configuration	
aperiodicTriggeringOffset			contains pointers and C Not con	SI-IM	
apenouic mggenr	Codebook Type		typel-Sing		
	Codebook Type Codebook Mode		typei-oing	giei aiiti	
Codebook	(Codebook Config-		<u>'</u>		
configuration	N1,CodebookConfig-N2)		Not con	figured	
3-1-1-3-1-3-1-3-1-3-1-3-1-3-1-3-1-3-1-3	CodebookSubsetRestriction		000001		
	RI Restriction		N/		
Physical channel	for CSI report		PUS		
CQI/RI/PMI delay		ms	8		

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

Table 6.2.2.1.2.2-2: Minimum requirements

Parameters	Test 1	Test 2
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 ± 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	g	kHz	30
Duplex Mode	Duplex Mode		TDD
TDD UL-DL patter	rn		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 used for CSI-RS (k ₀)		Row 5,4
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		9
	CSI-RS periodicity and offset	slot	10/1
	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (X)		2
	CDM Type		FD-CDM2
NZD COLDC for	Density (ρ)		1
NZP CSI-RS for	First subcarrier index in the PRB		Daw 2 (C.)
CSI acquisition	used for CSI-RS (k ₀ , k ₁)		Row 3,(6,-)
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		13
	NZP CSI-RS-timeConfig periodicity and offset	slot	10/1
	CSI-IM resource Type		Periodic
	CSI-IM RE pattern		0
CSI-IM	CSI-IM Resource Mapping		
configuration	(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
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			Not configured
	Codebook Type		typel-SinglePanel
	Codebook Mode		1
Codebook configuration	(CodebookConfig- N1,CodebookConfig-N2)		Not configured
	CodebookSubsetRestriction		010000
	RI Restriction		N/A
Physical channel			PUCCH
CQI/RI/PMI delay		ms	9.5
Maximum number	r of HARQ transmission		1
Measurement cha	annel		As specified in Table A.4-2, TBS.2-

6.2.2.2.1.2 Minimum requirement for periodic CQI reporting with Table 3

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 6.2.2.2.1.2-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) The reported CQI value according to the reference channel shall be in the range of ± 1 of the reported median more than 90% of the time.
- b) If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 10⁻⁵, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 10⁻⁵. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 10⁻⁵, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 10⁻⁵.
- c) The reported CQI value according to the reference channel shall be ≥ 1 .

Table 6.2.2.2.1.2-1: CQI reporting test parameters

	Parameter	Unit	Test 1
Bandwidth	Bandwidth		40
Subcarrier spacin	Subcarrier spacing		30
Duplex Mode	-		TDD
TDD UL-DL patte	rn		FR1.30-1
SNR		dB	1 2
Propagation chan	nel		AWGN
Antenna configura	ation		1x2 with static channel specified in Annex B.1
Beamforming Mod	del		As specified in Annex B.4.1
	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (X)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
ZP CSI-RS configuration	First subcarrier index in the PRB used for CSI-RS (k ₀)		Row 5,4
_	First OFDM symbol in the PRB used for CSI-RS (I ₀)		9
	CSI-RS periodicity and offset	slot	10/1
	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (X)		1
	CDM Type		No CDM
	Density (ρ)		3
NZP CSI-RS for CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁)		Row 1,(0,-)
·	First OFDM symbol in the PRB used for CSI-RS (I ₀)		1
	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 3
reportQuantity			cri-RI-PMI-CQI
timeRestrictionFor	ChannelMeasurements		Not configured
timeRestrictionFor	InterferenceMeasurements		Not configured
cqi-FormatIndicato	or		Wideband
pmi-FormatIndicat	or		Wideband
Sub-band Size		RB	16
Csi-ReportingBand	d		1111111
CSI-Report period	icity and offset	slot	10/9
aperiodicTriggerin	aperiodicTriggeringOffset		Not configured
	Codebook Type		typel-SinglePanel
	Codebook Mode		1
Codebook configuration	(CodebookConfig- N1,CodebookConfig-N2)		Not configured
	CodebookSubsetRestriction		000001
	RI Restriction		N/A
Physical channel for CSI report			PUCCH
CQI/RI/PMI delay		ms	9.5
Maximum number of HARQ transmission			1
Measurement channel			As specified in Table A.4-4, TBS.4-2

6.2.2.2.1.3 Minimum requirement for CQI reporting for PCell on band with shared spectrum access

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] for PCell on band with shared spectrum access. For each Downlink Transmission Duration the transmission power offset is randomly chosen between [0, +6] dB and 2 sets of CQI reports are obtained for each transmission power offset. The reporting accuracy of CQI under AWGN condition is determined by the reporting variance and BLER performance using the transport format indicated by the reported CQI median for each power offset. 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 6.2.2.2.1.3-1, and using the downlink physical channels specified in Annex A.4, the minimum requirements are specified by the following:

- a) For each transmission power offset the reported CQI value according to the reference channel shall be in the range of ± 1 of the reported median more than 90% of the time.
- b) For each transmission power offset, 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. For each transmission power offset, 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.
- c) The absolute difference in median CQI for each of transmission power offset shall be ≥ 2 .

Table 6.2.2.2.1.3-1: CQI reporting test parameters for PCell on band with shared spectrum access

	Parameter	Unit	Test 1
Bandwidth		MHz	20
Subcarrier spacing		kHz	30
Duplex Mode			TDD
Downlink Trans			As specified in Annex B.5
	Downlink period	ms	5
	LBT failure probability (plbt)		0.25
Downlink	Downlink transmission duration values set	slot	{4,6,7}
Transmission	Occupied OFDM symbols in slot other		14
Model Parameters	than the last slot of the downlink	symbol	14
1 didiliotois	duration		
	Occupied OFDM symbols in the last	symbol	14
TDD III DI	slot set of the downlink duration	-,	FD4 00 7
TDD UL-DL pat	tern	-ID	FR1.30-7
SNR		dB	8 9
$\widehat{E_s}$ for power off		dBm/Hz	-112
$\widehat{E_s}$ for power off		dBm/Hz	-106
Propagation ch	annel		AWGN
Antenna config	uration		2x2 with static channel specified in Annex B.1
Beamforming M	lodel		As specified in Annex B.4.1
Boarmonning iv	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		Row 5,4
ZP CSI-RS	used for CSI-RS (k ₀)		
configuration	First OFDM symbol in the PRB used for CSI-RS (I ₀)		9
	CSI-RS	slot	Not configured
	interval and offset	SIUL	-
	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)		2
	CDM Type		FD-CDM2
	Density (ρ)		1
N7D 001 D0 4-	First subcarrior index in the DDB		D 0 (0)
NZP CSI-RS fo CSI acquisition	used for CSI-RS (k ₀ , k ₁)		Row 3,(6,-)
Coi acquisition	First OFDM symbol in the PRB used		3
	for CSI-RS (I ₀)		<u> </u>
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggeringOffset	slot	0
	CSI-IM resource Type	2.0.	Aperiodic
	CSI-IM RE pattern		0
CSI-IM	CSI-IM Resource Mapping		-
configuration	(kcsi-im,lcsi-im)		(4, 9)
	CSI-IM timeConfig	slot	Not configured
	interval and offset		

ReportConfigType			Aperiodic
CQI-table			Table 2
reportQuantity			cri-RI-PMI-CQI
timeRestrictionFo	rChannelMeasurements		configured
timeRestrictionFo	rInterferenceMeasurements		configured
cqi-FormatIndicat	or		Wideband
pmi-FormatIndica	tor		Wideband
Sub-band Size		RB	8
csi-ReportingBan			1111111
CSI-Report interv	al and offset	slot	Not configured
Aperiodic Report	Slot Offset		7
CSI request			1 in slots i, where mod(i, 10) = 1,
			otherwise it is equal to 0
reportTriggrtSize			1
CSI-AperiodicTrig	ggerStateList		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-		Not configured
configuration	N1,CodebookConfig-N2)		Not configured
	CodebookSubsetRestriction		010000
RI Restriction			N/A
Physical channel	Physical channel for CSI report		PUSCH
CQI/RI/PMI delay	CQI/RI/PMI delay		9.5
Maximum numbe	Maximum number of HARQ transmission		1
Measurement cha	Measurement channel		As specified in Table A.4-2, TBS.2-8

6.2.2.2.2 CQI reporting under fading conditions

6.2.2.2.2.1 Minimum requirement for wideband CQI reporting

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

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

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

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

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

Parameter		Unit	Test 1 Test 2		st 2		
Bandwidth	andwidth			40			
Subcarrier spacin	kHz	30					
Duplex Mode				TD			
TDD UL-DL pattern				FR1.	30-1		
SNR		dB	6	7	12	13	
Propagation chan				TDLA	30-5		
Antenna configura				2×			
Correlation config			ULA high As specified in Annex B.4.1				
Beamforming Mod	•		As			3.4.1	
	CSI-RS resource Type Number of CSI-RS ports (X)		Periodic 4				
	. ,			FD-C			
	CDM Type Density (ρ)			<u> </u>	DIVIZ		
ZP CSI-RS	First subcarrier index in the PRB				<u> </u>		
configuration	used for CSI-RS (k₀)			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			Peri	odic		
	Number of CSI-RS ports (X)			2			
	CDM Type			FD-C	DM2		
NZP CSI-RS for	Density (ρ)			1			
CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁)		Row 3,(6,-)				
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		13				
	NZP CSI-RS-timeConfig periodicity and offset	slot	10/1				
	CSI-IM resource Type	Periodic		odic			
	CSI-IM RE pattern						
CCLIM	CSI-IM Resource Mapping						
CSI-IM configuration	(kcsi-im,lcsi-im)		(4, 9)				
	CSI-IM timeConfig periodicity and offset	slot	10/1				
ReportConfigType			Periodic				
CQI-table	,		Table 2				
reportQuantity				cri-RI-P			
	rChannelMeasurements			Not con			
	rInterferenceMeasurements			Not con			
cqi-FormatIndicate	or			Wide			
pmi-FormatIndica	tor			Wide	band		
Sub-band Size		RB		1	6		
Csi-ReportingBan			<u> </u>	1111			
CSI-Report period		slot		10			
aperiodicTriggerin				Not con			
	Codebook Type		1	typeI-Sin			
	Codebook Mode		1				
Codebook (CodebookConfig- configuration N1,CodebookConfig-N2)		Not configured					
	CodebookSubsetRestriction		<u> </u>	000			
	RI Restriction			N/			
Physical channel	for CSI report		1	PUC			
CQI/RI/PMI delay	(11450)	ms	1	9.			
Maximum number	of HARQ transmission		1	<u> 1</u>		TD 0 =	
Measurement cha	nnel		As spe	cified in Ta		, IBS.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 α and β are specified in Table 6.2.2.2.2.2;
- b) The ratio of the throughput obtained when transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level and that obtained when transmitting the transport format indicated by the reported wideband CQI median on a randomly selected sub-band among all the sub-bands shall be $\geq \gamma$, where γ is specified in Table 6.2.2.2.2.2;
- c) When transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level, the average BLER for the indicated transport format shall be greater than or equal to 0.02.

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

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

	Parameter	Unit	Test 1 Test 2	
Bandwidth		MHz	40	
Subcarrier spacing		kHz	30	
Duplex Mode			TDD	
TDD UL-DL patte	rn		FR1.30-1	
SNR		dB	8 9 14 15	
Propagation chan	nel		Two tap model specified in Annex B.2.4 with $a=1$, $f_D=5$ Hz, and $\tau_d=0.1125\mu s$	
Antenna configura	ation		2×2	
Correlation config			As per Annex B.1	
Beamforming Mod	del		As specified in Annex B.4.1	
	CSI-RS resource Type		Periodic	
	Number of CSI-RS ports (X)		4	
	CDM Type		FD-CDM2	
7D CCL DC	Density (ρ)		1	
ZP CSI-RS configuration	First subcarrier index in the PRB used for CSI-RS (k ₀)		Row 5,4	
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		9	
	CSI-RS periodicity and offset	slot	10/1	
	CSI-RS resource Type		Periodic	
	Number of CSI-RS ports (X)	-	2	
	CDM Type		FD-CDM2	
NZP CSI-RS for	Density (ρ)		1	
CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁)		Row 3,(6,-)	
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		13	
	NZP CSI-RS-timeConfig periodicity and offset	slot	10/1	
	CSI-IM resource Type		Periodic	
	CSI-IM RE pattern		0	
CSI-IM configuration	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(4, 9)	
	CSI-IM timeConfig periodicity and offset	slot	10/1	
ReportConfigType	9		Aperiodic	
CQI-table			Table 2	
reportQuantity			cri-RI-PMI-CQI	
	rChannelMeasurements		Not configured	
timeRestrictionFo	rInterferenceMeasurements		Not configured	
cqi-FormatIndicat	or		Subband	
pmi-FormatIndica	tor		Wideband	
Sub-band Size		RB	16	
csi-ReportingBan			1111111	
CSI-Report period		slot	Not configured	
Aperiodic Report Slot Offset				
Aponodio Nepolt	Slot Offset		8	
CSI request			8 1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0	
•			1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0	
CSI request			1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0 1 One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS	
CSI request reportTriggerSize CSI-AperiodicTrig	gerStateList		1 in slots i, where mod(i, 10) = 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 request reportTriggerSize	ggerStateList ngOffset		1 in slots i, where mod(i, 10) = 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	
CSI request reportTriggerSize CSI-AperiodicTrig	ngOffset Codebook Type		1 in slots i, where mod(i, 10) = 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 request reportTriggerSize CSI-AperiodicTrig aperiodicTriggerir	ngOffset Codebook Type Codebook Mode		1 in slots i, where mod(i, 10) = 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 1	
CSI request reportTriggerSize CSI-AperiodicTrig aperiodicTriggerir Codebook	ngOffset Codebook Type Codebook Mode (CodebookConfig-		1 in slots i, where mod(i, 10) = 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	
CSI request reportTriggerSize CSI-AperiodicTrig aperiodicTriggerir	ngOffset Codebook Type Codebook Mode		1 in slots i, where mod(i, 10) = 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 1	
CSI request reportTriggerSize CSI-AperiodicTrig aperiodicTriggerir Codebook	ngOffset Codebook Type Codebook Mode (CodebookConfig-N1,CodebookConfig-N2)		1 in slots i, where mod(i, 10) = 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/RI/PMI delay	ms	9.5
Maximum number of HARQ transmission		1
Measurement channel		As specified in Table A.4-2, TBS.2-6

Table 6.2.2.2.2-2: Minimum requirements

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

6.2.3 4RX requirements

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

6.2.3.1 FDD

6.2.3.1.1 CQI reporting definition under AWGN conditions

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

6.2.3.1.1.1 Minimum requirement for period CQI reporting

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

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

Table 6.2.3.1.1.1-1: CQI reporting definition test

Parameter		Unit	Test 1	Test 2
Bandwidth	Bandwidth		10	
Subcarrier spacing	Subcarrier spacing		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-CDM2	
ZP CSI-RS	Density (ρ)		1	
configuration	First subcarrier index in the PRB used for CSI-RS (k ₀)		Row 5	5,4
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		9	
	CSI-RS periodicity and offset	slot	5/1	
	CSI-RS resource Type		Period	dic
	Number of CSI-RS ports (X)		2	
	CDM Type		FD-CD	M2
NZP CSI-RS for	Density (ρ)		1	
CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁)		Row 3,((6,-)
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		13	
	NZP CSI-RS-timeConfig periodicity and offset	slot	5/1	
	CSI-IM resource Type		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	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 CSI report			PUCC	Н
CQI/RI/PMI delay Maximum number of HARQ transmission		ms	8	
iviaximum number	OI MAKŲ TRANSTIIISSION		1	0 A 4 2 TDC 2
Measurement channel			As specified in Tabl	€ A.4-2, IBS.2-

6.2.3.1.1.2 Minimum requirement for period CQI reporting with Table 3

For the parameters specified in Table 6.2.3.1.1.2-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) The reported CQI value according to the reference channel shall be in the range of ± 1 of the reported median more than 90 % of the time.
- b) If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 10⁻⁵, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 10⁻⁵. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 10⁻⁵, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 10⁻⁵.
- c) The reported CQI value according to the reference channel shall be ≥ 1 .

Table 6.2.3.1.1.2-1: CQI reporting test parameters

<u> </u>	Parameter	Unit	Test 1
Bandwidth		MHz	10
Subcarrier spacin	q	kHz	15
Duplex Mode			FDD
SNR		dB	-2 -1
Propagation chan	nel	-	AWGN
Antenna configura			1x4 with static channel specified in Annex B.1
Beamforming Mod	401		As specified in Annex B.4.1
Dearmorning woo	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (X)		4
	CDM Type		FD-CDM2
	Density (p)		1 D-CDW2
ZP CSI-RS	First subcarrier index in the PRB		l l
configuration	used for CSI-RS (k ₀)		Row 5,4
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		9
	CSI-RS periodicity and offset	slot	5/1
	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (X)		1
	CDM Type		No CDM
	Density (ρ)		3
NZP CSI-RS for	First subcarrier index in the PRB		D 4 (0)
CSI acquisition	used for CSI-RS (k ₀ , k ₁)		Row 1,(0,-)
4	First OFDM symbol in the PRB used for CSI-RS (I ₀)		1
	NZP CSI-RS-timeConfig periodicity and offset	slot	5/1
	CSI-IM resource Type		Periodic
	CSI-IM RE pattern		0
	CSI-IM Resource Mapping		
CSI-IM configuration	(Kcsi-im,lcsi-im)		(4, 9)
	CSI-IM timeConfig periodicity and offset	slot	5/1
ReportConfigType			Periodic
CQI-table			Table 3
reportQuantity			cri-RI-PMI-CQI
timeRestrictionFo	rChannelMeasurements		Not configured
	rInterferenceMeasurements		Not configured
cgi-FormatIndicate			Wideband
pmi-FormatIndica	+		Wideband
Sub-band Size		RB	8
csi-ReportingBand		IND.	1111111
CSI-Report periodicity and offset		clot	5/0
aperiodicTriggerin		slot	Not configured
apenduic mygeni	Codebook Type		typel-SinglePanel
	Codebook Type Codebook Mode		typer-onlyleranei
Cadabask			
Codebook configuration	(CodebookConfig- N1,CodebookConfig-N2)		Not configured
	CodebookSubsetRestriction		000001
	RI Restriction		N/A

Physical channel for CSI report		PUCCH	
CQI/RI/PMI delay	ms	8	
Maximum number of HARQ transmission		1	
Measurement channel		As specified in Table A.4-4, TBS.4-1	

6.2.3.1.2 CQI reporting under fading conditions

6.2.3.1.2.1 Minimum requirement for wideband CQI reporting

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

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

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

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

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

Parameter		Unit	Test 1 Test 2
Bandwidth		MHz	10
Subcarrier spacin	g	kHz	15
Duplex Mode			FDD
SNR		dB	3 4 9 10
Propagation chan			TDLA30-5
Antenna configura	ation		2×4
Correlation config			XP High
Beamforming Mod	del		As specified in Annex B.4.1
	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (X)		4
	CDM Type		FD-CDM2
7D 001 D0	Density (ρ)		1
ZP CSI-RS	First subcarrier index in the PRB		
configuration	used for CSI-RS (k ₀)		Row 5,4
	First OFDM symbol in the PRB used		_
	for CSI-RS (I ₀)		9
	CSI-RS	_	
	periodicity and offset	slot	5/1
	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (X)		2
	CDM Type		FD-CDM2
	Density (p)		1 1
NZP CSI-RS for	First subcarrier index in the PRB		<u> </u>
CSI acquisition			Row 3,(6,-)
	used for CSI-RS (k ₀ , k ₁)		
	First OFDM symbol in the PRB used		13
	for CSI-RS (I ₀)		
	NZP CSI-RS-timeConfig	slot	5/1
	periodicity and offset		B : "
	CSI-IM resource Type		Periodic
	CSI-IM RE pattern		0
CSI-IM	CSI-IM Resource Mapping		(4.0)
configuration	(kcsi-im,lcsi-im)		(4, 9)
· ·	COLINAtion of Confirm		
	CSI-IM timeConfig	slot	5/1
D 10 " T	periodicity and offset		B : P
ReportConfigType	9		Periodic
CQI-table			Table 2
reportQuantity			cri-RI-PMI-CQI
	rChannelMeasurements		Not configured
	rInterferenceMeasurements		Not configured
cqi-FormatIndicat			Wideband
pmi-FormatIndica	tor		Wideband
Sub-band Size		RB	8
csi-ReportingBan			1111111
CSI-Report period	dicity and offset	slot	5/0
aperiodicTriggering	ngOffset		Not configured
	Codebook Type		typel-SinglePanel
	Codebook Mode		1
Codebook	(CodebookConfig-		N. C.
configuration	N1,CodebookConfig-N2)		Not configured
J	CodebookSubsetRestriction		000001
	RI Restriction		N/A
Physical channel for CSI report			PUCCH
CQI/RI/PMI delay		me	8
	r of HARQ transmission	ms	0 1
iviaxiiiiuiii nuiiibe	UI HARQ IIZHSHIISSION		=
Measurement channel			As specified in Table A.4-2, TBS.2-

Table 6.2.3.1.2.1-2: Minimum requirements

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

6.2.3.1.2.2 Minimum requirement for sub-band CQI reporting

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

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

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

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

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

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

	Parameter	Unit	Test 1 Test 2
Bandwidth	Bandwidth		10
Subcarrier spacing		MHz kHz	15
Duplex Mode			FDD
SNR		dB	5 6 11 12
			Two tap model specified in Annex
Propagation chan	nel		B.2.4 with $a=1$, $f_D = 5$ Hz, and
Antenna configura	ation		τ _d =0.45μs 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
ZP CSI-RS	Density (ρ)		1
configuration	First subcarrier index in the PRB		Row 5,4
	used for CSI-RS (k ₀)		,
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		9
	CSI-RS	_	
	periodicity and offset	slot	5/1
	CSI-RS resource Type		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 ₀ , k ₁) First OFDM symbol in the PRB used		
	for CSI-RS (I ₀)		13
	NZP CSI-RS-timeConfig		
	periodicity and offset	slot	5/1
	CSI-IM resource Type		Periodic
	CSI-IM RE pattern		0
CSI-IM	CSI-IM Resource Mapping		
configuration	(Kcsi-im,lcsi-im)		(4, 9)
	CSI-IM timeConfig		
	periodicity and offset	slot	5/1
ReportConfigType			Aperiodic
CQI-table			Table 2
reportQuantity			cri-RI-PMI-CQI
	rChannelMeasurements		Not configured
	rInterferenceMeasurements		Not configured
cqi-FormatIndicate			Subband
pmi-FormatIndica	tor	DD	Wideband
Sub-band Size		RB	8 1111111
csi-ReportingBand		slot	Not configured
Aperiodic Report		3101	5
	0.000		1 in slots i, where mod(i, 5) = 1,
CSI request			otherwise it is equal to 0
reportTriggerSize			1
			One State with one Associated
CCI Apprication	gorStatol ist		Report Configuration
Col-Aperiodic Frig	CSI-AperiodicTriggerStateList		Associated Report Configuration contains pointers to NZP CSI-RS
			and CSI-IM
aperiodicTriggeringOffset			Not configured
. 55	Codebook Type		typel-SinglePanel
	Codebook Mode		1
Codebook	(CodebookConfig-		Not configured
configuration	N1,CodebookConfig-N2)		<u> </u>
	CodebookSubsetRestriction		000001
Dhygiaal ahannal	RI Restriction Physical channel for CSI report		N/A PUSCH
	ioi osi repoit	me	8 8
CQI/RI/PMI delay		ms	U

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

Table 6.2.3.1.2.2-2: Minimum requirements

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

6.2.3.2 TDD

6.2.3.2.1 CQI reporting definition under AWGN

6.2.3.2.1.1 Minimum requirement for CQI periodic reporting

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

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

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

Table 6.2.3.2.1.1-1: CQI reporting definition test

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

6.2.3.2.1.2 Minimum requirement for CQI periodic reporting with Table 3

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 6.2.3.2.1.2-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) The reported CQI value according to the reference channel shall be in the range of ± 1 of the reported median more than 90% of the time.
- b) If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 10⁻⁵, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 10⁻⁵. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 10⁻⁵, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 10⁻⁵.
- c) The reported CQI value according to the reference channel shall be ≥ 1 .

Table 6.2.3.2.1.2-1: CQI reporting test parameters

Parameter		Unit	Test 1
Bandwidth		MHz	40
Subcarrier spacin	g	kHz	30
Duplex Mode			TDD
TDD UL-DL patte	rn		FR1.30-1
SNR		dB	-2 -1
Propagation chan	nel		AWGN
Antenna configura	ation		1x4 with static channel specified in Annex B.1
Beamforming Mod	del		As specified in Annex B.4.1
	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (X)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
ZP CSI-RS configuration	First subcarrier index in the PRB used for CSI-RS (k ₀)		Row 5,4
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		9
	CSI-RS periodicity and offset	slot	10/1
	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (X)		1
	CDM Type		No CDM
	Density (ρ)		3
NZP CSI-RS for			
CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁)		Row 1,(0,-)
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		1
	NZP CSI-RS-timeConfig periodicity and offset	slot	10/1
CSI-IM configuration	CSI-IM resource Type		Periodic
	CSI-IM RE pattern		0
	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(4, 9)
	CSI-IM timeConfig periodicity and offset	slot	10/1

ReportConfigType			Periodic
CQI-table			Table 3
reportQuantity			cri-RI-PMI-CQI
timeRestrictionFor	ChannelMeasurements		Not configured
timeRestrictionFor	InterferenceMeasurements		Not configured
cqi-FormatIndicato	or		Wideband
pmi-FormatIndicat	or		Wideband
Sub-band Size		RB	16
csi-ReportingBand	1		1111111
CSI-Report period	icity and offset	slot	10/9
aperiodicTriggerin	gOffset		Not configured
	Codebook Type		typel-SinglePanel
	Codebook Mode		1
Codebook configuration	(CodebookConfig- N1,CodebookConfig-N2)		Not configured
	CodebookSubsetRestriction		000001
	RI Restriction		N/A
Physical channel for CSI report			PUCCH
CQI/RI/PMI delay		ms	9.5
Maximum number	of HARQ transmission		1
Measurement channel			As specified in Table A.4-4, TBS.4-2

6.2.3.2.1.3 Minimum requirement for CQI reporting for PCell on band with shared spectrum access

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] for PCell on band with shared spectrum access. For each Downlink Transmission Duration the transmission power offset is randomly chosen between [0, +6] dB and 2 sets of CQI reports are obtained for each transmission power offset. The reporting accuracy of CQI under AWGN condition is determined by the reporting variance and BLER performance using the transport format indicated by the reported CQI median for each power offset. 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 6.2.3.2.1.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) For each transmission power offset the reported CQI value according to the reference channel shall be in the range of ± 1 of the reported median more than 90% of the time.
- b) For each transmission power offset, 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. For each transmission power offset, 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.
- c) The absolute difference in median CQI for each of transmission power offset shall be ≥ 2 .

Table 6.2.2.2.1.3-1: CQI reporting test parameters for PCell on band with shared spectrum access

	Parameter	Unit	Test 1
Bandwidth	Bandwidth		20
Subcarrier space	ring	kHz	30
Duplex Mode			TDD
Downlink Trans	Downlink Transmission Model		As specified in Annex B.5
	Downlink period		5
	LBT failure probability (plbt)		0.25
Downlink	Downlink transmission duration values set		{4,6,7}
Transmission Model Parameters	Occupied OFDM symbols in slot other than the last slot of the downlink duration		14
	Occupied OFDM symbols in the last slot set of the downlink duration		14
TDD UL-DL pat	tern		FR1.30-7
SNR		dB	5 6
$\widehat{E_s}$ for power off	set 1	dBm/Hz	-112
$\widehat{E_s}$ for power off		dBm/Hz	-106
Propagation ch			AWGN
Antenna config			2×4 with static channel specified in Annex B.1
Beamforming M	lodel		As specified in Annex B.4.1
<u> </u>	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (X)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
ZP CSI-RS	First subcarrier index in the PRB used for CSI-RS (k ₀)		Row 5,4
configuration	First OFDM symbol in the PRB used for CSI-RS (I ₀)		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		Periodic
	Number of CSI-RS ports (X)		2
	CDM Type		FD-CDM2
	Density (ρ)		1
NZP CSI-RS fo	First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁)		Row 3,(6,-)
CSI acquisition	First OFDM symbol in the PRB used for CSI-RS (I ₀)		3
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggeringOffset		0
	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		0
CSI-IM configuration	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(4, 9)
. 3	CSI-IM timeConfig interval and offset	slot	Not configured

ReportConfigType			Aperiodic
CQI-table			Table 2
reportQuantity			cri-RI-PMI-CQI
timeRestrictionFo	rChannelMeasurements		configured
timeRestrictionFo	rInterferenceMeasurements		configured
cqi-FormatIndicat			Wideband
pmi-FormatIndica	tor		Wideband
Sub-band Size		RB	8
csi-ReportingBan			1111111
CSI-Report interv		slot	Not configured
Aperiodic Report	Slot Offset		7
CSI request			1 in slots i, where $mod(i, 10) = 1$,
			otherwise it is equal to 0
reportTriggrtSize			1
CSI-AperiodicTrig	gerStateList		One State with one Associated
			Report Configuration
			Associated Report Configuration
			contains pointers to NZP CSI-RS
	T		and CSI-IM
	Codebook Type		typel-SinglePanel
	Codebook Mode		1
Codebook	(CodebookConfig-		Not configured
configuration	N1,CodebookConfig-N2)		<u> </u>
	CodebookSubsetRestriction		010000
RI Restriction			N/A
Physical channel	Physical channel for CSI report		PUSCH
CQI/RI/PMI delay	CQI/RI/PMI delay		9.5
Maximum numbe	r of HARQ transmission		1
Measurement cha	Measurement channel		As specified in Table A.4-2, TBS.2-8

6.2.3.2.2 CQI reporting under fading conditions

6.2.3.2.2.1 Minimum requirement for wideband CQI reporting

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

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

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

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

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

Parameter		Unit	Te	est 1	Tes	st 2
Bandwidth	ndwidth			4	0	
Subcarrier spacin	ubcarrier spacing		30			
Duplex Mode			TDD			
TDD UL-DL patte	DD UL-DL pattern			FR1.	30-1	
SNR		dB	3	4	9	10
Propagation chan				TDLA	30-5	
Antenna configura				2>		
Correlation config				XP I		
Beamforming Mod	•		As	specified in		3.4.1
	CSI-RS resource Type		1	Peri		
	Number of CSI-RS ports (X)		-	- 4 - FD C		
	CDM Type Density (ρ)			FD-C	DIVIZ	
ZP CSI-RS	First subcarrier index in the PRB					
configuration	used for CSI-RS (k₀)			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			Peri		
	Number of CSI-RS ports (X)			2		
	CDM Type			FD-C		
NZP CSI-RS for	Density (ρ)			1		
CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁)			Row 3	3,(6,-)	
	First OFDM symbol in the PRB used for CSI-RS (I ₀)			1	3	
	NZP CSI-RS-timeConfig periodicity and offset	slot		10	/1	
	CSI-IM resource Type			Peri	odic	
	CSI-IM RE pattern			C)	
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				Tab	le 2	
reportQuantity				cri-RI-P	MI-CQI	
	rChannelMeasurements			Not con		
	rInterferenceMeasurements			Not con		
cqi-FormatIndicate				Wide		
pmi-FormatIndica	tor			Wide		
Sub-band Size		RB		1		
csi-ReportingBand		-1-1	1	1111		
CSI-Report period		slot		10		
aperiodicTriggerin			+	Not con		
	Codebook Type Codebook Mode		+	typeI-Sin 1		
Codebook	(Codebook Mode (CodebookConfig-		+			
configuration	N1,CodebookConfig-N2)			Not con	figured	
	CodebookSubsetRestriction			000		
RI Restriction				N/		
	Physical channel for CSI report			PUC		
CQI/RI/PMI delay		ms	1	9.		
Maximum numbei	of HARQ transmission		1	<u> 1</u>		TD 0 =
Measurement cha	nnel		As spe	cified in Ta		, IBS.2-

Table 6.2.3.2.2.1-2: Minimum requirements

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

6.2.3.2.2.2 Minimum requirement for sub-band CQI reporting

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

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

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

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

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

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

	Parameter	Unit	Test 1 Test 2
Bandwidth			40
Subcarrier spacin	g	kHz	30
Duplex Mode			TDD
TDD UL-DL patte	rn		FR1.30-1
SNR		dB	5 6 11 12
Propagation chan	nnel		Two tap model specified in Annex B.2.4 with $a=1$, $f_D=5$ Hz, and $\tau_d=0.1125\mu s$
Antenna configura	ation		2×4
Correlation config			As per Annex B.1
Beamforming Mo	del		As specified in Annex B.4.1
<u> </u>	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 ₀)		Row 5,4
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		9
	CSI-RS periodicity and offset	slot	10/1
	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (X)		2
	CDM Type		FD-CDM2
NZP CSI-RS for	Density (ρ)		1
CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁)		Row 3,(6,-)
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		13
	NZP CSI-RS-timeConfig periodicity and offset	slot	10/1
	CSI-IM resource Type		Periodic
	CSI-IM RE pattern		0
CSI-IM configuration	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(4, 9)
	CSI-IM timeConfig periodicity and offset	slot	10/1
ReportConfigType			Aperiodic
CQI-table			Table 2
reportQuantity			cri-RI-PMI-CQI
	rChannelMeasurements		Not configured
timeRestrictionFo	rInterferenceMeasurements		Not configured
cqi-FormatIndicat			Subband
pmi-FormatIndica	tor		Wideband
Sub-band Size		RB	16
csi-ReportingBan			1111111
CSI-Report period		slot	Not configured
Aperiodic Report	Slot Offset		8 1 in slots i, where mod(i, 10) = 1,
CSI request 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
aperiodicTriggerin	ngOffset		0
	Codebook Type		typel-SinglePanel
	Codebook Mode		<u> </u>
Codebook	(CodebookConfig-		Not configured
configuration	N1,CodebookConfig-N2)		Not configured
	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-

Table 6.2.2.1.2.2-2: Minimum requirements

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

6.2A Reporting of Channel Quality Indicator (CQI) for CA

6.2A.1 General

This clause includes the requirements for the reporting of channel quality indicator (CQI) with the UE configured for CA. The purpose is to verify that the CQI is correctly reported in accordance with the CQI definition given in TS 38.214 [12] for each CC with multiple cells configured for periodic reporting.

6.2A.2 1RX requirements

(Void)

6.2A.3 2RX requirements

6.2A.3.1 CQI reporting definition under AWGN conditions

6.2A.3.1.1 Minimum requirement for periodic CQI reporting

For each CA CQI reporting test defined in Table 6.2A.3.1.1-6, the test requirements and the test parameters are defined as below.

For each CC, the test parameters are specified in Table 6.2A.3.1.1-1. The additional parameters specified in Table 6.2A.3.1.1-2 are applicable for tests on FDD CC. The additional parameters specified in Table 6.2A.3.1.1-3 are applicable for tests on TDD CC.

For CA with 2 DL CC, for the SNR configuration specified in Table 6.2A.3.1.1-4, and using the downlink physical channels specified in Annex C.3.1 on each CC, the difference between the wideband CQI indices of PCell and SCell reported shall be such that

wideband CQI_{PCell} – wideband $CQI_{SCell} \ge 2$

for more than 90% of the time.

For CA with 3 or more DL CC, for the SNR configuration specified in Table 6.2A.3.1.1-5, and using the downlink physical channels specified in Annex C.3.1 on each cell, the difference between the wideband CQI indices of PCell and SCell1 reported, and the difference between the wideband CQI indices of SCell1 and SCell2, 3... reported shall be such that

wideband CQI_{PCell} – wideband $CQI_{SCell1} \ge 2$

wideband CQI_{SCell1} – wideband $CQI_{SCell2, 3...} \ge 2$

for more than 90% of the time.

Table 6.2A.3.1.1-1: CA CQI reporting test parameters for FDD and TDD CC

Parameter		Unit	Value
Propagation chan	Propagation channel		AWGN
Antonno configur	Antenna configuration		1x2 with static channel specified in
Antenna comigura	Antenna configuration		Annex B.1
	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (X)		4
ZP CSI-RS	CDM Type		FD-CDM2
configuration	Density (ρ)		1
comiguration	First subcarrier index in the PRB used for CSI-RS (k ₀)		Row 5, 4
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		9
	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (X)		1
NIZD COL DO (CDM Type		No CDM
NZP CSI-RS for	Density (p)		1
CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k ₀)		Row 2, 6
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		13
	CSI-IM resource Type		Periodic
CSI-IM	CSI-IM RE pattern		0
configuration	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(4, 9)
ReportConfigType	, ,		Periodic
CQI-table			Table 2
reportQuantity			cri-RI-PMI-CQI
timeRestrictionFo	rChannelMeasurements		Not configured
timeRestrictionFo	rInterferenceMeasurements		Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Csi-ReportingBand			1111111
aperiodicTriggeringOffset			Not configured
Physical channel for CSI report			PUCCH
Maximum numbe	r of HARQ transmission		1
Measurement cha	annel		Derived as per section 5.1.3.2 of TS 38.214 [12]

Table 6.2A.3.1.1-2: Additional test parameters for FDD CC

	Parameter		Value
Duplex Mode			FDD
Subcarrier spacin	g	kHz	15
ZP CSI-RS	CSI-RS	slot	5/1
configuration	periodicity and offset	SIOL	5/1
NZP CSI-RS for	NZP CSI-RS-timeConfig	slot	5/1
CSI acquisition	periodicity and offset	SIOL	5/1
CSI-IM	CSI-IM timeConfig	slot	5/1
configuration	periodicity and offset	3101	3/1
CSI-Report period	dicity and offset	slot	5/0
CQI/RI/PMI delay		ms	8
			8 for 5MHz and 10MHz,
Sub-band Size		RB	16 for 15MHz, 20MHz and 25MHz,
			32 for 30MHz, 40MHz and 50MHz

Table 6.2A.3.1.1-3: Additional test parameters for TDD CC

	Parameter	Unit	Value
Duplex Mode			TDD
Subcarrier spacin	g	kHz	30
TDD UL-DL patte	rn		FR1.30-1
ZP CSI-RS configuration	CSI-RS periodicity and offset	slot	10/1
NZP CSI-RS for CSI acquisition	NZP CSI-RS-timeConfig periodicity and offset	slot	10/1
CSI-IM configuration	CSI-IM timeConfig periodicity and offset	slot	10/1
CSI-Report period	dicity and offset	slot	10/9
CQI/RI/PMI delay		ms	9.5
Sub-band Size		RB	8 for 10MHz, 15MHz, 20MHz and 25MHz, 16 for 30MHz, 40MHz and 50MHz, 32 for 60MHz, 80MHz, 90MHz and 100MHz

Table 6.2A.3.1.1-4: SNR configurations for 2 DL CA

Parameter	PCell	SCell
SNR (dB)	10.0	4.0

Table 6.2A.3.1.1-5: SNR configurations for 3 or more DL CA

Parameter	PCell	SCell1	SCell2, 3
SNR (dB)	12.0	6.0	0.0

Table 6.2A.3.1.1-6: List of CA CQI reporting test

Test number		CA duplex mode and SCS combination		
1		FDD 15 kHz + TDD 30 kHz		
2		FDD 15 kHz + FDD 15 kHz		
3 TDD 30 kHz + TDD 30 kHz		TDD 30 kHz + TDD 30 kHz		
Note 1:		The applicability of requirements for different CA duplex modes, SCSs, is defined in 6.1.1.5.1.		
Note 2: The applicability of requirements for different CA configurations and bandwidth combination sets is defined in 6.1.1.5.2.				

6.2A.3.1.2 Minimum requirement for CQI reporting for SCell on band with shared spectrum access

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] for Scell on band with shared spectrum access. For each downlink transmission duration the transmission power offset is randomly chosen between [0, +6] dB and 2 sets of CQI reports are obtained for each transmission power offset. The reporting accuracy of CQI under AWGN condition is determined by the reporting variance and BLER performance using the transport format indicated by the reported CQI median for each power offset. 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 6.2A.3.1.2-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) For each transmission power offset the reported CQI value according to the reference channel shall be in the range of ± 1 of the reported median more than 90% of the time.
- b) For each transmission power offset, 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. For each transmission power offset, 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.

c) The absolute difference in median CQI for each of transmission power offset shall be \geq [2].

The test parameters for configuring the PCell are specified in Table 6.2A.3.1.2-2, but requirements are only applicable to SCell on band with shared spectrum access.

Table 6.2A.3.1.2-1: CQI reporting test parameters for SCell on band with shared spectrum access

Parameter		Unit	Test 1
Bandwidth		MHz	20
Subcarrier space	cing	kHz	30
Duplex Mode	-		TDD
Downlink Trans	mission Model		As specified in Annex B.5
	Downlink period	ms	5
	LBT failure probability (plbt)		0.25
Downlink	Downlink transmission duration values	slot	{3,4,6,7}
Transmission	set	3101	(3,4,0,7)
Model Parameters	Occupied OFDM symbols in slot other than the last slot of the downlink	symbols	14
Parameters	duration Occupied OFDM symbols in the last	-	
	slot of the downlink duration	symbols	[14]
TDD UL-DL pat	tern		FR1.30-7
SNR		dB	[8] [9]
$\widehat{E_s}$ for power off		dBm/Hz	-112
$\widehat{E_s}$ for power off		dBm/Hz	-106
Propagation ch	annel		AWGN
Antenna config	uration		2x2 with static channel specified in Annex B.1
Beamforming M	lodel		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 ₀)		Row 5,4
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		9
	CSI-RS periodicity and offset	slot	10/1
	CSI-RS resource Type		[Aperiodic]
	Number of CSI-RS ports (X)		2
	CDM Type		FD-CDM2
	Density (ρ)		1
NZD 001 D0 4-	First subcarrior index in the DDR		D 0 (0)
NZP CSI-RS fo CSI acquisition	used for CSI-RS (K ₀ , K ₁)		Row 3,(6,-)
CSI acquisition	First OFDM symbol in the PRB used for CSI-RS (I ₀)		3
	NZP CSI-RS-timeConfig periodicity and offset	slot	[Not configured]
	aperiodicTriggeringOffset		[0]
	CSI-IM resource Type		Periodic
	CSI-IM RE pattern		0
001.184	CSI-IM Resource Mapping		
CSI-IM configuration	(Kcsi-im,lcsi-im)		(4, 9)
	CSI-IM timeConfig periodicity and offset	slot	10/1
	Codebook Type		typel-SinglePanel
	Codebook Node		1
Codebook configuration	(CodebookConfig- N1,CodebookConfig-N2)		Not configured
	CodebookSubsetRestriction		010000
	CodebookSabsetKestilction		010000

RI Restriction		N/A
CQI/RI/PMI delay	ms	9.5
Maximum number of HARQ transmission		1
Measurement channel		As specified in Table A.4-2, TBS.2-8

Table 6.2A.3.1.2-2: Configuration parameters for PCell

Parameter	Unit	Test 1
Bandwidth	MHz	20
Subcarrier spacing	kHz	30
Duplex Mode		TDD
TDD UL-DL pattern		FR1.30-1
Propagation channel		AWGN
Antenna configuration		2x2 with static channel specified in Annex B.1
Beamforming Model		As specified in Annex B.4.1
ReportConfigType		Aperiodic
CQI-table CQI-table		Table 2
reportQuantity		cri-RI-PMI-CQI
timeRestrictionForChannelMeasurements		configured
timeRestrictionForInterferenceMeasurements		configured
cqi-FormatIndicator		Wideband
pmi-FormatIndicator		Wideband
Sub-band Size	RB	16
Csi-ReportingBand		1111111
CSI-Report periodicity and offset	slot	Not configured
aperiodicTriggeringOffset		7
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
Physical channel for CSI report		PUSCH

6.2A.4 4RX requirements

6.2A.4.1 CQI reporting definition under AWGN conditions

6.2A.4.1.1 Minimum requirement for CQI reporting for SCell on band with shared spectrum access

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] for Scell on band with shared spectrum access. For each downlink transmission duration the transmission power offset is randomly chosen between [0, +6] dB and 2 sets of CQI reports are obtained for each transmission power offset. The reporting accuracy of CQI under AWGN condition is determined by the reporting variance and BLER performance using the transport format indicated by the reported CQI median for each power offset. 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 6.2A.4.1.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) For each transmission power offset the reported CQI value according to the reference channel shall be in the range of ± 1 of the reported median more than 90% of the time.
- b) For each transmission power offset, 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. For each transmission power offset, 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.

c) The absolute difference in median CQI for each of transmission power offset shall be \geq [2].

The test parameters for configuring the PCell are specified in Table 6.2A.4.1.1-2, but requirements are only applicable to SCell on band with shared spectrum access.

Table 6.2A.4.1.1-1: CQI reporting test parameters for SCell on band with shared spectrum access

Parameter		Unit	Test 1	
Bandwidth			20	
Subcarrier spacing		MHz kHz	30	
Duplex Mode			TDD	
Downlink Trans	mission Model		As specified in Annex B.5	
	Downlink period	ms	5	
	LBT failure probability (p _{LBT})		0.25	
Downlink	Downlink transmission duration values	alat	(2.4.6.7)	
Transmission	set	slot	{3,4,6,7}	
Model	Occupied OFDM symbols in slot other			
Parameters	than the last slot of the downlink	symbols	14	
-	duration			
	Occupied OFDM symbols in the last	symbols	[14]	
TDD !!! D!	slot of the downlink duration			
TDD UL-DL pat	tern	ī	FR1.30-7	
SNR		dB	[5] [6]	
$\widehat{E_s}$ for power off		dBm/Hz	-112	
$\widehat{E_s}$ for power offs		dBm/Hz	-106	
Propagation cha	annel		AWGN	
Antenna configu	uration		2x4 with static channel specified in	
			Annex B.1	
Beamforming M			As specified in Annex B.4.1	
	CSI-RS resource Type		Periodic	
	Number of CSI-RS ports (X)		4 FD-CDM2	
	CDM Type Density (p)		1 1	
ZP CSI-RS	First subcarrier index in the PRB		I	
configuration	used for CSI-RS (k ₀)		Row 5,4	
Comigaration	First OFDM symbol in the PRB used			
	for CSI-RS (I ₀)		9	
	CSI-RS		10/1	
	periodicity and offset	slot	10/1	
	CSI-RS resource Type		[Aperiodic]	
	Number of CSI-RS ports (X)		2	
	CDM Type		FD-CDM2	
	Density (ρ)		1	
NZP CSI-RS for	First subcarrier index in the PRB		Row 3,(6,-)	
CSI acquisition	used for CSI-RS (k ₀ , k ₁)		1.0W 3,(0,-)	
00. 4044.0	First OFDM symbol in the PRB used		3	
	for CSI-RS (I ₀)		-	
	NZP CSI-RS-timeConfig	slot	[Not configured]	
	periodicity and offset			
	aperiodicTriggeringOffset CSI-IM resource Type		[0] Periodic	
	CSI-IM RE pattern		0	
	CSI-IM RE pattern CSI-IM Resource Mapping		U	
CSI-IM	(kcsi-im, lcsi-im)		(4, 9)	
configuration	(or-inityoor-inity)		(., 5)	
	CSI-IM timeConfig	1 /	40/4	
	periodicity and offset	slot	10/1	
	Codebook Type		typel-SinglePanel	
	Codebook Mode		1	
Codebook	(CodebookConfig-		Not configured	
configuration	N1,CodebookConfig-N2)			
	CodebookSubsetRestriction		010000	
	RI Restriction		N/A	

CQI/RI/PMI delay	ms	9.5
Maximum number of HARQ transmission		1
Measurement channel		As specified in Table A.4-2, TBS.2-8

Table 6.2A.4.1.1-2: Configuration parameters for PCell

Parameter	Unit	Test 1
Bandwidth	MHz	20
Subcarrier spacing	kHz	30
Duplex Mode		TDD
TDD UL-DL pattern		FR1.30-1
Propagation channel		AWGN
Antenna configuration		2x4 with static channel specified in Annex B.1
Beamforming Model		As specified in Annex B.4.1
ReportConfigType		Aperiodic
CQI-table		Table 2
reportQuantity		cri-RI-PMI-CQI
timeRestrictionForChannelMeasurements		configured
timeRestrictionForInterferenceMeasurements		configured
cqi-FormatIndicator		Wideband
pmi-FormatIndicator		Wideband
Sub-band Size	RB	16
Csi-ReportingBand		1111111
CSI-Report periodicity and offset	slot	Not configured
aperiodicTriggeringOffset		7
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
Physical channel for CSI report		PUSCH

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

$$\gamma = \frac{t_{ue, follow1, follow2}}{t_{rnd1, rnd2}}$$

In the definition of γ , for 4TX, 8TX, 16TX, and 32TX PMI requirements, $t_{ue,follow1,follow2}$ is 90 % of the maximum throughput obtained at $SNR_{follow1,follow2}$ using the precoders configured according to the UE reports, and $t_{md1,md2}$ is the throughput measured at $SNR_{follow1,follow2}$ with random precoding.

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

$$\gamma = \frac{t_{ue, follow1, follow2}}{t_{rndl, rnd2}}$$

In the definition of γ , for 16TX PMI requirements, $t_{ue,follow1,follow2}$ 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)

	rameter	Unit	Test 1
Bandwidth		MHz	10
Subcarrier spaci	ng	kHz	15
Duplex Mode	1		FDD TDLAGGE
Propagation cha	nnei		TDLA30-5
Antenna configu	ration		High XP 4 x 2 (N1,N2) = (2,1)
Beamforming Mo	odel		As specified in Annex B.4.1
	CSI-RS resource		Periodic
	Type		1 01100.10
	Number of CSI-RS		4
	ports (X) CDM Type		FD-CDM2
	Density (ρ)		1 1
	First subcarrier		·
ZP CSI-RS	index in the PRB		Daw 5 (4)
configuration	used for CSI-RS		Row 5, (4,-)
	(k_0, k_1)		
	First OFDM		
	symbol in the PRB		(9,-)
	used for CSI-RS		(, ,
	(l ₀ , l ₁) CSI-RS		
	periodicity and	slot	5/1
	offset	0101	G/ 1
	CSI-RS resource		Aporiodia
	Туре		Aperiodic
	Number of CSI-RS		4
	ports (X)		ED ODMO
	CDM Type		FD-CDM2
	Density (ρ) First subcarrier		1
	index in the PRB		
NZP CSI-RS	used for CSI-RS		Row 4, (0,-)
for CSI	(k_0, k_1)		
acquisition	First OFDM		
	symbol in the PRB		(13,-)
	used for CSI-RS		(10,)
	(l ₀ , l ₁) CSI-RS		
	periodicity and		Not configured
	offset		Not configured
	aperiodicTriggering		0
	Offset		0
	CSI-IM resource		Aperiodic
	Type CSI-IM RE pattern		Pattern 0
	CSI-IM Resource		1 attenio
CSI-IM	Mapping		(4,9)
configuration	(kcsi-im,lcsi-im)		(',-,
	CSI-IM timeConfig		
	periodicity and	slot	Not configured
	offset		
ReportConfigTyp	oe		Aperiodic
CQI-table reportQuantity			Table 1 cri-RI-PMI-CQI
	orChannelMeasure		
ments			Not configured
	orInterferenceMeasu		Not configured
rements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	8
	csi-ReportingBand		1111111
	CSI-Report periodicity and offset		Not configured
Aperiodic Report Slot Offset			4

CSI request			1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
reportTriggerSiz	e		1
CSI-AperiodicTr			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 channe			PUSCH
CQI/RI/PMI delay		ms	6
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.1-6.1 FDD
N	T		

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

Table 6.3.2.1.1-2: Minimum requirement

Parameter	Test 1
γ	1.3

6.3.2.1.2 Single PMI with 8TX TypeI-SinglePanel Codebook

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

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

	rameter	Unit	Test 1
Bandwidth		MHz	10
Subcarrier spac	ing	kHz	15
Duplex Mode	nanal		FDD TDL A20 F
Propagation cha	annei		TDLA30-5 High XP 8 x 2
Antenna configu			(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
	First subcarrier		
ZP CSI-RS	index in the PRB		Dow 5 (4)
configuration	used for CSI-RS		Row 5, (4,-)
	(k_0, k_1)		
	First OFDM		
	symbol in the PRB		(9,-)
	used for CSI-RS		(0,)
	(l ₀ , l ₁)		
	CSI-RS	alat	5/1
	periodicity and offset	slot	5/1
	CSI-RS resource		
	Type		Aperiodic
	Number of CSI-RS		0
	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)
acquisition	(k ₀ , k ₁) First OFDM		
	symbol in the PRB		
	used for CSI-RS		(5,-)
	(l ₀ , l ₁)		
	CSI-RS		
	periodicity and	slot	Not configured
	offset		-
	aperiodicTriggerin		0
	gOffset		Ŭ
	CSI-IM resource		Aperiodic
	Type		•
	CSI-IM RE pattern CSI-IM Resource		Pattern 0
CSI-IM	Mapping		(4,9)
configuration	(k _{CSI-IM} ,I _{CSI-IM})		(4,9)
	CSI-IM timeConfig		
	periodicity and	slot	Not configured
	offset		3
ReportConfigTy	pe		Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasure			Not configured
ments			
timeRestrictionForInterferenceMeas			Not configured
urements			-
cqi-FormatIndicator			Wideband Wideband
Sub-band Size	pmi-FormatIndicator		Wideband 8
csi-ReportingBand		RB	1111111
		slot	Not configured
	CSI-Report periodicity and offset Aperiodic Report Slot Offset		5
		i	•

CSI request			1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
reportTriggerSiz	e		1
CSI-AperiodicTr	iggerStateList		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,CodebookConf ig-N2)		(4,1)
configuration	(CodebookConfig- O1,CodebookConfig- ig-O2)		(4,1)
	CodebookSubsetR estriction		0x FFFF
	RI Restriction		0000010
Physical channe	l for CSI report		PUSCH
CQI/RI/PMI dela	ny	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 precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable i ₁ , i ₂ combination.			

Note 2: If the UE reports in an available uplink reporting instance at slot#n 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 Multiple 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)

Pa	rameter	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	lodel		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

			_
	First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁)		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁)		(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 ₀ , k ₁ , k ₂ , k ₃)		Row 12, (2, 4, 6, 8)
aoquomon	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
	ments timeRestrictionForInterferenceMeas		Not configured
cqi-FormatIndic	otor		Wideband
			Subband
pmi-FormatIndi	Calui	RB	Subband 8
			-
csi-ReportingBand		-l-+	1111111
CSI-Report interval and offset Aperiodic Report Slot Offset		slot	Not configured 5
CSI request			1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
reportTriggerSize			1
CSI-AperiodicT	riggerStateList		One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
	Codebook Type		typel-SinglePanel
	Codebook Mode		1
Codebook configuration	(CodebookConfig- N1,CodebookConfig-N2)		(4,2)
	(CodebookConfig- O1,CodebookCon fig-O2)		(4,4)

	CodebookSubset		0x
	Restriction		FFFF FFFF FFFF
			FFFF FFFF FFFF
	RI Restriction		0000010
Physical	channel for CSI report		PUSCH
CQI/RI/P	MI delay	ms	8
Maximum	n number of HARQ		4
transmiss	transmission		4
Measurement channel			R.PDSCH.1-6.3
Note 1:	When Throughput is meas	ured using	random precoder selection, the
precoder shall be updated			ot (1 ms granularity) with equal
	probability of each applicable i1, i2 combination.		
Note 2:	If the UE reports in an avai	ilable uplinl	k reporting instance at slot#n
	based on PMI estimation at a downlink slot not later than slot#(n-4),		
	this reported PMI cannot b		
	slot#(n+4).		
Note 3:			
specified in Annex B.2.3.2.3.			

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)

Pai	rameter	Unit	Test 1
Bandwidth		MHz	10
Subcarrier space	ing	kHz	15
Duplex Mode			FDD
Propagation cha	annel		TDLA30-5
Antenna configu	uration		High XP 32 x 2 (N1,N2) = (4,4)
Beamforming M			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 ₀ , k ₁)		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 for CSI acquisition	CSI-RS resource Type		Aperiodic
	Number of CSI- RS ports (X)		32
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1

	I		T
	First subcarrier		
	index in the PRB used for CSI-RS		Row 17, (2, 4, 6, 8)
	(k ₀ , k ₁ , k ₂ , k ₃)		
	First OFDM		
	symbol in the PRB		
	used for CSI-RS		(5, 12)
	(I_0, I_1)		
	CSI-RS		N
	interval and offset	slot	Not configured
	aperiodicTriggerin		
	gOffset		0
	CSI-IM resource		Aperiodic
	Type		Apendaic
	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	3101	140t configured
ReportConfigTy	pe		Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
	orChannelMeasure		Not configured
ments			
	ForInterferenceMeas		Not configured
urements	_1		
cqi-FormatIndicator			Wideband
pmi-FormatIndicator		DD	Wideband
Sub-band Size		RB	8
csi-ReportingBand		-1-4	1111111
CSI-Report interval and offset Aperiodic Report Slot Offset		slot	Not configured
Aperiodic Repo	rt Slot Oliset		5
CSI request			1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
reportTriggerSiz	70		otherwise it is equal to 0
report riggersiz	<u> </u>		One State with one Associated
			Report Configuration
CSI-AperiodicTi	ringerStateList		Associated Report
Correpondatori	nggorotatoLiot		Configuration contains pointers
			to NZP CSI-RS and CSI-IM
	Codebook Type		typel-SinglePanel
	Codebook Mode		1
	(CodebookConfig-		
	N1,CodebookConf		(4,4)
	ig-N2)		, , ,
	(CodebookConfig-		
Codebook	O1,CodebookCon		(4,4)
configuration	fig-O2)		
	CodebookSubset		0x
	Restriction		FFFF FFFF FFFF
			FFFF FFFF FFFF
			FFFF FFFF FFFF
	RI Restriction		FFFF FFFF FFFF 00000010
			()()()()()()()

Physical channel for CSI report			PUSCH
CQI/RI/P	MI delay	ms	8
Maximum	n number of HARQ		4
transmiss	sion		4
Measurer	ment channel		R.PDSCH.1-6.3
Note 1:	When Throughput is meas	ured using	random precoder selection, the
Note 2:	precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable i ₁ , i ₂ combination. ote 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-4), this reported PMI cannot be applied at the gNB downlink before slot#(n+4).		
Note 3:	· /		

Table 6.3.2.1.4-2: Minimum requirement

Parameter	Test 1	
γ	5.0	

6.3.2.1.5 Multiple PMI with 16TX TypeII Codebook

For the parameters specified in Table 6.3.2.1.5-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.1.5-2.

Table 6.3.2.1.5-1: Test parameters (dual-layer)

P	Parameter		Test 1
Bandwidth		MHz	10
Subcarrier spa	cing	kHz	15
Duplex Mode			FDD
Propagation ch	nannel		TDLA30-5
Antenna config	uration		XP Medium 16 x 2 (N1,N2) = (4,2)
Beamforming N			As specified in Annex B.4.1
	CSI-RS resource		Aperiodic
	Туре		Aperiodic
	Number of CSI-RS ports (X)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index		
ZP CSI-RS	in the PRB used for		Row 5, (4,-)
configuration	CSI-RS (k ₀ , k ₁) First OFDM symbol		
	in the PRB used for		(9,-)
	CSI-RS (I ₀ , I ₁)		
	CSI-RS	slot	Not configured
	interval and offset	3101	
	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		16
	ports (X)		-
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
NZP CSI-RS	First subcarrier index		Day: 42 (2.4.6.9)
for CSI	in the PRB used for		Row 12, (2, 4, 6, 8)
acquisition	CSI-RS (k ₀ , k ₁ , k ₂ , k ₃) First OFDM symbol		
	in the PRB used for		(5, -)
	CSI-RS (I ₀ , I ₁)		(0,)
	CSI-RS	1.4	N. 6
	interval and offset	slot	Not configured
	aperiodicTriggeringO		0
	ffset		Ů
	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM	CSI-IM Resource		
configuration	Mapping		(4,9)
	(kcsi-im,lcsi-im)		
	CSI-IM timeConfig	slot	Not configured
ReportConfigT	interval and offset		Aperiodic
ReportConfigType CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
	ForChannelMeasurem		
ents			Not configured
timeRestrictionForInterferenceMeasur ements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Subband
Sub-band Size		RB	8
csi-ReportingBand			1111111
	erval and offset	slot	Not configured
Aperiodic Repo	ort Slot Offset		5
CSI request			1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
reportTriggerS	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		typell
	L (numberOfBeams)		2
	N _{PSK} (phaseAlphabetSize)		8
	subbandAmplitude		True
Codebook configuration	(CodebookConfig- N1,CodebookConfig- N2)		(4,2)
Corniguration	(CodebookConfig- O1,CodebookConfig- O2)		(4,4)
	CodebookSubsetRes		0x 7FF
	triction		FFFF FFFF FFFF
	RI Restriction (typeII- RI-Restriction)		10
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	8
Maximum number of HARQ			4
transmission			7
Measurement channel			R.PDSCH.1-6.3
Note 1: When Throughput is measured		ed using ra	andom precoder selection, the

Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable i₁, i₂ combination. The random precoder generation shall follow 'typeI-SinglePanel' codebook configuration as specified in table 6.3.2.1.3-1.

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 dual-cluster beam directions shall be used as specified in Annex B.2.3.2.3A. The value of relative power ratio (p) shall be fixed as 1 during the test.

Table 6.3.2.1.5-2: Minimum requirement

Parameter	Test 1
γ	1.9

6.3.2.1.6 Multiple PMI with 16TX Enhanced Type II Codebook

For the parameters specified in Table 6.3.2.1.6-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.1.6-2.

Table 6.3.2.1.6-1: Test parameters (dual-layer)

Parameter		Unit	Test 1
Bandwidth		MHz	10
Subcarrier spa	cing	kHz	15
Duplex Mode			FDD
Propagation ch	nannel		TDLA30-5
Antenna config	uration		XP Medium 16 x 2 (N1,N2) = (4,2)
Beamforming N			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 ₀ , k ₁)		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁)		(9,-)
	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
	First subcarrier index		·
NZP CSI-RS for CSI acquisition	in the PRB used for CSI-RS (k ₀ , k ₁ , k ₂ , k ₃)		Row 12, (2, 4, 6, 8)
acquisition	First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁)		(5, -)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggeringO ffset		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
ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasurem ents			Not configured
timeRestrictionForInterferenceMeasur ements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Not configured
Sub-band Size		RB	4
csi-ReportingBand			1111111
	erval and offset	slot	Not configured
Aperiodic Repo	ort Slot Offset		5 1 in slots i, where mod(i, 5) = 1,
CSI request			otherwise it is equal to 0
reportTriggerSize			1

CSI-AperiodicTriggerStateList CSI-AperiodicTriggerStateList Codebook Type				
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	CSI-AperiodicTriggerStateList			Report Configuration Associated Report Configuration contains pointers
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		Codebook Type		typell-r16
R(numberOfPMISub bandsPerCQISubban d-r16)		paramCombination-		6
Codebook configuration N1,CodebookConfig- N2) (4,2) (CodebookConfig- O1,CodebookConfig- O2) (4,4) CodebookSubsetRes triction 0x 7FF FFFF FFFF FFFF FFFF FFFF FFFF FFF		bandsPerCQISubban		1
O1,CodebookConfig- O2) CodebookSubsetRes triction RI Restriction (typell- RI-Restriction-r16) Physical channel for CSI report CQI/RI/PMI delay Maximum number of HARQ transmission Measurement channel Note 1: When Throughput is measured using random precoder selection, the		N1,CodebookConfig-		(4,2)
triction FFFF FFFF FFFF FFFF FFFF RI Restriction (typell-RI-Restriction-r16) 0010 Physical channel for CSI report PUSCH CQI/RI/PMI delay ms 8 Maximum number of HARQ 4 transmission 4 Measurement channel R.PDSCH.1-6.3 Note 1: When Throughput is measured using random precoder selection, the		O1,CodebookConfig-		(4,4)
RI Restriction (typell-RI-Restriction-r16) Physical channel for CSI report CQI/RI/PMI delay Maximum number of HARQ transmission Measurement channel R.PDSCH.1-6.3 Note 1: When Throughput is measured using random precoder selection, the		CodebookSubsetRes		
RI-Restriction-r16)		triction		FFFF FFFF FFFF
CQI/RI/PMI delay ms 8 Maximum number of HARQ 4 transmission R.PDSCH.1-6.3 Note 1: When Throughput is measured using random precoder selection, the				0010
Maximum number of HARQ transmission Measurement channel Note 1: When Throughput is measured using random precoder selection, the	Physical chann	Physical channel for CSI report		PUSCH
transmission Measurement channel Note 1: When Throughput is measured using random precoder selection, the			ms	8
Measurement channel R.PDSCH.1-6.3				4
Note 1: When Throughput is measured using random precoder selection, the	transmission			4
	Measurement channel			R.PDSCH.1-6.3
precoder shall be updated in each slot (1 ms granularity) with equal				
probability of each applicable i ₁ , i ₂ combination. The random precoder				

probability of each applicable i1, i2 combination. The random precoder generation shall follow 'typel-SinglePanel' codebook configuration as specified in table 6.3.2.1.3-1.

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 dual-cluster beam directions shall be used as specified in AnnexB.2.3.2.3A. The value of relative power ratio (p) shall be fixed as 1 during the test.

Table 6.3.2.1.6-2: Minimum requirement

Parameter	Test 1
γ	2.2

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)

Parameter		Unit	Test 1
Bandwidth		MHz	40
Subcarrier spacing		kHz	30 TDD
Duplex Mode			FR1.30-1 as specified in Annex
TDD DL-U	L configuration		A
Propaga	ation channel		TDLA30-5
Antenna	configuration		High XP 4 x 2
	rming Model		(N1,N2) = (2,1) As specified in Annex B.4.1
Deamio	CSI-RS resource		
	Туре		Periodic
	Number of CSI-		4
	RS ports (X) CDM Type		FD-CDM2
	Density (ρ)		1 D-0DW2
	First subcarrier		
ZP CSI-RS	index in the PRB		Row 5, (4,-)
configuration	used for CSI-RS		, , ,
	(k ₀ , k ₁) First OFDM		
	symbol in the PRB		(0.)
	used for CSI-RS		(9,-)
	(l ₀ , l ₁)		
	CSI-RS periodicity and	slot	10/1
	offset	3101	10/1
	CSI-RS resource		Aperiodic
	Type		Aperiodic
	Number of CSI- RS ports (X)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier		
NZP CSI-RS	index in the PRB used for CSI-RS		Row 4, (0,-)
for CSI	(k ₀ , k ₁)		
acquisition	First OFDM		
	symbol in the PRB		(13,-)
	used for CSI-RS (I ₀ , I ₁)		(- / /
	CSI-RS		
	periodicity and	slot	Not configured
	offset		
	aperiodicTriggerin gOffset		0
	CSI-IM resource		
	Туре		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM	CSI-IM Resource		(4.0)
configuration	Mapping (kcsi-im,lcsi-im)		(4,9)
	CSI-IM timeConfig		
	periodicity and	slot	Not configured
offset			A no vio di o
ReportConfigType CQI-table			Aperiodic Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasure			Not configured
ments			140t configured
timeRestrictionForInterferenceMeas urements			Not configured
	cqi-FormatIndicator		Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	16
csi-ReportingBa		-1-1	1111111
CSI-Report periodicity and offset		slot	Not configured

Aperiodic	Repo	rt Slot Offset		8
CSI request			1 in slots i, where mod(i, 10) =	
•				1, otherwise it is equal to 0
reportTrig	gerSiz	<u>re</u>		1
				One State with one Associated Report Configuration
CSI Apori	odicTi	riggerStateList		Associated Report
COI-Apeni	ouic i i	iggerotateList		Configuration contains pointers
				to NZP CSI-RS and CSI-IM
		Codebook Type		typel-SinglePanel
		Codebook Mode		1
		(CodebookConfig-		
		N1,CodebookConf		(2,1)
Codebook		ig-N2)		
configurati		(CodebookConfig-		
Comigurati	1011	O1,CodebookCon		(4,1)
		fig-O2)		
		CodebookSubset		1111111
		Restriction		
		RI Restriction		0000001
		el for CSI report		PUSCH
CQI/RI/PN			ms	5.5
		er of HARQ		4
transmissi				·
Measurem				R.PDSCH.2-8.1 TDD
			random precoder selection, the	
				ot (0.5 ms granularity) with equal
	probability of each applicable i1, i2 combination.			
				k reporting instance at slot #n
				nk slot not later than slot#(n-4),
this reported PMI cannot be			e applied a	at the gNB downlink before
slot#(n+4).				
Note 3: Randomization of the princ				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	Pai	rameter	Unit	Test 1
Duplex Mode	Bandwidth			40
TDD DL-UL configurations Propagation channel Propagation channel Antenna configuration Antenna configuration Antenna configuration Antenna configuration 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 (k ₀ , k ₁) CSI-RS periodicity and offset CSI-RS resource Type Number of CSI-RS (k ₀ , k ₁) CSI-RS periodicity and offset CSI-RS resource Type Number of CSI-RS (k ₀ , k ₁) CDM Type Density (p) First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) CSI-RS periodicity and offset CSI-RS resource Type Number of CSI-RS (ro CDM Type Density (p) First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) CSI-RS periodicity and offset CSI-RS resource Type Number of CSI-RS (ro CDM Type Density (p) First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) CSI-RS periodicity and slot offset CSI-RS resource Type CSI-RS (ro CDM Type Density (p) First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) CSI-RS periodicity and offset CSI-IM resource Type CSI-IM resource Type CSI-IM Resource Mapping (k _{CSI-IM} Resource Mapping (t-SI-IM Resource Mapping (t-SI			kHz	
Propagation channel	Duplex Mode			
Antenna configuration	TDD DL-UI	TDD DL-UL configurations		
Rates and configuration (N1,N2) = (4,1) Beamforming Model As specified in Annex B.4.1 CSI-RS resource Type Periodic Number of CSI-RS ports (X) CDM Type Density (p) 1 First subcarrier index in the PRB used for CSI-RS (ko, ks) First OFDM symbol in the PRB used for CSI-RS (lo. I-) CSI-RS periodicity and offiset CSI-RS resource Type Aperiodic Number of CSI-RS (lo, ks) CSI-RS ports (X) CDM Type CDM4 (FD2, TD2) Density (p) 1 First Subcarrier index in the PRB used for CSI-RS (lo, ks) CSI-RS periodicity and offiset of CSI-RS (lo, ks) CSI-RS ports (X) CDM Type CDM4 (FD2, TD2) Density (p) 1 First Subcarrier index in the PRB used for CSI-RS (lo, ks) First OFDM symbol in the PRB used for CSI-RS (lo, ks) CSI-RS periodicity and offiset of CSI-RS (lo, ks)	Propaga	ation channel		
Beamforming Model	Antenna	configuration		
Type	Beamfo			As specified in Annex B.4.1
Number of CSI-R Rors (X) CDM Type				Periodic
RS ports (X)				
CDM Type				4
Density (p)				FD-CDM2
First subcarrier index in the PRB used for CSI-RS (kg, k1) First OFDM symbol in the PRB used for CSI-RS (kg, k1)				1
configuration Used for CSI-RS (k ₀ , k ₁)				
Used for CSI-RS (k ₀ , k ₁)				Row 5 (4 -)
First OFDM symbol in the PRB used for CSI-RS (lo, l1) CSI-RS periodicity and offset Tol/1 Size S	configuration			10W 3, (4,-)
Symbol in the PRB Used for CSI-RS (lo, lt) CSI-RS periodicity and offset CSI-RS resource Type Aperiodic Number of CSI-RS ports (X) SR ports (X) SR ports (X) CDM Type CDM4 (FD2, TD2) Density (p) Tirst subcarrier index in the PRB used for CSI-RS (lo, lt) CSI-RS periodicity and offset Aperiodic CSI-RS periodicity and offset Aperiodic CSI-IM resource Aperiodic CSI-IM TimeConfig Aperiodic CSI-IM timeRestrictionForlChannelMeasur Aperiodic CSI-IM timeRestrictionForlChannelMeasur Aperiodic CSI-IM timeRestrictionForlChannelMeasur Aperiodic CSI-IM timeRestrictionForlnterferenceMeas Aperiodic CSI-IM timeConfig Aperiodic Aperiodic CSI-IM timeConfig Aperi				
Used for CSI-RS				
(Io, Ir)				(9,-)
CSI-RS				
Deriodicity and offset		CSI-RS		
Offset			slot	10/1
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 (ko, k1) First OFDM symbol in the PRB used for CSI-RS (lo, l1) CSI-RS periodicity and offset aperiodicTriggerin gOffset CSI-IM configuration CSI-IM Resource Type CSI-IM Resource Mapping (kcsI-IM, limeConfig periodicity and offset aperiodicity and offset aperiodicity and configuration) CSI-IM Resource Type Aperiodic CSI-IM Resource Mapping (kcsI-IM, limeConfig periodicity and offset aperiodicity and offset aperiodicity and offset Aperiodic Table Table 1 ReportConfigType Aperiodic CQI-table Table Table 1 reportQuantity timeRestrictionForlChannelMeasur ements timeRestrictionForlInterferenceMeas urements University Aperiodic Wideband Sub-band Size RB 16 ReportInterferenceMeas University RB 11111111		offset		
Number of CSI- RS ports (X) S		CSI-RS resource		Aperiodic
RS ports (X)		, i		Aponodio
NZP CSI-RS for CSI acquisition NZP CSI-RS for CSI-RS (ko, k1) First OFDM symbol in the PRB used for CSI-RS (ko, k1) First OFDM symbol in the PRB used for CSI-RS (lo, l1) CSI-RS periodicity and offset aperiodic Triggerin gOffset CSI-IM resource Type Aperiodic CSI-IM RE pattern Pattern O CSI-IM Resource Mapping (A,9) (CSI-IM ItimeConfig periodicity and offset aperiodicity and offset aperiodicity and offset aperiodicity and offset aperiodicity and slot affset aperiodicity and offset aperiodicity and aperiodicity and offset aperiodicity and offset aperiodicity and aperio				8
NZP CSI-RS for CSI acquisition Density (p)				CDM4 (ED2, TD2)
NZP CSI-RS for CSI acquisition First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) First OFDM symbol in the PRB used for CSI-RS (l ₀ , l ₁) CSI-RS periodicity and offset aperiodicTriggerin gOffset CSI-IM resource Type CSI-IM Resource Mapping (kcsI-IM, lcSI-IM) CSI-IM timeConfiguration CSI-IM timeConfig periodicity and offset Slot Not configured offset CSI-IM Resource Mapping (kcsI-IM, lcSI-IM) CSI-IM timeConfig periodicity and offset Table 1 TeportQuantity Cri-RI-PMI-CQI timeRestrictionForIChannelMeasur ements Not configured Not configured Table 1 TeportQuantity TimeRestrictionForInterferenceMeas urements Not configured Not				1 (FD2, TD2)
NZP CSI-RS for CSI acquisition Index in the PRB used for CSI-RS (ko, k1)				'
for CSI acquisition Second CSI-RS (k ₀ , k ₁) First OFDM symbol in the PRB used for CSI-RS (l ₀ , l ₁) CSI-RS periodicity and offset Aperiodic Triggerin gOffset CSI-IM resource Type CSI-IM RE pattern Pattern 0	NZD OOL DO			D 0 (4.0)
CSI-IM configuration CSI-IM Resource Mapping (KcsI-M, IcsI-IM) CSI-IM timeConfig periodicity and offset CSI-IM Resource Type CSI-IM Resource Mapping (kcsI-M, IcsI-IM) CSI-IM timeConfig periodicity and offset CSI-IM timeConfig timeRestrictionForlChannelMeasur ements CSI-IM timeConfigured CSI-IM timeRestrictionForlChannelMeasur ements CSI-IM timeConfigured CSI-IM timeConf		used for CSI-RS		Row 8, (4,6)
First OFDM Symbol in the PRB used for CSI-RS (lo, lt) CSI-RS periodicity and offset aperiodicTriggerin gOffset CSI-IM resource Type CSI-IM RE pattern Pattern 0 CSI-IM Resource Mapping (k.CSI-IM, ICSI-IM) CSI-IM timeConfig periodicity and offset Table 1 reportQuantity timeRestrictionForlChannelMeasur ements Not configured timeRestrictionForlInterferenceMeas urements Cqi-FormatIndicator Wideband Sub-band Size RB 16 csi-ReportingBand 11111111				
used for CSI-RS (lo, l1) CSI-RS periodicity and offset aperiodicTriggerin gOffset CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (kcsI-IM, lcsI-IM) CSI-IM timeConfig periodicity and offset ReportConfigType CQI-table ReportQuantity timeRestrictionForIChannelMeasur ements timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size RB 16 csi-ReportingBand Not configured Not configured (A,9) (A,9) Aperiodic (A,9) Aperiodic C(A,9) Aperiodic C(A,9) Not configured C(A,9) Not configured Not configured Co	acquicition			
CSI-RS periodicity and offset aperiodicTriggerin gOffset aperiodicTriggerin gOffset Aperiodic				(5,-)
CSI-RS periodicity and offset aperiodicTriggerin gOffset CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (kcsi-IM, lcsi-IM) CSI-IM timeConfig periodicity and offset ReportConfigType CSI-IM resource Mapping (kcsi-IM, lcsi-IM) CSI-IM timeConfig periodicity and offset ReportQuantity timeRestrictionForIChannelMeasur ements timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Sub-band Size RB 16 csi-ReportingBand Not configured Not configured Videband Sub-band Size RB 16 csi-ReportingBand				
periodicity and offset aperiodicTriggerin gOffset CSI-IM resource Type CSI-IM RE pattern configuration CSI-IM Resource Mapping (kcsi-im, lcsi-im) CSI-IM timeConfig periodicity and offset ReportConfigType CQI-table reportQuantity timeRestrictionForIChannelMeasur ements timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Sub-band Size RB 16 CSI-IM Resource Mapping (4,9) (4,9)				
offset aperiodicTriggerin gOffset CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (kcsI-IM, lcsI-IM) CSI-IM timeConfig periodicity and offset ReportConfigType Aperiodic CQI-table Table 1 reportQuantity timeRestrictionForIChannelMeasur ements timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Sub-band Size CSI-IM resource Aperiodic (4,9) Not configured Not configured Not configured Not configured Not configured Wideband Wideband Sub-band Size RB 16 csi-ReportingBand			slot	Not configured
CSI-IM resource Type				3
CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (kcsi-im,lcsi-im) CSI-IM timeConfig periodicity and offset ReportConfigType CQI-table reportQuantity timeRestrictionForIChannelMeasur ements timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Sub-band Size cSI-IM Resource Mapping (kcsi-im,lcsi-im) CSI-IM Resource Mapping (kcsi-im,lcsi-im) CSI-IM Resource Mapping (kcsi-im,lcsi-im) Silot Not configured Not configured Videband Videband Videband Sub-band Size RB 16 Csi-ReportingBand				0
CSI-IM Configuration CSI-IM Resource Mapping (kcsi-im,lcsi-im) CSI-IM timeConfig periodicity and offset ReportConfigType Aperiodic CQI-table Table 1 reportQuantity Cri-RI-PMI-CQI timeRestrictionForIChannelMeasur ements timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband Sub-band Size RB 16 csi-ReportingBand Type Aperiodic Pattern 0 Adversion Pattern 0 Aperiodic Not configured Not configured Not configured Wideband Wideband Table 1 Not configured Not configured Not configured		_		ů
CSI-IM RE pattern Pattern 0 CSI-IM Resource Mapping (kcsi-iM, lcsi-iM) CSI-IM timeConfig periodicity and offset ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForIChannelMeasur ements timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband Sub-band Size RB 16 csi-ReportingBand 11111111				Aperiodic
CSI-IM configuration CSI-IM Resource Mapping (kcsi-iM, lcsi-iM) CSI-IM timeConfig periodicity and offset ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForIChannelMeasur ements timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband Sub-band Size RB 16 csi-ReportingBand (4,9)				Pattern 0
Mapping (kcsi-iM,lcsi-iM) CSI-IM timeConfig periodicity and offset Not configured offset	001.114			
ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForIChannelMeasur ements timeRestrictionForInterferenceMeas urements Cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 16 csi-Reportioging slot Not configured Not configured Not configured Wideband Not configured Not configured Not configured Not configured Not configured				(4,9)
periodicity and offset ReportConfigType CQI-table reportQuantity timeRestrictionForIChannelMeasur ements timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand Not configured Not configured Wideband Wideband Table 1 Table 1 Table 1 Tori-RI-PMI-CQI Not configured Not configured Wideband Not configured TimeRestrictionForInterferenceMeas Undeband Wideband Not configured Not configured Not configured Not configured	Corniguration			
ReportConfigType				
ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForIChannelMeasur ements timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 16 csi-ReportingBand 11111111			slot	Not configured
CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForIChannelMeasur ements Not configured timeRestrictionForInterferenceMeas urements Not configured cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 16 csi-ReportingBand 11111111	PenortConfigTv			Apariodic
reportQuantity cri-RI-PMI-CQI timeRestrictionForIChannelMeasur ements Not configured timeRestrictionForInterferenceMeas urements Not configured urements cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 16 csi-ReportingBand 11111111				
timeRestrictionForIChannelMeasur ements timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand Not configured Wideband Wideband Wideband 1111111				
timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand Not configured Wideband Wideband Sub-band Size RB 16 1111111	timeRestrictionForIChannelMeasur			
urementsNot configuredcqi-FormatIndicatorWidebandpmi-FormatIndicatorWidebandSub-band SizeRB16csi-ReportingBand1111111				3.55
cqi-FormatIndicatorWidebandpmi-FormatIndicatorWidebandSub-band SizeRB16csi-ReportingBand11111111				Not configured
pmi-FormatIndicatorWidebandSub-band SizeRB16csi-ReportingBand11111111				Wideband
Sub-band Size RB 16 csi-ReportingBand 1111111				
csi-ReportingBand 11111111			RB	
	csi-ReportingBa			
			slot	Not configured

Aperiodic Rep	ort Slot Offset		8
CSI request			1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
reportTriggerS	Size		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,CodebookConf ig-N2)		(4,1)
configuration	(CodebookConfig- O1,CodebookCon fig-O2)		(4,1)
	CodebookSubset Restriction		0x FFFF
	RI Restriction		0000010
Physical chan	nel for CSI report		PUSCH
CQI/RI/PMI de	elay	ms	6.5
Maximum nun transmission	nber of HARQ		4
Measurement	channel		R.PDSCH.2-8.2 TDD
		in each slo	random precoder selection, the ot (0.5 ms granularity) with equal
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).		k reporting instance at slot#n nk slot not later than slot#(n-6), 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.			direction shall be used as

Table 6.3.2.2.2-2: Minimum requirement

Parameter	Test 1
γ	1.5

6.3.2.2.3 Multiple PMI with 16TX TypeI-SinglePanel Codebook

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)

Parameter		Unit	Test 1
Ва	ndwidth	MHz	40
Subcar	rier spacing	kHz	30
Dup	lex Mode		TDD
TDD DL-UL 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)
Beamfo	rming Model		As specified in Annex B.4.1
ZP CSI-RS	CSI-RS resource Type		Aperiodic
configuration	Number of CSI- RS ports (X)		4
	CDM Type		FD-CDM2

	1 =		
	Density (ρ)		1
	First subcarrier		
	index in the PRB		Row 5, (4,-)
	used for CSI-RS		Row 5, (4,-)
	(k_0, k_1)		
	First OFDM		
	symbol in the PRB		
	used for CSI-RS		(9,-)
	(I ₀ , I ₁)		
	CSI-RS		
		slot	Not configured
	interval and offset		_
	ZP CSI-RS trigger		1 in slots i, where mod(i, 10) =
			1, otherwise it is equal to 0
	CSI-RS resource		Aperiodic
	Туре		7 7
	Number of CSI-		16
	RS ports (X)		
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier		
N70 001 00	index in the PRB		
NZP CSI-RS	used for CSI-RS		Row 12, (2, 4, 6, 8)
for CSI	(k ₀ , k ₁ , k ₂ , k ₃)		
acquisition	First OFDM		
	symbol in the PRB used for CSI-RS		(5, -)
	(l ₀ , l ₁)		
	CSI-RS	slot	Not configured
	interval and offset	0.01	1 tot oomigalou
	aperiodicTriggerin		0
	gOffset		0
	CSI-IM resource		Aporiodio
	Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM	CSI-IM Resource		
configuration	Mapping		(4,9)
garaner.	(kcsi-im,lcsi-im)		(1,0)
	CSI-IM timeConfig		
	interval and offset	slot	Not configured
			Appriodia
ReportConfigTy	pe		Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionF	ForIChannelMeasur		Not configured
ements			1401 oorinigalea
timeRestrictionF	ForInterferenceMeas		Not configured
urements			_
cqi-FormatIndic	ator		Wideband
	pmi-FormatIndicator		Subband
Sub-band Size		RB	16
csi-ReportingBand			1111111
CSI-Report interval and offset		slot	Not configured
Aperiodic Report Slot Offset		SIUL	8
Apenduic Report Slot Oliset			-
CSI request			1 in slots i, where mod(i, 10) =
ronortTriceror	reportTriggerSize		1, otherwise it is equal to 0
reportTriggerSize			1
			One State with one Associated
			Report Configuration
CSI-AperiodicTi	CSI-AperiodicTriggerStateList		Associated Report
			Configuration contains pointers
			to NZP CSI-RS and CSI-IM
	Codebook Type		typel-SinglePanel
Codebook	Codebook Mode		1
	(CodebookConfig-		
configuration	N1,CodebookConf		(4,2)
	ig-N2)		
	,		•

	(CodebookConfig- O1,CodebookCon fig-O2)		(4,4)
	CodebookSubset Restriction		0x FFFF FFFF FFFF FFFF FFFF FFFF FFFF FF
	RI Restriction		00000010
Physical o	channel for CSI report		PUSCH
CQI/RI/PI	MI delay	ms	6.5
Maximum number of HARQ			4
transmiss			D DDCCII 2 0 2 TDD
Measurement channel		L	R.PDSCH.2-8.3 TDD
	Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable i ₁ , i ₂ combination.		
Note 2: If the UE reports in an available uplink reporting instance at slot#n 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).			nk slot not later than slot#(n-6),
Note 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 6.3.2.2.3-2: 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)

Par	ameter	Unit	Test 1
Bai	ndwidth	MHz	40
Subcar	rier spacing	kHz	30
Dupl	lex Mode		TDD
TDD DL-UI	_ 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 ₀ , k ₁)		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (l ₀ , l ₁)		(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

		1	
	CSI-RS resource		Aperiodic
	Type Number of CSI-		·
	RS ports (X)		32
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier		·
NIZD COL DO	index in the PRB		D 47 (0 4 0 0)
NZP CSI-RS for CSI	used for CSI-RS		Row 17, (2, 4, 6, 8)
acquisition	(k_0, k_1, k_2, k_3)		
acquisition	First OFDM		
	symbol in the PRB		(5, 12)
	used for CSI-RS		(0, 12)
	(l ₀ , l ₁)		
	CSI-RS	slot	Not configured
	interval and offset		
	aperiodicTriggerin gOffset		0
	CSI-IM resource		
	Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM	CSI-IM Resource		T ditorri o
configuration	Mapping		(4,9)
	(kcsi-im,lcsi-im)		
	CSI-IM timeConfig	alat	Not configured
	interval and offset	slot	Not configured
ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
	ForlChannelMeasur		Not configured
ements			
	ForInterferenceMeas		Not configured
urements cqi-FormatIndic	ator		Wideband
pmi-FormatIndic			Wideband
Sub-band Size	batoi	RB	16
csi-ReportingBa	and	110	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	ze		1
			One State with one Associated
			Report Configuration
CSI-AperiodicTriggerStateList			Associated Report
			Configuration contains pointers
	Codebook Typo		to NZP CSI-RS and CSI-IM typeI-SinglePanel
Codebook configuration	Codebook Type Codebook Mode		typei-SinglePanel
	(CodebookConfig-		ı ı
	N1,CodebookConf		(4,4)
	ig-N2)		(', ',
	(CodebookConfig-		
	O1,CodebookCon		(4,4)
	fig-O2)		,
	CodebookSubset		0x
	Restriction		FFFF FFFF FFFF
			FFFF FFFF FFFF
			FFFF FFFF FFFF
	DI Doctriction		FFFF FFFF FFFF
	RI Restriction		0000010

Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	6.5
Maximum number of HARQ			4
transmission			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 probability of each applicable i ₁ , i ₂ combination.		
Note 2:	· · · · · · · · · · · · · · · · · · ·		
Note 3:	Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.		

Table 6.3.2.2.4-2: Minimum requirement

Parameter	Test 1
γ	5.0

6.3.2.2.5 Multiple PMI with 16TX TypeII Codebook

For the parameters specified in Table 6.3.2.2.5-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.2.5-2.

Table 6.3.2.2.5-1: Test parameters (dual-layer)

Parameter		Unit	Test 1
Bandwidth		MHz kHz	40
	Subcarrier spacing		30
Duplex Mode	Duplex Mode		TDD
TDD DL-UL configurations			FR1.30-1 as specified in Annex A
Propagation of	Propagation channel		TDLA30-5
Antenna conf	iguration		XP Medium 16 x 2 (N1,N2) = (4,2)
Beamforming	Model		As specified in Annex B.4.1
	CSI-RS resource Type		Aperiodic
	Number of CSI-RS		4
	ports (X)		-
	CDM Type		FD-CDM2
	Density (ρ)		1
ZP CSI-RS	First subcarrier index in the PRB used for		Pow 5 (4)
configuratio	CSI-RS (k ₀ , k ₁)		Row 5, (4,-)
n	First OFDM symbol in		
	the PRB used for CSI- RS (I ₀ , I ₁)		(9,-)
	CSI-RS interval and offset	slot	Not configured
			1 in slots i, where mod(i, 10) =
	ZP CSI-RS trigger		1, otherwise it is equal to 0
	CSI-RS resource Type		Aperiodic
	Number of CSI-RS		16
	ports (X)		CDM4 (ED2 ED2)
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ) First subcarrier index		'
NZP CSI-	in the PRB used for		Row 12, (2, 4, 6, 8)
RS for CSI	CSI-RS (k ₀ , k ₁ , k ₂ , k ₃)		100 12, (2, 1, 0, 0)
acquisition	First OFDM symbol in		
	the PRB used for CSI-		(5, -)
	RS (I ₀ , I ₁)		
	CSI-RS	slot	Not configured
	interval and offset		3
	aperiodicTriggeringOff set		0
	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM	CSI-IM Resource		
configuratio	Mapping		(4,9)
n	(kcsi-im,lcsi-im)		
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfig			Aperiodic
CQI-table			Table 1
	reportQuantity		cri-RI-PMI-CQI
timeRestriction ents	timeRestrictionForlChannelMeasurem		Not configured
timeRestriction	timeRestrictionForInterferenceMeasur		Not configured
ements cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Subband
Sub-band Size		RB	16
csi-ReportingBand			1111111
CSI-Report interval and offset		slot	Not configured
Aperiodic Re	Aperiodic Report Slot Offset		8
CSI request			1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
reportTriggerSize			1

CSI-AperiodicTriggerStateList		One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
Codebook Type		typell
L (numberOfBeams)		2
N _{PSK} (phaseAlphabetSize)		8
subbandAmplitude		True
(CodebookConfig- N1,CodebookConfig- N2)		(4,2)
(CodebookConfig- O1,CodebookConfig- O2)		(4,4)
CodebookSubsetRestri		0x 7FF
ction		FFFF FFFF FFFF
RI Restriction (typell- RI-Restriction)		10
Physical channel for CSI report		PUSCH
CQI/RI/PMI delay		6.5
Maximum number of HARQ transmission		4
Measurement channel		R.PDSCH.2-8.3 TDD
Note 1: When Throughput is measured using random precoder selection, the		
	Codebook Type L (numberOfBeams) NPSK (phaseAlphabetSize) subbandAmplitude (CodebookConfig-N1,CodebookConfig-O1,CodebookConfig-O1,CodebookConfig-O2) CodebookSubsetRestriction RI Restriction (typeII-RI-Restriction) nnel for CSI report elay mber of HARQ t channel nen Throughput is measure	Codebook Type L (numberOfBeams) NPSK (phaseAlphabetSize) subbandAmplitude (CodebookConfig- N1,CodebookConfig- N2) (CodebookConfig- O1,CodebookConfig- O2) CodebookSubsetRestri ction RI Restriction (typeII- RI-Restriction) nnel for CSI report elay ms mber of HARQ t channel nen Throughput is measured using ra

Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable i₁, i₂ combination. The random precoder generation shall follow 'typel-SinglePanel' codebook configuration as specified in table 6.3.2.2.3-1.

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 dual-cluster beam directions shall be used as specified in Annex B.2.3.2.3A. The value of relative power ratio (p) shall be fixed as 1 during the test.

Table 6.3.2.2.5-2: Minimum requirement

Parameter	Test 1
	1.9

6.3.2.2.6 Multiple PMI with 16Tx Enhanced Type II Codebook

For the parameters specified in Table 6.3.2.2.6-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.2.6-2.

Table 6.3.2.2.6-1: Test parameters (dual-layer)

Parameter		Unit	Test 1
Bandwidth		MHz	40
Subcarrier sp	acing	kHz	30
Duplex Mode	Duplex Mode		TDD
TDD DL-UL configurations			FR1.30-1 as specified in Annex A
Propagation of	channel		TDLA30-5
Antenna conf	iguration		XP Medium 16 x 2
Beamforming	_		(N1,N2) = (4,2) As specified in Annex B.4.1
Beamerming	CSI-RS resource Type		Aperiodic
	Number of CSI-RS		·
	ports (X)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index		
ZP CSI-RS	in the PRB used for		Row 5, (4,-)
configuratio	CSI-RS (k ₀ , k ₁)		
n	First OFDM symbol in the PRB used for CSI- RS (I ₀ , I ₁)		(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 Number of CSI-RS		Aperiodic
	ports (X)		16
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier index		
NZP CSI-	in the PRB used for		Row 12, (2, 4, 6, 8)
RS for CSI	CSI-RS (k ₀ , k ₁ , k ₂ , k ₃)		
acquisition	First OFDM symbol in the PRB used for CSI-		(5, -)
	RS (I ₀ , I ₁)		
	CSI-RS	slot	Not configured
	interval and offset aperiodicTriggeringOff		
	set		0
	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM	CSI-IM Resource		
configuratio	Mapping		(4,9)
n	(ксы-ім,Ісы-ім)		
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfig	ReportConfigType		Aperiodic
CQI-table			Table 1
reportQuantit			cri-RI-PMI-CQI
timeRestrictionForlChannelMeasurem ents			Not configured
timeRestriction	timeRestrictionForInterferenceMeasur		Not configured
ements cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Not configured
Sub-band Siz			8
csi-ReportingBand		RB	1111111
CSI-Report interval and offset		slot	Not configured
Aperiodic Report Slot Offset			8
CSI request			1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
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		typell-r16
	paramCombination-r16		6 (L =4, $p_v = 1/2$, $\beta = 1/2$)
	R(numberOfPMISubba		
	ndsPerCQISubband-		1
Codebook	r16)		
	(CodebookConfig-		
configuratio	N1,CodebookConfig-		(4,2)
n	N2)		
''	(CodebookConfig-		
	O1,CodebookConfig-		(4,4)
	O2)		
	CodebookSubsetRestri		0x 7FF
	ction		FFFF FFFF FFFF
	RI Restriction (typeII-		0010
	RI-Restriction-r16)		
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	6.5
Maximum number of HARQ			4
transmission			•
Measurement channel			R.PDSCH.2-8.3 TDD
Note 1: When Throughput is measured using random precoder selection, the			

Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable i₁, i₂ combination. The random precoder generation shall follow 'typeI-SinglePanel' codebook configuration as specified in table 6.3.2.2.3-1.

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 dual-cluster beam directions shall be used as specified in Annex B.2.3.2.3A. The value of relative power ratio (p) shall be fixed as 1 during the test.

Table 6.3.2.2.6-2: Minimum requirement

Parameter	Test 1
γ	2.2

6.3.3 4RX requirements

6.3.3.1 FDD

6.3.3.1.1 Single PMI with 4TX TypeI-SinglePanel Codebook

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

Table 6.3.3.1.1-1: Test parameters (single layer)

Parameter		Unit	Test 1
Bandwidth	Bandwidth		10
Subcarrier space	Subcarrier spacing		15
Duplex Mode			FDD
Propagation cha	annel		TDLA30-5
Antenna configu	ıration		High XP 4 x 4
			(N1,N2) = (2,1)
Beamforming M			As specified in Annex B.4.1
	CSI-RS resource		Periodic
	Type		1 enouic
	Number of CSI-		4
	RS ports (X)		-
	CDM Type		FD-CDM2
	Density (ρ)		1
70 001 00	First subcarrier		
ZP CSI-RS	index in the PRB		Row 5, (4,-)
configuration	used for CSI-RS		
	(k ₀ , k ₁)		
	First OFDM		
	symbol in the PRB used for CSI-RS		(9,-)
	(l ₀ , l ₁) CSI-RS		
	periodicity and	slot	5/1
	offset	SIUL	3/1
	CSI-RS resource		
	Type		Aperiodic
	Number of CSI-		
	RS ports (X)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier		·
N70 001 00	index in the PRB		
NZP CSI-RS	used for CSI-RS		Row 4, (0,-)
for CSI	(k_0, k_1)		
acquisition	First OFDM		
	symbol in the PRB		(42.)
	used for CSI-RS		(13,-)
	(I_0, I_1)		
	CSI-RS		
	periodicity and	slot	Not configured
	offset		
	aperiodicTriggerin		0
	gOffset		,
	CSI-IM resource		Aperiodic
	Туре		·
	CSI-IM RE pattern		Pattern 0
CSI-IM	CSI-IM Resource		(4.0)
configuration	Mapping		(4,9)
	(k _{CSI-IM} , l _{CSI-IM}) CSI-IM timeConfig		
	periodicity and	slot	Not configured
	offset	SIUL	Not configured
ReportConfigType			Aperiodic
CQI-table	<u> </u>		Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasure			
	ments		Not configured
	timeRestrictionForInterferenceMeas		
urements	urements		Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	8
csi-ReportingBand			111111
CSI-Report periodicity and offset		slot	Not configured
Aperiodic Repo			4
Apenduic Report Glot Gliset			

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	(CodebookConfig- N1,CodebookConf ig-N2)		(2,1)
configuration	(CodebookConfig- O1,CodebookCon fig-O2)		(4,1)
	CodebookSubset Restriction		11111111
	RI Restriction		0000001
Physical ch	annel for CSI report		PUSCH
CQI/RI/PM		ms	6
	number of HARQ		4
transmission			
	ent channel		R.PDSCH.1-6.1 FDD
Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable i ₁ , i ₂ 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			ot (1 ms granularity) with equal mbination. k reporting instance at slot#n hk slot not later than slot#(n-3),
slot#(n+3). Note 3: Randomization of the principle beam direction shall be used as			direction shall be used as

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

specified in Annex B.2.3.2.3.

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

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

Parameter		Unit	Test 1
Bandwidth		MHz	10
Subcarrier spacing		kHz	15
Duplex Mode			FDD
Propagation cha	annel		TDLA30-5
Antenna configu	uration		High XP 8 x 4 (N1,N2) = (4,1)
Beamforming M	odel		As specified in Annex B.4.1
	CSI-RS resource		Periodic
	Type		i enouic
	Number of CSI-		4
	RS ports (X)		·
	CDM Type		FD-CDM2
	Density (ρ)		1
ZP CSI-RS	First subcarrier index in the PRB		
configuration	used for CSI-RS		Row 5, (4,-)
Cornigulation	(k ₀ , k ₁)		
	First OFDM		
	symbol in the PRB		4-)
	used for CSI-RS		(9,-)
	(l ₀ , l ₁)		
	CSI-RS		
	periodicity and	slot	5/1
	offset		
	CSI-RS resource		Aperiodic
	Туре		Aponodio
	Number of CSI-		8
	RS ports (X)		ODMA (EDO EDO)
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ) First subcarrier		1
	index in the PRB		
NZP CSI-RS	used for CSI-RS		Row 8, (4,6)
for CSI	(k_0, k_1)		
acquisition	First OFDM		
	symbol in the PRB		(F.)
	used for CSI-RS		(5,-)
	(l ₀ , l ₁)		
	CSI-RS		N
	periodicity and	slot	Not configured
	offset aperiodicTriggerin		
	gOffset		0
	CSI-IM resource		A
	Туре		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM	CSI-IM Resource		
configuration	Mapping		(4,9)
garamen.	(kcsi-im,lcsi-im)		
	CSI-IM timeConfig		N
	periodicity and	slot	Not configured
offset ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasure			
ments			Not configured
timeRestrictionForInterferenceMeas			Not soution
urements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	8
csi-ReportingBa			1111111
	odicity 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	
reportTriggerSize			1	
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM	
	Code	book Type		typel-SinglePanel
	Code	book Mode		1
Codeboo	N1,Co	ebookConfig- odebookConf)		(4,1)
configura	tion (Code	ebookConfig- odebookCon 2)		(4,1)
	Code Restr	bookSubset iction		0x FFFF
	RI Restriction			0000010
Physical	Physical channel for CSI report			PUSCH
CQI/RI/P			ms	8
	Maximum number of HARQ transmission			4
Measurer	nent channel			R.PDSCH.1-6.2 FDD
precoder shall be updated probability of each applicate Note 2: If the UE reports in an avai		in each slo ble i ₁ , i ₂ cor ilable uplin	k reporting instance at slot#n	
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). Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.			at the gNB downlink before	

Table 6.3.3.1.2-2: Minimum requirement

Parameter	Test 1
γ	1.5

6.3.3.1.3 Multiple 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	cing	kHz	15
Duplex Mode			FDD
Propagation ch	annel		TDLC300-5
Antenna configuration			High XP 16 x 4 (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 (p)		1

	First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁)		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁)		(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 ₀ , k ₁ , k ₂ , k ₃)		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	rpe		Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
	ForChannelMeasure		
ments			Not configured
timeRestrictionForInterferenceMeas urements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Subband
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
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 configuration	Codebook Mode		1
	(CodebookConfig- N1,CodebookConfig-N2)		(4,2)
	(CodebookConfig- O1,CodebookCon fig-O2)		(4,4)

	CodebookSubset		0x	
	Restriction		FFFF FFFF FFFF	
			FFFF FFFF FFFF	
	RI Restriction		0000010	
Physical channel for CSI report			PUSCH	
CQI/RI/P	MI delay	ms	8	
Maximun	n number of HARQ		4	
transmiss	sion		4	
Measurement channel			R.PDSCH.1-6.3 FDD	
Note 1: When Throughput is measu		sured using	random precoder selection, the	
precoder shall be updated		in each slo	t (1 ms granularity) with equal	
probability of each applicable i ₁ , i ₂ co			mbination.	
Note 2:	If the UE reports in an ava	ilable uplinl	k reporting instance at slot#n	
based on PMI estimation a		at a downlin	k slot not later than slot#(n-4),	
	this reported PMI cannot b			
	slot#(n+4).	, , , , , , , , , , , , , , , , , , , ,		
Note 3:	,			
	specified in Annex B.2.3.2			

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	ing	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 ₀ , k ₁)		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 for CSI acquisition	CSI-RS resource Type		Aperiodic
	Number of CSI- RS ports (X)		32
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1

	I		T
	First subcarrier		
	index in the PRB used for CSI-RS		Row 17, (2, 4, 6, 8)
	(k ₀ , k ₁ , k ₂ , k ₃)		
	First OFDM		
	symbol in the PRB		
	used for CSI-RS		(5, 12)
	(I_0, I_1)		
	CSI-RS		N
	interval and offset	slot	Not configured
	aperiodicTriggerin		
	gOffset		0
	CSI-IM resource		Aperiodic
	Type		Apendaic
	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	3101	140t configured
ReportConfigTy	pe		Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
	orChannelMeasure		Not configured
ments			
	ForInterferenceMeas		Not configured
urements	_1		
cqi-FormatIndic			Wideband
	pmi-FormatIndicator		Wideband
Sub-band Size		RB	8
csi-ReportingBand CSI-Report interval and offset		-1-4	1111111
		slot	Not configured
Aperiodic Repo	rt Slot Oliset		5
CSI request			1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
reportTriggerSiz	70		otherwise it is equal to 0
report riggersiz	<u> </u>		One State with one Associated
			Report Configuration
CSI-AperiodicTi	ringerStateList		Associated Report
Correpondatori	nggorotatoLiot		Configuration contains pointers
			to NZP CSI-RS and CSI-IM
	Codebook Type		typel-SinglePanel
	Codebook Mode		1
	(CodebookConfig-		
	N1,CodebookConf		(4,4)
	ig-N2)		
	(CodebookConfig-		
Codebook	O1,CodebookCon		(4,4)
configuration	fig-O2)		
	CodebookSubset		0x
	Restriction		FFFF FFFF FFFF
			FFFF FFFF FFFF
			FFFF FFFF FFFF
	RI Restriction		FFFF FFFF FFFF 00000010
			()()()()()()()

Physical channel for CSI report			PUSCH
CQI/RI/P		ms	8
Maximum	n number of HARQ		4
transmiss	sion		4
Measurer	ment channel		R.PDSCH.1-6.3 FDD
Note 1:	When Throughput is meas	ured using	random precoder selection, the
Note 2:	precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable i ₁ , i ₂ combination. 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:	,		

Table 6.3.3.1.4-2: Minimum requirement

Parameter	Test 1
γ	7.0

6.3.3.1.5 Multiple PMI with 16TX TypeII Codebook

For the parameters specified in Table 6.3.3.1.5-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.1.5-2.

Table 6.3.3.1.5-1: Test parameters (dual-layer)

Subcarrier spacing	Parameter		Unit	Test 1
Duplex Mode	Bandwidth		MHz	10
Propagation channel		cing	kHz	
Antenna configuration				
Beamforming Model	Propagation ch	nannel		
As specified in Annex B.4.1	Antenna config	Antenna configuration		
Type	Beamforming N			
Number of CSI-RS ports (X) CDM Type				Aperiodic
Dots (X)				
Density (p)				4
ZP CSI-RS In the PRB used for CSI-RS (kg, k1) First OFDM symbol in the PRB used for CSI-RS (kg, k1) CSI-RS (kg, k1) First OFDM symbol in the PRB used for CSI-RS (lg, l-1) C		CDM Type		FD-CDM2
In the PRB used for		Density (ρ)		1
CSI-RS (ko, k1)		First subcarrier index		
First OFDM symbol In the PRB used for CSI-RS (lo, lr) CSI-RS Interval and offset Interval and offs				Row 5, (4,-)
In the PRB used for CSI-RS (lo, l₁) CSI-RS interval and offset Slot Not configured	Comigaration			
CSI-RS (I ₀ , I ₁)				(9,-)
CSI-RS interval and offset zP CSI-RS trigger 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0		CSI-RS (I ₀ , I ₁)		
Technic Tech		CSI-RS	alat	Not configured
CSI-RS resource Type Aperiodic NZP CSI-RS ports (X) CDM Type CDM4 (FD2, TD2) Density (p) 1 First subcarrier index in the PRB used for CSI-RS (b, k1, k2, k3) First OFDM symbol in the PRB used for CSI-RS (b, l1) CSI-RS (l0, l1) CSI-RS (l0, l1) CSI-RS (l0, l1) CSI-RB interval and offset aperiodicTriggeringO ffset CSI-IM CSI-IM Resource Type Aperiodic CSI-IM Resource Mapping (ksi-IM, lcsi-IM) CSI-IM Resource Mapping (ksi-IM) CSI-IM Resource Type Aperiodic ReportConfigType Aperiodic ReportQuantity TimeRestrictionForChannelMeasurem ents timeRestrictionForChannelMeasurem ents cqi-FormatIndicator Wideband Sub-band Size Csi-RB 8 si-Report Interval and offset Slot Not configured 11 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0		interval and offset	SIOL	· ·
Type Number of CSI-RS ports (X) CDM Type Density (p) NZP CSI-RS for CSI acquisition NZP CSI-RS for CSI first subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁ , k ₂ , k ₃) First OFDM symbol in the PRB used for CSI-RS (k ₀ , k ₁ , k ₂ , k ₃) CSI-RS for CSI-RS for cSI-RS for CSI-RS (k ₀ , k ₁ , k ₂ , k ₃) Not configured Not configured Not configured Not configured Not configured ReportConfigType CSI-IM Resource for cSI-IM for configured for cSI-IM for configured for cSI-IM for configured for cSI-IM for configured for configured for configured for configured Not configured				
Number of CSI-RS ports (X) CDM Type Density (p) 1				Aperiodic
NZP CSI-RS for CSI acquisition NZP CSI-RS for CSI-RS (ko, k1, k2, k3) First subcarrier index in the PRB used for CSI-RS (ko, k1, k2, k3) First OFDM symbol in the PRB used for CSI-RS (ko, k1) CSI-RS interval and offset aperiodic TriggeringO ffset CSI-IM resource Type Aperiodic CSI-IM Resource Mapping (kcsi-IM) CSI-IM Resource Mapping (kcsi-IM) CSI-IM timeConfig interval and offset and offs		Number of CSI-RS		16
Density (p) First subcarrier index in the PRB used for CSI-RS (ko, k1, k2, k3)				-
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$				CDM4 (FD2, TD2)
$ \begin{array}{c} NZP CSI-RS \\ \text{for CSI} \\ \text{acquisition} \end{array} $				1
in the PRB used for CSI-RS (k ₀ , k ₁ , k ₂ , k ₃) First OFDM symbol in the PRB used for CSI-RS (l ₀ , l ₁) CSI-RS (l ₀ , l ₁) CSI-RS interval and offset aperiodicTriggeringO ffset CSI-IM resource Type CSI-IM RE pattern CSI-IM RE pattern CSI-IM Resource Mapping (k _{CSI-IM} , l _{CSI-IM}) CSI-IM timeConfig interval and offset ReportConfigType ReportConfigType ReportQuantity timeRestrictionForChannelMeasurem ents timeRestrictionForInterferenceMeasur ements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-Report interval and offset CSI request In the PRB used for CSI-R, k ₂ , k ₃) Row 12, (2, 4, 6, 8) Rot configured Row 12, (2, 4, 6, 8) Rot configured Rot configured	NZP CSI-RS			
First OFDM symbol in the PRB used for CSI-RS (lo, l-1) CSI-RS (lo, l-1) CSI-RS interval and offset aperiodicTriggeringO ffset CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (4,9) CSI-IM timeConfig interval and offset ReportConfigType CQI-table ReportQuantity Table 1 reportQuantity timeRestrictionForChannelMeasurem ents timeRestrictionForInterferenceMeasur ements cqi-FormatIndicator Sub-band Size csi-Report interval and offset CSI-Report offset RB RB RB RB RB RB RB RB RB R				Row 12, (2, 4, 6, 8)
First OFDM symbol in the PRB used for CSI-RS (lo, l1) CSI-RS (lo, l1) CSI-RS interval and offset aperiodicTriggeringO ffset	acquisition			
CSI-RS (lo, l1) CSI-RS interval and offset aperiodic TriggeringO ffset CSI-IM resource Type Aperiodic CSI-IM Resource Mapping (4,9) (KCSI-IM, ICSI-IM) CSI-IM timeConfig interval and offset Aperiodic CQI-table TeportQuantity Cri-RI-PMI-CQI timeRestrictionForChannelMeasurem ents timeRestrictionForInterferenceMeasurements cqi-FormatIndicator Wideband Sub-band Size RB 8 CSI-REPOrt Interval and offset SIot Not configured REPORT CONFIGURATION NOT CONFIGURED NOT CONFIGURE				(5.)
CSI-RS interval and offset aperiodicTriggeringO ffset				(5, -)
interval and offset aperiodicTriggeringO ffset CSI-IM resource Type Aperiodic CSI-IM RE pattern Pattern O CSI-IM Resource Mapping (kcsi-im,lcsi-im) CSI-IM timerconfig interval and offset ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasurem ents timeRestrictionForInterferenceMeasur ements cqi-FormatIndicator Wideband Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report Slot Offset 5 CSI request In slots i, where mod(i, 5) = 1, otherwise it is equal to 0				
aperiodicTriggeringO ffset CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (4,9) CSI-IM Resource Mapping (4,9) CSI-IM timeConfig interval and offset ReportConfigType CQI-table reportQuantity timeRestrictionForChannelMeasurem ents timeRestrictionForInterferenceMeasur ements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size RB 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8			slot	Not configured
CSI-IM resource Type CSI-IM RE pattern Pattern 0				
Type CSI-IM RE pattern CSI-IM Resource Mapping (kCSI-IM,ICSI-IM) CSI-IM timeConfig interval and offset ReportConfigType CQI-table reportQuantity timeRestrictionForChannelMeasurem ents timeRestrictionForInterferenceMeasur ements 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 Not configured Not configured Subband Not configured 1111111 Not configured 11 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0				0
CSI-IM RE pattern CSI-IM Resource Mapping (kcsi-im,lcsi-im) CSI-IM timeConfig interval and offset ReportConfigType CQI-table reportQuantity timeRestrictionForChannelMeasurem ents timeRestrictionForInterferenceMeasur ements cqi-FormatIndicator pmi-FormatIndicator pmi-FormatIndicator sub-band Size csi-ReportingBand CSI-Report interval and offset CSI request CSI-IM Resource Mapping (4,9) (4,9) Not configured Not configured Not configured Not configured Not configured Subband Sub-band Size Size Size Size Size Size Size Size				Aperiodic
CSI-IM Resource Mapping (kcsI-IM, lcsI-IM) CSI-IM timeConfig interval and offset ReportConfigType CQI-table reportQuantity timeRestrictionForChannelMeasurem ents timeRestrictionForInterferenceMeasur ements cqi-FormatIndicator Sub-band Size Sub-band Size Report Slot Offset CSI request CSI-IM Resource Mapping (4,9) (4,9) (4,9) Not configured Not configured Not configured Not configured ReportConfigType Aperiodic Not configured Not configured Not configured Not configured Not configured Not configured Sub-band Sub-band Size Size Size Size Size Size Size Size				Pattern 0
configuration Mapping (k _{CSI-IM} , l _{CSI-IM}) CSI-IM timeConfig interval and offset ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasurem ents timeRestrictionForInterferenceMeasur ements cqi-FormatIndicator Wideband pmi-FormatIndicator Subband Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report interval and offset Aperiodic Report Slot Offset CSI request Mot configured Not configured Not configured Not configured Not configured Videband Sub-band Size RB 8 CSI-Report interval and offset Slot Not configured Time Restriction For Interval and offset Slot Not configured Not configured Table 1 Table 1 Not configured Not configured Not configured Not configured Time Restriction For Interval and offset Slot Not configured Time Restriction For Interval and offset Slot Not configured Time Restriction For Interval and offset Slot Not configured Time Restriction For Interval and offset Slot Not configured Time Restriction For Interval and offset Slot Not configured Time Restriction For Interval and offset Slot Not configured Time Restriction For Interval Aperiodic Report Slot Offset Slot Not configured Time Restriction For Interval Aperiodic Report Slot Offset Slot Not configured Time Restriction For Interval Aperiodic Report Slot Offset Slot Not configured Time Restriction For Interval Aperiodic Report Slot Offset Slot Not configured	CSI-IM			T ditorrio
(kcsi-im, lcsi-im) CSI-IM timeConfig interval and offset slot Not configured ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasurem ents Not configured timeRestrictionForInterferenceMeasur ements Not configured cqi-FormatIndicator Wideband pmi-FormatIndicator Subband 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				(4.9)
CSI-IM timeConfig interval and offset slot Not configured ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasurem ents Not configured timeRestrictionForInterferenceMeasur ements Wideband cqi-FormatIndicator Wideband pmi-FormatIndicator Subband 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 timeRestrictionForChannelMeasurem ents timeRestrictionForInterferenceMeasur ements cqi-FormatIndicator Wideband pmi-FormatIndicator Subband Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report interval and offset Aperiodic Report Slot Offset CSI request Aperiodic Ap		CSI-IM timeConfig	elot	Not configured
CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasurem ents Not configured timeRestrictionForInterferenceMeasur ements Wideband cqi-FormatIndicator Subband pmi-FormatIndicator Subband 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			3101	-
reportQuantity timeRestrictionForChannelMeasurem ents timeRestrictionForInterferenceMeasur ements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size Sci-Report interval and offset Aperiodic Report Slot Offset CSI request Not configured Not configured Wideband Sub-band 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				
timeRestrictionForChannelMeasurem ents timeRestrictionForInterferenceMeasur ements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-Report interval and offset Aperiodic Report Slot Offset CSI request Not configured Wideband Subband Subband 1111111 RB 8 1111111 Not configured				
ents timeRestrictionForInterferenceMeasur ements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-Report interval and offset Aperiodic Report Slot Offset CSI request Not configured Wideband Subband Subband Subband 1111111 Not configured Not configured Not configured I in slots i, where mod(i, 5) = 1, otherwise it is equal to 0				cri-Ki-PMI-CQI
ements cqi-FormatIndicator pmi-FormatIndicator Subband Sub-band Size csi-ReportingBand CSI-Report interval and offset Aperiodic Report Slot Offset CSI request Not configured Not configured 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0	ents			Not configured
cqi-FormatIndicator Wideband pmi-FormatIndicator Subband 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				Not configured
pmi-FormatIndicator Subband 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
Sub-band Size CSi-ReportingBand CSI-Report interval and offset Aperiodic Report Slot Offset CSI request RB 8 1111111 Not configured 5 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0				
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			RB	
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				1111111
Aperiodic Report Slot Offset 5 CSI request 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0			slot	
otherwise it is equal to 0				5
	CSI request			
	reportTriggerS	ze		1 1

CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
	Codebook Type		typell
	L (numberOfBeams)		2
	N _{PSK} (phaseAlphabetSize)		8
	subbandAmplitude		True
Codebook configuration	(CodebookConfig- N1,CodebookConfig- N2)		(4,2)
Comiguration	(CodebookConfig- O1,CodebookConfig- O2)		(4,4)
	CodebookSubsetRes		0x 7FF
	triction		FFFF FFFF FFFF
	RI Restriction (typeII- RI-Restriction)		10
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	8
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.1-6.3
Note 1: When Throughout is measured us			andom precoder selection, the

Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable i₁, i₂ combination. The random precoder generation shall follow 'typeI-SinglePanel' codebook configuration as specified in table 6.3.3.1.3-1.

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 dual-cluster beam directions shall be used as specified in Annex B.2.3.2.3A. The value of relative power ratio (p) shall be fixed as 1 during the test.

Table 6.3.3.1.5-2: Minimum requirement

Parameter	Test 1
γ	1.9

6.3.3.1.6 Multiple PMI with 16Tx Enhanced Type II Codebook

For the parameters specified in Table 6.3.3.1.6-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.1.6-2.

Table 6.3.3.1.6-1: Test parameters (dual-layer)

Parameter		Unit	Test 1
Bandwidth		MHz	10
Subcarrier spa	cing	kHz	15
Duplex Mode			FDD
Propagation ch	nannel		TDLA30-5
Antenna config	juration		XP Medium 16 x 4 (N1,N2) = (4,2)
Beamforming N	Model		As specified in Annex B.4.1
•	CSI-RS resource		Appriadia
	Type		Aperiodic
	Number of CSI-RS		4
	ports (X)		
	CDM Type		FD-CDM2
	Density (ρ)		1
ZP CSI-RS configuration	First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁)		Row 5, (4,-)
Comiguration	First OFDM symbol		
	in the PRB used for CSI-RS (I ₀ , I ₁)		(9,-)
	CSI-RS	-1-4	Not configurated
	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		16
	ports (X)		CDM4 (FD2, TD2)
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
NZP CSI-RS	First subcarrier index in the PRB used for		Row 12, (2, 4, 6, 8)
for CSI	CSI-RS (k ₀ , k ₁ , k ₂ , k ₃)		10W 12, (2, 4, 0, 0)
acquisition	First OFDM symbol in the PRB used for		(5, -)
	CSI-RS (I ₀ , I ₁) CSI-RS interval and offset	slot	Not configured
	aperiodicTriggeringO		
	ffset		0
	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM configuration	CSI-IM Resource Mapping		(4,9)
	(k _{CSI-IM} ,I _{CSI-IM}) CSI-IM timeConfig		
	interval and offset	slot	Not configured
ReportConfigT	ReportConfigType		Aperiodic
CQI-table		-	Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasurem ents			Not configured
timeRestrictionForInterferenceMeasur ements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Not configured
Sub-band Size		RB	4
csi-ReportingBand			1111111
	CSI-Report interval and offset		Not configured
Aperiodic Report Slot Offset			5 1 in slots i, where mod(i, 5) = 1,
CSI request			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		typeII-r16
	paramCombination- r16		6 (L =4, $p_v = 1/2$, $\beta = 1/2$)
	R(numberOfPMISub bandsPerCQISubban d-r16)		1
Codebook configuration	(CodebookConfig- N1,CodebookConfig- N2)		(4,2)
	(CodebookConfig- O1,CodebookConfig- O2)		(4,4)
	CodebookSubsetRes		0x 7FF
	triction		FFFF FFFF FFFF
	RI Restriction (typeII- RI-Restriction-r16)		0010
Physical chann	nel for CSI report		PUSCH
CQI/RI/PMI de	CQI/RI/PMI delay		8
Maximum number of HARQ			4
transmission			4
Measurement channel			R.PDSCH.1-6.3
			andom precoder selection, the (1 ms granularity) with equal
			pination. The random precoder
probability of each applicable 11, 12 combinati			manon. The famoun precodel

probability of each applicable i₁, i₂ combination. The random precod generation shall follow 'typeI-SinglePanel' codebook configuration as specified in table 6.3.3.1.3-1.

If the UE reports in an available uplink reporting instance at slot#n based Note 2: 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 dual-cluster beam directions shall be used as Note 3: specified in Annex B.2.3.2.3A. The value of relative power ratio (p) shall be fixed as 1 during the test.

Table 6.3.3.1.6-2: Minimum requirement

Parameter	Test 1
γ	2.2

6.3.3.2 **TDD**

6.3.3.2.1 Single PMI with 4TX TypeI-SinglePanel Codebook

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

Table 6.3.3.2.1-1: Test parameters (single layer)

Parameter		Unit	Test 1
Bandwidth		MHz	10
Subcarrier spac	ing	kHz	15
Duplex Mode	annal .		FDD TDL A20 F
Propagation cha	annei		TDLA30-5 High XP 8 x 4
Antenna configu	ıration		(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
	First subcarrier		
ZP CSI-RS	index in the PRB		Row 5, (4,-)
configuration	used for CSI-RS		10W 3, (+,-)
	(k ₀ , k ₁)		
	First OFDM symbol in the PRB		
	used for CSI-RS		(9,-)
	(l ₀ , l ₁)		
	CSI-RS		
	periodicity and	slot	5/1
	offset		
	CSI-RS resource		Aperiodic
	Type 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		1,00
acquisition	(k ₀ , k ₁) First OFDM		
	symbol in the PRB		
	used for CSI-RS		(5,-)
	(l ₀ , l ₁)		
	CSI-RS		
	periodicity and	slot	Not configured
	offset		
	aperiodicTriggerin gOffset		0
	CSI-IM resource		
	Туре		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM	CSI-IM Resource		
configuration	Mapping		(4,9)
	(k _{CSI-IM} , l _{CSI-IM})		
	CSI-IM timeConfig periodicity and	slot	Not configured
	offset	SIUL	Not configured
ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasure			Not configured
ments timeRestrictionForInterferenceMeas			-
urements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size			8
	csi-ReportingBand		1111111
	odicity 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
Codebook	(CodebookConfig- N1,CodebookConfig-N2)		(4,1)
configuration	(CodebookConfig- O1,CodebookConfig- ig-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
Note 1: When Throughout is measured using rendem pro			

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

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

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

	rameter	Unit	Test 1
Bandwidth		MHz	40
Subcarrier space	ina	kHz	30
Duplex Mode	5		TDD
TDD DL-UL con	figuration		FR1.30-1 as specified in Annex A
Propagation cha	annel		TDLA30-5
Antenna configu	uration		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 ₀ , k ₁)		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (lo, l1)		(9,-)
	CSI-RS interval and offset	slot	10/1
NZP CSI-RS	CSI-RS resource Type		Aperiodic
for CSI acquisition	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 ₀ , k ₁)		Row 4, (0,-)
	First OFDM symbol in the PRB used for CSI-RS (l ₀ , l ₁)		(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	ре		Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
	orChannelMeasure		Not configured
timeRestrictionF urements	timeRestrictionForInterferenceMeas		Not configured
cqi-FormatIndica	ator		Wideband
pmi-FormatIndio			Wideband
Sub-band Size			16
csi-ReportingBand		RB	111111
CSI-Report interval and offset		slot	Not configured
		3101	8
CSI request	Aperiodic Report Slot Offset CSI request		1 in slots i, where $mod(i, 10) = 1$,
			otherwise it is equal to 0
	reportTriggerSize 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
Codebast	Codebook Mode (CodebookConfig- N1,CodebookConfig-N2)		(2,1)
Codebook configuration	(CodebookConfig- O1,CodebookConfig-O2)		(4,1)
	CodebookSubsetR estriction		11111111
	RI Restriction		0000001
Physical channel for CSI report			PUSCH
CQI/RI/PMI dela	ay	ms	5.5
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.2-8.1 TDD
Note 1: When Throughput is mossi		irod using	

Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable i₁, i₂ combination.

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

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

Table 6.3.3.2.1-2: 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			TDD FR1.30-1 as specified in Annex
TDD DL-UL con	figurations		A
Propagation cha	annel		TDLA30-5
Antenna configu	uration		High XP 8 x 4
Beamforming M			(N1,N2) = (4,1) As specified in Annex B.4.1
beamorning w	CSI-RS resource		
	Type		Periodic
	Number of CSI-		4
	RS ports (X)		
	CDM Type Density (p)		FD-CDM2
	First subcarrier		'
ZP CSI-RS	index in the PRB		Row 5, (4,-)
configuration	used for CSI-RS		10W 3, (4,-)
	(k ₀ , k ₁) First OFDM		
	symbol in the PRB		45.
	used for CSI-RS		(9,-)
	(l ₀ , l ₁)		
	CSI-RS	olot	10/1
	periodicity and offset	slot	10/1
	CSI-RS resource		Anariadia
	Туре		Aperiodic
	Number of CSI-		8
	RS ports (X) CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier		·
NZP CSI-RS for CSI	index in the PRB		Row 8, (4,6)
	used for CSI-RS		1100 0, (1,0)
acquisition	(k ₀ , k ₁) First OFDM		
	symbol in the PRB		(F.)
	used for CSI-RS		(5,-)
	(l ₀ , l ₁)		
	CSI-RS periodicity and	slot	Not configured
	offset	O.O.	Trot comigared
	aperiodicTriggerin		0
	gOffset		Ů.
	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM	CSI-IM Resource		
configuration	Mapping		(4,9)
Jgurumun	(kcsi-im,lcsi-im) CSI-IM timeConfig		
	periodicity and	slot	Not configured
	offset	3101	Not configured
ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
ements	timeRestrictionForChannnelMeasur ements		Not configured
	timeRestrictionForInterferenceMeas		Not configured
urements			Not configured
cqi-FormatIndic			Wideband
pmi-FormatIndio	zator	RB	Wideband 16
csi-ReportingBa	ınd	I/D	1111111
	odicity and offset	slot	Not configured

Aperiodic Re	port Slot Offset		8
CSI request			1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
reportTrigger	Size		1
CSI-Aperiodi	cTriggerStateList		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	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
Measuremen	t channel		R.PDSCH.2-8.2 TDD
Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable i ₁ , i ₂ combination. Note 2: If the UE reports in an available uplink reporting instance at slot#n 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

Parameter	Test 1
γ	1.5

6.3.3.2.3 Multiple PMI with 16TX Typel-SinglePanel Codebook

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)

Pai	rameter	Unit	Test 1
Bandwidth		MHz	40
Subcarrier space	cing	kHz	30
Duplex Mode			TDD
TDD DL-UL cor	nfigurations		FR1.30-1 as specified in Annex A
Propagation cha	annel		TDLC300-5
Antenna configu	uration		High XP 16 x 4 (N1,N2) = (4,2)
Beamforming M	lodel		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

	First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁)		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁)		(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 ₀ , k ₁ , k ₂ , k ₃)		Row 12, (2, 4, 6, 8)
aoquiomon	First OFDM symbol in the PRB used for CSI-RS (l ₀ , l ₁)		(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
	ForChannnelMeasur		
ements			Not configured
	ForInterferenceMeas		Not configured
cqi-FormatIndic	ator		Wideband
pmi-FormatIndi			Subband
Sub-band Size		RB	16
	csi-ReportingBand		1111111
CSI-Report interval and offset		slot	Not configured
	Aperiodic Report Slot Offset		8
CSI request			1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
reportTriggerSi-	reportTriggerSize		1, 00101 WISE It IS Equal to 0
reportinggeron			One State with one Associated
CSI-AperiodicTriggerStateList			Report Configuration
Col-Aperiodic I	nggerotateList		Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
	Codebook Turos		
	Codebook Type Codebook Mode		typel-SinglePanel 1
	(CodebookConfig-		I I
Codebook configuration	N1,CodebookConf ig-N2)		(4,2)
	(CodebookConfig- O1,CodebookCon		(4,4)
	fig-O2)		

	CodebookSubset		0x
	Restriction		FFFF FFFF FFFF
			FFFF FFFF FFFF
	RI Restriction		0000010
Physical	channel for CSI report		PUSCH
CQI/RI/P	MI delay	ms	6.5
Maximum number of HARQ			4
transmission			4
Measurement channel		R.PDSCH.2-8.3 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 applical	ole i ₁ , i ₂ cor	mbination.
Note 2:			
	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			t the gNB downlink before
	slot#(n+6).	• •	•
Note 3:	\ <i>\</i>		
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)

Pai	ameter	Unit	Test 1
Bandwidth		MHz	40
Subcarrier space	ing	kHz	30
Duplex Mode			TDD
TDD DL-UL cor	figurations		FR1.30-1 as specified in Annex A
Propagation cha	annel		TDLA30-5
Antenna configu	uration		High XP 32 x 4 (N1,N2) = (4,4)
Beamforming M	odel		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 ₀ , k ₁)		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	CSI-RS resource Type		Aperiodic
for CSI acquisition	Number of CSI- RS ports (X)		32
	CDM Type		CDM4 (FD2, TD2)

	Density (a)		1
	Density (ρ) First subcarrier		1
	index in the PRB		
	used for CSI-RS		Row 17, (2, 4, 6, 8)
	(k ₀ , k ₁ , k ₂ , k ₃) First OFDM		
	symbol in the PRB used for CSI-RS		(5, 12)
	(I ₀ , I ₁) CSI-RS		
		slot	Not configured
	interval and offset		
	aperiodicTriggerin gOffset		0
	CSI-IM resource		
			Aperiodic
	Type		Dottorn O
CCLIM	CSI-IM RE pattern		Pattern 0
CSI-IM	CSI-IM Resource		(4.0)
configuration	Mapping		(4,9)
	(kcsi-im,lcsi-im)		
	CSI-IM timeConfig	slot	Not configured
PonortConfinT	interval and offset		
ReportConfigTy CQI-table	γ pe		Aperiodic Table 1
	reportQuantity		cri-RI-PMI-CQI
timeRestrictionForChannnelMeasur			Not configured
ements timeRestrictionForInterferenceMeas			
urements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	16
csi-ReportingBand		- ND	111111
CSI-Report interval and offset		slot	Not configured
Aperiodic Report Slot Offset		0.00	8
			1 in slots i, where mod(i, 10) =
CSI request	CSI request		1, otherwise it is equal to 0
reportTriggerSiz	7e		1
. opon niggoron			One State with one Associated
			Report Configuration
CSI-AperiodicT	riggerStateList		Associated Report
22.7.50.1001011	33-1-310-01		Configuration contains pointers
			to NZP CSI-RS and CSI-IM
	Codebook Type		typel-SinglePanel
	Codebook Mode		1
	(CodebookConfig-		
	N1,CodebookConf		(4,4)
	ig-N2)		, , ,
	(CodebookConfig-		
Codebook	O1,CodebookCon		(4,4)
configuration	fig-O2)		, , ,
	CodebookSubset		0x
	Restriction		FFFF FFFF FFFF
			FFFF FFFF FFFF
			FFFF FFFF FFFF
			FFFF FFFF FFFF
i	RI Restriction		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: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable i ₁ , i ₂ combination. Note 2: If the UE reports in an available uplink reporting instance at slot#n 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:	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

6.3.3.2.5 Multiple PMI with 16TX TypeII Codebook

For the parameters specified in Table 6.3.3.2.5-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.2.5-2.

Table 6.3.3.2.5-1: Test parameters (dual-layer)

	Parameter	Unit	Test 1
Bandwidth		MHz	40
Subcarrier spacing		kHz	30
Duplex Mode	Duplex Mode		TDD
TDD DL-UL configurations			FR1.30-1 as specified in Annex A
Propagation of	channel		TDLA30-5
Antenna conf			XP Medium 16 x 4 (N1,N2) = (4,2)
Beamforming	Model		As specified in Annex B.4.1
	CSI-RS resource Type		Aperiodic
	Number of CSI-RS		4
	ports (X)		
	CDM Type		FD-CDM2
	Density (ρ)		1
ZP CSI-RS configuratio	First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁)		Row 5, (4,-)
n	First OFDM symbol in the PRB used for CSI- RS (I ₀ , I ₁)		(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		16
	ports (X)		
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
NZP CSI- RS for CSI	First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁ , k ₂ , k ₃)		Row 12, (2, 4, 6, 8)
acquisition	First OFDM symbol in the PRB used for CSI- RS (I ₀ , I ₁)		(5, -)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggeringOff set		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
ReportConfig			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForlChannelMeasurem ents			Not configured
timeRestrictionForInterferenceMeasur ements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Subband
Sub-band Size		RB	16
csi-ReportingBand			1111111
CSI-Report interval and offset		slot	Not configured
Aperiodic Report Slot Offset			8
CSI request			1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
reportTrigger	Size		1

CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
	Codebook Type		typell
	L (numberOfBeams)		2
	N _{PSK} (phaseAlphabetSize)		8
	subbandAmplitude		True
Codebook configuratio n	(CodebookConfig- N1,CodebookConfig- N2)		(4,2)
	(CodebookConfig- O1,CodebookConfig- O2)		(4,4)
	CodebookSubsetRestri ction		0x 7FF FFFF FFFF FFFF
	RI Restriction (typell- RI-Restriction)		10
Physical channel for CSI report			PUSCH
CQI/RI/PMI d	CQI/RI/PMI delay		6.5
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.2-8.3 TDD
Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable i ₁ , i ₂ combination. The random precoder generation shall follow 'typeI-SinglePanel' codebook configuration as			

specified in table 6.3.3.2.3-1.

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).

Randomization of the dual-cluster beam directions shall be used as Note 3: specified in Annex B.2.3.2.3A. The value of relative power ratio (p) shall be fixed as 1 during the test.

Table 6.3.3.2.5-2: Minimum requirement

Parameter	Test 1
γ	1.8

6.3.3.2.6 Multiple PMI with 16Tx Enhanced Type II Codebook

For the parameters specified in Table 6.3.3.2.6-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.2.6-2.

Table 6.3.3.2.6-1: 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 of	channel		TDLA30-5
			XP Medium 16 x 4
Antenna conf	iguration		(N1,N2) = (4,2)
Beamforming			As specified in Annex B.4.1
	CSI-RS resource Type		Aperiodic
	Number of CSI-RS		4
	ports (X) CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index		'
ZP CSI-RS	in the PRB used for		Row 5, (4,-)
configuratio	CSI-RS (k ₀ , k ₁)		
n	First OFDM symbol in		(0.)
	the PRB used for CSI- RS (I ₀ , I ₁)		(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		16
	ports (X) CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier index		·
NZP CSI-	in the PRB used for		Row 12, (2, 4, 6, 8)
RS for CSI	CSI-RS (k ₀ , k ₁ , k ₂ , k ₃)		
acquisition	First OFDM symbol in		(5.)
	the PRB used for CSI- RS (I ₀ , I ₁)		(5, -)
	CSI-RS		
	interval and offset	slot	Not configured
	aperiodicTriggeringOff		0
	set		
	CSI-IM resource Type		Aperiodic
CSI-IM	CSI-IM RE pattern		Pattern 0
configuratio	CSI-IM Resource Mapping		(4,9)
n	(ксы-ім,Ісы-ім)		(4,3)
	CSI-IM timeConfig	alat	Not configured
	interval and offset	slot	Not configured
ReportConfig	Туре		Aperiodic
CQI-table			Table 1
reportQuantit	nForlChannelMeasurem		cri-RI-PMI-CQI
timeRestrictionForlChannelMeasurem ents			Not configured
timeRestrictionForInterferenceMeasur			Not configured
ements			Wideband
cqi-FormatIndicator pmi-FormatIndicator			Not configured
Sub-band Size		RB	8
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
reportTrigger	Size		1

CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
	Codebook Type		typell-r16
Codebook configuratio n	paramCombination-r16		6 (L =4, $p_v = 1/2$, $\beta = 1/2$)
	R(numberOfPMISubba ndsPerCQISubband- r16)		1
	(CodebookConfig- N1,CodebookConfig- N2)		(4,2)
	(CodebookConfig- O1,CodebookConfig- O2)		(4,4)
	CodebookSubsetRestri		0x 7FF
	ction		FFFF FFFF FFFF
	RI Restriction (typeII- RI-Restriction-r16)		0010
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	6.5
Maximum number of HARQ			4
transmission			•
Measurement channel			R.PDSCH.2-8.3 TDD
pı	When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal		
	probability of each applicable i ₁ , i ₂ combination. The random precoder		
	generation shall follow 'typeI-SinglePanel' codebook configuration as		
	specified in table 6.3.3.2.3-1. Note 2: If the UE reports in an available uplink reporting instance at slot#n bas on PMI estimation at a downlink slot not later than slot#(n-6), this		

Table 6.3.3.2.6-2: Minimum requirement

reported PMI cannot be applied at the gNB downlink before slot#(n+6).

Randomization of the dual-cluster beam directions shall be used as specified in Annex B.2.3.2.3A. The value of relative power ratio (p) shall

Parameter	Test 1
γ	2.2

6.4 Reporting of Rank Indicator (RI)

be fixed as 1 during the test.

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

6.4.1 1RX requirements

Note 3:

(Void)

6.4.2 2RX requirements

6.4.2.1 FDD

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

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

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

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

Table 6.4.2.1-1: RI Test (FDD)

	Parameter	Unit	Test 1	Test 2	Test 3
Bandwidth		MHz	10	10	10
Subcarrier sp	acing	kHz	15	15	15
Duplex Mode			FDD	FDD	FDD
SNR		dB	0	20	20
Propagation of			TDLA30-5	TDLA30-5	TDLA30-5
Antenna confi	iguration		ULA Low 2x2	ULA Low 2x2	ULA High 2x2
Beamforming	Model		As defined in	As defined in	As defined in
Beamleming			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		Row 5, (4,-)	Row 5, (4,-)	Row 5, (4,-)
n	PRB used for CSI-RS (k ₀ , k ₁)			, (. , ,	, (. , ,
	First OFDM symbol in the PRB		(9,-)	(9,-)	(9,-)
	used for CSI-RS (I ₀ , I ₁)		(-,,	(-,,	(-,,
	CSI-RS	slot	5/1	5/1	5/1
	periodicity and offset		Davis dia	Dania dia	Davis dia
	CSI-RS resource Type		Periodic	Periodic	Periodic
	Number of CSI-RS ports (X)		2 FD-CDM2	2 ED CDM2	2 FD CDM2
NZP CSI-	CDM Type			FD-CDM2	FD-CDM2
RS for CSI	Density (p) First subcarrier index in the		1	1	1
acquisition	PRB used for CSI-RS (k ₀ , k ₁)		Row 3 (6,-)	Row 3 (6,-)	Row 3 (6,-)
	First OFDM symbol in the PRB				
	used for CSI-RS (I ₀ , I ₁)		(13,-)	(13,-)	(13,-)
	NZP CSI-RS-timeConfig				
	periodicity and offset	slot	5/1	5/1	5/1
	CSI-IM resource Type		Periodic	Periodic	Periodic
	CSI-IM RE pattern		Pattern 0	Pattern 0	Pattern 0
CSI-IM	CSI-IM Resource Mapping				
configuratio	(kcsi-im,lcsi-im)		(4,9)	(4,9)	(4,9)
n	CSI-IM timeConfig		E /4	E /4	E /4
	periodicity and offset	slot	5/1	5/1	5/1
ReportConfig			Periodic	Periodic	Periodic
CQI-table			Table 2	Table 2	Table 2
reportQuantity	,		cri-RI-PMI-CQI	cri-RI-PMI-	cri-RI-PMI-
reportiquantity	y		CII-KI-FIVII-CQI	CQI	CQI
timePestrictio	nForChannelMeasurements		not configured	not	not
timercestrictio	The ordinal menule as dreiner its		not configured	configured	configured
timeRestrictio	nForInterferenceMeasurements		not configured	not	not
				configured	configured
cqi-FormatInd			Wideband	Wideband	Wideband
pmi-FormatIn			Wideband	Wideband	Wideband
Sub-band Siz		RB	8	8	8
csi-Reporting			1111111	1111111	1111111
CSI-Report pe	eriodicity and offset	slot	5/0	5/0	5/0
	Codebook Type		typel-	typel-	typel-
	On data and Maria		SinglePanel	SinglePanel	SinglePanel
	Codebook Mode		1	1	1
Codok!	(CodebookConfig-		N/A	N/A	N/A
Codebook	N1,CodebookConfig-N2)				
configuration	CodebookSubsetRestriction		010000 for	000011 for	000011 for
			fixed rank 2, 010011 for	fixed rank 1, 010011 for	fixed rank 1, 010011 for
			following rank	following rank	following rank
	RI Restriction		N/A	N/A	N/A
Physical char	nnel for CSI report		PUCCH	PUCCH	PUCCH
CQI/RI/PMI d		me	8 8	8 8	8
Maximum nur	mber of HARQ transmission	ms	1	1	1
			Fixed RI = 2	Fixed RI = 1	Fixed RI = 1
RI Configurati	ion		and follow RI	and follow RI	and follow RI
1	asurements channels are specifie				

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

Table 6.4.2.1-2: Minimum requirement (FDD)

	Test 1	Test 2	Test 3
24	N/A	1.05	0.9
72	1.0	N/A	N/A

6.4.2.2 TDD

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

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

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

Table 6.4.2.2-1: RI Test (TDD)

	Parameter	Unit	Test 1	Test 2	Test 3
Bandwidth		MHz	40	40	40
Subcarrier sp	acing	kHz	30	30	30
Duplex Mode			TDD	TDD	TDD
TDD Slot Cor	figuration		FR1.30-1	FR1.30-1	FR1.30-1
SNR	<u> </u>	dB	0	20	20
Propagation of	channel	_	TDLA30-5	TDLA30-5	TDLA30-5
Antenna conf			ULA Low 2x2	ULA Low 2x2	ULA High 2x2
			As defined in	As defined in	As defined in
Beamforming	Model		Annex B.4.1	Annex B.4.1	Annex B.4.1
	CSI-RS resource Type		Periodic	Periodic	Periodic
	Number of CSI-RS ports (X)		4	4	4
	CDM Type		FD-CDM2	FD-CDM2	FD-CDM2
ZP CSI-RS	Density (ρ)		1	1 D-0DIVIZ	1 0-001012
configuratio	First subcarrier index in the			·	ı
n	PRB used for CSI-RS (k ₀ , k ₁)		Row 5, (4,-)	Row 5, (4,-)	Row 5, (4,-)
''	First OFDM symbol in the PRB				
	used for CSI-RS (I ₀ , I ₁)		(9,-)	(9,-)	(9,-)
	CSI-RS				
		slot	10/1	10/1	10/1
	periodicity and offset		Daviadia	Daviadia	Daviadia
	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	First subcarrier index in the		Row 3 (6,-)	Row 3 (6,-)	Row 3 (6,-)
acquisition	PRB used for CSI-RS (k ₀ , k ₁)		11011 0 (0,)	11011 0 (0,)	11011 0 (0,)
	First OFDM symbol in the PRB		(13,-)	(13,-)	(13,-)
	used for CSI-RS (I ₀ , I ₁)		(10,-)	(13,-)	(13,-)
	NZP CSI-RS-timeConfig	slot	10/1	10/1	10/1
	periodicity and offset	3101			
	CSI-IM resource Type		Periodic	Periodic	Periodic
CSI-IM	CSI-IM RE pattern		Pattern 0	Pattern 0	Pattern 0
	CSI-IM Resource Mapping		(4.0)	(4.0)	(4.0)
configuratio	(k _{CSI-IM} ,I _{CSI-IM})		(4,9)	(4,9)	(4,9)
n	CSI-IM timeConfig	4 ما م	40/4	40/4	4.0/4
	periodicity and offset	slot	10/1	10/1	10/1
ReportConfig	Type		Periodic	Periodic	Periodic
CQI-table			Table 2	Table 2	Table 2
			: DI DMI OOI	cri-RI-PMI-	cri-RI-PMI-
reportQuantity	y		cri-RI-PMI-CQI	CQI	CQI
				not	not
timeRestrictio	nForChannelMeasurements		not configured	configured	configured
				not	not
timeRestrictio	nForInterferenceMeasurements		not configured	configured	configured
cqi-FormatInd	licator		Wideband	Wideband	Wideband
pmi-FormatIn			Wideband	Wideband	Wideband
Sub-band Siz		RB	16	16	16
csi-Reporting		ואט	1111111	1111111	1111111
	eriodicity and offset	slot	10/9	10/9	10/9
COI-Kepoit pe		SIUL			
	Codebook Type		typel- SinglePanel	typel-	typel-
	O - d - b d - M - d -			SinglePanel	SinglePanel
	Codebook Mode		1	1	1
0-4 .	(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
			following rank	following rank	following rank
	RI Restriction		N/A	N/A	N/A
	nnel for CSI report		PUCCH	PUCCH	PUCCH
CQI/RI/PMI d		ms	9.5	9.5	9.5
Maximum nur	nber of HARQ transmission		1	1	1
PI Configurati			Fixed RI = 2	Fixed RI = 1	Fixed RI = 1
RI Configurati			and follow RI	and follow RI	and follow RI
Note 1: Me	asuraments channels are specifie	d in Table	A 4.2 TDC 2.2 io	used for Donk 1	account TDC 2.4

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

Table 6.4.2.2-2: Minimum requirement (TDD)

	Test 1	Test 2	Test 3
21	N/A	1.05	0.9
72	1.0	N/A	N/A

6.4.3 4RX requirements

6.4.3.1 FDD

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

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

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

Table 6.4.3.1-1: RI Test (FDD)

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

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

Table 6.4.3.1-2: Minimum requirement (FDD)

	Test 1	Test 2	Test 3	Test 4
29	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 spa	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 c			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
			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 (ρ)		1	1	1	1
configuratio n	First subcarrier index in the		Row 5, (4,-)	Row 5, (4,-)	Row 5, (4,-)	Row 5, (4,-)
''	PRB used for CSI-RS (k ₀ , k ₁) First OFDM symbol in the PRB					
	used for CSI-RS (I ₀ , I ₁)		(9,-)	(9,-)	(9,-)	(9,-)
ł	CSI-RS					
	periodicity and offset	slot	10/1	10/1	10/1	10/1
	CSI-RS resource Type		Periodic	Periodic	Periodic	Periodic
ł	Number of CSI-RS ports (X)		2	2	2	4
Ì	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		Row 3 (6,-)	Row 3 (6,-)	Row 3 (6,-)	Row 4 (0,-)
acquisition	PRB used for CSI-RS (k ₀ , k ₁)		ROW 3 (6,-)	ROW 3 (6,-)	ROW 3 (6,-)	ROW 4 (0,-)
	First OFDM symbol in the PRB		(13,-)	(13,-)	(13,-)	(13,-)
	used for CSI-RS (I ₀ , I ₁)		(13,-)	(13,-)	(13,-)	(13,-)
	NZP CSI-RS-timeConfig	slot	10/1	10/1	10/1	10/1
	periodicity and offset	0.01				
	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	(k _{CSI-IM} ,I _{CSI-IM}) CSI-IM timeConfig					
	periodicity and offset	slot	10/1	10/1	10/1	10/1
ReportConfig			Periodic	Periodic	Periodic	Periodic
CQI-table	1,400		Table 2	Table 2	Table 2	Table 2
				cri-RI-PMI-	cri-RI-PMI-	cri-RI-PMI-
reportQuantity	y		cri-RI-PMI-CQI	CQI	CQI	CQI
timo Postriotio	n For Channal Magauramenta		not configured	not	not	not
umeresincio	nForChannelMeasurements		not configured	configured	configured	configured
timeRestrictio	nForInterferenceMeasurements		not configured	not	not	not
			•	configured	configured	configured
cqi-FormatInd			Wideband	Wideband	Wideband	Wideband
pmi-FormatInd			Wideband	Wideband	Wideband	Wideband
Sub-band Size		RB	16	16	16	16
csi-Reporting		-1.1	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	ı	l	ı
	N1,CodebookConfig-N2)		N/A	N/A	N/A	(2,1)
	CodebookSubsetRestriction		010000 for	000011 for	000011 for	
Codebook	2 3 4 3 5 5 1 1 CHOING		fixed rank 2,	fixed rank 1,	fixed rank 1,	
configuration			010011 for	010011 for	010011 for	11111111
3			following rank	following rank	following rank	
	RI Restriction		<u> </u>	<u> </u>	<u> </u>	00000010 for
						fixed Rank 2
			N/A	N/A	N/A	and
						00001111 for
						follow RI
	nnel for CSI report		PUCCH	PUCCH	PUCCH	follow RI PUCCH
CQI/RI/PMI de		ms	PUCCH 9.5	PUCCH 9.5 1	PUCCH 9.5	follow RI

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

Table 6.4.3.2-2: Minimum requirement (TDD)

	Test 1	Test 2	Test 3	Test 4
21	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, 7.1.1.5.

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

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 advanced receiver	FR2 TDD	PDSCH	Clause 7.2.2.2.1 (Test 3-1)	
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	
DRX Adaptation (<i>drx-Adaptation-r16</i>)	FR2 TDD	PDCCH	Clause 7.3.2.2.3	If the Test 3-1 in Clause 7.3.2.2.3 is passed, the test coverage can be considered fulfilled without executing Test 1-2 in clause 7.3.2.2.1.
256QAM for PDSCH (pdsch-256QAM-FR2)	FR2 TDD	PDSCH	Clause 7.2.2.2.1 (Test 1-4)	
256QAM for PDSCH (pdsch- 256QAM-FR2)	FR2 TDD	SDR	Clause 7.5A.1	For UE capable of pdsch- 256QAM-FR2 for certain band(s), mcs-Table is configured to '64QAM' for SDR test.

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	FR2 TDD	PDSCH SDR	Clause 7.2 Clause 7.5.1 Clause 7.5A.1	
(onePortsPTRS)			Glause 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)				
	_C corresponds to NR CA configurations and bandwidth combination s defined in Clause 5.5A.1 of TS 38.101-2 [7].				
CA_N corresponds to NR CA configurations and bandwidth combination sets defined in Clause 5.5A.2 of TS 38.101-2 [7]. CA_AX corresponds to NR CA configurations and bandwidth combination sets 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 $DataRate = 10^{-3} \sum_{j=1}^{J} TBS_{j} 2^{\mu_{j}}$ 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	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 conving	Physical Cell ID		0
Common serving cell parameters	SSB position in burst		1
celi 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 Single Panel Type I,
	PDCCH & PDCCH DMRS Precoding configuration		Random per slot with equal probability of each applicable i ₁ , i ₂ combination, and with REG bundling granularity for number of Tx larger than 1
Cross carrier schedul			Not configured
	First subcarrier index in the PRB used for CSI-RS (<i>k</i> 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

			0
	Frequency Occupation		Start PRB 0 Number of PRB = ceil(BWP size/4)*4
	QCL info		TCI state #0
	First subcarrier index in the PRB used for CSI-RS (k_0)		0
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		12
	Number of CSI-RS ports (X)		2
	CDM Type		FD-CDM2
NZP CSI-RS for	Density (ρ)		1
CSI acquisition	CSI-RS periodicity	Slots	60 kHz SCS: 80 120 kHz SCS: 160
	CSI-RS offset		0
	Frequency Occupation		Start PRB 0 Number of PRB = ceil(BWP size/4) *4
	QCL info		TCI state #1
	First subcarrier index in the PRB used for CSI-RS (k ₀)		4
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		12
	Number of CSI-RS ports (X)		4
ZP CSI-RS for CSI	CDM Type		FD-CDM2
acquisition	Density (p)		1
	CSI-RS periodicity	Slots	60 kHz SCS: 80 120 kHz SCS: 160
	CSI-RS offset		0
	Frequency Occupation		Start PRB 0 Number of PRB = ceil(BWP size/4) *4
	First subcarrier index in the PRB used for CSI-RS		k ₀ =0 for CSI-RS resource 1,2
	First OFDM symbol in the PRB used for CSI-RS		I ₀ = 8 for CSI-RS resource 1 I ₀ = 9 for CSI-RS resource 2
	Number of CSI-RS ports (X)		1 for CSI-RS resource 1,2
	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	Slots	60 kHz SCS: 80 for CSI- RS resource 1,2 120 kHz SCS: 160 for CSI-RS resource 1,2
	CSI-RS offset	Slots	0 for CSI-RS resource 1,2
	Frequency Occupation		Start PRB 0 Number of PRB = ceil(BWP size/4)*4
	Repetition		ON
	QCL info		TCI state #1
	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 PDSCH DMRS CDM group(s) without data		1
TCI state #0	SSB index		SSB #0
	<u> </u>		·

	Type 1 QCL information	QCL Type	Туре С
	Type 2 QCL	SSB index	SSB #0
	information	QCL Type	Type D
	Type 1 QCL information	CSI-RS resource	CSI-RS resource 1 from 'CSI-RS for tracking' configuration
TCI 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
	Frequency den		2
PTRS configuration	Time density (Lpt-rs)	1
Resource Element Offset		2	
Maximum number of	code block group	os for ACK/NACK feedback	1
Maximum number of	HARQ transmiss	sion	4
HARQ ACK/NACK bu	undling		Multiplexed
Redundancy version	coding sequence)	{0,2,3,1}
PDSCH & PDSCH D	MRS Precoding o	configuration	Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i ₁ , i ₂ combination, andwith Wideband granularity
Symbols for all unused REs		OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1	
Physical signals, cha	nnels mapping a	nd precoding	As specified in Annex B.4.1
Note 1: LIE ecoum	on that the TCL of	tate for the DDSCH is identical to the	TCI state applied for the DDCCH

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 38.101-2 [7] for tested channel bandwidth and subcarrier spacing.

Table 7.2-2: 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

7.2.1 1RX requirements

(Void)

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

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, 1-4, 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>I</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 1-4 and 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 wideband for Test 1-1, 2 for other tests Test 2-1: Type 1 with start RB = 30, L _{RBs} = 6 Other tests: Type 0 Test 2-1: N/A 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			8 for Test 1-1, 1-3, 1-4, 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)

		D. 1 . W				Correlation	Reference value	
Test num	Referenc e channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Modulatio n and code rate	TDD UL- DL pattern	Propagatio n condition	matrix and antenna configuratio n	Fraction of maximum throughpu t (%)	SNR _B _B (dB)
1-1	R.PDSCH .5-1.1 TDD	100 / 120	QPSK, 0.30	FR2.120- 1A	TDLC60- 300	2x2 ULA Low	70	-0.4
1-2	R.PDSCH .5-2.1 TDD	100 / 120	16QAM, 0.48	FR2.120- 1	TDLA30- 300	2x2 ULA Low	30	1.7
1-3	R.PDSCH .5-3.1 TDD	100 / 120	64QAM, 0.46	FR2.120- 1	TDLA30- 300	2x2 XPL Medium	70	12.4
1-4	R.PDSCH .5-10.1 TDD	50 / 120	256QAM 0.67	FR2.120- 1	TDLD30-75	2x2 ULA Low	70	20.2

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 _{BB} (dB)
2-1	R.PDSCH. 5-4.1 TDD	100 / 120	QPSK, 0.30	FR2.12 0-2	TDLA30-75	2x2 ULA Low	70	4.1
2-2	R.PDSCH. 5-2.2 TDD	100 / 120	16QAM, 0.48	FR2.12 0-1	TDLA30- 300	2x2 ULA Low	70	14.4
2-3	R.PDSCH. 5-5.2 TDD	50 / 120	16QAM,0.4 8	FR2.12 0-2	TDLA30-75	2x2 ULA Low	70	14.0
2-4	R.PDSCH. 5-2.3 TDD	200 / 120	16QAM, 0.48	FR2.12 0-1	TDLA30- 300	2x2 ULA Low	70	14.2
2-5	R.PDSCH. 4-1.1 TDD	50 / 60	16QAM, 0.48	FR2.60- 1	TDLA30-75	2x2 ULA Low	70	14.3
2-6	R.PDSCH. 5-6.1 TDD	100 / 120	64QAM, 0.43	FR2.12 0-2	TDLA30-75	2x2 ULA Low	70	18.6

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

	Test		Bandwidt h (MHz) /	Modulatio	TDD UL-		Correlation matrix and	Reference Fraction of	value
	num	Reference channel	Subcarrier spacing (kHz)	n and code rate	DL pattern	Propagatio n condition	antenna configuratio n	maximum throughpu t (%)	SNR _B _B (dB)
Ī	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	
	k0		0	
	Starting symbol (S)		1	
	Length (L)		13	
	PDSCH aggregation factor		2	
PDSCH configuration	PRB bundling type		Static	
1 Door Conniguration	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			2	
The number of slots between final repetition of PDSCH and corresponding HARQ-ACK information			As defined in Annex A.1.3 (Note 1)	
Note 1: ACK/NACK feedback is generated for PDSCH on slot i, where mod(i,4) = 1, where i is the slot index per				

frame; $i = \{0,...,79\}$

Table 7.2.2.2.3: Minimum performance for Rank 1 (FRC)

Test	Reference	Bandwidth (MHz) /	Modulation	TDD UL-	Propagation	Correlation matrix and	Refere valu	
num		Subcarrier and code spacing rate (kHz)	and code rate	DL pattern	condition	antenna configuration	Target BLER	SNR (dB)
1-1	R.PDSCH. 5-10.1 TDD	100 / 120	16QAM, 0.37	FR2.120-2	TDLA30-75	2x2 ULA Low	1% (Note 1)	-1.1

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. 3-3, with the addition of test parameters in Table 7.2.2.2. 3-2 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. 3-1.

Table 7.2.2.2. 3-1: Test purpose

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

Table 7.2.2.2. 3-2: Test parameters

Parameter			Value
Duplex mode			TDD
Active DL BWP inc	dex		1
PDCCH configuration	Number of PDCCH candidates and aggregation levels		1/AL8
comgaration	Mapping type		Type B
	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. 3-3: Minimum performance for Rank 1

		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. 5-1.2 TDD	100 / 120	QPSK, 0.30	FR2.120- 1	[TDLA30-75]	2x2, ULA Low	70	1.3	

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			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		1
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:	Note 1: The applicability of requirements for different CA duplex modes, SCSs, CA configurations and bandwidth					
	combination 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		Parameter	Unit	Value
Common	Carrier	Offset between Point A and the		0
Carrier (Note 1)	configuration			
Configuration #1 Cyclic prefix Normal Common serving cell parameters SSB position in burst 1 SSB position in burst 1 1 SSB position in burst 1 1 SSB position in burst ms 20 SIOts for PDCCH monitoring Each slot Number of PDCCH candidates 1 Frequency domain resource allocation for CORESET Start from RB = 0 TCI state TCI state #1 TCI state TCI state #1 First subcarrier index in the PRB used for CSI-RS (k0) CSI-RS resource 2:		carrier (Note 1)		
Common serving cell parameters		Cyclic prefix		Normal
SSS position in burst SSS position in burst SSS position in burst SSS periodicity ms 20				
SSB periodicity				·
Slots for PDCCH monitoring Number of PDCCH candidates 1				
Number of PDCCH candidates	parameters		ms	
PDCCH				Each slot
Configuration Configuration Configuration Configuration Tile state Configuration Tile state T		Number of PDCCH candidates		1
TCl state #1 TCl state #1 First subcarrier index in the PRB used for CSI-RS (k0)				with contiguous RB
First subcarrier index in the PRB used for CSI-RS (k0)		TCI state		
Used for CSI-RS (k0)				
CSI-RS resource 1: 4				0
First OFDM symbol in the PRB used for CSI-RS (I0)				4
CSI-RS for tracking				8
Number of CSI-RS ports (X) 1				4
CDM Type				8
Density (p)	CSI-RS for	Number of CSI-RS ports (X)		1
CSI-RS periodicity	tracking	CDM Type		No CDM
CSI-RS offset				3
CSI-RS offset		CSI-RS periodicity	Slots	160
Repetition Slots				
Frequency Occupation Frequency Occupation CQL info First subcarrier index in the PRB used for CSI-RS (k0) Number of PRB = ceil(BWP size/4)*4 CSI-RS resource 1: 8 CSI-RS resource 2: 9 Number of CSI-RS (l0) Number of CSI-RS ports (X) CDM Type Density (p) Density (p) CSI-RS periodicity Slots CSI-RS resource 2: 9 No CDM No CDM CSI-RS resource 2: 9 No CDM TO SIMP Slots CSI-RS resource 1: 8 CSI-RS resource 2: 9 No CDM No CDM To SI-RS resource 2: 9 No CDM Slots Frequency Occupation Frequency Occupation Frequency Occupation CSI-RS offset Slots Slots Slots Slots TCI state #1 Single Panel Type I, Random per slot with equal probability of each applicable is, iz combination, and with REG bundling granularity for number of Tx larger than 1		CSI-RS offset	Slots	
Start PRB 0 Number of PRB = ceil(BWP size/4)*4		COI NO Oliset	Cioto	
Frequency Occupation QCL info GCL info First subcarrier index in the PRB used for CSI-RS (k0) First OFDM symbol in the PRB used for CSI-RS (l0) Number of CSI-RS (l0) Number of CSI-RS ports (X) CDM Type Density (p) CSI-RS periodicity CSI-RS periodicity CSI-RS periodicity CSI-RS periodicity Slots CSI-RS resource 1: 8 CSI-RS resource 2: 9 No CDM No CDM 120 kHz SCS: 160 for CSI-RS resource 1,2 CSI-RS resource 1: 8 CSI-RS periodicity Slots Frequency Occupation Frequency Occupation CSI-RS periodicity Slots Slots TCI state #1 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				
CCL info QCL info GCL info GCL info First subcarrier index in the PRB used for CSI-RS (k0) First OFDM symbol in the PRB used for CSI-RS (l0) Number of CSI-RS ports (X) CDM Type Density (p) CSI-RS periodicity CSI-RS periodicity CSI-RS offset CSI-RS offset CSI-RS offset Slots Frequency Occupation CSI-RS periodicity Frequency Occupation CSI-RS periodicity CSI-RS offset CSI-RS offset Slots TCI state #1 Single Panel Type I, Random per slot with equal probability of each applicable in, i2 combination, and with REG bundling granularity for number of Tx larger than 1				
CCL info		Frequency Occupation		
First subcarrier index in the PRB used for CSI-RS (k0) First OFDM symbol in the PRB used for CSI-RS (l0) Number of CSI-RS ports (X) CDM Type Density (p) CSI-RS periodicity CSI-RS periodicity CSI-RS periodicity CSI-RS periodicity CSI-RS periodicity Slots CSI-RS resource 2: 9 No CDM Density (p) 3 120 kHz SCS: 160 for CSI-RS resource 1,2 CSI-RS offset Slots CSI-RS resource 1,2 Start PRB 0 Number of PRB = ceil(BWP size/4) *4 Repetition QCL info PDCCH & PDCCH DMRS Precoding configuration PDCCH & PDCCH DMRS Precoding configuration ON CSI-RS resource 1,2 Start PRB 0 Number of PRB = ceil(BWP size/4) *4 Repetition ON TCI state #1 Single Panel Type I, Random per slot with equal probability of each applicable ii, i2 combination, and with REG bundling granularity for number of Tx larger than 1		OCL info		
used for CSI-RS (k0) First OFDM symbol in the PRB used for CSI-RS (l0) Number of CSI-RS ports (X) CDM Type Density (p) CSI-RS periodicity CSI-RS periodicity CSI-RS periodicity CSI-RS periodicity CSI-RS offset CSI-RS offset Slots Slots 120 kHz SCS: 160 for CSI-RS resource 1,2 CSI-RS offset Slots CSI-RS resource 1,2 Start PRB 0 Number of PRB = ceil(BWP size/4) *4 Repetition QCL info PDCCH & PDCCH DMRS Precoding configuration Value of PRS of				TCI state #0
First OFDM symbol in the PRB used for CSI-RS (I0) CSI-RS resource 1: 8 CSI-RS resource 2: 9				0
First OFDM symbol in the PRB used for CSI-RS (I0) Number of CSI-RS ports (X) CDM Type Density (p) Density (p) CSI-RS periodicity CSI-RS periodicity CSI-RS periodicity Slots 120 kHz SCS: 160 for CSI-RS resource 1,2 CSI-RS offset Slots Of for CSI-RS resource 1,2 Start PRB 0 Number of PRB = ceil(BWP size/4) *4 Repetition QCL info PDCCH & PDCCH DMRS Precoding configuration First OFDM symbol in the PRB Slots SI-RS resource 2: 9 No CDM 120 kHz SCS: 160 for CSI-RS resource 1,2 Start PRB 0 Number of PRB = ceil(BWP size/4) *4 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		decarer cer ite (ite)		CSI-RS resource 1:
Used for CSI-RS (I0) CSI-RS resource 2: 9		First OFDM symbol in the PRB		
NZP CSI-RS for beam refinement NZP CSI-RS for beam refinement Density (ρ) 3 120 kHz SCS: 160 120 kHz SCS: 160 kHz				
NZP CSI-RS for beam refinement CSI-RS periodicity CSI-RS offset CSI-RS offset CSI-RS offset Slots Slots 120 kHz SCS: 160 for CSI-RS resource 1,2 CSI-RS offset Slots O for CSI-RS resource 1,2 Start PRB 0 Number of PRB = ceil(BWP size/4) *4 Repetition QCL info PDCCH & PDCCH DMRS Precoding configuration CDM Type No CDM Slots 120 kHz SCS: 160 for CSI-RS resource 1,2 Start PRB 0 Number of PRB = ceil(BWP size/4) *4 Repetition ON TCI state #1 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				
NZP CSI-RS for beam refinement Density (p)		Number of CSI-RS ports (X)		1
beam refinement CSI-RS periodicity Slots Slots 120 kHz SCS: 160 for CSI-RS resource 1,2 CSI-RS offset Slots O for CSI-RS resource 1,2 Start PRB 0 Number of PRB = ceil(BWP size/4) *4 Repetition QCL info PDCCH & PDCCH DMRS Precoding configuration PDCCH & PDCCH DMRS Precoding configuration ON QCL info 120 kHz SCS: 160 for CSI-RS resource 1,2 Start PRB 0 Number of PRB = ceil(BWP size/4) *4 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		CDM Type		No CDM
refinement CSI-RS periodicity Slots for CSI-RS resource 1,2 CSI-RS offset Slots 0 for CSI-RS resource 1,2 Start PRB 0 Number of PRB = ceil(BWP size/4) *4 Repetition ON TCI state #1 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	NZP CSI-RS for	Density (ρ)		3
CSI-RS offset CSI-RS offset CSI-RS offset Slots Tesource 1,2 Start PRB 0 Number of PRB = ceil(BWP size/4) *4 Repetition QCL info TCI state #1 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	beam			120 kHz SCS: 160
CSI-RS offset CSI-RS offset CSI-RS offset Slots O for CSI-RS resource 1,2 Start PRB 0 Number of PRB = ceil(BWP size/4) *4 Repetition ON TCI state #1 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	refinement	CSI-RS periodicity	Slots	for CSI-RS resource
CSI-RS offset CSI-RS offset Slots resource 1,2				,
resource 1,2 Start PRB 0 Number of PRB = ceil(BWP size/4) *4 Repetition QCL info TCl state #1 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		CSI-RS offset	Slots	
Frequency Occupation Number of PRB = ceil(BWP size/4) *4 Repetition QCL info TCl state #1 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		COI-IXO Oliset	Oloto	
Ceil(BWP size/4) *4 Repetition				
Repetition QCL info TCI state #1 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		Frequency Occupation		
PDCCH & PDCCH DMRS Precoding configuration QCL info TCl state #1 Single Panel Type I, Random per slot with equal probability of each applicable i ₁ , i ₂ combination, and with REG bundling granularity for number of Tx larger than 1				
PDCCH & PDCCH DMRS Precoding configuration Single Panel Type I, Random per slot with equal probability of each applicable i ₁ , i ₂ combination, and with REG bundling granularity for number of Tx larger than 1				
PDCCH & PDCCH DMRS Precoding configuration Random per slot with equal probability of each applicable i ₁ , i ₂ combination, and with REG bundling granularity for number of Tx larger than 1		QCL into		
PDCCH & PDCCH DMRS Precoding configuration with equal probability of each applicable i ₁ , i ₂ combination, and with REG bundling granularity for number of Tx larger than 1				
PDCCH & PDCCH DMRS Precoding configuration probability of each applicable i ₁ , i ₂ combination, and with REG bundling granularity for number of Tx larger than 1				
PDCCH & PDCCH DMRS Precoding configuration applicable i ₁ , i ₂ combination, and with REG bundling granularity for number of Tx larger than 1				
combination, and with REG bundling granularity for number of Tx larger than 1				
with REG bundling granularity for number of Tx larger than 1	PDCCH & PDCCH	H DMRS Precoding configuration		
granularity for number of Tx larger than 1				
number of Tx larger than 1				
than 1				
	TCI state #0	SSB index		SSB #0

	Type 1 QCL information	QCL Type	Type C	
	Type 2 QCL	SSB index	SSB #0	
	information	QCL Type	Type D	
	Type 1 QCL information	CSI-RS resource	CSI-RS resource 1 from 'CSI-RS for tracking' configuration	
TCI state #1		QCL Type	Type A	
TOT 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 unused REs			OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1	
The number of slots between PDSCH and corresponding HARQ-ACK information			Specific to each TDD UL-DL pattern and as defined in Annex A.1.3.	
Note 1: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38 101-1 [6] for tested channel bandwidth and subcarrier spacing				

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

7.3.1 1RX requirements

(Void)

2RX requirements 7.3.2

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 6 for test 1-2		
Interleaver size		3 for test 1-1 2 for test 1-2		
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	Aggregation	Reference	Propagation	Antenna configuration		erence value
num ber	(MHz)	ET RB	duration	Aggregation level	Channel	Propagation Condition	and correlation Matrix	Pm- dsg (%)	SNR _{BB} (dB)
1-1	100	60	1	2	R.PDCCH. 5-1.1 TDD	TDLA30-75	1x2 Low	1	6.4
1-2	100	60	1	4	R.PDCCH. 5-1.2 TDD	TDLA30-300	1x2 Low	1	3.0

7.3.2.2.2 2 Tx Antenna performances

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

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

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

7.3.2.2.3 Minimum requirements for power saving

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

The parameters specified in Table 7.3.2.2.3-1 are valid for normal PDCCH in DRX on period and PDCCH in DRX off period.

Table 7.3.2.2.3-1: Test Parameters

	Parameter	Unit	1 Tx Antenna					
TDD	UL-DL pattern		FR2.120-1					
CCE to	REG mapping type		Interleaved					
RE	G bundle size		6					
In	terleaver size		2					
	Shift index		0					
	DRX cycle	ms	10					
ps	-WakeUp-r16		absent					
Wake-up indicate	ation bit in DCI format 2_6		1					
	PS-offset		(T _{minimumTimeGap} +1)/2 ^μ /0.125					
PDCCH DCI format	Number of PDCCH candidates		1					
2_6 configuration	Frequency domain resource allocation for CORESET		Start from RB = 0 with contiguous RB allocation					
	TCI state		TCI state #1					
PDCCH configuration	Slots for PDCCH monitoring		Each slot during DRX-on period					
Note: T _{minimumTimeGap} is signaled as a part of <i>drx-Adaptation-r16</i> UE capability.								

For the parameters specified in Table 7.3.2.2.3-2, the average probability of a missed downlink scheduling grant (Pmdsg) observed on PDCCH during DRX on shall be below the specified value in Table 7.3.2.2.3-2. The downlink physical setup is in accordance with Annex C.5.1.

Table 7.3.2.2.3-2: Minimum performance requirements with 120 kHz SCS

Toot	Bandwidth	CORESET	CORESET	Aggregation	Reference	Branagation	Antenna configuration	Refer	rence lue
Test number	(MHz)	RB	duration	level	Channel	Propagation Condition	and Pm-	dsg	SNR _{BB} (dB)
2.1	100	60	1	4	R.PDCCH. 5-1.2 TDD	TDLA30-300	1x2 Low	1	3.0
3-1	100	00	!	8	I R PDCCH I		TAZ 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	Reference Propagation Antenna configuration		Referer	nce value
number	Subcarrier spacing (kHz)	channel	condition	and correlation matrix	Pm- bch (%)	SNR _{BB} (dB)
1	100 / 120	R.PBCH.5	TDLA30-300	1 x 2 Low	1	-6.3
2	100 / 240	R.PBCH.6	TDLA30-75	1 x 2 Low	1	-6.1

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

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

7.5 Sustained downlink data rate provided by lower layers

7.5.1 FR2 single carrier requirements

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

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

7.5A Sustained downlink data rate provided by lower layers

7.5A.1 FR2 CA requirements

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

The purpose of the test is to verify that the Layer 1 and Layer 2 correctly process in a sustained manner the received packets corresponding to the maximum data rate indicated by UE capabilities. The sustained downlink data rate shall be verified in terms of the success rate of delivered PDCP SDU(s) by Layer 2. The test case below specifies the RF conditions and the required success rate of delivered TB by Layer 1 to meet the sustained data rate requirement.

The test parameters are determined by the following procedure:

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

$$DataRate = 10^{-3} \sum_{j=1}^{J} TBS_j 2^{\mu_j}$$

where

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

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

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

- Step 2: Choose the CA bandwidth combination among all supported CA configurations that achieves maximum data rate in step 1 among all UE capabilities.
 - Set of per CC UE capabilities includes channel bandwidth, subcarrier spacing, number of PDSCH MIMO layers, modulation format and scaling factor in accordance with clause 4.1.2 of TS 38.306 [14].
 - When there are multiple sets of CA bandwidth combinations and UE capabilities (channel bandwidth, subcarrier spacing, number of MIMO layer, modulation format, scaling factor) with same data rate, select one among sets with the smallest aggregated channel bandwidth.
- Step 3: For each CC in chosen CA bandwidth combination, use determined MCS for each CC in step 1 for that CA configuration based on test parameters and indicated UE capabilities.

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

The TB success rate is defined as 100%*NDL_correct_rx/ (NDL_newtx + NDL_retx), where NDL_newtx is the number of newly transmitted DL transport blocks, NDL_retx is the number of retransmitted DL transport blocks, and NDL_correct_rx is the number of correctly received DL transport blocks.

The test parameters are specified in Table 7.5A.1-1.

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

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

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

	Parameter	Unit	Value
PDSCH transmission			Transmission scheme 1
PTRS epre-Ratio			0
Channel bandwidth		MHz	Channel bandwidth from selected CA bandwidth combination
	Physical Cell ID		0
Common serving	SSB position in burst		First SSB in Slot #0
cell parameters	SSB periodicity	ms	20
·	First DMRS position for Type A PDSCH 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
- John garation	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
	Number of PRBs in CORESET		Table 7.5A.1-2
	Number of PDCCH candidates and aggregation levels		1/8
PDCCH	CCE-to-REG mapping type		Non-interleaved
configuration	DCI format		1-1
Comiguration	TCI State		TCI state #1
	PDCCH &PDCCH DMRS Precoding configuration		Single Panel Type I, Random per slot with equal probability of precoder index 0 and 2, and with REG bundling granularity for number of Tx larger than 1
	Mapping type		Type A
	k0		0
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		wideband
PDSCH	Resource allocation type		Type 0
configuration	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
	Starting symbol (S)		1
	Length (L)		13
	DMRS Type		Type 1
	Number of additional DMRS		<u>T</u>
PDSCH DMRS	Length		1 {1000} for 1 Layer CCs
configuration	Antenna ports indexes		{1000, 1001} for 2 Layers CCs
	Number of PDSCH DMRS CDM group(s) without data		1
PTRS	Frequency density (K _{PT-RS})		2
configuration	Time density (L _{PT-RS})		1
	Subcarrier indexes in the PRB used for CSI-RS		k ₀ = 3 for CSI-RS resource 1,2,3,4
	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
CSI-RS for tracking	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		Т			T 00 111 000 001 001 D0
CSI-RS offset				I	60 kHz SCS: 80 for CSI-RS resource
CSI-RS offset		CSI-RS periodicity		Slots	
CSI-RS offset				I	
CSI-RS offset				İ	
CSI-RS offset				I	
120 kHz SCS: 80 for CSI-RS resource 1 and 2 81 for CSI-RS resource 3 and 4 Start PRB 0 CSI-RS resource 3 and 4 Start PRB 0 CSI-RS resource 1 and 2 Star				I	
80 for CSI-RS resource 1 and 2 8 for CSI-RS resource 1 2 8 for CSI-RS resource 1 2 10 PRB = cell(BWP size/4)* Frequency Occupation		CSI-RS offset		Slots	
Right Frequency Occupation Start PRB 0				I	120 kHz SCS:
Frequency Occupation				I	
Frequency Occupation				ļ	
OCL info		Frequency Occupa	ition	I	
Subcarrier indexes in the PRB used for CSI-RS OFDM symbols in the PRB used for CSI-RS OFDM symbols in the PRB used for CSI-RS OFDM symbols in the PRB used for CSI-RS of CSI-RS ports (X)				}	
CSI-RS CSI-RS CSI-RS RS			in the DDD used for		TCI state #0
OFDM symbols in the PRB used for CSI-RS D = 13			III the FND used for	1	$k_0 = 4$
RS			the PRB used for CSI-		
Number of CSI-RS ports (X) Same as number of transmit antent CDM Type				I	I ₀ = 13
Density (p)			ports (X)		Same as number of transmit antenna
CSI acquisition	NZD CCL DC for	CDM Type	, ,	<u> </u>	'FD-CDM2'
CSI-RS periodicity					1
CSI-RS offset	OOI acquisition	CSI-RS periodicity		Slote	
Frequency Occupation				JIU13	1
Frequency Occupation		CSI-RS offset		 	<u> </u>
OCL info Subcarrier indexes in the PRB used for CSI-RS CSI-RS		Frequency Occupa	ition		- · · · · · · · · · · · · · · · · · · ·
Subcarrier indexes in the PRB used for CSI-RS OFDM symbols in the PRB used for CSI-RS					,
CSI-RS CSI-RS CSI-RS CSI-RS Number of CSI-RS ports (X) A A CDM Type CSI-RS periodicity Slots 120 kHz SCS: 80 120 kHz SCS: 160 CSI-RS periodicity Slots 120 kHz SCS: 160 CSI-RS periodicity Slots 120 kHz SCS: 160 CSI-RS periodicity Slots 120 kHz SCS: 160 CSI-RS offset O Number of PRB = ceil(BWP size/4)* CSI-RS First of DFDM symbol in the PRB used for CSI-RS First of DFDM symbol in the PRB used for CSI-RS Number of CSI-RS resource 1,2 CDM Type Slots CSI-RS resource 1,2 CDM Type Slots			in the PRR used for		
OFDM symbols in the PRB used for CSI-RS			iii tile i ND useu loi	1	$k_0 = 0$
RS			the PRB used for CSI-		
Number of CSI-RS ports (X) 4 CDM Type 'FD-CDM2'				I	I ₀ = 12
ZP CSI-RS for CSI acquisition		Number of CSI-RS	ports (X)		4
CSI-RS periodicity	ZP CSI-RS for CSI				'FD-CDM2'
CSI-RS periodicity Slots 120 kHz SCS: 160	acquisition	Density (ρ)	Density (ρ)		1
CSI-RS offset		CSI-RS periodicity		Slots	
Frequency Occupation					
Frequency Occupation		CSI-RS offset		}	_
First subcarrier index in the PRB used for CSI-RS		Frequency Occupa	ition	I	
CSI-RS		First subcarrier ind	ev in the PRR used for		
First OFDM symbol in the PRB used for CSI-RS			CX III tillo I IND adoca loi	I	k₀=0 for CSI-RS resource 1,2
CSI-RS Number of CSI-RS ports (X) 1 for CSI-RS resource 2 1 for CSI-RS resource 1,2			I in the PRB used for		l ₀ = 8 for CSI-RS resource 1
CSI-RS for beam refinement CSI-RS periodicity Slots Slots CSI-RS resource 1,2				I	
Density (p) 3 for CSI-RS resource 1,2 60 kHz SCS: 80 for CSI-RS resource 1,2 1,2 120 kHz SCS: 160 for CSI-RS resource 1,2 120 kHz SCS: 80 for CSI-RS resource 1,2 120 kHz SCS: 80 for CSI-RS resource 1,2 120 kHz SCS: 80 for CSI-RS resource 1,2 120 kHz SCS: 160 for CS		Number of CSI-RS	ports (X)		1 for CSI-RS resource 1,2
CSI-RS for beam refinement CSI-RS periodicity Slots 60 kHz SCS: 80 for CSI-RS resource 1,2 120 kHz SCS: 160 for CSI-RS resource 1,2 120 kHz SCS: 80 for CSI-RS resource 1,2 120 kHz SCS: 160 for CSI-RS for CSI-RS resource 1,2 12		CDM Type			'No CDM' for CSI-RS resource 1,2
CSI-RS periodicity		Density (ρ)		<u></u>	
CSI-RS periodicity Slots 120 kHz SCS: 160 for CSI-RS resource 1,2				I	
CSI-RS offset Slots O for CSI-RS resource 1,2	retinement	CSI-RS periodicity		Slots	
CSI-RS offset Slots 0 for CSI-RS resource 1,2		' '		I	
Frequency Occupation Start PRB 0		CSI-RS offset		Slots	
Repetition				JIUIS	·
Repetition		Frequency Occupa	ition		
TCI state #1 Type 1 QCL SSB index SSB #0		Repetition			
Type 1 QCL SSB index SSB #0					
TCl state #0 Information QCL Type Type C			SSB index		
TCI state #1 Type 2 QCL information QCL Type Type D CSI-RS resource Type A Type 2 QCL information QCL Type CSI-RS resource Tracking configuration Type 2 QCL information QCL Type CSI-RS resource Type A Type 2 QCL information QCL Type Type Type D Maximum number of code block groups for ACK/NACK SSB #0 CSI-RS resource 1 from 'CSI-RS for tracking' configuration Type D	TCI state #0				
TCI state #1 Type 1 QCL information CSI-RS resource CSI-RS resource 1 from 'CSI-RS for tracking' configuration QCL Type Type A CSI-RS resource 1 from 'CSI-RS for tracking' configuration CSI-RS resource 1 from 'CSI-RS for tracking' configuration CSI-RS resource 1 from 'CSI-RS for tracking' configuration QCL Type Type D Maximum number of code block groups for ACK/NACK 1	. 51 51415 #5			<u> </u>	
TCI state #1 Type 1 QCL information QCL Type Type A Type 2 QCL information QCL Type CSI-RS resource tracking' configuration Type 2 QCL information QCL Type Type D Maximum number of code block groups for ACK/NACK		intormation	QCL Type		
TCI state #1 Type 2 QCL Type Type 2 QCL information QCL Type CSI-RS resource C		Type 1 QCL	CSI-RS resource		
Type 2 QCL information CSI-RS resource 1 from 'CSI-RS for tracking' configuration QCL Type Type D Maximum number of code block groups for ACK/NACK			OCI Type		
Type 2 QCL information CSI-RS resource tracking' configuration	TCI state #1				
Maximum number of code block groups for ACK/NACK 1 Type D Type D			CSI-RS resource		
Maximum number of code block groups for ACK/NACK		information	QCL Type		
	NA i	f code block arouns fo			
recubach	Maximum number of	i code block groups it			

Number of HARQ Pr	rocesses	10 for FR2.60-1 and 8 for FR2.120-1			
K1 value		Specific to each UL-DL pattern			
Maximum number of	HARQ transmission	4			
HARQ ACK/NACK b	undling	Multiplexed			
Redundancy version	coding sequence	{0,2,3,1}			
TDD UL-DL pattern		60 kHz SCS: FR2.60-1 120 kHz SCS: FR2.120-1			
PDSCH & PDSCH D	MRS Precoding configuration	Single Panel Type I, Precoder index 0 per slot with Wideband granularity for Rank 2			
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			
Propagation condition	n	Static propagation condition No external noise sources are applied			
Antenna	1 layer CCs	1x2 or 1x4			
configuration	2 layers CCs	2x2 or 2x4			
Physical signals, channels mapping and precoding As specified in Annex B.4.1					
Note 1: PDSCH is scheduled only on full DL slots not containing SSB or TRS. Note 2: UE assumes that the TCl state for the PDSCH is identical to the TCl state applied for the PDCCH transmission.					

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

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 PDSCH MIMO layers	Maximum modulation format (Note 1)	dulation 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

Note 1: For the band(s) on which UE supporting "Maximum modulation format" of 8, the MCS index is derived from the rows with "Maximum modulation format" of 6.

Note 2: MCS Index is based on MCS index Table 1 defined in clause 5.1.3.1 of TS 38.214 [12].

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

MCS Index (Note 1)	SNR _{BB} (dB) for maximum number of PDSCH MIMO Layers = 1	SNR _{BB} (dB) for maximum number of PDSCH MIMO Layers = 2	
13	6.2	9.0	
14	7.2	9.9	
15	8.2	10.9	
16	8.7	11.6	
17	10.1	13.2	
18	10.7	13.7	
19	11.7	14.7	
20	12.7	15.6	
21	13.6	16.5	
22	14.8	17.6	
23	15.6	18.6	
24	16.9	19.7	
25	18.3	21.2	
26	19.3	22.3	
27	20.5	23.3	

Note 1: MCS Index is based on MCS index Table 1 defined in clause 5.1.3.1 of TS 38.214 [12].

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, 8.1.1.5.

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

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

The performance requirements in Table 8.1.1.3-1 shall apply for UEs which support optional UE features only.

Table 8.1.1.3-1: Requirements applicability for optional UE features

UE feature/capability [14]	Test	type	Test list	Applicability notes
256QAM modulation scheme for PDSCH for FR2 (pdsch-256QAM-FR2)	FR2 TDD	CQI	Clause 8.2.2.2. 2.1 (Tests 3 and 4)	The test coverage can be considered fulfilled without executing of Test 1 and 2 from Clause 8.2.2.2. 2.1 if UE passes Test 3 and 4 from Clause 8.2.2.2.1

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.

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

UE feature/capability [14]	Test t	уре	Test list	Applicability notes
Supported maximum number of PDSCH MIMO layers (maxNumberMIMO-	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	
(Ollerolist TN3)		RI	Clause 8.4	

8.1.1.5 Applicability of Channel Quality Indicator (CQI) reporting requirements for CA

8.1.1.5.1 Applicability and test rules for different CA configurations and bandwidth combination sets

The performance requirement for CA CQI tests in clause 8.2A are defined independent of CA configurations and bandwidth combination sets specified in clasue 5.5A in TS 38.101-2 [7].

For UEs supporting multiple CA capabilities, test any one of the supported CA capabilities with largest aggregated CA bandwidth combination. The categorization of CA capability is specified in clasue 7.1.1.5.1.

For UEs supporting multiple CA configurations from the selected CA capability, test any one of the supported CA configurations with largest aggregated CA bandwidth combination. For simplicity, the CA configuration refers to combination of CA configuration and bandwidth combination set.

A single uplink CC is configured for all tests.

8.1.1.5.2 Test coverage for different number of componenet carriers

For CA CQI tests specified in clause 8.2A, among all supported CA capabilities, if corresponding CA tests with the largest number of CCs supported by the UE are tested, the test coverage can be considered fulfilled without executing the CA tests with less than the largest number of CCs supported by the UE.

8.1.2 Common test parameters

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

Table 8.1.2-1: Test parameters for CSI test cases

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

	T		
	PDCCH & PDCCH DMRS Precoding configuration		Multi-path fading propagation conditions: Single Panel Type I, Random per slot with equal probability of each applicable i1, i2 combination, and with REG bundling granularity for number of Tx larger than 1
Cross carrier sch	nedulina		Not configured
	Mapping type		Type A
	kO		0
	Starting symbol (S)		2
	Length (L)		12
	PDSCH aggregation factor		1
PDSCH			· · · · · · · · · · · · · · · · · · ·
	PRB bundling type		Static
configuration	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver		N1/A
	bundle size		N/A
	DMRS Type		Type 1
	Number of additional DMRS		1
	14difficor of additional bivinto		{1000} for Rank1
	DMPS ports indexes		{1000,1001} for
PDSCH DMRS	DMRS ports indexes		Rank2
	14		Rankz
configuration	Maximum number of OFDM symbols for DL front loaded DMRS		1
	Number of PDSCH DMRS CDM group(s) without data		2
DTDO	Frequency density (KPT-RS)		2
PTRS	Time density (L _{PT-RS})		1
configuration	Resource Element Offset		2
	First subcarrier index in the PRB		0 for CSI-RS
	used for CSI-RS (k_0)		resource 1,2,3,4
	daed for COTTC (NO)		4 for CSI-RS
	First OFDM symbol in the DDD		resource 1 and 3
	First OFDM symbol in the PRB		
	used for CSI-RS (Io)		8 for CSI-RS
			resource 2 and 4
	Number of CSI-RS ports (X)		1 for CSI-RS
	rtamper of deritte perite (xt)		resource 1,2,3,4
	CDM Type		No CDM for CSI-RS
	ODW Type		resource 1,2,3,4
	Density (ρ)		3 for CSI-RS
CSI-RS for	Defisity (p)		resource 1,2,3,4
tracking	CSI-RS periodicity	slot	120kHz SCS: 160 for CSI-RS resource
	·	-	1,2,3,4
			120 kHz SCS:
			80 for CSI-RS
	CSI-RS offset	slot	resource 1 and 2
	COI NO CIISCI	3101	81 for CSI-RS
			resource 3 and 4
			Start PRB 0
	Fraguency Coouncies		
	Frequency Occupation		Number of PRB =
	001: (ceil(BWP size/4)*4
	QCL info		TCI state #0
NZP CSI-RS			Start PRB 0
for CSI	Frequency Occupation		Number of PRB =
acquisition			ceil(BWP size /4)*4
acquisition	QCL info		TCI state #1

7D 001 D0 (Start PRB 0
ZP CSI-RS for CSI acquisition	Frequency C	ccupation		Number of PRB =
COI acquisition	· ·			ceil(BWP size /4)*4
		ier index in the PRB		k ₀ =0 for CSI-RS
	used for CSI	-RS		resource 1,2
	First OFDM	washal in the DDD		I ₀ = 8 for CSI-RS
	used for CSI	symbol in the PRB		resource 1 I ₀ = 9 for CSI-RS
	used for CSI	-K3		resource 2
				1 for CSI-RS
	Number of C	SI-RS ports (X)		resource 1,2
				'No CDM' for CSI-RS
CCL DC for	CDM Type			resource 1,2
CSI-RS for beam	Density (ρ)			3 for CSI-RS
refinement	Density (p)			resource 1,2
Tellilelilelil				120 kHz SCS: 160
	CSI-RS perio	odicity	Slots	for CSI-RS resource
				1,2
	CSI-RS offse	et	Slots	0 for CSI-RS
			• • • • • • • • • • • • • • • • • • • •	resource 1,2
	F			Start PRB 0
	Frequency C	ccupation		Number of PRB =
	Depotition			ceil(BWP size /4)*4
	Repetition QCL info			TCI state #1
	Type 1	SSB index		SSB #0
	QCL			
TCI state #0	information	QCL Type		Type C
TOT State #0	Type 2	SSB index		SSB #0
	QCL information	QCL Type		Type D
				CSI-RS resource 1
	Type 1	CSI-RS resource		from 'CSI-RS for
	QCL	COI-ING TESOUICE		tracking'
	information			configuration
TCI state #1		QCL Type		Type A
. C. State				CSI-RS resource 1
	Type 2	CSI-RS resource		from 'CSI-RS for
	QCL information			tracking'
		OCL Turns		configuration
Number of HAR	Processes	QCL Type		Type D 8
HARQ ACK/NAC	· ·			Multiplexed
Redundancy ver		THENCE		{0,2,3,1}
reduited for	sion coding sc	querioc		For FR2.120-1:
				3 if mod $(i.5) = 0$,
				6 if $mod(i,5) = 0$,
				For FR2.120-2:
K1 value				11 if $mod(i,8) = 0$,
(PDSCH-to-HAR	O-timing-indica	ator)		7] if $mod(i,8) = 4$,
, DOON TO MAIN				6]if $mod(i,8) = 5$,
				where i is slot index
			per radio fame with	
				values 0-79.
				OP.1 FDD as
				defined in Annex
Cumb ala fari	0 1 1 (105			A.5.1.1
Symbols for unused REs				OP.1 TDD as
				defined in Annex
				A.5.2.1
Physical signals	channels man	ping and precoding		As specified in
. Tryotodi digitalo,		ping and proceding		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.

Note 4: Additional PDCCH configuration for aperiodic reporting is only for test cases with aperiodic CSI reporting configured.

8.2 Reporting of Channel Quality Indicator (CQI)

8.2.1 1RX requirements

(Void)

8.2.2 2RX requirements

8.2.2.1 FDD

(Void)

8.2.2.2 TDD

8.2.2.2.1 CQI reporting under AWGN conditions

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

8.2.2.2.1.1 Minimum requirement for periodic CQI reporting

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

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

Table 8.2.2.2.1.1-1 Test parameters

	Parameter	Unit	Test 1 Test 2	2
Bandwidth		MHz	100	
Subcarrier sp	acing	kHz	120	
Duplex Mode			TDD	
TDD Slot Con	ifiguration	ID	FR2.120-2 Annex A.1	
SNR _{BB} Propagation of	sh a resal	dB	8 9 14 1 AWGN	5
Propagation C	mannei		2×2 with static chann	<u> </u>
Antenna confi	iguration		specified in Annex B	
Beamforming	Model		As specified in Anne B.4.1	ΣX
	CSI-RS resource Type		Periodic	
	Number of CSI-RS ports (X)		4	
	CDM Type		FD-CDM2	
ZP CSI-RS	Density (ρ)		1	
configuratio n	First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁)		8	
	First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁)		13	
	CSI-RS periodicity and offset	slot	8/1	
	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 ₀ , k ₁)			
	First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁)		13	
	NZP CSI-RS-timeConfig periodicity and offset	slot	8/1	
	CSI-IM resource Type		Periodic	
	CSI-IM RE pattern		1	
CSI-IM	CSI-IM Resource Mapping		· ·	
configuratio	(kcsi-im,lcsi-im)		(8, 13)	
n	CSI-IM timeConfig	-1-4	0/4	
	periodicity and offset	slot	8/1	
ReportConfig	Туре		Periodic	
CQI-table			Table 1	
reportQuantity			cri-RI-PMI-CQI	
timeRestrictio	nForChannelMeasurements		Not configured	
	nForInterferenceMeasurements		Not configured	
cqi-FormatInd			Wideband	
pmi-FormatIn		- D-D	Wideband	
Sub-band Siz		RB	8	
csi-Reporting		-1-4	111111111	
	eriodicity and offset	slot	8/3	
aperiodicTrigg	Codebook Type		Not configured typel-SinglePanel	
	Codebook Type Codebook Mode		typer-SinglePaner 1	
Codebook	(CodebookConfig-		•	
configuration	N1,CodebookConfig-N2)		Not configured	
Johngaration	CodebookSubsetRestriction		010000	
	RI Restriction		N/A	
Physical char	nnel for CSI report		PUCCH	
11, 21001 01101	CQI/RI/PMI delay	ms	8.375	
Maximum nur	mber of HARQ transmission		1	
Measurement			As specified in Table A.4-1, TBS.1-2	е
		l	A. T -1, 100.1-2	

8.2.2.2.2 CQI reporting under fading conditions

8.2.2.2.2.1 Minimum requirement for wideband CQI reporting

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

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

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

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

Table 8.2.2.2.1-1 Test parameters

	Parameter	Unit	Test 1 Test 2	Test 3 Test 4
Bandwidth	Parameter	MHz	100	50
	Subcarrier spacing			20
Duplex Mode	<u>.</u>	kHz		DD
TDD Slot Con	figuration		FR2.120-2	Annex A.1.3
SNR _{BB}		dB	6 7 12 13	7 8 20 21
Propagation of	channel			30-35
Antenna confi	guration			<2 High
Beamforming			As specified in	n Annex B.4.1
	CSI-RS resource Type			iodic
	Number of CSI-RS ports (X)			1
7D 001 D0	CDM Type			CDM2
ZP CSI-RS configuratio	Density (ρ) First subcarrier index in the		,	
n	PRB used for CSI-RS (k ₀ , k ₁)		8	3
	First OFDM symbol in the PRB			
	used for CSI-RS (I ₀ , I ₁)		1	3
	CSI-RS	slot	8.	/1
	periodicity and offset	3101		
	CSI-RS resource Type			riodic
	Number of CSI-RS ports (X) CDM Type			<u>2</u> DM2
	Density (ρ)			
NZP CSI-	First subcarrier index in the			-
RS for CSI	PRB used for CSI-RS (k ₀ , k ₁)		(6
acquisition	First OFDM symbol in the PRB		1	3
	used for CSI-RS (I ₀ , I ₁)		Į.	ა
	NZP CSI-RS-timeConfig	slot	Not configured	
-	periodicity and offset aperiodicTriggeringOffset		0	
	CSI-IM resource Type		Aperiodic	
	CSI-IM RE pattern			1
CSI-IM	CSI-IM Resource Mapping		/0	40)
configuratio n	(kcsi-im,lcsi-im)		(0,	13)
	CSI-IM timeConfig	slot	Not cor	nfigured
ReportConfig	periodicity and offset			riodic
CQI-table	туре		Table 1	Table 2
reportQuantity	/			PMI-CQI
	nForChannelMeasurements		i	nfigured
timeRestrictio	nForInterferenceMeasurements		Not cor	nfigured
cqi-FormatInd				band
pmi-FormatIn				band
Sub-band Siz		RB		3
csi-Reporting	eriodicity and offset	slot	1111 Not cor	
	port Slot Offset	SIUL		ingureu S
	Join Giot Gilset		·	(i, 8) = 1, otherwise it is
CSI request				I to 0
reportTrigger	Size		,	1
			One State with one Config	Associated Report
CSI-Aperiodic	:TriggerStateList			onfiguration contains
				SI-RS and CSI-IM
Codebook Type				glePanel
	Codebook Mode		,	
Codebook	(CodebookConfig-		Not cor	nfigured
configuration	N1,CodebookConfig-N2)			
	CodebookSubsetRestriction		000	001 /A
Physical chan	RI Restriction anel for CSI report		PUS	
i ilysical cildi	CQI/RI/PMI delay	ms		375
Maximum nur	mber of HARQ transmission	1110	1.0	
			As specified in Table	As specified in Table
ivieasurement	easurement channel A.4-1, TBS.1-1 A.4-2, TBS.2		A.4-2, TBS.2-7	

Table 8.2.2.2.1-2 Minimum requirements

	Test 1	Test 2	Test 3	Test 4
α[%]	2	2	2	2
γ	1.05	1.05	1.05	1.05

8.2A Reporting of Channel Quality Indicator (CQI) for CA

8.2A.1 General

This clause includes the requirements for the reporting of channel quality indicator (CQI) with the UE configured for CA. The purpose is to verify that the CQI is correctly reported in accordance with the CQI definition given in TS 38.214 [12] for each CC with multiple cells configured for periodic reporting.

8.2A.2 1RX requirements

(Void)

8.2A.3 2RX requirements

8.2A.3.1 CQI reporting definition under AWGN conditions

8.2A.3.1.1 Minimum requirement for periodic CQI reporting

For the CA CQI reporting test defined in Table 8.2A.3.1.1-4, the test requirements and the test parameters are defined as below.

For each CC, the test parameters are specified in Table 8.2A.3.1.1-1.

For CA with 2 DL CC, for the SNR configuration specified in Table 8.2A.3.1.1-2, and using the downlink physical channels specified in Annex C.5.1 on each CC, the difference between the wideband CQI indices of PCell and SCell reported shall be such that

 $wideband \ CQI_{PCell} - wideband \ CQI_{SCell} \geq 2$

for more than 90% of the time.

For CA with 3 or more DL CC, for the SNR configuration specified in Table 8.2A.3.1.1-3, and using the downlink physical channels specified in Annex C.5.1 on each cell, the difference between the wideband CQI indices of PCell and SCell1 reported, and the difference between the wideband CQI indices of SCell1 and SCell2, 3... reported shall be such that

 $wideband \ CQI_{PCell} - wideband \ CQI_{SCell1} \geq 2$

wideband CQI_{SCell1} – wideband $CQI_{SCell2, 3...} \ge 2$

for more than 90% of the time.

Table 8.2A.3.1.1-1: CA CQI reporting test parameters for each CC

	Parameter	Unit	Value
Subcarrier sp	acing	kHz	120
Duplex Mode			TDD
TDD Slot Configuration			FR2.120-2 Annex A.1.3
Propagation of			AWGN
Antonno conf	iguration		1x2 with static channel
Antenna conf	iguration		specified in Annex B.1
	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (X)		4
ZP CSI-RS	CDM Type		FD-CDM2
configuratio	Density (ρ)		1
n	First subcarrier index in the		8
''	PRB used for CSI-RS (k ₀ , k ₁)		0
	First OFDM symbol in the PRB		13
	used for CSI-RS (I ₀ , I ₁)		13
	CSI-RS periodicity and offset	slot	8/1
	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (X)		1
	CDM Type		No CDM
NZP CSI-	Density (ρ)		1
RS for CSI	First subcarrier index in the		6
acquisition	PRB used for CSI-RS (k ₀ , k ₁)		Ŭ
	First OFDM symbol in the PRB		13
	used for CSI-RS (I ₀ , I ₁)		
	NZP CSI-RS-timeConfig	slot	8/1
	periodicity and offset		
	CSI-IM resource Type		Periodic
CSI-IM	CSI-IM RE pattern		1
configuratio	CSI-IM Resource Mapping		(8, 13)
n	(KCSI-IM, ICSI-IM)		· · · ·
	CSI-IM timeConfig	slot	8/1
PoportConfig	periodicity and offset		Doriodio
ReportConfig CQI-table	туре		Periodic Table 1
reportQuantit	,		cri-RI-PMI-CQI
timoPostrictio	y nForChannelMeasurements		Not configured
	nForInterferenceMeasurements		Not configured
cqi-FormatInd			Wideband
pmi-Formatin			Wideband
pini-i Unnatin	uicatoi		8 for 50MHz, 100MHz,
Sub-band Siz	Α.	RB	16 for 200MHz,
Oub band Oiz		I ND	32 for 400MHz
csi-Reporting	Band		111111111
CSI-Report p	eriodicity and offset	slot	8/3
aperiodicTrig		5.50	Not configured
	nnel for CSI report		PUCCH
CQI/RI/PMI d		ms	8.375
	mber of HARQ transmission		1
			Derived as per section
Measuremen	t channel		5.1.3.2 of TS 38.214 [12]
L			

Table 8.2A.3.1.1-2: SNR configurations for 2 DL CA

Parameter	PCell	SCell
SNR (dB)	10.0	4.0

Table 8.2A.3.1.1-3: SNR configurations for 3 or more DL CA

Parameter	PCell	SCell1	SCell2, 3
SNR (dB)	12.0	6.0	0.0

Table 8.2A.3.1.1-4: List of CA CQI reporting test

Test number		CA duplex mode and SCS combination	
1		TDD 120 kHz + TDD 120 kHz	
Note 1: The applicability of requirements for different CA configurations and		pplicability of requirements for different CA configurations and	
	bandwidth combination sets is defined in 8.1.1.5.1.		

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 scheme 1 with 2TX and higher layer parameter *codebookType* set to 'typeI-SinglePanel' are specified in terms of the ratio

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

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

8.3.1 1RX requirements

(Void)

8.3.2 2RX requirements

8.3.2.1 FDD

(Void)

8.3.2.2 TDD

8.3.2.2.1 Single PMI with 2TX TypeI-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)

Bandwidth	Pai	rameter	Unit	Test 1	Test 2
FR2.120-2 as specified in Annex A.1.3 FR2.120-1 as specified in Annex A.1.3 FR2.120-1 as specified in Annex A.1.3 TDLA30-35 TDLA					
TDD DL-UL configuration	Subcarrier spacir	ng	kHz	120	120
Propagation channel	TDD DL-UL conf	iguration		specified in	specified in
Antenna configuration	Propagation char	nnel			
Beamforming Model					
Type					
Density (p)		Туре		Periodic	Periodic
Density (p)				4	4
First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) First OFDM symbol in the PRB used for CSI-RS (k ₀ , k ₁) CSI-RS resource Type CSI-RS resource Type CSI-RS (k ₀ , k ₁) First Subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) CSI-RS resource Type Aperiodic Aperiodic				_	_
Index in the PRB used for CSI-RS (ko, k1) First OFDM symbol in the PRB used for CSI-RS (ko, k1) CSI-RS periodicity and offset CSI-RS resource Type Aperiodic Aperi				1	1
In the PRB used for CSI-RS (lo, l1)		index in the PRB used for CSI-RS (k ₀ , k ₁)		Row 4, (8,-)	Row 4, (8,-)
CSI-RS periodicity and offset Slot offset		in the PRB used for		(13,-)	(13,-)
Type		CSI-RS periodicity and offset	slot	8/1	5/1
Dorts (X)		Туре		Aperiodic	Aperiodic
Density (p)				2	2
NZP CSI-RS for CSI acquisition First subcarrier index in the PRB used for CSI-RS (ko, k1)		CDM Type		FD-CDM2	FD-CDM2
NZP CSI-RS for CSI acquisition Index in the PRB used for CSI-RS (ko, k1) First OFDM symbol in the PRB used for CSI-RS (lo, lt1) CSI-RS periodicity and offset Quantity		• (1.7		1	1
in the PRB used for CSI-RS (Io, I1) CSI-RS periodicity and offset aperiodicTriggering Offset CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (kcsi-IM, Icsi-IM) CSI-IM timeConfig periodicity and offset ReportConfigType ReportConfigType CQI-table ReportQuantity timeRestrictionForChannelMeasureme nts In the PRB used for CSI-RS (Io, I1) Not configured	for CSI	index in the PRB used for CSI-RS (k ₀ , k ₁)		Row 3, (6,-)	Row 3, (6,-)
periodicity and offset aperiodicTriggering Offset CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (kcsI-IM, lcsI-IM) CSI-IM timeConfig periodicity and offset ReportConfigType ReportConfigType ReportQuantity ReportQuantity Table 1 reportQuantity timeRestrictionForChannelMeasureme nts Not configured		in the PRB used for CSI-RS (I ₀ , I ₁)		(13,-)	(13,-)
CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (kcsi-im,lcsi-im) CSI-IM timeConfig periodicity and offset ReportConfigType ReportConfigType CQI-table reportQuantity timeRestrictionForChannelMeasureme nts Not configured		periodicity and	slot	Not configured	Not configured
Type CSI-IM RE pattern CSI-IM Resource Mapping (kcsi-iM, lcsi-iM) CSI-IM timeConfig periodicity and offset ReportConfigType CQI-table CQI-table reportQuantity timeRestrictionForChannelMeasureme nts Type Aperiodic Aperiodi				0	0
CSI-IM Resource Mapping (kcsi-iM,lcsi-iM) CSI-IM timeConfig periodicity and offset ReportConfigType ReportConfigType CQI-table reportQuantity timeRestrictionForChannelMeasureme nts RestrictionForInterferenceMeasur Not configured		Туре		Aperiodic	Aperiodic
CSI-IM configuration Mapping (kcsi-iM, lcsi-iM)		CSI-IM RE pattern		Pattern 1	Pattern 1
periodicity and offset		Mapping (kcsi-im,lcsi-im)		(8,13)	(8,13)
CQI-table Table 1 Table 1 reportQuantity cri-RI-PMI-CQI cri-RI-PMI-CQI timeRestrictionForChannelMeasureme nts Not configured Not configured		periodicity and	slot	Not configured	Not configured
reportQuantity cri-RI-PMI-CQI cri-RI-PMI-CQI timeRestrictionForChannelMeasureme nts Not configured Not configured timeRestrictionForInterferenceMeasur		е		•	Aperiodic
timeRestrictionForChannelMeasureme nts Not configured Not configured timeRestrictionForInterferenceMeasur				<u> </u>	
timeRestrictionForInterferenceMeasur Not configured Not configured	timeRestrictionFo	orChannelMeasureme			
	timeRestrictionFo	orInterferenceMeasur			

cqi-FormatIndica	ator		Wideband	Wideband	
pmi-FormatIndic	ator		Wideband	Wideband	
Sub-band Size		RB	8	8	
csi-ReportingBa	nd		111111111	111111111	
CSI-Report perio	odicity and offset	slot	Not configured	Not configured	
Aperiodic Repor	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	
reportTriggerSiz	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 channel for CSI report		PUSCH	PUSCH	
	CQI/RI/PMI delay		1.375	1.75	
Maximum number of HARQ transmission			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).					

(0.125 ms granularity).

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

cannot be applied at the gNB downlink before slot#(n+4)].

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

Table 8.3.2.2.1-2: Minimum requirement

Parameter	Test 1	Test 2
γ	1.05	1.05

8.4 Reporting of Rank Indicator (RI)

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

8.4.1 1RX requirements

(Void)

8.4.2 2RX requirements

8.4.2.1 FDD

(Void)

8.4.2.2 TDD

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

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

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

Table 8.4.2.2-1: RI Test (TDD)

	Parameter	Unit	Test 1	Test 2	Test 3
Bandwidth		MHz	100	100	100
Subcarrier sp		kHz	120	120	120
Duplex Mode			TDD	TDD	TDD
TDD Slot Cor	nfiguration		FR2.120-2	FR2.120-2	FR2.120-2
SNR		dB	0	16	16
Propagation			TDLA30-35	TDLA30-35	TDLA30-35
Antenna conf	iguration		ULA Low 2x2	ULA Low 2x2	XP High 2x2
Beamforming	Model		As defined in Annex B.4.1	As defined in Annex B.4.1	As defined in Annex B.4.1
	CSI-RS resource Type		Periodic	Periodic	Periodic
	Number of CSI-RS ports (X)		4	4	4
	CDM Type		FD-CDM2	FD-CDM2	FD-CDM2
ZP CSI-RS	Density (ρ)		1	1	1
configuratio n	First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁)		Row 4, (8,-)	Row 4, (8,-)	Row 4, (8,-)
	First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁)		(13,-)	(13,-)	(13,-)
	CSI-RS	1.	8/1	8/1	8/1
	periodicity and offset	slot	5		5 , 1
	CSI-RS resource Type		Aperiodic	Aperiodic	Aperiodic
	Number of CSI-RS ports (X)		2	2	2
	CDM Type		FD-CDM2	FD-CDM2	FD-CDM2
NZP CSI-	Density (ρ)		1	1	1
RS for CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁)		Row 3 (6,-)	Row 3 (6,-)	Row 3 (6,-)
aoquiomon	First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁)		(13,-)	(13,-)	(13,-)
	NZP CSI-RS-timeConfig	slot	Not configured	Not	Not
	periodicity and offset	SIUL		configured	configured
	aperiodicTriggeringOffset		0	0	0
	CSI-IM resource Type		Periodic	Periodic	Periodic
CSI-IM	CSI-IM RE pattern		Pattern 1	Pattern 1	Pattern 1
configuratio n	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(8,13)	(8,13)	(8,13)
	CSI-IM timeConfig periodicity and offset	slot	Not configured	Not configured	Not configured
ReportConfig			Aperiodic	Aperiodic	Aperiodic
CQI-table	Туре		Table 1	Table 1	Table 1
reportQuantit	у		cri-RI-PMI-CQI	cri-RI-PMI- CQI	cri-RI-PMI- CQI
timeRestriction	onForChannelMeasurements		not configured	not configured	not configured
timeRestriction	onForInterferenceMeasurements		not configured	not configured	not configured
cqi-FormatInd	dicator		Wideband	Wideband	Wideband
pmi-FormatIndicator			Wideband	Wideband	Wideband
Sub-band Size		RB	8	8	8
csi-Reporting	csi-ReportingBand		111111111	111111111	111111111
CSI-Report periodicity and offset		slot	Not configured	Not configured	Not configured
Aperiodic Re	port Slot Offset		6	6	6
CSI request			1 in slots i, where mod(i, 8) = 1,	1 in slots i, where mod(i, 8) = 1,	1 in slots i, where mod(i, 8) = 1,
·			otherwise it is equal to 0	otherwise it is equal to 0	otherwise it is equal to 0
reportTrigger	Size		1	1	1

CSI-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
Note 1: Measurements channels are specified in Table A 4-1 TRS 1-1 is used for Rank 1 case TRS 1-2					

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

Table 8.4.2.2-2: Minimum requirement (TDD)

	Test 1	Test 2	Test 3
24	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	(Note 1, Note 2)	(Note 1, Note 3)
Intra-band	N/A	Clause 9.5B.1.1 is executed for	Clause 9.5B.1.2 is executed for
scenarios are not		inter-band EN-DC scenarios	inter-band EN-DC scenarios
supported			
UE does not	Clause 9.5B.1.1 is	Clause 9.5B.1.1 is executed for	Clause 9.5B.1.1 is only executed
indicate	only executed for	both intra-band and inter-band	for intra-band EN-DC scenarios
"intraBandENDC-	intra-band EN-DC	EN-DC scenarios	
Support" or UE	scenarios		
indicates "both" in			
"intraBandENDC-			
Support" (Note 4)			
UE indicates "non-	Clause 9.5B.1.2 is	Clause 9.5B.1.1 is executed for	Clause 9.5B.1.2 is executed for
contiguous" in	only executed for	inter-band EN-DC scenarios	both intra-band and inter-band
"intraBandENDC-	intra-band EN-DC		EN-DC scenarios
Support" (Note 5)	scenarios		

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.

Note 2: TBD.

Note 3: UE supports intra-band non-contiguous EN-DC requirements for supported inter-band EN-DC combinations.

Note 4: UE supports intra-band contiguous EN-DC, or both intra-band contiguous and non-contiguous EN-DC for supported intra-band EN-DC combinations.

Note 5: UE supports only intra-band non-contiguous EN-DC for supported intra-band EN-DC combinations.

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 ^{Note 1}
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 UE Rx antenna configuration is not relevant for the test configuration and has no impact on the test implementation.

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

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

9.1.2.2 TDD

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

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

Table 9.1.2.2-1: Common Test Parameters (TDD)

Parameter	Unit	Value
UL DL configuration		2 (Note1)
Special subframe 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 ^{Note 2}
Codebook subset restriction		10
Symbols for all unused REs		OCNG in Annex A.5
Transmission mode Transmission time difference between E- UTRA cell and NR cell(s) Antenna configuration Codebook subset restriction Symbols for all unused	μs	No external noise sources are applied 1 O All NR cells are in FR1: 1x2 Any NR cell is in FR2: 1 Tx ^{Note 2}

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

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

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

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

9.2 PDSCH Demodulation

9.2A PDSCH demodulation for CA

9.2A.1 NR CA between FR1 and FR2

(Void)

9.2B PDSCH demodulation for DC

9.2B.1 EN-DC

9.2B.1.1 EN-DC within FR1

9.2B.1.1.1 PDSCH

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

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

9.2B.1.2.1 PDSCH

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

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

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

9.2B.2 NR DC between FR1 and FR2

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

9.3 PDCCH demodulation

9.3A PDCCH demodulation for CA

9.3A.1 NR CA between FR1 and FR2

(Void)

9.3B PDCCH demodulation for DC

9.3B.1 EN-DC

9.3B.1.1 EN-DC within FR1

9.3B.1.1.1 PDCCH

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

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

9.3B.1.2.1 PDCCH

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

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

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

9.3B.2 NR DC between FR1 and FR2

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

9.4 Void

9.4A SDR test for CA

9.4A.1 NR CA between FR1 and FR2

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

The purpose of the test is to verify that the Layer 1 and Layer 2 correctly process in a sustained manner the received packets corresponding to the maximum data rate indicated by UE capabilities. The sustained downlink data rate shall be verified in terms of the success rate of delivered PDCP SDU(s) by Layer 2. The test case below specifies the conditions and the required success rate of delivered TB by Layer 1 to meet the sustained data rate requirement.

The test parameters are determined by the following procedure:

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

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

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

9.4B SDR test for DC

9.4B.1 EN-DC

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

9.4B.1.1 EN-DC within FR1

9.4B.1.1.1 SDR test

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

The purpose of the test is to verify that the Layer 1 and Layer 2 correctly process in a sustained manner the received packets corresponding to the maximum data rate indicated by UE capabilities. The sustained downlink data rate shall be verified in terms of the success rate of delivered PDCP SDU(s) by Layer 2. The test case below specifies the RF conditions and the required success rate of delivered TB by Layer 1 to meet the sustained data rate requirement.

The test parameters are determined by the following procedure:

- Select one EN-DC bandwidth combination among all supported EN-DC configurations and set of per component carrier (CC) UE capabilities among all supported UE capabilities that provides the largest data rate [in accordance with clause 4.1.2 of TS 38.306 [14]].
 - Set of per NR CC UE capabilities includes channel bandwidth, subcarrier spacing, number of PDSCH MIMO layers, modulation format and scaling factor in accordance with clause 4.1.2 of TS 38.306 [14].
 - Set of per E-UTRA CC UE capabilities includes channel bandwidth, number of PDSCH MIMO layers and modulation format in accordance with clause 4.1.2 of TS 38.306 [14].
 - When there are multiple sets of EN-DC bandwidth combinations and UE capabilities with same largest data rate, select one among sets with the smallest aggregated channel bandwidth.
- For each NR FR1 CC in EN-DC bandwidth combination, use Table 5.5A-5 in Clause 5.5A to determine MCS based on test parameters and indicated UE capabilities.
- For each E-UTRA CC in EN-DC bandwidth combination, use Table 9.4B.1.1.1-2 and Table 9.4B.1.1.1-3 to determine FRC based on test parameters and indicated UE capabilities.

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

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

For the configuration of DRB type of Split bearer, the TB success rate across CGs is defined as TB success rate = 100%*NDL_correct_rx/ (NDL_newtx + NDL_retx), where NDL_newtx is the number of newly transmitted DL transport blocks, NDL_retx is the number of retransmitted DL transport blocks, and NDL_correct_rx is the number of correctly received DL transport blocks. All the above numbers of transmitted, retransmitted or correctly received DL transport blocks are calculated as the sum of the numbers of DL transport blocks across all the CGs used for DC transmission or reception.

- For the configuration of DRB type of MCG or SCG bearer, the TB success rate across CGs is defined as TB success rate = 100%*NDL_correct_rx/ (NDL_newtx + NDL_retx), where NDL_newtx is the number of newly transmitted DL transport blocks, NDL_retx is the number of retransmitted DL transport blocks, and DL_correct_rx is the number of correctly received DL transport blocks. All the above numbers of transmitted, retransmitted or correctly received DL transport blocks are calculated as the sum of the numbers of DL transport blocks per CG used for DC.

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
T Topagation condition		No external noise sources are applied
$\hat{E}_{_{s}}$ 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 lover	Bandwidth	Reference channel					
MIMO 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 layer	10	R.PDSCH.4-1.2 FDD	R.PDSCH.4-3.2 FDD	R.PDSCH.4-5.2 FDD			
Z layei	15	R.PDSCH.4-1.3 FDD	R.PDSCH.4-3.3 FDD	R.PDSCH.4-5.3 FDD			
	20	R.PDSCH.4-1.4 FDD	R.PDSCH.4-3.4 FDD	R.PDSCH.4-5.4 FDD			
	5	R.PDSCH.4-2.1 FDD	R.PDSCH.4-4.1 FDD	R.PDSCH.4-6.1 FDD			
4 layer	10	R.PDSCH.4-2.2 FDD	R.PDSCH.4-4.2 FDD	R.PDSCH.4-6.2 FDD			
	15	R.PDSCH.4-2.3 FDD	R.PDSCH.4-4.3 FDD	R.PDSCH.4-6.3 FDD			
	20	R.PDSCH.4-2.4 FDD	R.PDSCH.4-4.4 FDD	R.PDSCH.4-6.4 FDD			

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

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

9.4B.1.2 EN-DC including FR2 NR carrier

9.4B.1.2.1 SDR test

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

The purpose of the test is to verify that the Layer 1 and Layer 2 correctly process in a sustained manner the received packets corresponding to the maximum data rate indicated by UE capabilities. The sustained downlink data rate shall be verified in terms of the success rate of delivered PDCP SDU(s) by Layer 2. The test case below specifies the conditions and the required success rate of delivered TB by Layer 1 to meet the sustained data rate requirement.

The test parameters are determined by the following procedure:

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

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

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

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

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

The purpose of the test is to verify that the Layer 1 and Layer 2 correctly process in a sustained manner the received packets corresponding to the maximum data rate indicated by UE capabilities. The sustained downlink data rate shall be verified in terms of the success rate of delivered PDCP SDU(s) by Layer 2. The test case below specifies the conditions and the required success rate of delivered TB by Layer 1 to meet the sustained data rate requirement.

The test parameters are determined by the following procedure:

- Step 1: Calculate the NR FR1 data rate for EN-DC bandwidth combinations, using a procedure from clause 4.1.2 of TS 38.306 [14], for all supported EN-DC configurations and set of per NR component carrier (CC) UE capabilities among all supported UE capabilities:
 - Set of per NR CC UE capabilities includes a channel bandwidth, subcarrier spacing, number of PDSCH MIMO layers, modulation format and scaling factor as defined in clause 4.1.2 of TS 38.306 [14].
- Step 2: Calculate the NR FR2 data rate for EN-DC bandwidth combinations, using a procedure from Clause 7.5A, for all supported EN-DC configurations and set of per NR component carrier (CC) UE capabilities among all supported UE capabilities:
 - Set of per NR CC UE capabilities includes a channel bandwidth, subcarrier spacing, number of PDSCH MIMO layers, modulation format and scaling factor as defined in clause 4.1.2 of TS 38.306 [14].
- Step 3: Calculate the E-UTRA data rate for EN-DC bandwidth combinations, using a procedure from clause 4.1.2 of TS 38.306 [14], for all supported EN-DC configurations and set of per E-UTRA component carrier (CC) UE capabilities among all supported UE capabilities:
 - Set of per E-UTRA CC UE capabilities includes a channel bandwidth, number of PDSCH MIMO layers and modulation format as defined in clause 4.1.2 of TS 38.306 [14].

- Step 4: Select the EN-DC bandwidth combination among all supported EN-DC configurations that achieves the maximum total data rate in steps 1, 2 and 3 among all UE capabilities:
 - When there are multiple sets of EN-DC bandwidth combinations and UE capabilities with the same largest data rate, select a single set among sets with the smallest aggregated channel bandwidth.
- Step 5: For each NR FR2 CC in the selected EN-DC bandwidth combination, use MCS determined in step 2 for that EN-DC bandwidth combination based on test parameters and indicated UE capabilities.

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

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

9.4B.2 NR DC between FR1 and FR2

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

9.4B.3 NE-DC

9.4B.3.1 NE-DC within FR1

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

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 Reference channel Power at a port (dB		Reference channel				ion of mum
	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 Reference c (MHz)		Reference channel		antenna 3m/Hz)	Fract Maxi	ce value ion of mum hput (%)
	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		Power at port (dE		Fract Maxi	ce value ion of mum hput (%)
	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 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 MCG CC 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.

11 V2X requirements

This clause contains the performance requirements for the sidelink physical channels specified for V2X Sidelink Communication.

11.1 Demodulation performance requirements (Conducted requirements)

11.1.1 General

11.1.1.1 Applicability of requirements

11.1.1.1 General

The minimum performance requirements are applicable to all V2X operating bands defined in TS 38.101-1[6] Clause 5.2E.

The minimum performance requirements in Clause 11.1 are mandatory for UE supporting NR SL operation (*sl-Reception-r16*), except test cases listed in Clauses 11.1.1.1.2.

11.1.1.1.2 Applicability of requirements for mandatory UE V2X features with capability signalling

The performance requirements in Table 11.1.1.1.2-1 shall apply for V2X UEs which support mandatory UE features with capability signalling only.

Table 11.1.1.1.2-1: Requirements applicability for mandatory features with UE capability signalling

UE feature/capability [14]	Test t	уре	Test list	Applicability notes
Support of synchronization sources for NR sidelink (sync-Sidelink-r16)	FR1	PSBCH	Clause 11.1.4.1.1	
Supports of PSFCH format 0 (psfch-FormatZeroSidelink-r16)	FR1	PSSCH	Clause 11.1.2.1.1 Clause 11.1.6.1.1 Clause 11.1.7.1.1	
		PSCCH	Clause 11.1.3.1.1	
		PSFCH	Clause 11.1.5.1.1	

11.1.1.2 Common test parameters

Parameters specified in Table 11.1.1.2-1 are applied for all test cases in this clause unless otherwise stated.

Table 11.1.1.2-1: Common test parameters

	Parameter	Unit	Value
Carrier	Offset between Point A and the lowest usable subcarrier on this carrier (Note 1)	RBs	0
configuration	Subcarrier spacing	kHz	30
	Cyclic prefix		Normal
	RB offset	RBs	0
SL 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
PT-RS configuration			PT-RS is not configured
	PSCCH Time resource	Symbols	2
	PSCCH Frequency resource	PRBs	10
	PSFCH number of cyclic shift pairs		n1
	PSFCH hopping ID		0
	PSFCH candidate resource type		allocSubCH
Resource pool	Set of PRBs for PSFCH transmission		ones(1,100) for 40 MHz and ones(1,50) for 20 MHz
configuration	PSSCH RSRP threshold		66 (infinity dBm)
	Synchronization reference		GNSS
	Subchannel size	PRBs	10
	Number of sub-channels		5 for 20 MHz and 10 for 40 MHz
	Start PRB for first sub-channel		0
		1	ones(1, 160)

PSSCH demodulation requirements 11.1.2

11.1.2.1 2Rx requirements

11.1.2.1.1 Minimum requirements

The purpose of the requirements in this subclause is to verify the PSSCH for V2X demodulation performance with a single active PSSCH link.

The minimum requirements are specified in Table 11.1.2.1.1-2 with the test parameters specified in Table 11.1.2.1.1-1. In this test scenario, GNSS or GNSS-equivalent synchronization source is used and sidelink UE 1 transmits PSCCH and PSSCH.

Table 11.1.2.1.1-1: Test parameters

	Parameter	Unit		Value	
	Parameter	Offic	Test 1	Test 2	Test 3
Active cell(s)			None		
	Sidelink transmissions		PSCCH + PSSCH		
	PSSCH DMRS pattern (Note 1)		{3,4}	{2,3}	{2,2}
C:daliale	Index of sub-channel allocation		[0,1]	[0,1]	[0]
Sidelink UE 1	Timing offset (Note 2)	μs		CP/2-12*64*T	С
UE I	Frequency offset (Note 3)	Hz		+600	
	Synchronization		GNS	S or GNSS-equ	uivalent
	Antenna configuration		1x2 Low		
PSFCH re	source period	Slot	4 4 4		
MinTimeG	apPSFCH	Slot	3	3	3

Note 1: {x, y}: x and y means the number of DMRS symbols for slot with PSFCH transmission and without PSFCH transmission, respectively.

Note 2: Time offset of sidelink UE receive signal with respect to GNSS referring timing.

Note 3: Frequency offset of sidelink UE receive signal with respect to GNSS reference frequency.

Table 11.1.2.1.1-2: Minimum performance

	Reference	Bandwidth (MHz)/	Modulation format	Propagation	Reference	ce value
Test num.	channel	Subcarrier spacing(kHz)	and code rate	condition	PSSCH BLER (%)	SNR(dB) of PSSCH
1	R.PSSCH.2-1.1	20 / 30	QPSK, 0.30	TDLA30-2700		3.4
2	R.PSSCH.2-1.2	20 / 30	16QAM, 0.37	TDLA30-1400	10%	8.8
3	R.PSSCH.2-1.3	20 / 30	64QAM, 0.43	TDLA30-180		14.8

11.1.3 PSCCH demodulation requirements

11.1.3.1 2Rx requirements

11.1.3.1.1 Minimum requirements

The purpose of the requirements in this subclause is to verify the PSCCH for V2X demodulation performance with a single active PSSCH link.

The minimum requirements are specified in Table 11.1.3.1.1-2 with the test parameters specified in Table 11.1.3.1.1-1. In this test scenario, GNSS or GNSS-equivalent synchronization source is used and Sidelink UE 1 transmits PSCCH and PSSCH.

Table 11.1.3.1.1-1: Test Parameters

	Parameter		Test 1
Active cell(s)			None
	Sidelink Transmissions		PSCCH+PSSCH
	Timing offset (Note 1)	μs	CP/2-12*64*Tc
Sidelink UE 1	Frequency offset (Note 2)	Hz	+600
	Synchronization		GNSS or GNSS-equivalent
	Antenna configuration		1x2 Low
	PSSCH RMC		R.PSSCH.2-1.1

NOTE 1: Time offset of Sidelink UE receive signal with respect to GNSS reference timing.

NOTE 2: Frequency offset of Sidelink UE receive signal with respect to GNSS reference frequency.

NOTE 3: OCC index i for PSCCH DMRS is randomly selected from {0, 1, 2} for each PSCCH transmission.

Table 11.1.3.1.1-2: Minimum performance

	PSCCH Bandwidth			Reference value		
Test numbe	Reference r channel	(MHz) / Subcarrier spacing (kHz)	Propagation condition	Probability of missed PSCCH (%)	SNR (dB) of PSCCH	
1	R.PSCCH.2-1.1	20 / 30	TDLA30-1400	1	4.7	

11.1.4 PSBCH demodulation requirements

11.1.4.1 2Rx requirements

11.1.4.1.1 Minimum requirements

The purpose of the requirements in this subclause is to verify the PSBCH demodulation performance with a single active link.

The minimum requirements are specified in Table 11.1.4.1.1-2 with the test parameters specified in Table 11.1.4.1.1-1. The Sidelink UE 1 is synchronized to SLSS as synchronization reference.

Table 11.1.4.1.1-1: Test Parameters

	Parameter	Unit	Test 1		
Active cell(s)			None		
	Sidelink Transmissions		SLSS+PSBCH (Note 3)		
	slssid		0		
Sidelink UE 1	Time offset (Note 1)	μs	0		
Sidelifik de 1	Frequency offset (Note 2)	ote 2) Hz 0			
	Synchronization source		SLSS		
	Antenna configuration		1x2 Low		
Note 1: Time of	ffset of Sidelink UE receive signa	I with respect to	o GNSS reference timing.		
Note 2: Frequency offset of Sidelink UE receive signal with respect to GNSS reference frequency.					
Note 3: PSBCI	H transmits together with correspond	onding SLSS in	the same slot.		

Table 11.1.4.1.1-2: Minimum performance

	Bandwidth (MHz)	width (MHz)		Reference value		
Test number	/ Subcarrier spacing (kHz)	PSBCH Reference channel	Propagation condition	Probability of missed PSBCH (%)	SNR (dB)	
1	20 / 30	R.PSBCH.2-1	TDLA30-180	1	0.1	

11.1.5 PSFCH demodulation requirements

11.1.5.1 2Rx requirements

11.1.5.1.1 Minimum requirements

11.1.5.1.1.1 NACK missed detection requirements

The NACK missed detection probability is the probability of not detecting an NACK when an NACK was sent. The test parameters are configured in table 11.1.5.1.1.1-1.

Table 11.1.5.1.1.1-1: Test Parameters

Parameter	unit	Test 1
Allocated resource blocks	RB	1
The number of PSFCH symbols (Note 1)	symbol	2
Number of information bits	bit	1
Synchronization source		GNSS
Timing offset (Note 2)	μs	CP/2-12*64*Tc
Frequency offset (Note 3)	Hz	600
PSFCH resource period	Slots	1
Antenna configuration		1x2 Low
Note 1: First symbol is included. First sym	hol is used for	AGC and not used for

Note 1: First symbol is included. First symbol is used for AGC and not used for demodulation.

Note 2: Time offset of sidelink UE receive signal with respect to GNSS referring

Note 3: Frequency offset of sidelink UE receive signal with respect to GNSS reference frequency.

The NACK missed detection probability shall not exceed 1% at the SNR given in table 11.1.5.1.1.1-2.

Table 11.1.5.1.1.1-2: Minimum requirements

Toot	Bandwidth (MHz) / Propagation		Reference value		
Test num.	Subcarrier spacing (kHz)	Propagation condition	NACK missed detection probability (%)	SNR (dB)	
1	20 / 30	TDLA30-180	1	9.5	

11.1.5.1.1.2 DTX to NACK requirements

The DTX to NACK probability, i.e. the probability that NACK is detected when nothing was sent:

$$Prob(PSFCH\ DTX \to NACK\ bits) = \frac{\#(false\ NACK\ bits)}{\#(PSFCH\ DTX)*\#(NACK\ bits)}$$

where:

- #(false NACK bits) denotes the number of detected NACK bits.
- #(NACK bits) denotes the number of encoded bits per slot
- #(PSFCH DTX) denotes the number of DTX occasions

The test parameters are configured in table 11.5.1.1.1-1.

The DTX to NACK probability shall not exceed 1%.

11.1.6 Power imbalance performance with two links

11.1.6.1 2RX requirements

11.1.6.1.1 Minimum requirements

The purpose of this test is to check the demodulation performance when receiving PSSCH transmissions from two Sidelink UEs with power imbalance in one slot.

The minimum requirements are specified in Table 11.1.6.1.1-2 with the test parameters specified in Table 11.1.6.1.1-1. The Sidelink UE 1 and 2 are synchronized to GNSS or GNSS-equivalent synchronization reference.

Table 11.1.6.1.1-1: Test Parameters

	Parameter	Unit	Test 1
Active cell(s)			None
Active Sidelink UE	(s)		Sidelink UE 1, Sidelink UE 2
	Sidelink Transmissions		PSCCH + PSSCH
	PSSCH DMRS pattern(Note 1)		{2,3}
	Sub-channel allocation		Sub-channel 0
Sidelink UE 1	Time offset (Note 2)	μs	0
Sidelifik de i	Frequency offset (Note 3)	Hz	0
	Antenna configuration		1x2 Low
	PSFCH periodicity	Slots	4
	MinTimeGapPSFCH	Slots	3
	Sidelink Transmissions		PSCCH + PSSCH
	PSSCH DMRS pattern(Note 1)		{2,3}
	Sub-channel allocation		Sub-channnel 3
Sidelink UE 2	Time offset (Note 2)	μs	0
Sidelifik de 2	Frequency offset (Note 3)	Hz	0
	Antenna configuration		1x2 Low
	PSFCH periodicity	Slots	4
	MinTimeGapPSFCH	Slots	3
Note 1: {x, v}:	x and v means the number of DM	RS symbols	for slot with PSFCH transmission and without

Note 1: {x, y}: x and y means the number of DMRS symbols for slot with PSFCH transmission and without PSFCH transmission, respectively.

Table 11.1.6.1.1-2: Minimum performance

	Bandwidth		PSSCH	Modulation		Reference value	
Test number	(MHz)/ Subcarrier spacing(kHz)	Sidelink UE	Reference channel	format and code rate	Propagation condition	PSSCH BLER (%)	SNR (dB) of PSSCH
1	20 / 30	1	R.PSSCH.2-1.4	QPSK, 0.30	AWGN	(Note 1)	30.35
1 20/30	2	R.PSSCH.2-1.4	QPSK, 0.30	AWGN	10	4.8	
Note 1:	Note 1: There is no BLER requirement for Sidelink UE 1.						

11.1.7 HARQ buffer soft combining test

11.1.7.1 2Rx requirement

11.1.7.1.1 Minimum requirement

The purpose of this test is to verify the maximum number of HARQ processes per TTI supported by the V2X UE.

The minimum requirement is specified in Table 11.1.7.1.1-2 with the test parameters specified in Table 11.1.7.1.1-1.

Note 2: Time offset of received signal by Sidelink UE with respect to GNSS reference timing.

Note 3: Frequency offset of received signal by Sidelink UE with respect to GNSS reference frequency.

Table 11.1.7.1.1-1: Test Parameters

	Parameter	Unit	Test 1
Active cell(s)			None
Active Sidelink	UE(s)		Sidelink UE i, $0 \le i \le n$ (Note 1,2)
	Sidelink Transmissions		PSCCH + PSSCH
	PSSCH DMRS pattern		{2}
	Time gap between initial transmission and retransmission	Slots	[n (Note 3)]
Sidelink UE i,	Timing offset (Note 4)	μs	0
0 ≤ i ≤ <i>n</i>	Frequency offset (Note 5)	Hz	0
	Synchronization source		GNSS or GNSS-equivalent
	Antenna configuration		1x2 Low
	Redundancy version coding sequence		{0,2}
PSFCH resource	ce period	Slots	1

Note 1: n is the number of HARQ process UE can support (based on IE harg-RxProcessSidelink)

Note 2: When n = 16 or 24, sidelink UEs transmit one by one circularly for every slot;

When n=32, the first 31 UEs transmit signal one by one circularly for every slot and in the first subchannel, and the 32nd UE transmits signal in the first slot but in the second subchannel; When n=48, the first 31 UEs transmit signal one by one circularly for every slot and in the first subchannel, the next 17 UEs transmit signal in the same slot as the first 17 UEs but in the second subchannel;

When n=64, first 31 UEs transmit signal one by one circularly for every slot and in the first subchannel, the next 31 UEs transmit signal one by one circularly for every slot and in the second subchannel, the last 2 UEs transmit signal in the same slot as the first 2 UEs in the third subchannel

Note 3: k = n if n < 32, otherwise k = 31

Note 4: Time offset of Sidelink UE receive signal is with respect to GNSS reference timing.

Note 5: Frequency offset of Sidelink UE receive signal is with respect to GNSS reference frequency.

Table 11.1.7.1.1-2: Minimum performance

Test	Pandwidth (MUz) /	Bandwidth (MHz) / PSSCH Reference		Reference value		
num.	Subcarrier spacing(kHz)	channel	Propagation condition	PSSCH BLER (%)	SNR (dB) of PSSCH	
1	20 / 30	R.PSSCH.2-1.5	AWGN	5	10.9	

11.1.8 PSCCH decoding capability test

11.1.8.1 2RX requirements

11.1.8.1.1 Minimum requirements

The purpose of this test is to verify the maximum number of received PSCCHs per TTI supported by the V2X UE.

The minimum requirements are specified in Table 11.1.8.1.1-2 with the test parameters specified in Table 11.1.8.1.1-1 and the test procedure is specified as follows:

- 10 UEs transmit PSCCHs and corresponding PSSCHs to the tested UE per slot with each UE occupying one subchannel.
- x UEs transmit PSCCHs and corresponding PSSCHs with high priority level on x subchannels that are randomly selected from 10 subchannels per slot and 10-x UEs transmit PSCCHs and corresponding PSSCHs with low priority level on the remaining subchannels. The indication of priority level specified in Clause 5.4.3.3 of TS 23.287 [12] and Clause 5.22.1.3.1 of TS 38.321 [8] is included in PSCCH.

Where x equals to:

- The number of PSFCH(s) resources that the tested UE can transmit in a slot (i.e. IE *psfch-TxNumber* specified in clause 4.2.16.1.6 of TS 38.306 [14]) if the number of PSFCH(s) resources that the tested UE can transmit in a slot is less than 10

- 10, otherwise.

The probability of PSCCH miss detection is calculated as follows:

$$Prob(PSCCH\ miss\ detection\) = \frac{\#(missing\ ACK/NACK)}{\#(Tx\ high\ priority\ PSCCH/PSSCH)}$$

Where:

- # (Tx high priority PSCCH/PSSCH) denotes the total number of transmitted PSCCH/PSSCH with high priority level.
- # (missing ACK/NACK) denotes the total number of missing ACK/NACK with high priority.

Table 11.1.8.1.1-1: Test Parameters

Parameter			Unit	Value		
Member ID (Note	1)		0			
Sidelink Transmissions				PSCCH + PSSCH		
	Timing offset (Note 2)		μs	0		
	Frequency offset (Note 3)		Hz	0		
	Synchronization source			GNSS		
Sidelink UE i,	Propagation Channel			Static propagation condition without external noise		
,	Antenna configuration			1x2 Low		
0 ≤ i ≤ 9 (Note	PSSCH RMC			R.PSSCH.2-1.1		
5)	PSCCH RMC (Note 4)			R.PSCCH.2-1.1		
	Source ID			0		
	PSFCH periodicity		Slots	1		
	MinTimeGapPSFCH		Slots	2		
	PSFCH Resource (Note 6)	RB index		10*i		
	FSFCIT Resource (Note 6)	CS pair index		0		
Note 1: Member	er ID is an identifier uniquely id	entifying a membe	er.			
Note 2: Time of	ffset of received signal by Side	link UE with respe	ect to GI	NSS reference timing.		
Note 3: Freque	ency offset of Sidelink UE recei	ved signal by with	respect	to GNSS reference		
freque	ncy.					
	ndex for PSCCH DMRS is rand), 1, 2} for each PSCCH			
transmission as per in Clause 8.4.1.3.2 of TS 38.211[9].						
	te 5: Each UE occupies one sub-channel so that all sub-channels are filled.					
	apping procedure of PSSCH re	source and PSF0	CH resou	rce is specified in Clause		
16.3 01	TS 38.213 [11].					

Table 11.1.8.1.1-2: Minimum performance

Test	Bandwidth (MHz) /	PSCCH Reference	Propagation Channel	Reference value
Number	Subcarrier spacing(kHz)	channel	Propagation Channel	Probability of missed PSCCH (%)
1	40 / 30	R.PSCCH.2-1.1	Static propagation condition without external noise	1

11.1.9 PSFCH decoding capability test

11.1.9.1 2RX requirements

11.1.9.1.1 Minimum requirements

The purpose of this test is to verify the maximum number of PSFCHs received by UE per slot in group cast scenario by using ACK/NACK feedback mode. In each slot, a group of UEs transmits PSFCHs to the tested UE. Information transmitted in each PSFCH is randomly selected from Option A, Option B and Option C with probability of 50%, 25%

and 25% respectively. Transmitted PSFCHs are related to one PSSCH which is transmitted by tested UE and occupies all the subchannels.

- Option A: All the UEs in the group transmit ACKs
- Option B: One UE transmits NACK and the rest of UEs transmit ACKs. The PSFCH resource index with NACK is random per slot
- Option C: One UE transmits nothing (i.e.DTX) and the rest of UEs transmit ACKs. The PSFCH resource index of the DTX is random per slot.

The minimum requirements are specified in Table 11.1.9.1.1-2 with the test parameters specified in Table 11.1.9.1.1-

Table 11.1.9.1.1-1: Test parameters

Parameter		Unit	Test 1	
HARQ-ACK informat	HARQ-ACK information		ACK or NACK	
Source ID of tested I	Source ID of tested UE		0	
	Sidelink transmissions for		PSFCH	
	Timing offset (Note 1)	μs	0	
	Frequency offset (Note 2)	Hz	0	
	Synchronization source		GNSS or GNSS-equivalent	
	Propagation Channel		Static propagation condition	
Sidelink UE i,	Fropagation Channel		No external noise sources are applied	
$0 \le i \le N-1$ (Note 3)	Antenna configuration		1x2 Low	
0 = 1 = 14-1 (Note 5)	Member ID(Note 4)		i	
	PSFCH resource allocation(Note 5)		N UEs transmit PSFCHs one by one on each RB with CS pair index 0. i.e. UE 0 transmits PSFCH on RB 0, UE 1 transmits PSFCH on RB 1,, UE (N-1) transmits PSFCH on RB N-1	
	PSFCH periodicity	Slots	1	
Note 1: Time offset of received signal by Sidelink UE with respect to GNSS reference timing. Note 2: Frequency offset of received signal by Sidelink UE with respect to GNSS reference frequency. Note 3: N equals to the number of PSFCH(s) resources that UE can receive in a slot as specified in Clause 4.2.16.1.6 of TS 38.306[14](IE psfch-RxNumber)).				
	D is an identifier uniquely identi Hs in a slot are corresponding to			

Table 11.1.9.1.1-2: Minimum requirement

Pandwidth (MUz)			Reference value				
Test Number	Bandwidth (MHz) / Subcarrier spacing(kHz)	Propagation Channel	Probability of success detection slot with ACK only	Probability of success detection slot with NACK or DTX			
1	40 / 30	Static propagation condition without external noise	99	99			
Note 1: The probability of success detection slot with ACK only is the probability that the corresponding PSSCH is not retransmitted when Option A is selected.							
	·						

Annex A (normative): Measurement channels

A.1 General

A.1.1 Throughput definition

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

A.1.2 TDD UL-DL configurations for FR1

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

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

	Parameter	Unit	UL-DL pattern
	Parameter	Unit	FR1.15-1
TDD Slot Configuration pattern (Note 1)			DDDSU
Special Slot Con	figuration (Note 2)		10D+2G+2U
referenceSubcarrierSpacing			15
pattern1	dl-UL-TransmissionPeriodicity	ms	5
	nrofDownlinkSlots		3
	nrofDownlinkSymbols		10
	nrofUplinkSlot		1
	nrofUplinkSymbols		2
The number of s	lots between PDSCH and corresponding		4 if $mod(i,5) = 0$
HARQ-ACK info	rmation (Note 3)		3 if $mod(i,5) = 1$
			2 if $mod(i,5) = 2$
			6 if $mod(i,5) = 3$
Note 1: D den	otes a slot with all DL symbols; S denotes a	a slot with a	a mix of DL, UL and

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

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

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

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

Parameter Uni			UL-DL pattern						
		Unit	FR1.30-1	1 FR1.30-2 FR1.30-3 FR1.30-4 F			FR1.30-5	FR1.30-6	
TDD Slot Configuration pattern	(Note 1)		7DS2U	DDDSU	DDDSUDDSUU	DDDSUUDDDD	DSUU	DS ₁ S ₂ U	
Special Slot Configuration (Note 2)			6D+4G+4U	10D+2G+2U	10D+2G+2U	6D+4G+4U	12D+2G	\$1: 10D+2G+2U \$2: 12D+2G+0U	
referenceSubcarrierSpacing		kHz	30	30	30	30	30	30	
pattern1									
·	dl-UL- TransmissionPeriodicity	ms	5	2.5	2.5	3	2	1	
	nrofDownlinkSlots		7	3	3	3	1	1	
	nrofDownlinkSymbols		6	10	10	6	12	10	
	nrofUplinkSlot		2	1	1	2	2	0	
	nrofUplinkSymbols		4	2	2	4	0	2	
pattern2	dl-UL- TransmissionPeriodicity	ms	N/A	N/A	2.5	2	N/A	1	
	nrofDownlinkSlots		N/A	N/A	2	4	N/A	0	
	nrofDownlinkSymbols		N/A	N/A	10	0	N/A	12	
	nrofUplinkSlot		N/A	N/A	2	0	N/A	1	
	nrofUplinkSymbols		N/A	N/A	2	0	N/A	0	
The number of slots between 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) = 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		
Falaili	etei	Oilit	FR1.30-1A		
TDD Slot Configuration pattern (I			7DS2U		
Special Slot Configuration (Note	kHz	6D+4G+4U N/A			
referenceSubcarrierSpacing					
pattern1 (Note 4)					
	dl-UL- TransmissionPeriodicity	ms	N/A		
	nrofDownlinkSlots		N/A		
	nrofDownlinkSymbols		N/A		
	nrofUplinkSlot		N/A		
	nrofUplinkSymbols		N/A		
PDCCH DCI Configuration	DCI Format		1-1 for slot indices with mod(i,10) = 0,1,2,3,4,5,6,7		
	Scheduled Grant		Symbol 2-13 for slot indices with mod(i,10) = 0,1,2,3,4,5,6 and Symbol 2-5 for slot indices with mod(i,10) = 7		
The number of slots between PD HARQ-ACK information (Note 3) (PDSCH-to-HARQ-timing-indicat			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		
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.					
information.	Note 2: D, G and U denote DL, guard and UL symbols, respectively. The field is for				
Note 3: i is the slot index per f Note 4: Do not configure tdd-l	rame; i = {0,,19} <i>JL-DL-ConfigurationCommon</i>	ısing RF	RC configuration		

Table A.1.2-2b: TDD UL-DL configuration for SCS 30 kHz for PDSCH on band with shared spectrum access

Parameter		Unit	UL-DL pattern
	Parameter	Unit	FR1.30-7
TDD Slot Configuration pattern (Note 1)			7DS2U
Special Slot Configura	tion (Note 2)		6D+4G+4U
referenceSubcarrierSp	pacing	kHz	30
Pattern 1	dl-UL-TransmissionPeriodicity	ms	5
	nrofDownlinkSlots	slot	7
	nrofDownlinkSymbols	symbol	6
	nrofUplinkSlot	slot	2
	nrofUplinkSymbols	symbol	4
Pattern 2	dl-UL-TransmissionPeriodicity	ms	N/A
	nrofDownlinkSlots		N/A
	nrofDownlinkSymbols		N/A
	nrofUplinkSlot		N/A
	nrofUplinkSymbols		N/A
The number of slots be	etween PDSCH and corresponding		8 if $mod(i,10) = 0$
HARQ-ACK informatio	n (Note 3)		7 if $mod(i,10) = 1$
			6 if $mod(i,10) = 2$
			5 if mod(i,10) = 3
			4 if mod(i,10) = 4
			3 if mod(i,10) = 5
			2 if mod(i,10) = 6

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.

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

	Parameter	l lmi4	UL-DL pattern
Parameter		Unit —	FR2.60-1
TDD Slot Configurati	guration pattern (Note 1)		DDSU
Special Slot Configur	ation (Note 2)		11D+3G+0U
referenceSubcarrierS	Spacing	kHz	60
pattern1	dl-UL-	ms	4
	TransmissionPeriodicity		ı
	nrofDownlinkSlots		2
	nrofDownlinkSymbols		11
	nrofUplinkSlot		1
	nrofUplinkSymbols		0
The number of slots	petween PDSCH and corresponding		3 if $mod(i,4) = 0$
HARQ-ACK information (Note 3)			2 if $mod(i,4) = 1$
	,		5 if $mod(i,4) = 2$
Note 1. Delenates	a alat with all DI averabala. Calamatan a	-1-4	

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 of all slots in every 5ms $i = \{0,...,9\}$ Note 4: The slot i, mod (i,10)=9 is idle slot with no UL transmission.

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

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

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

	Parameter	Unit	UL-DL pattern		
r arameter		Onit	FR2.120-1	FR2.120-2	
TDD Slot Configuration pattern (Note 1)			DDDSU	DDSU	
Special Slot Configuration	n (Note 2)		10D+2G+2U	11D+3G+0U	
referenceSubcarrierSpac	cing	kHz	120	120	
pattern1	dI-UL-	ms	0.625	0.5	
	TransmissionPeriodicity		0.020	3.3	
	nrofDownlinkSlots		3	2	
	nrofDownlinkSymbols		10	11	
	nrofUplinkSlot		1	1	
	nrofUplinkSymbols		2	0	
The number of slots betw	veen 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 $mod(i,5) = 3$		

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

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

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

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

	Parameter			UL-DL pattern			
	Farame	Unit	FR2.120-1A				
TDD Slot	Configuration pattern (N	lote 1)		DDDSU			
Special S	Slot Configuration (Note 2		10D+2G+2U				
reference	SubcarrierSpacing	•	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 [OCI 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			
HARQ-A	The number of slots between PDSCH and corresponding HARQ-ACK information(Note 3)			4 if mod(i,5) = 0 3 if mod(i,5) = 1 2 if mod(i,5) = 2 6 if mod(i,5) = 3			
Note 1:	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 3: Note 4:	information. i is the slot index per fr Do not configure <i>tdd-U</i>	ame; i = {0,,79} IL-DL-ConfigurationCommon (using R	RC configuration.			

A.2 Void

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

A.3 DL reference measurement channels

A.3.1 General

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

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

A.3.2 Reference measurement channels for PDSCH performance requirements

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

A.3.2.1 FDD

A.3.2.1.1 Reference measurement channels for SCS 15 kHz FR1

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

Parameter	Unit			Value		
Deference channel		R.PDSCH.1-	R.PDSCH.1-	R.PDSCH.1-	R.PDSCH.1-	R.DSCH.1-
Reference channel		1.1 FDD	1.2 FDD	1.3 FDD	1.4 FDD	2.5 FDD
Channel bandwidth	MHz	10	10	10	10	10
Subcarrier spacing	kHz	15	15	15	15	15
Number of allocated resource blocks	PRBs	52	6	52	52	52
Number of consecutive PDSCH symbols		12	12	7	12	12
Allocated slots per 2 frames	Slots	19	19	19	19	19
MCS table		64QAM	64QAM	64QAM	64QAMLowSE	64QAMLowSE
MCS index		4	4	4	14	19
Modulation		QPSK	QPSK	QPSK	QPSK	16QAM
Target Coding Rate		0.30	0.30	0.30	0.59	0.54
Number of MIMO layers		1	1	1	1	2
Number of DMRS REs		18	12	12	12	12
Overhead for TBS determination		0	0	0	0	0
Information Bit Payload per Slot						
For Slot i = 0	Bits	N/A	N/A	N/A	N/A	N/A
For Slots i = 1,, 19	Bits	3904	480	2280	8064	29704
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	16	16	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	1	1	1	1	4
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	12480	1512	6864	13104	49920
For Slots i =1,, 9, 12,, 19	Bits	13104	1584	7488	13728	54912
Max. Throughput averaged over 2 frames	Mbps	3.709	0.456	2.166	7.661	28.219
Note 1: SS/PBCH bloc Note 2: Slot i is slot ind) with periodicity	/ 20 ms		

Note 2: Slot i is slot index per 2 frames

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

Unit			Value		
	R.PDSCH.1-	R.PDSCH.1-	R.PDSCH.1-	R.PDSCH.1-	R.PDSCH.1-
	2.1 FDD	2.2 FDD	2.3 FDD	2.4 FDD	2.5 FDD
MHz	10	10	10	10	10
kHz	15	15	15	15	15
DDBc	52	52	52	52	52
FKD5	52	52	52	52	
	12	12	12	12	12
	12	12	12	12	
Slots	19	19	19	19	19
	64QAM	64QAM	64QAM	64QAM	64QAM
	13	13	13	13	16
	16QAM	16QAM	16QAM	16QAM	16QAM
	0.48	0.48	0.48	0.48	0.64
	1	2	3	4	1
	12	12	24	24	12
	0	0	0	0	0
	U	U	U	U	
Bits	N/A	N/A	N/A	N/A	N/A
Bits	13064	26120	35856	48168	17424
Bits	N/A	N/A	N/A	N/A	N/A
Bits	24	24	24	24	24
CBs	N/A	N/A	N/A	N/A	N/A
CBs	2	4	5	6	3
Bits	N/A	N/A	N/A	N/A	N/A
Bits	26208	52416	71136	94848	26208
Bits	27456	54912	74880	99840	27456
Mbps	12.411	24.814	34.063	45.760	16.553
	Bits Bits Bits Bits Bits Bits Bits Bits	R.PDSCH.1- 2.1 FDD MHz 10 kHz 15 PRBs 52 12 Slots 19 64QAM 13 16QAM 0.48 1 12 0 Bits N/A Bits 13064 CBs N/A CBs 2 Bits N/A Bits 24 Bits N/A Bits 24	R.PDSCH.1- 2.1 FDD MHz 10 10 10 KHz 15 15 15 PRBs 52 52 12 12 12 Slots 19 64QAM 64QAM 13 13 13 16QAM 0.48 0.48 1 2 12 12 0 0 0 Bits N/A Bits 13064 CBs N/A N/A Bits 24 Bits N/A N/A Bits 1/A N/A Bits 26208 Bits 27456 54912	R.PDSCH.1- 2.1 FDD R.PDSCH.1- 2.2 FDD R.PDSCH.1- 2.3 FDD MHz 10 10 10 kHz 15 15 15 PRBs 52 52 52 12 12 12 12 Slots 19 19 19 64QAM 64QAM 64QAM 64QAM 13 13 13 13 16QAM 16QAM 16QAM 0.48 0.48 0.48 0.48 0.48 12 12 24 0 0 0 0 0 Bits N/A N/A N/A Bits N/A N/A N/A CBs 2 4 5 Bits N/A N/A N/A Bits N/A N/A N/A Bits 26208 52416 71136 Bits 27456 54912 74880	R.PDSCH.1- 2.1 FDD R.PDSCH.1- 2.2 FDD R.PDSCH.1- 2.3 FDD R.PDSCH.1- 2.4 FDD MHz 10 10 10 10 kHz 15 15 15 15 PRBs 52 52 52 52 12 12 12 12 12 Slots 19 19 19 19 19 64QAM 64QAM 64QAM 64QAM 64QAM 13 13 13 13 13 16QAM 16QAM 16QAM 16QAM 16QAM 0.48 0.48 0.48 0.48 0.48 1 2 3 4 24 0 0 0 0 0 Bits N/A N/A N/A N/A Bits N/A N/A N/A N/A Bits N/A N/A N/A N/A CBs 2 4 5 6 Bi

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

Note 2:

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

Parameter	Unit			Value		
Deference channel		R.PDSCH.1-	R.PDSCH.1-	R.PDSCH.1-	R.PDSCH.1-	
Reference channel		3.1 FDD	3.2 FDD	3.3 FDD	3.4 FDD	
Channel bandwidth	MHz	10	10	10	10	
Subcarrier spacing	kHz	15	15	15	15	
Number of allocated resource	PRBs	52	52	26 (Note 3)	26 (Note 4)	
blocks	PRDS	52				
Number of consecutive PDSCH		12	12	12	12	
symbols		12				
Allocated slots per 2 frames	Slots	19	19	19	19	
MCS table		64QAM	64QAM	64QAM	64QAM	
MCS index		19	19	19	19	
Modulation		64QAM	64QAM	64QAM	64QAM	
Target Coding Rate		0.51	0.51	0.51	0.51	
Number of MIMO layers		2	2	2	2	
Number of DMRS REs		12	24	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	42016	37896	18960	18960	
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	5	5	3	3	
Binary Channel Bits Per Slot						
For Slot i = 0	Bits	N/A	N/A	N/A	N/A	
For Slots i = 10, 11	Bits	78624	67392	33696	33696	
For Slots i = 1,, 9, 12,, 19	Bits	82368	74880	37440	37440	
Max. Throughput averaged over 2 frames	Mbps	39.915	36.001	18.012	18.012	

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

Note 2:

Slot i is slot index per 2 frames PDSCH is scheduled in PRB numbers from 0 to 25. Note 3: Note 4: PDSCH is scheduled in PRB numbers from 26 to 51.

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

Parameter	Unit		Value
Defended should		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 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 frames Note 1: SS/PBCH block is transmitted.	Mbps	42.841	

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

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

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

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

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

Parameter	Unit			Value	
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	N1/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		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	33816	
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	5	
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	49920	74880	
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	32.1252	

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

Parameter	Unit			Value		
Reference 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	U	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	
Reference channel		R.PDSCH.1-	R.PDSCH.1-		
Reference channel		11.1 FDD	11.2 FDD		
Channel bandwidth	MHz	10	10		
Subcarrier spacing	kHz	15	15		
Number of allocated resource	PRBs	52	52		
blocks	FKD5	52			
Number of consecutive PDSCH		12	12		
symbols		12			
Allocated slots per 2 frames	Slots	18	18		
MCS table		64QAMLowSE	64QAMLowSE		
MCS index		19	19		
Modulation		16QAM	16QAM		
Target Coding Rate		0.54	0.54		
Number of MIMO layers		1	1		
Number of DMRS REs		12	12		
Overhead for TBS determination		0	0		
Information Bit Payload per Slot					
For Slot i = 0,1	Bits	N/A	N/A		
For Slots i = 2,, 19	Bits	14856	14856		
Transport block CRC per Slot					
For Slot i = 0,1	Bits	N/A	N/A		
For Slots i = 2,, 19	Bits	24	24		
Number of Code Blocks per Slot					
For Slot i = 0,1	CBs	N/A	N/A		
For Slots i = 2,, 19	CBs	2	2		
Binary Channel Bits Per Slot					
For Slot i = 0,1	Bits	N/A	N/A		
For Slots i = 10, 11	Bits	26208	24960		
For Slots i =2,, 9, 12,, 19	Bits	27456	27456		
Max. Throughput averaged over 2	Mbps	6.685	6.685		
frames	MINDE	(NOTE 3)	(NOTE 4)		

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

Note 2:

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

Note 4:

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

Parameter	Unit		Value
Reference channel		R.PDSCH.1-	
Reference chamilei		12.1 FDD	
Channel bandwidth	MHz	10	
Subcarrier spacing	kHz	15	
Number of allocated resource	PRBs	52	
blocks	1 1103	52	
Number of consecutive PDSCH		2	
symbols			
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

Note 2: Slot i is slot index per 2 frames

A.3.2.1.3 Reference measurement channels for SCS 60 kHz FR1

A.3.2.1.4 Reference measurement channels for E-UTRA

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

Parameter	Unit		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_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.

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

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

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

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

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

Parameter	Unit	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_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 6: Resource blocks $n_{PRB} = 0..24$ in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 7: Resource blocks $n_{PRB} = 3..49$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..49$ in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 8: Resource blocks nPRB = 4..74 are allocated for the user data in sub-frame 5, and resource blocks nPRB = 0..74 in sub-frames 0,1,2,3,4,6,7,8,9.
- Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0,1,2,3,4,6,7,8,9.

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

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

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

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

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

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

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

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

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

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

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

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

A.3.2.2 TDD

A.3.2.2.1 Reference measurement channels for SCS 15 kHz FR1

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		
D ()		R.PDSCH.1-	R.PDSCH.1-			
Reference 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 Slots 0 and Slot i, if mod(i, 10) =		N1/A	N1/A	N1/A	N1/A	
{8,9} for i from {0,,39}		N/A	N/A	N/A	N/A	
For Slot i, if $mod(i, 5) = 3$ for i from		N1/A	N1/A			
{0,,19}		N/A	N/A			
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i			4.4			
from {1,,19}		9	11			
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 Slots 0 and Slot i, if mod(i, 10) =		21/2	21/2	21/2	21/2	
{8,9} for i from {0,,39}		N/A	N/A	N/A	N/A	
For Slot i, if $mod(i, 5) = 3$ for i from		N1/A	N1/A			
{0,,19}		N/A	N/A			
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i		40	40			
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	NI/A	NI/A			
{2,3,4} for i from {0,,19}	DIIS	N/A	N/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}	Dito	IN//A	IN/A			
For Slot i, if $mod(i, 5) = \{0,1\}$ for i from	Bits	16	16			
{1,,19}	Dito	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	14/73	14/71			
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}						
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}	210	3301	10000			
Max. Throughput averaged over 2	Mbps	0.865	1.134			
frames	-					
Note 1: SS/PBCH block is transmitted.	in sint #() i	with neriodicity 2	/II 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

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	PRDS	25	52	79	106	133		
Number of consecutive PDSCH								
symbols								
For Slot i, if mod(i, 5) = 3 for i	ļ	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	10	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}	DIIS	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}	DIIS	12552	20120	39930	33200	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	ı	3	4	5	0		
For Slot i, if $mod(i, 5) = \{0,1,2\}$	CBs	2	4	5	7	9		
for i from {1,,19}	CDS	2	4	5	1	9		
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	33066	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	
Defenses skamel		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					
blocks	PRBs	160	216	270	
Number of consecutive PDSCH					
symbols					
For Slot i, if $mod(i, 5) = 3$ for i					
from {0,,19}		8	8	8	
For Slot i, if $mod(i, 5) = \{0,1,2\}$					
for i from $\{1,,19\}$		12	12	12	
Allocated slots per 2 frames	Slots	15	15	15	
	31013	64QAM	64QAM	64QAM	
MCS table					
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	D:4-	54040	00070	00040	
from {0,,19}	Bits	51216	69672	86040	
For Slot i, if $mod(i, 5) = \{0,1,2\}$	D::	70000	100550	405000	
for i from {1,,19}	Bits	79896	108552	135296	
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					
from {0,,19}	Bits	24	24	24	
For Slot i, if $mod(i, 5) = \{0,1,2\}$					
for i from {1,,19}	Bits	24	24	24	
Number of Code Blocks per					
Slot					
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	D:4-	NI/A	NI/A	NI/A	
For Slote i 40 44	Bits	N/A	N/A	N/A	
For Slots i = 10, 11	Bits	161280	217728	272160	
For Slot i, if $mod(i, 5) = 3$ for i	Bits	107520	145152	181440	
from {0,,19}					
For Slot i, if $mod(i, 5) = \{0,1,2\}$	Bits	168960	228096	285120	
for i from {1,,9,12,,19}	2110		22000	200120	
Max. Throughput averaged	Mbps	54.186	73.638	91.621	
over 2 frames				01.021	
Note 1: SS/PBCH block is tran		•	eriodicity 20 ms		
Note 2: Slot i is slot index per 2	2 frames				

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					
		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}		4	4	IN/A	IV/A				
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}		0	U	IN//A	14/73				
For Slot i, if mod(i, 10) =		18	12	12	12				
{0,1,2,3,4,5,6} for i from {1,,39}									
Overhead for TBS determination		0	0	0	0				
Information Bit Payload per Slot									
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}	5.10	14/71	14/71	1471	1471				
For Slot i, if $mod(i, 10) = 7$ for i from	Bits	2664	144	N/A	N/A				
{0,,39}									
For Slot i, if mod(i, 10) =	Bits	8064	480	4608	16392				
{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				
$= \{8,9\} \text{ for i from } \{0,\dots,39\}$ For Slot i, if mod(i, 10) = 7 for i from									
$\{0,,39\}$	Bits	16	16	N/A	N/A				
For Slot i, if mod(i, 10) =									
{0,1,2,3,4,5,6} for i from {1,,39}	Bits	24	16	24	24				
Number of Code Blocks per Slot									
For Slots 0 and Slot i, if mod(i, 10)									
$= \{8,9\}$ for i from $\{0,,39\}$	CBs	N/A	N/A	N/A	N/A				
For Slot i, if $mod(i, 10) = 7$ for i from		_	_						
{0,,39}	CBs	1	1	N/A	N/A				
For Slot i, if mod(i, 10) =	05								
{0,1,2,3,4,5,6} for i from {1,,39}	CBs	1	1	1	2				
Binary Channel Bits Per Slot									
For Slots 0 and Slot i, if mod(i, 10)	D::	N1/A	N1/A	N1/A	N1/0				
$= \{8,9\}$ 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 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}									
Max. Throughput averaged over 2	Mbps	11.419	0.677	6.221	22.129				
frames	-			0.221	22.123				
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms									

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

Defense	Unit			Value		
		R.PDSCH.2-	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	2.5 TDD
Channel bandwidth	MHz	40	40	40	40	40
Subcarrier spacing	kHz	30	30	30	30	30
Allocated resource blocks	PRBs	106	106	106	106	106
Number of consecutive						
PDSCH symbols						
For Slots 0 and Slot i, if						N/A
$mod(i, 10) = \{8,9\}$ for i from		N/A	N/A	N/A	N/A	
{0,,39}						
For Slot i, if $mod(i, 10) = 7$		4	4	4	4	4
for i from {0,,39}		7	7	7	7	
For Slot i, if mod(i, 10) =						12
{0,1,2,3,4,5,6} for i from		12	12	12	12	
{1,,39}						
Allocated slots per 2 frames		31	31	31	31	31
MCS table		64QAM	64QAM	64QAM	64QAM	64QAMLowSE
MCS index		13	13	13	13	19
Modulation		16QAM	16QAM	16QAM	16QAM	16QAM
Target Coding Rate		0.48	0.48	0.48	0.48	0.54
Number of MIMO layers		1	2	3	4	2
Number of DMRS REs						
For Slots 0 and Slot i, if						N/A
$mod(i, 10) = \{8,9\}$ for i from		N/A	N/A	N/A	N/A	
{0,,39}						
For Slot i, if $mod(i, 10) = 7$		6	6	12	12	6
for i from {0,,39}		0	0	12	12	
For Slot i, if mod(i, 10) =						12
{0,1,2,3,4,5,6} for i from		12	12	24	24	
{1,,39}						
Overhead for TBS		0	0	0	0	0
determination		U	U	U	U	
Information Bit Payload per						
Slot						
For Slots 0 and Slot i, if						N/A
$mod(i, 10) = \{8,9\}$ for i from	Bits	N/A	N/A	N/A	N/A	
{0,,39}						
For Slot i, if $mod(i, 10) = 7$	Bits	8456	16896	22032	29192	19464
for i from {0,,39}	Dito	0 100	10000	22002	20102	
For Slot i, if mod(i, 10) =						60456
{0,1,2,3,4,5,6} for i from	Bits	26632	53288	73776	98376	
{1,,39}						
Transport block CRC per Slot						
For Slots 0 and Slot i, if						N/A
$mod(i, 10) = \{8,9\}$ for i from	Bits	N/A	N/A	N/A	N/A	
{0,,39}						
For Slot i, if $mod(i, 10) = 7$	Bits	24	24	24	24	24
for i from {0,,39}						
For Slot i, if $mod(i, 10) =$	D.,	0.4		0.4		24
{0,1,2,3,4,5,6}for i from	Bits	24	24	24	24	
{1,,39}						
Number of Code Blocks per						
Slot	1					N1/A
For Slots 0 and Slot i, if	0.0	N1/A	N1/A	N1/A	N1/A	N/A
$mod(i, 10) = \{8,9\}$ for i from	CBs	N/A	N/A	N/A	N/A	
{0,,39}						0
For Slot i, if $mod(i, 10) = 7$	CBs	2	3	3	4	3
for i from {0,,39}	1					0
For Slot i, if $mod(i, 10) =$	CD-	4	7		10	8
10 4 9 9 4 E Cl for : from	CBs	4	7	9	12	
{0,1,2,3,4,5,6} for i from		I				
{1,,39}						
{1,,39} Binary Channel Bits Per Slot						A1/6
{1,,39} Binary Channel Bits Per Slot For Slots 0 and Slot i, if	D.:	N1/A	N1/A	N1/A	N1/A	N/A
{1,,39} Binary Channel Bits Per Slot	Bits	N/A	N/A	N/A	N/A	N/A

For Slot i, if $mod(i, 10) = 7$ for i from $\{0,,39\}$	Bits	17808	35616	45792	61056	35616	
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,19,22,,39}	Bits	55968	111936	152640	203520	111936	
Max. Throughput averaged over 2 frames	Mbps	37.644	75.318	104.004	138.646	85.508	
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms							

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-	R.PDSCH.2-	R.PDSCH.2-	R.PDSCH.2-
Reference charmer		3.1 TDD	3.2 TDD	3.3 TDD	3.4 TDD
Channel bandwidth	MHz	40	40	40	40
Subcarrier spacing	kHz	30	30	30	30
Allocated resource blocks	PRBs	106	106	53 (Note 3)	53 (Note 4)
Number of consecutive PDSCH					
symbols					
For Slots 0 and Slot i, if mod(i, 10) =		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 $\{0,,39\}$		4	4	4	4
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39}		12	12	12	12
Allocated slots per 2 frames		31	31	31	31
MCS table		64QAM	64QAM	64QAM	64QAM
MCS index		19	19	19	19
Modulation		64QAM	64QAM	64QAM	64QAM
Target Coding Rate		0.51	0.51	0.51	0.51
Number of MIMO layers		2	2	2	2
Number of DMRS REs					
For Slots 0 and Slot i, if mod(i, 10) =		N1/A	N/A	N/A	N/A
{8,9} for i from {0,,39}		N/A			
For Slot i, if mod(i, 10) = 7 for i from		6	12	12	12
{0,,39}		6			
For Slot i, if mod(i, 10) =		12	24	24	24
{0,1,2,3,4,5,6} for i from {1,,39}					
Overhead for TBS determination		0	0	0	0
Information Bit Payload per Slot					
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	27144	23040	11528	11528
For Slot i, if mod(i, 10) =	Bits	83976	77896	38936	38936
{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) =			N/A	N/A	N/A
{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	24	24	24
For Slot i, if mod(i, 10) =	Bits	24	24	24	24
{0,1,2,3,4,5,6}for i from {1,,39}	DIIS	24			
Number of Code Blocks per Slot					
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}	CBs	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 10) = 7 for i from			3	2	2
{0,,39}	CBs	4	3		
For Slot i, if mod(i, 10) =			10	5	5
{0,1,2,3,4,5,6} for i from {1,,39}	CBs	10	10		
Binary Channel Bits Per Slot					
For Slots 0 and Slot i, if mod(i, 10) =			N/A	N/A	N/A
{8,9} for i from {0,,39}	Bits	N/A	, .		
For Slots i = 20, 21	Bits	160272	137376	68688	68688
For Slot i, if $mod(i, 10) = 7$ for i from			45792	22896	22896
{0,,39}	Bits	53424			
For Slot i, if mod(i, 10) =			152640	76320	76320
{0,1,2,3,4,5,6} for i from	Bits	167904			
{1,,19,22,,39}					
Max. Throughput averaged over 2	Mbps	118.796	109.768	54.869	54.869
frames					
Note 1: SS/PBCH block is transmitte	ed in slot	#0 with periodic	city 20 ms		

Note 2: Slot i is slot index per 2 frames

Note 3: PDSCH is scheduled in PRB numbers from 0 to 52. Note 4: PDSCH is scheduled in PRB numbers from 53 to 105.

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

Parameter	Unit		Va	alue			
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 Slots 0 and Slot i, if mod(i, 10) =		N1/A					
{8,9} for i from {0,,39}		N/A					
For Slot i, if mod(i, 10) = 7 for i from $\{0,,39\}$		4					
For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,6\}$ for i from $\{1,,39\}$		12					
Allocated slots per 2 frames		31					
MCS table		256QAM					
MCS index		24					
Modulation		256QAM					
Target Coding Rate		0.82					
Number of MIMO layers Number of DMRS REs		1					
For Slots 0 and Slot i, if mod(i, 10) =							
{8,9} for i from {0,,39}		N/A					
For Slot i, if mod(i, 10) = 7 for i from $\{0,,39\}$		6					
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ for i from $\{1,,39\}$		12					
Overhead for TBS determination		0					
Information Bit Payload per Slot							
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}	Bits	N/A					
For Slot i, if $mod(i, 10) = 7$ for i from $\{0,,39\}$	Bits	29192					
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ for i from $\{1,,39\}$	Bits	92200					
Transport block CRC per Slot							
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}	Bits	N/A					
For Slot i, if $mod(i, 10) = 7$ for i from $\{0,,39\}$	Bits	24					
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ for i from $\{1,,39\}$	Bits	24					
Number of Code Blocks per Slot							
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}	CBs	N/A					
For Slot i, if $mod(i, 10) = 7$ for i from $\{0,,39\}$	CBs	4					
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ for i from $\{1,,39\}$	CBs	11					
Binary Channel Bits Per Slot							
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}	Bits	N/A					
For Slots $i = 20, 21$	Bits	106848					
For Slot i, if $mod(i, 10) = 7$ for i from $\{0,,39\}$	Bits	35616					
For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,6\}$ for i from $\{1,,19,22,,39\}$	Bits	111936					
Max. Throughput averaged over 2 frames	Mbps	130.308					
		uith periodicity 20) ms				
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms Note 2: Slot i is slot index per 2 frames							

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

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

Table A.3.2.2.2-6: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-3

Parameter	Unit		Value	
Reference channel		R.PDSCH.2-		
	N 41 1	6.1 TDD		
Channel bandwidth	MHz	40		
Subcarrier spacing Allocated resource blocks	kHz PRBs	30 106		
Number of consecutive PDSCH	FRD5	106		
symbols				
For Slot 0 and Slot i, if mod(i, 10) =		N1/A		
{4,8,9} for i from {0,,39}		N/A		
For Slot i, if mod(i, 10) = $\{3,7\}$ for i from $\{0,,39\}$		8		
For Slot i, if $mod(i, 10) = \{0,1,2,5,6\}$ for i from $\{1,,39\}$		12		
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 0 and Slot i, if mod(i, 10) = {4,8,9} for i from {0,,39}		N/A		
For Slot i, if $mod(i, 10) = \{3,7\}$ for i from $\{0,,39\}$		12		
For Slot i, if mod(i, 10) = $\{0,1,2,5,6\}$ for i from $\{1,,39\}$		12		
Overhead for TBS determination		0		
Information Bit Payload per Slot		ŭ		
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) =	Bits	N/A		
$\{4,8,9\}$ for i from $\{0,,39\}$ For Slot i, if mod(i, 10) = $\{3,7\}$ for i from	Bits	24		
$\{0,,39\}$ For Slot i, if mod(i, 10) = $\{0,1,2,5,6\}$ for	Bits	24		
i from {1,,39}	Dito	21		
Number of Code Blocks per Slot				
For Slot 0 and Slot i, if mod(i, 10) = {4,8,9} for i from {0,,39}	CBs	N/A		
For Slot i, if mod(i, 10) = $\{3,7\}$ for i from $\{0,,39\}$	CBs	1		
For Slot i, if $mod(i, 10) = \{0,1,2,5,6\}$ for i from $\{1,,39\}$	CBs	2		
Binary Channel Bits 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 = 20, 21	Bits	26712	 	
For Slot i, if mod(i, 10) = $\{3,7\}$ for i from $\{0,,39\}$	Bits	17808		
For Slot i, if $mod(i, 10) = \{0,1,2,5,6\}$ for i from $\{1,,19,22,,39\}$	Bits	27984		
Max. Throughput averaged over 2 frames	Mbps	10.184		
Note 1: SS/PBCH block is transmitted i	n slot #0 v	vith periodicity 20	1	
Note 2: Slot i is slot index per 2 frames	515 <i>t</i> #6 v	portodioity 20	5 m5	

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		Va	lue	
Deference 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 Slots 0 and Slot i, if mod(i, 10) =		N/A			
{8,9} for i from {0,,39}					
For Slot i, if mod(i, 10) = 7 for i from		4			
{0,,39}					
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$		12			
for i from {1,,39} Allocated slots per 2 frames		31		+	
MCS table		64QAM			
MCS table		13			
Modulation		16QAM			
Target Coding Rate		0.48			
Number of MIMO layers		2			
Number of DMRS REs					
For Slots 0 and Slot i, if mod(i, 10) =					
{8,9} for i from {0,,39}		N/A			
For Slot i, if $mod(i, 10) = 7$ for i from					
{0,,39}		6			
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$					
for i from {1,,39}		12			
Overhead for TBS determination		0			
Information Bit Payload per Slot					
For Slots 0 and Slot i, if mod(i, 10) =	D::	N1/A			
{8,9} for i from {0,,39}	Bits	N/A			
For Slot i, if mod(i, 10) = 7 for i from	Dita	40000			
{0,,39}	Bits	16896			
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$	Bits	53288			
for i from {1,,39}	DIIS	33200			
Transport block CRC per Slot					
For Slots 0 and Slot i, if mod(i, 10) =	Bits	N/A			
{8,9} for i from {0,,39}	Dita	IN/A			
For Slot i, if mod(i, 10) = 7 for i from	Bits	24			
{0,,39}	Ditto				
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$	Bits	24			
for i from {1,,39}	D.KO				
Number of Code Blocks per Slot					
For Slots 0 and Slot i, if mod(i, 10) =	CBs	N/A			
{8,9} for i from {0,,39}		-			
For Slot i, if $mod(i, 10) = 7$ for i from	CBs	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) =					
$\{8,9\}$ for i from $\{0,,39\}$	Bits	N/A			
For Slot i, if mod(i, 10) = {0,5} for i from					
$\{1,,19,22,,39\}$	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					
{0,,39}	Bits	35616			
For Slot i, if $mod(i, 10) = \{1,2,3,4,6\}$ for	D::	444000			
i from {1,,19,22,,39}	Bits	111936			
Max. Throughput averaged over 2	N 41	75.040			
frames	Mbps	75.318			
Note 1: SS/PBCH block is transmitted i	n slot #0 v	vith periodicity 20) ms	•	•
Note 2: Slot i is slot index per 2 frames					

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

Parameter	Unit			Value	
Reference 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	1 11/7	1 11/7	1 11/7	
For CSI-RS Slot i, if mod(i,10) =1 for i	Bits	N/A	N/A	N/A	
from {0,,39}	Dita				
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	24070	43170	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}	Dito	14/71	14// (14/7 (
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	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}	5.1.0				
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, if $mod(i, 10) = \{0,2,3,4,5,6\}$	CBs	3	6	10	
for i from {1,,19,22,,39}			_		
Binary Channel Bits Per Slot	1				
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}	ļ				
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	48336	96672	145008	
For Slot i, if mod(i, 10) = $\{0,2,3,4,5,6\}$	Bits	50880	101760	152640	
for i from {1,,19,22,,39}					
Max. Throughput averaged over 2	Mbps	28.2624	56.5524	96.5724	
frames Note 1: SS/PBCH block is transmitted	, i				

Note 1:

Note 2:

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

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

Parameter	Unit		Va	alue	
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 Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,,39}		N/A			
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 Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,,39}		N/A			
For Slot i, if $mod(i, 10) = 3$ for i from $\{0,,39\}$		6			
For Slot i, if $mod(i, 10) = \{0,1,2,6,7,8,9\}$ for i from $\{1,,39\}$		12			
Overhead for TBS determination		0			
Information Bit Payload per Slot					
For Slots 0 and Slot i, if $mod(i, 10) = {4,5}$ for i from ${0,,39}$	Bits	N/A			
For Slot i, if $mod(i, 10) = 3$ for i from $\{0,,39\}$	Bits	13064			
For Slot i, if $mod(i, 10) = \{0,1,2,6,7,8,9\}$ 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 $mod(i, 10) = \{0,1,2,6,7,8,9\}$ for i from $\{1,,39\}$	Bits	24			
Number of Code Blocks per Slot					
For Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,,39}	CBs	N/A			
For Slot i, if $mod(i, 10) = 3$ for i from $\{0,,39\}$	CBs	2			
For Slot i, if $mod(i, 10) = \{0,1,2,6,7,8,9\}$ for i from $\{1,,39\}$	CBs	5			
Binary Channel Bits Per Slot					
For Slots 0 and Slot i, if $mod(i, 10) = \{4,5\}$ 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 frames	Mbps	57.930			
Note 1: SS/PBCH block is transmitted i	n slot #0 w	uth periodicity 20) ms		I
Note 2: Slot i is slot index per 2 frames	σισι πυ V	This positionity 20	, mo		

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-
		10.1 TDD	10.2 TDD	10.3 TDD	10.4 TDD	10.5 TDD
Channel bandwidth	MHz	40	40	40	40	40
Subcarrier spacing Allocated resource blocks	kHz PRBs	30 106	30 106	30 106	30 106	30 106
Number of consecutive PDSCH	PRBS	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 17	64QAM	64QAM
MCS index		13 16QAM	13 16QAM	64QAM	13 16QAM	17 64QAM
Modulation 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		ı	1	ı		
For Slot i, if $mod(i, 10) = 7$ for		_		_		_
i from {0,,39}		6	N/A	6	N/A	6
For Slot i, if mod(i, 10) =						
{0,1,2,3,4,5,6} for i from		18	18	18	18	18
{1,,39}						
Overhead for TBS		0	0	0	0	0
determination		-	-	Ů	Ů	Ů
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						
from {0,,39}	Bits	8456	N/A	11528	N/A	23040
For Slot i, if mod(i, 10) =						
{0,1,2,3,4,5,6} for i from	Bits	25608	25608	33816	51216	67584
{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}	Ditto	21	21	2 1	2 '	21
Number of Code Blocks per						
Slot						
For Slots 0 and Slot i, if mod(i,	CBs	N/A	N/A	N/A	N/A	N/A
$10) = \{8,9\}$ for i from $\{0,,39\}$	ODS	IN//A	IN/A	IN/A	IN/A	IN/A
For Slot i, if $mod(i, 10) = 7$ for i	CBs	2	N/A	2	N/A	3
from {0,,39}			-		•	
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from	CBs	4	4	5	7	9
{1,,39}	CDS	7	4	3	,	9
Binary Channel Bits Per Slot						
For Slots 0 and Slot i, if mod(i,	D::	N1/A	N1/A	N1/A	N1/A	N1/A
$10) = \{8,9\}$ for i from $\{0,,39\}$	Bits	N/A	N/A	N/A	N/A	N/A
For Slots i = 1,2,21,22 (Note	Bits	52176	52176	78264	104352	156528
3)	טונס	32170	32170	70204	107002	130320
For Slot i, if $mod(i, 10) = 7$ for i	Bits	17808	N/A	26712	N/A	53424
from {0,,39}				·-·-	•	
For Slot i, if mod(i, 10) =	Bits	52424	53424	80136	106949	160272
{0,1,2,3,4,5,6} for i from {3,,20,23,,39}	DIIS	53424	JS424	80136	106848	160272
Max. Throughput averaged	1.00	00.00-	0.4 =====	4	05	05.015.
over 2 frames	Mbps	36.262	34.5708	47.9572	69.1416	95.8464
Note 1: SS/PBCH block is tran	smitted i	n slot #0 with no	eriodicity 20 ms	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
Note 3: Binary Channel Bits are calculated under assumption of 52 PRBs TRS allocation.

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

Parameter	Unit		Value	
Reference channel		R.PDSCH.2- 11.1 TDD		
Channel bandwidth	MHz	40		
Subcarrier spacing	kHz	30		
Allocated resource blocks	PRBs	106		
Number of consecutive PDSCH				
symbols				
For Slot 0 and Slot i, if $mod(i, 4) = \{2,3\}$		N/A		
for i from {0,,39}		,		
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 0 and Slot i, if $mod(i, 4) = \{2,3\}$ for i from $\{0,,39\}$		N/A		
For Slot i, if $mod(i, 4) = 0$ for i from $\{1,,39\}$		18		
For Slot i, if $mod(i, 4) = 1$ for i from $\{0,,39\}$		18		
Overhead for TBS determination		0		
Information Bit Payload per Slot				
For Slot 0 and Slot i, if $mod(i, 4) = \{2,3\}$ for i from $\{0,,39\}$	Bits	N/A		
For Slot i, if $mod(i, 4) = 0$ for i from $\{1,,39\}$	Bits	8064		
For Slot i, if $mod(i, 4) = 1$ for i from $\{0,,39\}$	Bits	6528		
Transport block CRC per Slot				
For Slot 0 and Slot i, if $mod(i, 4) = \{2,3\}$ for i from $\{0,,39\}$	Bits	N/A		
For Slot i, if $mod(i, 4) = 0$ for i from $\{1,,39\}$	Bits	24		
For Slot i, if $mod(i, 4) = 1$ for i from $\{0,,39\}$	Bits	24		
Number of Code Blocks per Slot				
For Slot 0 and Slot i, if $mod(i, 4) = \{2,3\}$ for i from $\{0,,39\}$	CBs	N/A		
For Slot i, if $mod(i, 4) = 0$ for i from $\{1,,39\}$	CBs	1		
For Slot i, if $mod(i, 4) = 1$ for i from $\{0,,39\}$	CBs	1		
Binary Channel Bits Per Slot				
For Slot 0 and Slot i, if $mod(i, 4) = \{2,3\}$	5	N1/2		
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 $\{1,,19,22,,39\}$	Bits	26712		
For Slot i, if $mod(i, 4) = 1$ for i from $\{0,,19,22,,39\}$	Bits	21624		
Max. Throughput averaged over 2 frames	Mbps	6.893		
Note 1: SS/PBCH block is transmitted i Note 2: Slot i is slot index per 2 frames	n slot #0 w	vith periodicity 20) ms	

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

Parameter	Unit	T	Value		
Reference channel		R.PDSCH.2-			
		12.1 TDD			
Channel bandwidth	MHz kHz	40 30			
Subcarrier spacing Allocated resource blocks	PRBs	106			
Number of consecutive PDSCH	LVD2	100			
symbols					
For Slot 0 and Slot i, if mod(i, 4) = 3 for i		NI/A			
from {0,,39}		N/A			
For Slot i, if $mod(i, 4) = 0$ for i from		12			
$\{1,,39\}$ For Slot i, if mod(i, 4) = 1 for i from					
		8			
$\{0,,39\}$ For Slot i, if mod(i, 4) = 2 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				1	
For Slot 0 and Slot i, if $mod(i, 4) = 3$ for i		N/A			
from $\{0,,39\}$ For Slot i, if mod(i, 4) = 0 for i from		+		+	
$\{1,,39\}$		18			
For Slot i, if $mod(i, 4) = 1$ for i from					
{0,,39}		18			
For Slot i, if mod(i, 4) = 2 for i from		40			
{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 $\{0,,39\}$ For Slot i, if mod(i, 4) = 0 for i from		-			
	Bits	8064			
$\{0,,39\}$	Bits	4992			
For Slot i, if $mod(i, 4) = 2$ for i from	D:1-	0500			
{0,,39}	Bits	6528			
Transport block CRC per Slot					
For Slot 0 and Slot i, if $mod(i, 4) = 3$ for	Bits	N/A			
i from {0,,39}	Bito	14// 1			
For Slot i, if $mod(i, 4) = 0$ for i from	Bits	24			
$\{1,,39\}$ 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	5	0.4			
{0,,39}	Bits	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}	000	IN/A			1
For Slot i, if $mod(i, 4) = 0$ for i from	CBs	1			
				+	
For Slot 1, if $mod(1, 4) = 1$ for 1 from $\{0,,39\}$	CBs	1			
For Slot i, if $mod(i, 4) = 2$ for i from				+	
{0,,39}	CBs	1			
Binary Channel Bits Per Slot					
For Slot 0 and Slot i, if mod(i, 4) = 3 for	Bits	N/A			
i from {0,,39}				1	
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	Bits	26712			
{1,,19,22,,39}		1		1	

For Slot i, if $mod(i, 4) = 1$ for i from $\{1,,19,22,,39\}$	Bits	16536					
For Slot i, if $mod(i, 4) = 2$ for i from $\{0,,39\}$	Bits	21624					
Max. Throughput averaged over 2 frames	Mbps	9.389					
Note 1: SS/PBCH block is transmitted Note 2: Slot i is slot index per 2 frames	lote 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms						

Table A.3.2.2.13: PDSCH Reference Channel for TDD CC with UL-DL pattern FR1.30-1 and CA scenario

Parameter	Unit			Value		
Reference channel		R.PDSCH.2-	R.PDSCH.2-	R.PDSCH.2-	R.PDSCH.2-	R.PDSCH.2-
		13.1 TDD	13.2 TDD	13.3 TDD	13.4 TDD	13.5 TDD
Channel bandwidth	MHz	5	10	15	20	25
Subcarrier spacing	kHz	30	30	30	30	30
Allocated resource blocks	PRBs	11	24	38	51	65
Number of consecutive PDSCH						
symbols For Slot i, if mod(i, 10) = 7 for i						
from $\{0,,39\}$		4	4	4	4	4
For Slot i, if mod(i, 10) =						
{0,1,2,3,4,5,6} for i from		12	12	12	12	12
{1,,39}		12	12	12	12	12
Allocated slots per 2 frames		31	31	31	31	31
MCS table		64QAM	64QAM	64QAM	64QAM	64QAM
MCS index		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		6	6	6	6	6
from {0,,39}		U	U	U	Ü	U
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		_	_	_	_	
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						
from $\{0,,39\}$	Bits	1800	3840	6144	8192	10504
For Slot i, if mod(i, 10) =						
{0,1,2,3,4,5,6} for i from	Bits	5504	12040	18960	25608	32776
{1,,39}	Ditto	0001	12010	10000	20000	02110
Transport block CRC per Slot						
For Slots 0 and Slot i, if mod(i,	D:40	NI/A	NI/A	NI/A	NI/A	NI/A
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	Bits	16	24	24	24	24
from {0,,39}	Dita	10	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	1	1	1	1	2
For Slot i, if mod(i, 10) =						
{0,1,2,3,4,5,6} for i from	CBs	1	2	3	4	4
{1,,39}	020	·	_		·	
Binary Channel Bits Per Slot						
For Slots 0 and Slot i, if mod(i,	D:40	NI/A	NI/A	NI/A	NI/A	NI/A
10) = $\{8,9\}$ for i from $\{0,,39\}$	Bits	N/A	N/A	N/A	N/A	N/A
For Slots i = 20, 21	Bits	11088	24192	38304	51408	65520
For Slot i, if mod(i, 10) = 7 for i	Bits	3696	8064	12768	17136	21840
from {0,,39}	סווט	3030	0004	12/00	17130	210 1 0
For Slot i, if mod(i, 10) =			_	_	_	
{0,1,2,3,4,5,6} for i from	Bits	11616	25344	40128	53856	68640
{1,,19,22,,39}						
Max. Throughput averaged	Mbps	7.790	17.022	26.825	36.209	46.348
over 2 frames	•					
Note 1: SS/PBCH block is tran		1-4 !!^ !!!				

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}	Dita	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	_		 	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

Parameter	Unit			Value		
Reference channel		R.PDSCH.2-				
		15.1 TDD				
Channel bandwidth	MHz	100				
Subcarrier spacing	kHz	30				
Allocated resource blocks	PRBs	273				
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		12				
{1,,39}						
Allocated slots per 2 frames		31				
MCS table		64QAM				
MCS index Modulation		13 16QAM				
Target Coding Rate		0.48				
Number of MIMO layers		2				
Number of DMRS REs						
For Slot i, if $mod(i, 10) = 7$ for i		_				
from {0,,39}		6				
For Slot i, if mod(i, 10) =						
{0,1,2,3,4,5,6} for i from		12				
{1,,39}						
Overhead for TBS		0				
determination 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	D:4-	44040				
from {0,,39}	Bits	44040				
For Slot i, if mod(i, 10) =						
{0,1,2,3,4,5,6} for i from	Bits	139376				
{1,,39}						
Transport block CRC per Slot For Slots 0 and Slot i, if mod(i,						
10) = {8,9} for i from {0,,39}	Bits	N/A				
For Slot i, if $mod(i, 10) = 7$ for i						
from {0,,39}	Bits	24				
For Slot i, if mod(i, 10) =						
{0,1,2,3,4,5,6} for i from	Bits	24				
{1,,39}						
Number of Code Blocks per						
Slot For Slots 0 and Slot i, if mod(i,		N/A				
10) = {8,9} for i from {0,,39}	CBs	1 N/ /*\				
For Slot i, if mod(i, 10) = 7 for i	65	_			1	
from {0,,39}	CBs	6				
For Slot i, if mod(i, 10) =						
{0,1,2,3,4,5,6} for i from	CBs	17				
{1,,39}					 	
Binary Channel Bits Per Slot					1	
For Slots 0 and Slot i, if mod(i,	Bits	N/A				
10) = {8,9} 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}	Bits	91728				
For Slot i, if mod(i, 10) =						
{0,1,2,3,4,5,6} for i from	Bits	288288				
{1,,19,22,,39}						
Max. Throughput averaged	Mbps	196.966				
over 2 frames	•		riodicity 00			
Note 1: SS/PBCH block is tran		ii siot #U with pe	enodicity 20 ms			
TNOTE Z. SIDET IS SIDE ITILIEX PET	ı nanıes					

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

Parameter	Unit		\	/alue		
Reference channel		R.PDSCH.1-	R.PDSCH.1-			
Reference channel		16.1 TDD	16.2 TDD		,	
Channel bandwidth	MHz	40	40			
Subcarrier spacing	kHz	30	30			
Allocated resource blocks	PRBs	106	106			
Number of consecutive PDSCH						
symbols					,	
For Slot i, if $mod(i, 10) = \{0, 7\}$ for i		NI/A	N/A			
from {0,,39}		N/A			1	
For Slot i, if mod(i, 10) =		40	12			
{1,2,3,4,5,6} for i from {1,,39}		12			1	
Allocated slots per 2 frames		24	24			
MCS table		64QAMLowSE	64QAMLowSE			
MCS index		19	19			
Modulation		16QAM	16QAM			
Target Coding Rate		0.54	0.54			
Number of MIMO layers		1	1			
Number of DMRS REs			12			
For Slot i, if $mod(i, 10) = \{0, 7\}$ for i		N1/A	N/A			
from {0,,39}		N/A			1	
For Slot i, if mod(i, 10) =		40	12			
{0,1,2,3,4,5,6} for i from {1,,39}		12			,	
Overhead for TBS determination		0	0			
Information Bit Payload per Slot						
For Slot i, if $mod(i, 10) = \{0,7,8,9\}$	Bits	N/A	N/A			
for i from {0,,39}	DIIS	IN/A			,	
For Slot i, if mod(i, 10) =	Bits	30216	30216			
{1,2,3,4,5,6} for i from {1,,39}	DIIS	30216			,	
Transport block CRC per Slot						
For Slot i, if $mod(i, 10) = \{0,7,8,9\}$	Bits	N/A	N/A			
for i from {0,,39}	DIIS	IN/A				
For Slot i, if mod(i, 10) =	Bits	24	24			
{1,2,3,4,5,6} for i from {1,,39}	Dita	24				
Number of Code Blocks per Slot						
For Slot i, if $mod(i, 10) = \{0,7,8,9\}$	CBs	N/A	N/A		1	
for i from {0,,39}	ODS	IN//A				
For Slot i, if mod(i, 10) =	CBs	2	2		1	
{1,2,3,4,5,6} for i from {1,,39}	ODS					
Binary Channel Bits Per Slot						
For Slot i, if $mod(i, 10) = \{0,7,8,9\}$	Bits	N/A	N/A			
for i from {0,,39}						
For Slot i = 21	Bits	53424	50880			
For Slot i, if $mod(i, 10) =$			55968			
{1,2,3,4,5,6} for i from	Bits	55968				
{1,,19,22,,39}						
Max. Throughput averaged over 2	Mbps	18.130	18.130			
frames Note 1: SS/PBCH block is transmi	-	(NOTE 3)	(NOTE 4)			

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: Throughput is calculated under assumption of aggregation factor 2. Note 4: Throughput is calculated under assumption of repetition number 2

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		6			
{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 transmit Note 2: Slot i is slot index per 2 fran		t #0 with periodici	y 20 ms		

Table A.3.2.2.2-18: PDSCH Reference Channel for PDSCH on band with shared spectrum access with TDD UL-DL pattern FR1.30-7

Parameter	Unit		V	alue	
Reference channel		R.PDSCH.1-	R.PDSCH.1-	R.PDSCH.1-	R.PDSCH.1-
		18.1 TDD	18.2 TDD	18.3 TDD	18.4 TDD
Channel bandwidth	MHz	20	40	60	80
Subcarrier spacing	kHz	30	30	30	30
Allocated resource blocks	PRBs	51	106	162	217
Number of consecutive PDSCH symbols					
For Slot 0 and slot i, if mod(i, 10) =7 for i from {0,,39}		N/A	N/A	N/A	N/A
For Slot i, if mod(i, 10) = {3, 5, 6} for i from {1,,39}	symb ol	{4,7,10,12}	{4,7,10,12}	{4,7,10,12}	{4,7,10,12}
For Slot i, if mod(i, 10) = {0, 1, 2, 4} for i from {1,,39}	symb ol	12	12	12	12
3 Allocated slots per 2 frames	slot	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		2	2	2	2
Number of DMRS REs					
For Slot 0 and slot i, if $mod(i, 10) = 7$ for i from $\{0,,39\}$		N/A	N/A	N/A	N/A
For Slot i, if mod(i, 10) = {3, 5, 6} for i from {1,,39}	symb ol	{6,12}	{6,12}	{6,12}	{6,12}
For Slot i, if mod(i, 10) = {0, 1, 2, 4} for i from {1,,39}	symb ol	12	12	12	12
Overhead for TBS determination		0	0	0	0
Information Bit Payload per Slot					
For Slot 0 and slot i, if mod(i, 10) = 7 for i from {0,,39}	Bits	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 10) = {3, 5, 6} for i from {1,,39}	Bits	{8192,14088, 16392,25608}	{16896,29192, 44040,53288}	{26120,45096, 67584,81976,}	{34816,60456, 90176,110632}
For Slot i, if mod(i, 10) = {0, 1, 2, 4} for i from {1,,39}	Bits	25608	53288	81976	110632
Transport block CRC per Slot					
For Slot 0 and slot i, if mod(i, 10) = 7 for i from {0,,39}	Bits	N/A	N/A	N/A	N/A
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 Slot 0 and slot i, if mod(i, 10) = 7 for i from {0,,39}	CBs	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 10) = {3, 5, 6} for i from {1,,39}	CBs	{1,2,4,4}	{3,4,6,7}	{4,6,9,10}	{5,8,11,14}

For Slot i, if mod(i, 10) = {0, 1, 2, 4} for i from {1,,39}	CBs	4	7	10	14
Binary Channel Bits Per Slot					
For Slot 0 and slot i, if mod(i, 10) = 7 for i from {0,,39}	Bits	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 10) = {3, 5, 6} for i from {1,,39}	Bits	{17136,29376, 44064,53865}	{35616,61056, 91854,11193}	{54432,93312, 139968,171072}	{72912,124992, 187488,229152}
For Slot i, if mod(i, 10) = {0, 1, 2, 4} for i from {1,,39}	Bits	53865	111936	171073	229152

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: For {a1,a2,a3,a4}, a1, a2, a3 and a4 stand for the setup when the number of OFDM sybmols is

6,9,12,14 respectively.

Note 5: The slot i, mod (i,10)=9 is idle slot with no UL transmission.

- 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
		R.PDSCH.4-	
Reference channel		1.1 TDD	
Channel bandwidth	MHz	50	
Subcarrier spacing	kHz	60	
Allocated resource blocks	PRBs	66	
Number of consecutive PDSCH	11120	- 55	
symbols			
For Slots 0 and Slot i, if $mod(i, 4) = 3$ for			
i from {0,,79}		N/A	
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			
{1,,79}		13	
Allocated slots per 2 frames		59	
MCS table		64QAM	
MCS index		13	
Modulation		16QAM	
Target Coding Rate		0.48	
Number of MIMO layers		2	
Number of DMRS REs			
For Slots 0 and Slot i, if $mod(i, 4) = 3$ for			
i from {0,,79}		N/A	
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		0	
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			
	Bits	25608	
$\{1,,79\}$ For Slot i, if mod(i, 4) = $\{0,1\}$ for i from			
$\{1,,79\}$	Bits	34816	
Transport block CRC per Slot			
For Slots 0 and Slot i, if $mod(i, 4) = 3$			
	Bits	N/A	
for i from $\{0,,79\}$ For Slot i, if mod(i, 4) = 2 for i from			
1	Bits	24	
$\{1,, 79\}$ For Slot i, if mod(i, 4) = $\{0,1\}$ for i from			
$\{1,,79\}$	Bits	24	
Number of Code Blocks per Slot			
For Slots 0 and Slot i, if $mod(i, 4) = 3$			
for i from $\{0,,79\}$	CBs	N/A	
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			
	CBs	5	
{1,,79} 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	סווס	09900	
	Bits	54912	
$\{4,, 79\}$ For Slot i, if mod(i, 4) = $\{0,1\}$ for i from			
	Bits	73128	
{1,,39,42,,79}			
Max. Throughput averaged over 2	Mbps	93.499	
frames Note 1: SS/PBCH block is transmitted	-	vith periodicity 2	1
Note 2: Slot i is slot index per 2 frames		viti periodicity 20	O IIIS

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-	R.PDSCH.5-		
Reference channel		1.1 TDD	1.2 TDD		
Channel bandwidth	MHz	100	100		
Subcarrier spacing	kHz	120	120		
Allocated resource blocks	PRBs	66	66		
Number of consecutive PDSCH					
symbols					
For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,,159}		N/A	N/A		
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 159\}$		9	2		
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,159\}$		13	2		
Allocated slots per 2 frames		127	127		
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 Slots 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,159\}$		N/A	N/A		
For Slot i, if mod(i, 5) = 3 for i from $\{0,, 159\}$		12	6		
For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i from $\{1,,159\}$		12	6		
Overhead for TBS determination		6	0		
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		
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 159\}$	Bits	3624	736		
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,159\}$	Bits	5504	736		
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		
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 159\}$	Bits	16	16		
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,159\}$	Bits	24	16		
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		
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 159\}$	CBs	1	1		
For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i from $\{1,,159\}$	CBs	1	1		
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		
For Slots i = 80, 81	Bits	17490	2310	 	·
For Slot i, if mod(i, 5) = 3 for i from {0,, 159}	Bits	12210	2310		
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,79,82,,159\}$	Bits	18282	2310		
Max. Throughput averaged over 2	Mbps	31.942	4.673		
frames Note 1: SS/PBCH block is transmitted	-				

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

Parameter	Unit			Value				
		R.PDSCH.5-	R.PDSCH.5-	R.PDSCH.5-				
Reference channel		2.1 TDD	2.2 TDD	2.3 TDD	Į.			
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 Slots 0 and Slot i, if mod(i, 5) = 4		N/A	NI/A	NI/A				
for i from {0,,159}		IN/A	N/A	N/A				
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	Į.			
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 Slots 0 and Slot i, if $mod(i, 5) = 4$								
for i from {0,,159}		N/A	N/A	N/A	Į.			
For Slot i, if $mod(i, 5) = 3$ for i from								
{0,, 159}		12	12	12	Į.			
For Slot i, if $mod(i, 5) = \{0, 1, 2\}$ for i								
from {1,,159}		12	12	12	Į.			
Overhead for TBS determination		6	6	6				
Information Bit Payload per Slot								
For Slots 0 and Slot i, if $mod(i, 5) = 4$			21/4					
for i from {0,,159}	Bits	N/A	N/A	N/A	Į.			
For Slot i, if $mod(i, 5) = 3$ for i from	Dito	11070	22526	45006				
{0,, 159}	Bits	11272	22536	45096				
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i	Bits	17424	34816	69672				
from {1,,159}	DIIS	17424	34010	09072				
Transport block CRC per Slot								
For Slots 0 and Slot i, if $mod(i, 5) = 4$	Bits	N/A	N/A	N/A	Į.			
for i from {0,,159}	Dita	IN//A	IN//A	TN//A				
For Slot i, if $mod(i, 5) = 3$ for i from	Bits	24	24	24	Į.			
{0,, 159}	Dito	2-7	24	27				
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i	Bits	24	24	24				
from {1,,159}	Dito							
Number of Code Blocks per Slot								
For Slots 0 and Slot i, if $mod(i, 5) = 4$	CBs	N/A	N/A	N/A				
for i from {0,,159}				,				
For Slot i, if $mod(i, 5) = 3$ for i from	CBs	2	3	6				
{0,, 159}			_	_				
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i	CBs	3	5	9				
from {1,,159}		-	_	_				
Binary Channel Bits Per Slot								
For Slots 0 and Slot i, if $mod(i, 5) = 4$	Bits	N/A	N/A	N/A				
for i from {0,,159}								
For Slots i = 80, 81	Bits	36564	69960	139920				
For Slots i = 82	Bits	34980	73128	146256				
For Slots i = 83	Bits	22308	48840	97680				
For Slot i, if $mod(i, 5) = 3$ for i from	Bits	24420	48840	97680				
{0,, 159}		-						
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i	Bits	36564	73128	146256				
from {1,,79,84,,159}								
Max. Throughput averaged over 2 frames	Mbps	100.799	201.434	403.096				
	l in slot #0) with periodicity	/ 20 ms	<u>1</u>	L			
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms Note 2: Slot i is slot index per 2 frames								
INOTE 2. OIDT I IS SIDE I ITUEX PET 2 ITAITIES								

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 Slots 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,159\}$		N/A		
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 Slots 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,159\}$		N/A		
For Slot i, if mod(i, 5) = 3 for i from {0,, 159}		12		
For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i from $\{1,,159\}$		12		
Overhead for TBS determination		6		
Information Bit Payload per Slot				
For Slots 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,159\}$	Bits	N/A		
For Slot i, if mod(i, 5) = 3 for i from {0,, 159}	Bits	16136		
For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i from $\{1,,159\}$	Bits	25104		
Transport block CRC per Slot				
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 $mod(i, 5) = 4$ for i from $\{0,,159\}$	CBs	N/A		
For Slot i, if mod(i, 5) = 3 for i from {0,, 159}	CBs	2		
For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i from $\{1,,159\}$	CBs	3		
Binary Channel Bits Per Slot				
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} Max. Throughput averaged over 2	Mbps	145.062		
frames	-	101 1 11 1	L	<u> </u>
Note 1: SS/PBCH block is transmitted i Note 2: Slot i is slot index per 2 frames		vith periodicity 20) ms	

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

Parameter	Unit		Valu	e	
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 Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$		N/A			
for i from {0,,159} 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 Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$		N/A			
For Slot i, if mod(i, 4) = 2 for i from {1,, 159}		12			
For Slot i, if $mod(i, 4) = \{0,1\}$ for i from $\{1,,159\}$		12			
Overhead for TBS determination		6			
Information Bit Payload per Slot					
For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$	Bits	N/A			
For Slot i, if mod(i, 4) = 2 for i from {1,, 159}	Bits	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 $\{1,,159\}$	Bits	16			
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	1			
For Slot i, if mod(i, 4) = $\{0,1\}$ for i from $\{1,,159\}$	CBs	1			
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	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	Bits	3324			
{1,,79,82,,159} Max. Throughput averaged over 2	Mbps	5.548			
frames			<u> </u>		
Note 1: SS/PBCH block is transmitted in Note 2: Slot i is slot index per 2 frames		vitri periodicity 20) ms		

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-			
	N 41 1-	5.1 TDD	5.2 TDD			+
Channel bandwidth Subcarrier spacing	MHz kHz	100 120	50 120			+
Allocated resource blocks	PRBs	66	32			+
Number of consecutive PDSCH	TINDS	00	32			
symbols						
For Slots 0 and Slot i, if mod(i, 4) = 3		N/A	N/A			
for i from {0,,159} 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 $\{1,,159\}$		13	13			
Allocated slots per 2 frames		119	119			
MCS table		64QAM	64QAM			
MCS index		13	13			
Modulation		16QAM	16QAM			
Target Coding Rate		0.48	0.48			
Number of MIMO layers		2	2		<u> </u>	
Number of DMRS REs					<u> </u>	+
For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$		N/A	N/A			
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						
For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$	Bits	N/A	N/A			
For Slot i, if $mod(i, 4) = 2$ for i from $\{1,, 159\}$	Bits	25608	12552			
For Slot i, if $mod(i, 4) = \{0,1\}$ for i from $\{1,,159\}$	Bits	34816	16896			
Transport block CRC per Slot						
For Slots 0 and Slot i, if $mod(i, 4) = 3$ 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 $\{1,,159\}$	Bits	24	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	N/A			
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 $\{1,,159\}$	CBs	5	3			
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 $\{1,,79,82,,159\}$	Bits	73128	35456			
Max. Throughput averaged over 2 frames	Mbps	188.739	91.843			
Note 1: SS/PBCH block is transmitted	in slot #0	with periodicity (1 20 ms	1	<u> </u>	
Note 2: Slot i is slot index per 2 frames		portodioity /				

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

Parameter	Unit		Val	lue	
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 Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$		N/A			
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 Number of DMRS REs		2			
For Slots 0 and Slot i, if $mod(i, 4) = 3$ for					
i from {0,,159}		N/A			
For Slot i, if mod(i, 4) = 2 for i from {1,, 159}		12			
For Slot i, if $mod(i, 4) = \{0,1\}$ for i from $\{1,,159\}$		12			
Overhead for TBS determination		6			
Information Bit Payload per Slot					
For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$	Bits	N/A			
For Slot i, if $mod(i, 4) = 2$ for i from $\{1,, 159\}$	Bits	34816			
For Slot i, if $mod(i, 4) = \{0,1\}$ for i from $\{1,,159\}$	Bits	47112			
Transport block CRC per Slot					
For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$	Bits	N/A			
For Slot i, if $mod(i, 4) = 2$ for i from $\{1,, 159\}$	Bits	24			
For Slot i, if $mod(i, 4) = \{0, 1\}$ for i from $\{1,, 159\}$	Bits	24			
Number of Code Blocks per Slot					
For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$	CBs	N/A			
For Slot i, if $mod(i, 4) = 2$ for i from $\{1,, 159\}$	CBs	5			
For Slot i, if $mod(i, 4) = \{0,1\}$ for i from $\{1,,159\}$	CBs	6			
Binary Channel Bits Per Slot					
For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$	Bits	N/A			
For Slot i = 80, 81	Bits	114940			
For Slot i, if $mod(i, 4) = 2$ for i from $\{4,, 159\}$	Bits	82368			
For Slot i, if $mod(i, 4) = \{0,1\}$ for i from $\{1,,79,82,,159\}$	Bits	109692			
Max. Throughput averaged over 2 frames	Mbps	255.724			
Note 1: SS/PBCH block is transmitted i	n slot #0 w	ı ith periodicity 20		I	
Note 2: Slot i is slot index per 2 frames		Title portodioity 20	,		

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 $\{0,, 159\}$		9	9	9	9
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,159\}$		13	13	13	13
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 $\{0,, 159\}$		12	12	12	12
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,159\}$		12	12	12	12
Overhead for TBS determination		6	6	6	6
Information Bit Payload per Slot		ŭ		- J	ŭ
For Slots 0 and Slot i, if mod(i, 5) =	D:4-	N1/A	NI/A	NI/A	NI/A
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 $\{0,, 159\}$	Bits	7680	15880	31752	63528
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 $\{0,, 159\}$	Bits	24	24	24	24
For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i from $\{1,,159\}$	Bits	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 $\{0,,159\}$ For Slot i, if mod(i, 5) = 3 for i from	CBs	1			
$\{0,, 159\}$ For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i	CDS	ı	2	4	8
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 from $\{1,,79,84,,159\}$	Bits	35456	73128	146256	292512
Max. Throughput averaged over 2	Mbps	68.262	139.750	279.601	558.899
frames Note 1: SS/PBCH block is transmitted.	-	#0 with pariadia	rity 20 me	I	
Note 2: Slot i is slot index per 2 fram		#o with periodit	ыц 20 IIIS		

Table A.3.2.2.5-10: PDSCH Reference Channel for TDD UL-DL pattern FR2.120-1 (256QAM)

Parameter	Unit		Value
Reference channel		R.PDSCH.5-	
Reference charmer		10.1 TDD	
Channel bandwidth	MHz	50	
Subcarrier spacing	kHz	120	
Allocated resource blocks	PRBs	32	
Number of consecutive PDSCH			
symbols			
For Slot i, if $mod(i, 5) = 3$ for i from		9	
{0,, 159}			
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i		13	
from {1,,159}			
Allocated slots per 2 frames		127	
MCS table		256QAM	
MCS index		20	
Modulation		256QAM	
Target Coding Rate		0.67	
Number of MIMO layers		1	
Number of DMRS REs			
For Slot i, if $mod(i, 5) = 3$ for i from		12	
{0,, 159}			
For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i		12	
from {1,,159}			
Overhead for TBS determination		6	
Information Bit Payload per Slot		NI/A	
For Slots 0 and Slot i, if $mod(i, 5) = 4$	Bits	N/A	
for i from $\{0,,159\}$ For Slot i, if mod(i, 5) = 3 for i from			
	Bits	15368	
$\{0,, 159\}$ For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i			
from $\{1,,159\}$	Bits	23568	
Transport block CRC per Slot			
For Slots 0 and Slot i, if $mod(i, 5) = 4$		N/A	
for i from {0,,159}	Bits	IN/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 $mod(i, 5) = 4$		21/2	
for i from {0,,159}	CBs	N/A	
For Slot i, if $mod(i, 5) = 3$ for i from	OD-	0	
{0,, 159}	CBs	2	
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i	CD-	2	
from {1,,159}	CBs	3	
Binary Channel Bits Per Slot			
For Slots 0 and Slot i, if mod(i, 5) = 4	D:4-	N/A	
for i from {0,,159}	Bits		
For Slots i = 80, 81	Bits	33920	
For Slot i, if mod(i, 5) = 3 for i from	Bits	23680	
{0,, 159}	סווט	23000	
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i	Bits	35456	
from {1,,79,82,,159}	סווט		
Max. Throughput averaged over 2	Mbps	136.537	
frames	•		
Note 1: SS/PBCH block is transmitted		ith periodicity 2	20 ms
Note 2: Slot i is slot index per 2 frames			

Note 2: Slot i is slot index per 2 frames

Table A.3.2.2.5-11: PDSCH Reference Channel for TDD UL-DL pattern FR2.120-2

Parameter	Unit		Value	
Reference channel		R.PDSCH.5-10.1 TDD		
Channel bandwidth	MHz	100		
Subcarrier spacing	kHz	120		
Allocated resource blocks	PRBs	66		
Number of consecutive PDSCH				
symbols				
For Slot i, if $mod(i, 4) = \{0,1\}$ for i		40		
from {2,,159}		13		
Allocated slots per 2 frames		78		
MCS table		64QAMLowSE		
MCS index		16		
Modulation		16QAM		
Target Coding Rate		0.37		
Number of MIMO layers		1		
Number of DMRS REs				
For Slot i, if $mod(i, 4) = \{0,1\}$ for i		40		
from {2,,159}		12		
Overhead for TBS determination		6		
Information Bit Payload per Slot				
For Slots 0, 1 and Slot i, if mod(i, 4)	Bits	N/A		
$= \{2,3\}$ for i from $\{0,,159\}$	DIIS	IN/A		
For Slot i, if $mod(i, 4) = \{0,1\}$ for i	Bits	13320		
from {2,,159}	Dita	13320		
Transport block CRC per Slot				
For Slots 0, 1 and Slot i, if mod(i, 4)	Bits	N/A		
$= \{2,3\}$ for i from $\{0,,159\}$	Dita	19/74		
For Slot i, if $mod(i, 4) = \{0,1\}$ for i	Bits	24		
from {2,,159}	Dito	27		
Number of Code Blocks per Slot				
For Slots 0, 1 and Slot i, if mod(i, 4)	CBs	N/A		
= {2,3} for i from {0,,159}	050			
For Slot i, if mod(i, 4) = $\{0,1\}$ for i	CBs	2		
from {2,,159}		_		
Binary Channel Bits Per Slot				
For Slots 0,1 and Slot i, if $mod(i, 4) =$	Bits	N/A		
{2, 3} for i from {0,,159}	D::	•		
For Slot i = 80, 81	Bits	34980		
For Slot i, if $mod(i, 4) = \{0, 1\}$ for i	Bits	36564		
from {2,,159}				
Max. Throughput averaged over 2	Mbps	25.974 (Note 3)		
frames Note 1: SS/PRCH block is transmitted	d in clot t	(Note 3)		

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

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

A.3.2.2.6 Reference measurement channels for E-UTRA

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

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

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

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

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

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

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

Parameter	Unit	Value				
Reference channel		R.PDSCH.6-	R.PDSCH.6-	R.PDSCH.6-		
		3.1 TDD	3.2 TDD	3.3 TDD		
Channel bandwidth	MHz	10	15	20		
Allocated resource blocks		Note 7	Note 8	Note 9		
Uplink-Downlink Configuration (Note 3)		2	2	2		
Number of HARQ Processes per component		10	10	10		
carrier						
Allocated subframes per Radio Frame (D+S)		6	6	6		
Modulation		256QAM	256QAM	256QAM		
Coding Rate						
For Sub-Frames 1,2,6,7		N/A	N/A	N/A		
For Sub-Frames 3,4		0.74	0.79	0.74		
For Sub-Frames 8,9		0.85	0.88	0.85		
For Sub-Frame 5		0.76	0.76	0.74		
For Sub-Frame 0		0.78	0.77	0.76		
Information Bit Payload (Note 4)						
For Sub-Frames 1,2,6,7	Bits	N/A	N/A	N/A		
For Sub-Frames 3,4	Bits	42368	63776	84760		
For Sub-Frames 8,9	Bits	48936	75376	97896		
For Sub-Frame 5	Bits	40576	61664	81176		
For Sub-Frame 0	Bits	42368	63776	84760		
Number of Code Blocks						
(Notes 4 and 5)						
For Sub-Frames 1,2,6,7	CBs	N/A	N/A	N/A		
For Sub-Frames 3,4	CBs	7	11	14		
For Sub-Frames 8,9	CBs	8	13	16		
For Sub-Frame 5	CBs	7	11	14		
For Sub-Frame 0	CBs	7	11	14		
Binary Channel Bits (Note 4)						
For Sub-Frames 1,2,6,7	Bits	N/A	N/A	N/A		
For Sub-Frames 3,4	Bits	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_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 7: Resource blocks $n_{PRB} = 3..49$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..49$ in sub-frames 0,3,4,8,9.
- Note 8: Resource blocks n_{PRB} = 4..74 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..74 in sub-frames 0,3,4,8,9.
- Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0,3,4,8,9.

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

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

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

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

Parameter	Unit		Valu	е	
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_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
- Note 7: Resource blocks $n_{PRB} = 3..49$ are allocated for the user data in sub-frame 5, and resource blocks $n_{PRB} = 0..49$ in sub-frames 0,3,4,8,9.
- Note 8: Resource blocks n_{PRB} = 4..74 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..74 in sub-frames 0,3,4,8,9.
- Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0,3,4,8,9.

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

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

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

A.3.3 Reference measurement channels for PDCCH performance requirements

A.3.3.1 FDD

A.3.3.1.1 Reference measurement channels for SCS 15 kHz FR1

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

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

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

Paramete r	Uni t		Value								
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	R.PDCCH. 1-2.7 FDD			
Subcarrier spacing	kHz	15	15	15	15	15	15	15			
CORESET frequency domain allocation		24	24	24	48	48	48	48			
CORESET time domain allocation		2	2	2	2	2	2	2			
Aggregatio n level		2	4	2	4	8	16	8			
DCI Format		1_0	1_0	1_1	1_1	1_1	1_0	2_6			
Payload (without CRC)	Bits	39	39	52	52	52	39	12			

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	Bits	39	39	52	52	52	39
CRC)							

A.3.3.2.2 Reference measurement channels for SCS 30 kHz FR1

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

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

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-	R.PDCCH.				
channel		1.1 TDD	1.2 TDD	1.3 TDD	5-1.4 TDD				
Subcarrier	kHz	120	120	120	120				
spacing									
CORESET		60	60	60	60				
frequency domain									
allocation									
CORESET time		1	1	1	1				
domain allocation									
Aggregation level		2	4	8	8				
DCI Format		1_0	1_1	1_1	2_6				
Payload (without	Bits	40	56	56	12				
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	Va	lue
Reference channel		R.PBCH.1	R.PBCH.2
SS/PBCH block subcarrier spacing	kHz	15	30
Modulation		QPSK	QPSK
Target coding rate		56/864	56/864
Payload (without CRC and timing	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

CSI reference measurement channels A.4

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

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

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

TBS Schem	е			TBS.1-1	TBS.1-2				
MCS table						640	QAM		
Number of allocated PDSCH resource blocks				66	66				
Number of o	consecutive PI	DSCH symbo	ls	12	12				
Number of F	PDSCH MIMO	layers		1	2				
Number of [DMRS REs (N	ote 1)		24	24				
Overhead for	or TBS determ	ination		6	6				
Available RI	E-s			7590	7590				
CQI index	Spectral	MCS	Modulatio		Infor	mation Bit	Payload p	er Slot	
	efficiency	index	n						
0	OOR	OOR	OOR	N/A	N/A				
1	0.2344	0		1800	3624				
2	0.2344	0		1800	3624				
3	0.3770	2	ODGK	2856	5640				
4	0.6016	4	QPSK	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	04QAW	33816	67584				
14	5.1152	26		38936	77896				
15	5.5547	28		42016	83976				
	lumber of DMI		des the overhe					a	

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

Note 4: Spectral efficiency is based on MCS Table defined in Table 5.1.3.1-1 of TS 38.214 [12]

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

TBS Sche	eme			TBS.2 -1	TBS.2 -2	TBS.2 -3	TBS.2 -4	TBS.2 -5	TBS.2 -6	TBS.2 -7	TBS.2
MCS table	256QAM							-8			
	of allocated F	PDSCH reso	ource	52	52	106	106	8	16	32	51
blocks	n anocatou i	20011100	34.00	02	02			Ü	'	02	31
	f consecutiv	e PDSCH s	symbols	12	12	12	12	12	12	12	12
	f PDSCH M			1	2	1	2	1	1	1	2
	f DMRS RE	•		24	24	24	24	24	24	24	24
	I for TBS det			0	0	0	0	0	0	6	0
	RE-s for PD			6240	6240	12720	12720	960	1920	3680	6120
CQI	Spectral	MCS	Modulati				Bit Paylo				0120
index	efficienc	index	on				,				
	у										
0	OOR	OOR	OOR	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1	0.2344	0		1480	2976	2976	5896	224	456	848	1864
2	0.3770	1	QPSK	2408	4744	4744	9480	368	736	1416	4616
3	0.8770	3		5504	11016	11016	22536	848	1736	3240	10760
4	1.4766	5		9224	18432	18960	37896	1416	2856	5376	17928
5	1.9141	7	16QAM	12040	24072	24576	49176	1864	3752	6912	23568
6	2.4063	9		15112	30216	30728	61480	2408	4608	8712	29192
7	2.7305	11		16896	33816	34816	69672	2600	5248	9992	33816
8	3.3223	13		20496	40976	42016	83976	3240	6400	12040	40976
9	3.9023	15	040414	24576	49176	49176	98376	3752	7424	14344	48168
10	4.5234	17	64QAM	28168	56368	57376	11477 6	4352	8712	16392	55304
11	5.1152	19		31752	63528	65576	13117	4864	9736	18432	62504
							6				
12	5.5547	21		34816	69672	69672	13937	5248	10760	20496	67584
							6				
13	6.2266	23	0=004	38936	77896	79896	15988	6016	12040	22536	75792
4.4	0.04.44	25	256QA	42022	00040	00004	0	0050	40000	25404	00070
14	6.9141	25	M	43032	86040	88064	17620 8	6656	13320	25104	83976
15	7.4063	27		46104 92200 94248 18857 7040 14088 27144						90176	
Note 1:	Number of	DMRS PE	l s includes th	e overbo	ad of the		6 DM grour	l Ne without	data		
Note 1.											
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											
Note 4:											
Note 4: Spectral efficiency is based on MCS Table defined in Table 5.1.3.1-2 of TS 38.214 [12]											

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

TBS Schem	Scheme TBS.3-1 TBS.3-2 TBS.3-3 TBS.3-4								
MCS table				2560	QAM				
Number of a	blocks	52	52	106	106				
Number of c	Number of consecutive PDSCH symbols				12	12	12		
Number of F	PDSCH MIMO	layers		3	4	3	4		
Number of DMRS REs (Note 1)				24	24	24	24		
Overhead for	r TBS determ	ination		0	0	0	0		
Available R	E-s for PDSCH	+		6240	6240	12720	12720		
CQI index	Spectral	MCS	Modulation		Infor	mation Bit F	Payload per	r Slot	
	efficiency	index							
0	OOR	OOR	OOR	N/A	N/A	N/A	N/A		
1	0.2344	0		4360	5896	8976	11784		
2	0.3770	1	QPSK	7048	9480	14344	18976		
3	0.8770	3		16392	22032	33816	45096		
4	1.4766	5		27656	36896	56368	75792		
5	1.9141	7	16QAM	35856	48168	73776	98376		
6	2.4063	9		45096	60456	92200	122976		
7	2.7305	11		51216	67584	104496	139376		
8	3.3223	13		62504	81976	127080	167976		
9	3.9023	15	64QAM	73776	98376	147576	196776		
10	4.5234	17		83976	112648	172176	229576		
11	5.1152	19		96264	127080	196776	262376		
12	5.5547	21		104496	139376	213176	278776		
13	6.2266	23	256QAM	116792	155776	237776	319784		
14	6.9141	25	ZOOQAW	129128	172176	262376	352440		
15	7.4063	27		139376	184424	278776	376896		
Note 1: Number of DMRS REs includes the overhead of the DM-RS CDM groups without data Note 2: PDSCH is not scheduled on slots containing CSI-RS or slots which are not full DL Note 3: PDSCH is not scheduled on slots containing PBCH, i.e. slot#0 per 20ms periodicity									
Note 4: Spectral efficiency is based on MCS Table defined in Table 5.1.3.1-2 of TS 38.214 [12]									

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

TBS Schem	е			TBS.4-1	TBS.4-2				
MCS table						64QAI	//LowSE		
Number of allocated PDSCH resource blocks			52	106					
Number of c	onsecutive PI	DSCH symbo	ls	12	12				
Number of F	DSCH MIMO	layers		1	1				
Number of D	MRS REs (N	ote 1)		24	24				
Overhead fo	r TBS determ	ination		0	0				
Available RE	s for PDSCF	1		6240	12720				
CQI index	Spectral	MCS	Modulatio		Infor	mation Bit	Payload p	er Slot	
	efficiency	index	n						
0	OOR	OOR	OOR	N/A	N/A				
1	0.0586	0		368	768				
2	0.0977	2		608	1256				
3	0.1523	4		984	2024				
4	0.2344	6	QPSK	1480	2976				
5	0.3770	8	QFSK	2408	4744				
6	0.6016	10		3752	7680				
7	0.8770	12		5504	11016				
8	1.1758	14		7296	14856				
9	1.4766	16		9224	18960				
10	1.9141	18	16QAM	12040	24576				
11	2.4063	20		15112	30728				
12	2.7305	22		16896	34816				
13	3.3223	24	64QAM	20496	42016				
14	3.9023	26	04QAW	24576	49176				
15		28168	57376						
Note 2: P	DSCH is not s	scheduled on	des the overhe slots containir	ng CSI-RS	or slots whi	ch are not	full DL	a	
			slots containir						

OFDMA Channel Noise Generator (OCNG) A.5

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 C	ORESETS appointed by the search	ch spaces in use.

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

A.5.2 OCNG Patterns for TDD

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

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

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

A.6 SL reference measurement channels

A.6.1 General

The transport block size (TBS) determination procedure is described in clause 8.1.3 of TS 38.214 [12].

A.6.2 Reference measurement channels for PSSCH performance requirements

A.6.2.1 Reference measurement channels for SCS 15 kHz FR1

A.6.2.2 Reference measurement channels for SCS 30 kHz FR1

Table A.6.2.2-1: PSSCH Reference Channel

Paramete	r	Unit			Value		
Reference channel			R.PSSCH.	R.PSSCH.	R.PSSCH.	R.PSSCH.	R.PSSCH.
			2-1.1	2-1.2	2-1.3	2-1.4	2-1.5
Channel bandwidth		MHz	20	20	20	20	20
Subcarrier spacing		kHz	30	30	30	30	30
Allocated resource bloc	cks	RB	20	20	10	10	10
CP-OFDM symbols for PSFCH(Note 1)	slot with		9	9	9	9	9
CP-OFDM symbols for PSFCH	slot without		12	12	12	12	-
Modulation order			QPSK	16QAM	64QAM	QPSK	64QAM
MCS index			4	11	17	4	27
Number of MIMO layer	Number of MIMO layers		1	1	1	1	1
Number of DMRS REs			21	15	12	15	12
Number of REs for SCI	format 1-A		240	240	240	240	240
2 nd stage SCI format	Payloads	Bits	35	35	35	35	35
2-A configuration	α		1	1	1	1	1
2-A configuration	$eta_{o\!f\!fset}$		3.5	5	5	3.5	2.5
Overhaed for TBS dete	ermination		0	0	0	0	0
Transport Block Size for PSFCH	or slot with	Bits	704	1800	984	208	3496
Transport Block Size for PSFCH	or slot without	Bits	1128	2856	1928	432	-
Transport block CRC		Bits	24	24	24	24	16
Maximum number of HARQ transmissions			1	1	1	1	2
Binary Channel Bits for PSFCH	slots with		2304	4848	2232	744	3816
Binary Channel Bits for PSFCH	slots without	Bits	3744	7728	4392	1464	-

Note 1: OFDM symbols is for PSCCH/PSSCH transmission not including first symbol (AGC), PSFCH symbols, and guard symbols.

A.6.3 Reference measurement channels for PSCCH performance requirements

A.6.3.1 Reference measurement channels for SCS 15 kHz FR1

A.6.3.2 Reference measurement channels for SCS 30 kHz FR1

Table A.6.3.2-1: PSCCH Reference Channel

Parameter	Unit	Value
Reference channel		R.PSCCH.2-1.1
Allocated resource blocks		10
OFDM Symbols per slot (Note 2)		2
Modulation		QPSK
Payload (without CRC)	Bits	26
CRC	Bits	24
SCI Format		1-A
Binary Channel Bits	Bits	180

NOTE 1: The first OFDM symbol of a PSSCH and its associated PSCCH is duplicated as described in clauses 8.3.1.5 and 8.3.2.3 of TS 38.211. This symbol is used for AGC and not used for demodulation.

A.6.4 Reference measurement for PSBCH performance requirements

A.6.4.1 Reference measurement channels for SCS 15 kHz FR1

A.6.4.2 Reference measurement channels for SCS 30 kHz FR1

Table A.6.4.2-1: PSBCH Reference Channel

Parameter	Unit	Value
Reference channel		R.PSBCH.2-1
Channel bandwidth	MHz	20
Allocated resource blocks		11
CP-OFDM Symbols per slot (see Note 1)		8
Modulation		QPSK
Transport Block Size (without CRC)	Bits	32
Transport block CRC	Bits	24
Binary Channel Bits	Bits	1782

Note 1: PSBCH transmissions are rate-matched for 9 CP-OFDM symbols per slot. The first symbol is used for AGC and the last symbol is gap and shall not be used for PSBCH transmission as per TS 38.211.

NOTE 2: First OFDM symbol is not included.

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).

Initial channel matrix for LOS component of TDL-D channel model is equal to channel matrix of Static propagation conditions in Clause B.1.

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 dB \rightarrow -8.8 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.
- Note: Delay profile for TDLD30 is generated under assumption that Steps 1-8 are applied for taps with Rayleigh distribution.

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 \sim 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
TDLC300	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
TDLD30	10	30 ns	375 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

Table B.2.1.2-4 TDLD30 (DS = 30 ns)

Tap#	Delay [ns]	Power [dB]	Fading distribution
4	0	-0.2	LOS path
ı	0	-12.4	Rayleigh
2	20	-21	Rayleigh
3	40	-16.7	Rayleigh
4	55	-18.3	Rayleigh
5	80	-21.9	Rayleigh
6	120	-27.8	Rayleigh
7	240	-23.6	Rayleigh
8	285	-24.8	Rayleigh
9	290	-30.0	Rayleigh
10	375	-27.6	Rayleigh
Note 1:	Tap #1 follows a Ricean distribution.		

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
TDLD30-75	TDLD30	75 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, α and β in Table B.2.3.1-3 defines the spatial correlation between the antennas at the gNB and UE.

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

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

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

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

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

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

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

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

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

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

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

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

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

1x2 case	$R_{high} = \begin{pmatrix} 1 & 0.9 \\ 0.9 & 1 \end{pmatrix}$			
2x1 case	$R_{high} = \begin{pmatrix} 1 & 0.9 \\ 0.9 & 1 \end{pmatrix}$			
2x2 case	$R_{high} = \begin{pmatrix} 1 & 0.9 & 0.9 & 0.81 \\ 0.9 & 1 & 0.81 & 0.9 \\ 0.9 & 0.81 & 1 & 0.9 \\ 0.81 & 0.9 & 0.9 & 1 \end{pmatrix}$			
4x2 case	$R_{high} = \begin{pmatrix} 0.8999 & 1.0000 & 0.8894 & 0.9883 & 0.8587 & 0.9542 & 0.8099 & 0.9883 & 0.8894 & 0.9883 & 0.8894 & 0.9542 & 0.8894 & 0.9883 & 0.8894 & 0.9542 & 0.8894 & 0.9883 & 0.8894 & 0.9883 & 0.8894 & 0.9883 & 0.8587 & 0.9542 & 0.8587 & 0.9883 & 0.8894 & 1.0000 & 0.8999 & 0.9883 & 0.8999 & 0.8099 & 0.9542 & 0.8587 & 0.9883 & 0.8894 & 1.0000 & 0.8894 & 0.8999 & 0.8099 & 0.9542 & 0.8587 & 0.9883 & 0.8894 & 1.0000 & 0.8999 & 0.8099 & 0.9542 & 0.8587 & 0.9883 & 0.8894 & 1.0000 & 0.8999 & 0.8099 & 0.9542 & 0.8587 & 0.9883 & 0.8894 & 1.0000 & 0.8999 & 0.8099 & 0.9542 & 0.8587 & 0.9883 & 0.8894 & 1.0000 & 0.8999 & 0.8099 & 0.9542 & 0.8587 & 0.9883 & 0.8894 & 1.0000 & 0.8999 & 0.8099 & 0.9542 & 0.8587 & 0.9883 & 0.8894 & 1.0000 & 0.8999 & 0.8099 & 0.9542 & 0.8587 & 0.9883 & 0.8894 & 1.0000 & 0.8999 & 0.8099 & 0.8099 & 0.9542 & 0.8587 & 0.9883 & 0.8894 & 1.0000 & 0.8999 & 0.8099$	0.8099 0.8999 0.8587 0.9542 0.8894 0.9883 0.8999 1.0000		
4x4 case	$R_{high} = \begin{bmatrix} 1.0000 & 0.9882 & 0.9541 & 0.8999 & 0.9882 & 0.9767 & 0.9430 & 0.8894 & 0.9541 & 0.9430 & 0.9105 & 0.8587 & 0.899 \\ 0.9882 & 1.0000 & 0.9882 & 0.9541 & 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9541 & 0.9430 & 0.9105 & 0.8882 \\ 0.9541 & 0.9882 & 1.0000 & 0.9882 & 0.9430 & 0.9767 & 0.9882 & 0.9767 & 0.9105 & 0.9430 & 0.9541 & 0.9430 & 0.9541 \\ 0.8999 & 0.9541 & 0.9882 & 1.0000 & 0.8894 & 0.9430 & 0.9767 & 0.9882 & 0.8587 & 0.9105 & 0.9430 & 0.9541 & 0.809 \\ 0.9882 & 0.9767 & 0.9430 & 0.8894 & 1.0000 & 0.9882 & 0.9541 & 0.8999 & 0.9882 & 0.9767 & 0.9430 & 0.8894 & 0.95 \\ 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 1.0000 & 0.9882 & 0.9541 & 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.94 \\ 0.9430 & 0.9767 & 0.9882 & 0.9767 & 0.9541 & 0.9882 & 1.0000 & 0.9882 & 0.9430 & 0.9767 & 0.9882 & 0.859 \\ 0.9541 & 0.9430 & 0.9105 & 0.8587 & 0.9882 & 0.9767 & 0.9430 & 0.8894 & 0.9430 & 0.9767 & 0.9882 & 0.9541 & 0.8999 & 0.9541 & 0.9430 & 0.9541 & 0.9430 & 0.9105 & 0.9430 & 0.9541 & 0.9430 & 0.9105 & 0.9430 & 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 1.0000 & 0.9882 & 0.9541 & 0.9430 & 0.9541 & 0.9430 & 0.9541 & 0.9430 & 0.9541 & 0.9430 & 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9884 & 0.8999 & 0.8894 & 0.8587 & 0.9430 & 0.9541 & 0.9430 & 0.9541 & 0.9430 & 0.9767 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9882 & 0.97$	994 0.8999 0.8894 0.8587 687 0.8894 0.8999 0.8894 699 0.8587 0.8894 0.8999 641 0.9430 0.9105 0.8587 430 0.9541 0.9430 0.9105 105 0.9430 0.9541 0.9430 687 0.9105 0.9430 0.9541 682 0.9767 0.9430 0.8894 667 0.9882 0.9767 0.9430 130 0.9767 0.9882 0.9767 694 0.9430 0.9767 0.9882 2000 0.9882 0.9541 0.8999 682 1.0000 0.9882 0.9541 6541 0.9882 1.0000 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 _{mediu}		1 0.9000 0.6561 0.3874	0.9000 1 0.9000 0.6561	0.90 0 1	00 0.6 0.9	3874 5561 9000 1					
2x4 case				$_{liumA}=$	1.0000 0.9000 0.656 0.3874 0.3000 0.2700 0.1963 0.1162	0 1.00 1 0.90 1 0.65 4 0.65 0 0.27 0 0.30 0 0.30 0 0.19	000 0 000 1 561 0 700 0 700 0 700 0	.9000 .0000 .9000 .1968 .2700 .3000 .2700	0.3874 0.6561 0.9000 1.0000 0.1162 0.1968 0.2700 0.3000	0.270 0.196 0.116 1.000 0.900 0.656 0.383	00 0.3 68 0.2 62 0.1 60 0.9 60 1.0 61 0.9 74 0.6	5000 5700 968 9000 9000 9000 5561	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)) 1 1)		
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 0.8748 0.7873 0.5739 0.3389 0.5856 0.5270 0.3842	0.8748 0.7873 0.5739 0.9000 1.0000 0.9000 0.6561 0.7873 0.5739 0.5270 0.5856	0.7873 0.8748 0.7873 0.6561 0.9000 1.0000 0.9000 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 0.6560 0.9000 0.9000 0.5733 0.8748	2 0.2269 0 0.3842 6 0.5270 0 0.5856 0 0.3389 0 0.5739 6 0.8748 0 0.6561 0 0.9000 0 1.0000 9 0.3389 3 0.5739 3 0.7873 3 0.8748	0.2700 0.1968 0.1162 0.5856 0.5270 0.3842 0.2269 0.8748 0.7873 0.5739 0.3389 1.0000 0.9000 0.6561	0.3000 0.2700 0.1968 0.5270 0.5856 0.5270 0.3842 0.7873 0.8748 0.7873 0.5739 0.9000 1.0000	0.2700 0.3000 0.2700 0.3842 0.5270 0.5856 0.5270 0.5739 0.7873 0.8748 0.7873 0.6561 0.9000	0.1968 0.2700 0.3000 0.2269 0.3842 0.5270 0.5856 0.3389 0.5739 0.7873 0.8748 0.3874 0.6561

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

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

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

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

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

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

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

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

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

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

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

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

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

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

where

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

The matrix Γ is defined as

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

A permutation matrix P elements are defined as

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

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

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

$$R_{gNB} = R_{gNB_Dim,1} \otimes R_{gNB_Dim,2}$$

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,

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

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

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

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

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

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

The spatial correlation matrices at UE side are as follows:

- For 1 antenna element with the same polarization,

$$R_{UE}=1$$
.

- For 2 antenna elements with the same polarization,

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

B.2.3.2.2 MIMO Correlation Matrices using cross polarized antennas

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

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

Corr	relation Model	$lpha_1$	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 α₁ applies when more than one pair of cross-polarized antenna elements in first dimension at gNB side.							
Note 2:	Note 2: Value of α_2 applies when more than one pair of cross-polarized antenna elements in second dimension at qNB side.							
Note 3: Value of β applies when more than one pair of cross-polarized antenna elements at UE side.								

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

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)x2 high spatial correlation case, a=0.00010. For the 16 (4,2,2)x2 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.

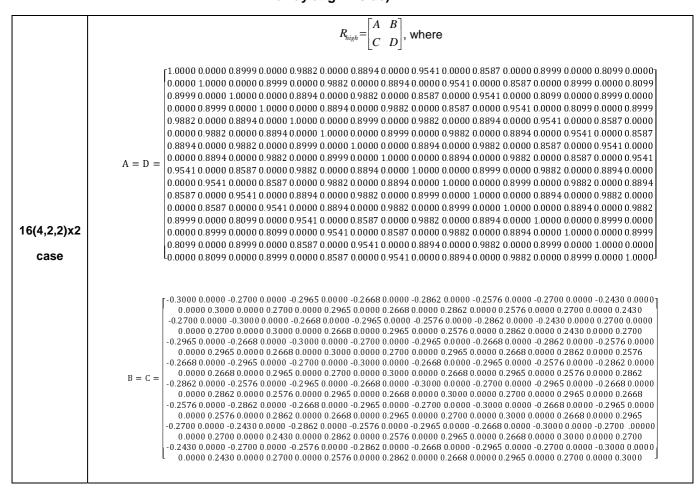
Table B.2.3.2.2-2: MIMO correlation matrices for high spatial correlation (1D cross polarized antenna array at gNB side)

				Γ 1 /	2000 /	0000	0.00	200 (0000	0.20	000 0	0000	0.27	700 0	0000	1	
					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	0.3000	0.00	000 ().2700		
					9000	0.0000	1.00	000 (0.0000	-0.27	700 0	0.0000	-0.30	000	0.0000		
4(2,1,2)x2					0000	0.9000	0.0	000 1	.0000	0.00	000 0	.2700	0.00	000 (0.3000		
case			$R_{high} =$	-0	3000	0.0000	-0.2	700 (0.0000	1.00	00 0	.0000	0.90	00 (0.0000		
						0.3000											
									0.2700	0.00		.0000	0.00).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	000 (0.3000	0.00	00 0	.9000	0.00	000 1	.0000		
				1.0	0000	0.9000	0.0	000	0.0000	-0.30	000 -(0.2700	0.000	00 0.	0000		
				0.9	9000	1.0000	0.0	000	0.0000	-0.27	'00 -(0.3000	0.000	00 0.	0000		
				0.0	0000	0.0000		000	0.9000			.0000	0.300		2700		
2(1,1,2)x4			R_{high}	=	0000	0.0000		000	1.0000			.0000	0.270		000		
case			mgn	-0.	3000	-0.270		000	0.0000	1.00	00 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		
				0.0	0000	0.0000	0.3	000	0.2700	0.00	000 0	.0000	1.000	0.9	000		
				0.0	0000	0.0000	0.2	700	0.3000	0.00	000 0	.0000	0.900	0 1.0	000		
		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		0.0000	0.0000	0.8100	0.9000	0.0000	0.0000	-0.2700	-0.3000	0.0000	0.0000	-0.2430	-0.2700	0.0000	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
	$R_{ m high}$ $=$	0.0000		0.9000	1.0000	0.0000	0.0000	0.8100	0.9000	0.0000	0.0000	0.2700 0.0000	0.3000	0.0000	0.0000	0.2430 0.0000	0.2700
		0.9000 0.8100		0.0000	0.0000	1.0000 0.9000	0.9000 1.0000	0.0000	0.0000	-0.2700 -0.2430	-0.2430 -0.2700	0.0000	0.0000	-0.3000 -0.2700	-0.2700 -0.3000	0.0000	0.0000
		0.0000		0.9000	0.8100	0.0000	0.0000	1.0000	0.9000	0.0000	0.0000	0.2700	0.2430	0.0000	0.0000	0.3000	0.2700
4(2,1,2)x4		0.0000	0.0000	0.8100	0.9000	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				0.0000	0.0000		-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		0.0000	0.0000 0.2700	-0.2430 0.0000	-0.2700 0.0000	0.0000 0.2700	0.0000 0.2430	0.9000 0.0000	1.0000 0.0000	0.0000 1.0000	0.0000	0.8100	0.9000	0.0000	0.0000 0.8100
		0.0000		0.2700	0.3000	0.0000	0.0000	0.2430	0.2430	0.0000	0.0000	0.9000	1.0000	0.0000	0.0000	0.8100	0.9000
				0.0000	0.0000		-0.2700	0.0000	0.0000	0.9000	0.8100	0.0000	0.0000	1.0000	0.9000	0.0000	0.0000
				0.0000	0.0000		-0.3000	0.0000	0.0000	0.8100	0.9000	0.0000	0.0000	0.9000	1.0000	0.0000	0.0000
		0.0000		0.2700	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		0.2430	0.2700	0.0000	0.0000	0.2700	0.3000	-0.3000	0.0000	0.8100 -0.2965	0.9000	-0.2862	0.0000	-0.2700	0.0000
		1.0000 0.0000			0.0000		0.0000		0.8999		0.0000			0.0000		0.0000	
									0.0000								0.0000
		0.9883							0.0000								0.0000
		0.9542			0.0000				0.9342								
		0.0000			0.9883				0.0000								
		0.8999							0.0000								
0/4 4 2)2		0.0000							1.0000								
8(4,1,2)x2 case	$R_{high} =$	-0.3000							0.0000							0.8999	
3400		0.0000							0.2700								
		-0.2965							0.0000					0.9883		0.9542	
		0.0000							0.0000			0.0000		0.0000		0.0000	
		-0.2862							0.0000				0.0000	1.0000		0.9883	
		0.0000							0.2965					0.0000		0.0000	
		-0.2700							0.0000							1.0000	
									0.3000								
	I	_ 0.0000	0.2700	0.000	, 0.2002	0.000	0.2703	0.000	0.5000	0.000	0.0777	0.000	0.7572	0.000	0.7003	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,
- $D_{\theta_{1,2}}(N_2)$ 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,

$$D_{\theta_{L}}(1) = 1.$$

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,

$$D_{ heta_{k,i}}(4) = egin{bmatrix} 1 & 0 & 0 & 0 \ 0 & e^{j heta_{k,i}} & 0 & 0 \ 0 & 0 & e^{j2 heta_{k,i}} & 0 \ 0 & 0 & 0 & e^{j3 heta_{k,i}} \end{bmatrix}.$$

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.2.3.2.3-1, and k is the linear increment of $2^{-\mu}$ for every slot throughout the simulation, the index i=1,2 stands for first dimension and second dimension respectively.
- w is the precoding matrix for Nt transmission antennas,
- y is the received signal, x is the transmitted signal, and n is AWGN.
- μ corresponds to subcarrier spacing configuration, $\Delta f = 2^{\mu} \cdot 15 [\text{kHz}]$

For the 1D cross-polarized antenna array at gNB, the corresponding random channel matrix H can be calculated by letting N_2 =1, i.e.,

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

Table B.2.3.2.3-1: The step of phase variation

Variation Step	Value (rad/ms)
$\Delta heta$	1.2566×10 ⁻³

B.2.3.2.3A Beam steering approach with dual cluster beams

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

$$y = \left[\sqrt{\frac{1}{1+p^2}} H_m D_{\theta_{k,1},\theta_{k,2}}^{(m)} + \sqrt{\frac{p^2}{1+p^2}} H_s D_{\theta_{k,1},\theta_{k,2}}^{(s)} \right] Wx + n$$

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

- $H_{\rm III}$, $H_{\rm S}$ are independent channels for the first beam and second beam with the Nr xNt channel matrix per subcarrier.
- $D_{\theta_{k,1},\theta_{k,2}}^{(m)}$, $D_{\theta_{k,1},\theta_{k,2}}^{(s)}$ are the steering matrix for first beam and second beam
- $D_{\theta_{i,j}}(N_1)$ 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 infirst 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,
- p is the relative power ratio of the second beam to the first beam, the value of p is specific to a test case,

For 1 antenna element of the same polarization in one direction, $D_{\theta_{n-1}}(1) = 1$.

For 2 antenna elements of 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 of 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 of 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.2.3.2.3A-1, and k is the linear increment of $2^{-\mu}$ for every slot throughout the simulation, the index i=1,2 stands for first dimension and second dimension respectively.
- w is the precoding matrix for Nt transmission antennas,
- y is the received signal, x is the transmitted signal, and n is AWGN.
- $_{μ}$ corresponds to subcarrier spacing configuration, $\Delta f = 2^{μ} \cdot 15 \text{[kHz]}$

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.2.3.2.3A-1: The step of phase variation

Variation Step	Value (rad/subframe)
$\Delta heta^{\!$	1.2566×10 ⁻³
$\Delta oldsymbol{ heta}^{(s)}$	2.5132×10 ⁻³

B.2.4 Two-tap propagation conditions for CQI tests

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

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

in continuous time (t, τ) representation, with \mathcal{T}_d the delay, a constant value of a and f_D the Doppler frequency. The same $h(t,\tau)$ is used to describe the fading channel between every pair of Tx and Rx.

B.3 High Speed Train Scenario

B.3.1 Single Tap Channel Profile

The high speed train condition for the test of the baseband performance is a non fading propagation channel with one tap. Doppler shift is given by

$$f_s(t) = f_d \cos \theta(t) \tag{B.3.1.1}$$

where $f_s(t)$ is the Doppler shift and f_d is the maximum Doppler frequency. The cosine of angle $\theta(t)$ is given by

$$\cos\theta(t) = \frac{D_s/2 - vt}{\sqrt{D_{\min}^2 + (D_s/2 - vt)^2}}, \ 0 \le t \le D_s/v$$
(B.3.1.2)

$$\cos \theta(t) = \frac{-1.5D_s + vt}{\sqrt{D_{\min}^2 + (-1.5D_s + vt)^2}}, \ D_s/v < t \le 2D_s/v$$
(B.3.1.3)

$$\cos\theta(t) = \cos\theta(t) \mod(2D_s/v), t > 2D_s/v$$
(B.3.1.4)

where $D_s/2$ is the initial distance of the train from gNB, and D_{\min} is gNB Railway track distance, both in meters; v is the velocity of the train in m/s, t is time in seconds.

Doppler shift and cosine angle are given by equation B.3.1.1 and B.3.1.2-B.3.1.4 respectively, where the required input parameters listed in Table B.3.1-1 and the resulting Doppler shift shown in Figures B.3.1-1, B.3.1-2, B.3.1-3, B.3.1-4 are applied for all frequency bands.

Value **Parameter** HST-750 HST-972 HST-1000 HST-1667 D_s 300 m 300 m 300 m 300 m D_{min} 2 m 2 m 2 m 2 m 500 km/h 500 km/h 300 km/h 300 km/h 972 Hz for 15 kHz SCS 750 Hz for 15 kHz SCS 1000 Hz for 30 kHz 1667 Hz for 30 kHz f_d SCS test test test SCS test

Table B.3.1-1: High speed train scenario

- Note 1: Parameters for HST conditions in Table B.3.1-1 including f_d and Doppler shift trajectories presented on 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) .

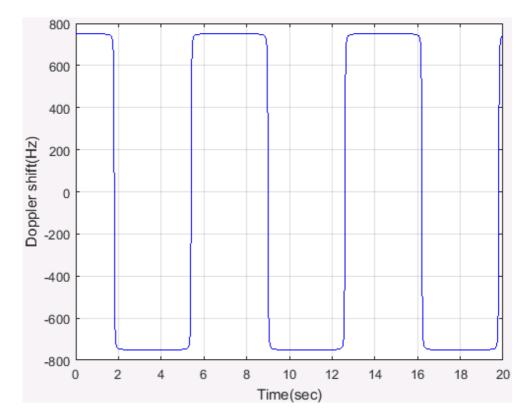


Figure B.3.1-1: Doppler shift trajectory ($f_{\scriptscriptstyle d}$

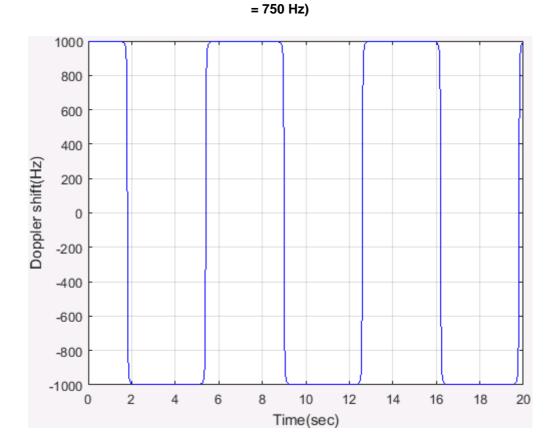


Figure B.3.1-2: Doppler shift trajectory (f_d = 1000 Hz)

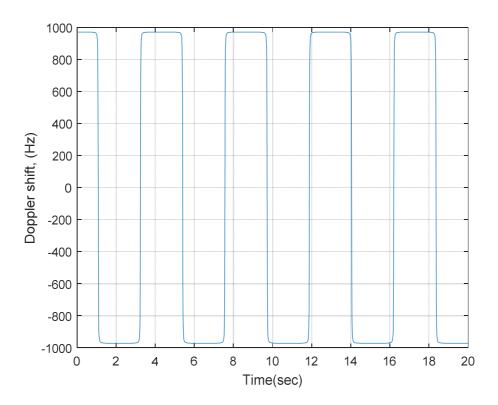


Figure B.3.1-3: Doppler shift trajectory (f_d = 972 Hz)

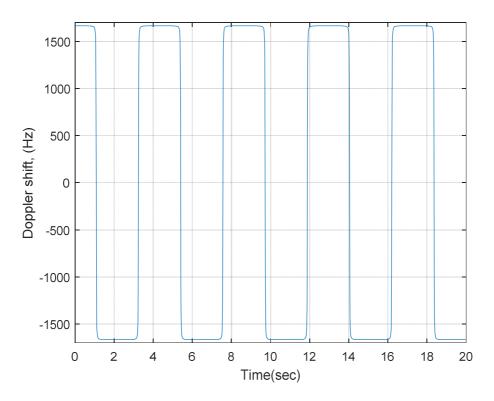


Figure B.3.1-4: Doppler shift trajectory (f_d = 1667 Hz)

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.

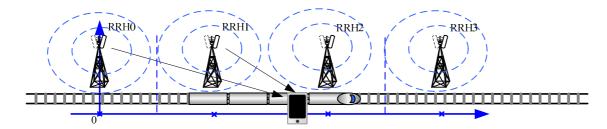


Figure B.3.2-1: Deployment of HST-SFN

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:

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

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

Table B.3.2-1: HST-SFN scenario

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.

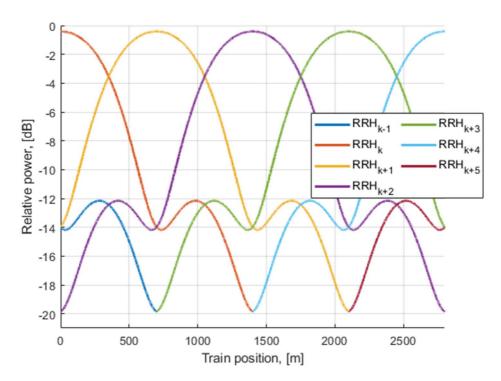


Figure B.3.2-2 Relative power level trajectories

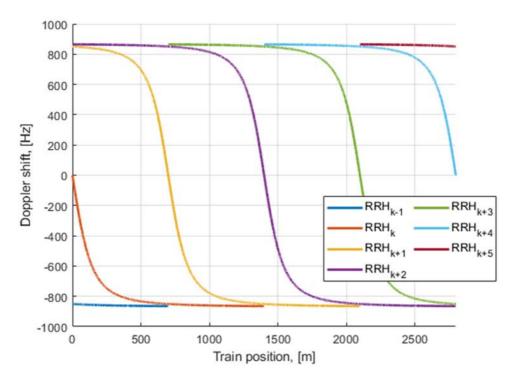


Figure B.3.2-3 Doppler shift trajectories (f_d = 870 Hz)

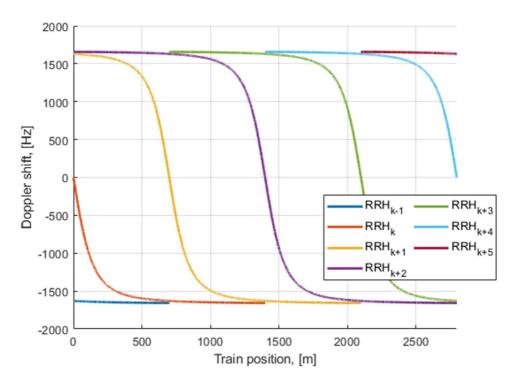


Figure B.3.2-4 Doppler shift trajectories (f_d = 1667 Hz)

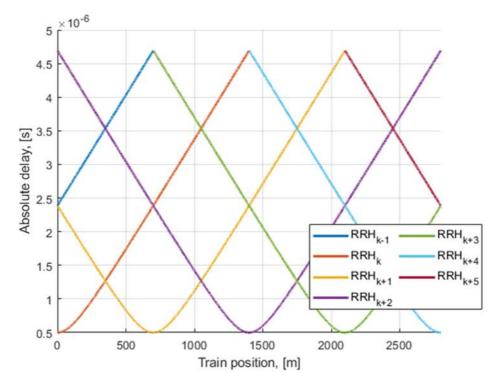


Figure B.3.2-5 Absolute delay trajectories

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.

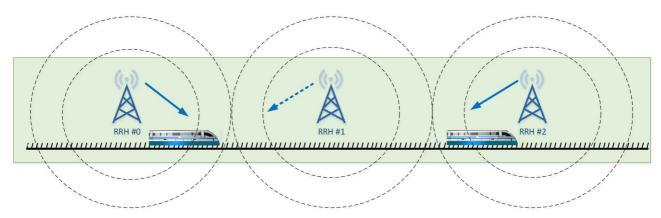


Figure B.3.3-1: Deployment of HST-DPS

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. 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)

However, RRH k is considered for PDSCH and PDCCH signal transmission only in the range:

$$k * D_s - \frac{D_s}{2} \le a < k * D_s + \frac{D_s}{2}$$
 (B.3.3.4)

Propagation delay difference are not considered between signals from different RRHs.

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

$$F_{D,k} = f_C \times real \left[-v \times \frac{y - x_k}{\left| y - x_k \right| \times C} \right] \text{ for } k * D_s - \frac{D_s}{2} \le a < k * D_s + \frac{D_s}{2}$$
 (B.3.3. 5)

In the above v (m/s) is the moving speed of the train, f_C (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
ν	500 km/h
f_d	870 Hz for 15 kHz SCS test; 1667 Hz for 30 kHz SCS test

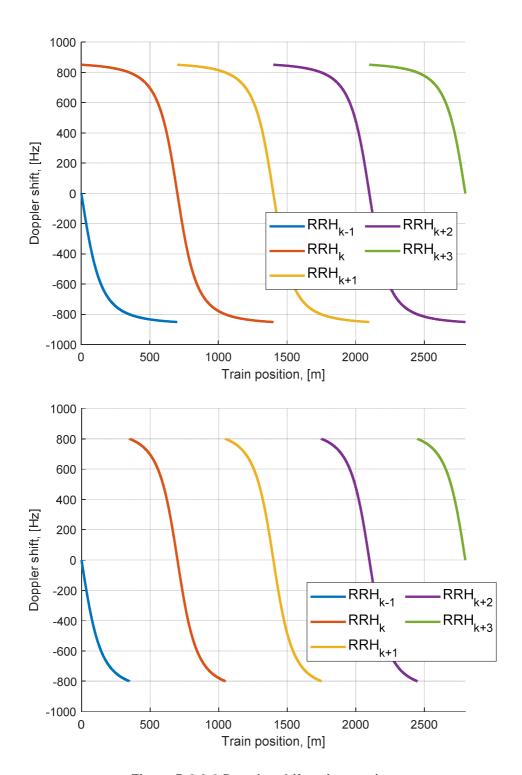


Figure B.3.3-2 Doppler shift trajectory (f_d = 870 Hz)

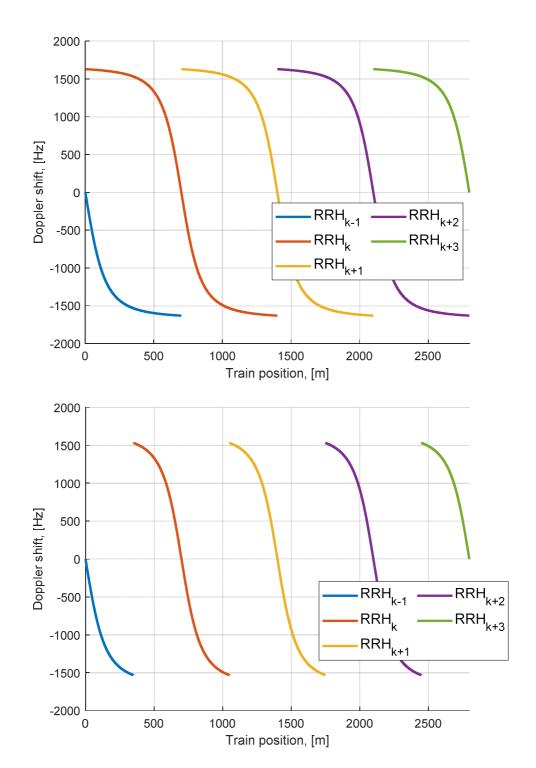


Figure B.3.3-3 Doppler shift trajectory (f_d = 1667 Hz)

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) $p = p_0, p_0 + 1, \dots, p_0 + N_p - 1, y^{(p)}(i) = \sum_{k=0}^{n} \frac{1}{N_k} \left(\sum_{k=0}^{n} \frac{1}{N_k} \sum_{k=0}^{n} \frac{1$

 $\begin{bmatrix} y^{(p_0)}(i) & y^{(p_0+1)}(i) & \dots & y^{(p_0+N_p-1)}(i) \end{bmatrix}^T, & i=0,1,\dots,M \text{ ap symb} -1, \text{ with } M \text{ ap symb} \text{ being the number of modulation} \\ & \text{symbols per antenna port including the reference signal symbols, and generates a block of signals } y^{(q)}_{bf}(i) = \\ & \left[y^{(0)}_{bf}(i) & y^{(1)}_{bf}(i) & \dots & y^{(N_{ANT}-1)}_{bf}(i) \right]^T \text{ the elements of which are to be mapped onto the frequency-time index pair } \left(k,l\right) \\ & \text{as per the test configuration but transmitted on different physical antenna elements:} \\ \end{aligned}$

$$y_{bf}^{(q)}(i) = W(i)y^{(p)}(i)$$

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

B.5 Downlink Transmission Model for requirements on bands with shared spectrum access

This clause provides a description of the Downlink Transmission Model to be used in PDSCH Demodulation and CQI reporting performance tests on bands with shared spectrum access.

The model as designed in the following applies to both configurations for *channelAccessMode=*'semiStatic' or 'dynamic'.

B.5.1 Downlink Transmission Model for bands with shared spectrum access

The Downlink Period for performance tests on bands with shared spectrum access is defined as the duration included in the Test Configuration Parameters.

For tests configured with the RRC Parameter *channelAccessMode*='semiStatic', the duration of the Fixed Frame Period (FFP) equals the duration of the Downlink Period.

For each Downlink Period, the downlink signal to be transmitted is allocated according to the steps listed below:

- Select the Downlink Transmission Duration in number of slots, randomly and with equally distributed probability, from the set of possible Downlink Transmission Duration values as included in the Test Configuration Parameters;
 - a. This duration includes occupied OFDM symbols and non-occupied OFDM symbols within the Downlink Transmission;
- 2. Depending on the Downlink Transmission Duration chosen in the previous step:
 - b. If the Downlink Transmission Duration equals 2 slots, all the OFDM symbols in both slots are fully allocated to downlink transmission, else;
 - c. If the Downlink Transmission Duration is larger than 2 slots, the configuration of occupied symbols in the last slot included in the downlink duration is selected in number of symbols, randomly and with equally distributed probability, from the set of possible 'Occupied OFDM symbols in the last slot of the downlink duration' as included in the Test Configuration Parameters;

For each Downlink Period, the last Slot is not scheduled for downlink transmission. This is to comply with the Idle period requirement in case of *channelAccessMode=*'semiStatic', and to align the test setup. In the case of *channelAccessMode=*'semiStatic', it can be assumed that the Channel Occupancy Time (COT) covers the entire duration of the Downlink Period except for the last slot.

For each Downlink Period, a uniform random variable from [0, 1] is generated. If the random variable is less than the p_{LBT} value included in the Test Configuration Parameters, the entire Downlink Period duration is muted across the entire bandwidth. This applies to all the signals that were scheduled for transmission, including but not limited to PDSCH, PDCCH, SSB, TRS, CSI-RS, etc.

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				
EPRE ratio of LTE CRS to NR SSS	dB	0 (Note 4)				
Note 1: Value is derived from Table 4.1-1 in TS 38.214 [12] based on "Number of DM-RS CDM groups without data" and "DMRS Type" parameters specified for each test.						
Note 2: The value is the energy of per RE for a single antenna port before pre-coding.						

Note 2: The value is the energy of per RE for a single antenna port before pre-coding.

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

Note 4: It is only applicable to LTE-NR coexistence tests.

C.4 Setup (Radiated)

Table C.4-1 describes the downlink Physical Channels that are required for connection set up.

Table C.4-1: Downlink Physical Channels required for connection set-up

Physical Channel
PBCH
SSS
PSS
PDCCH
PDSCH
PBCH DMRS
PDCCH DMRS
PDSCH DMRS
CSI-RS
PTRS

C.5 Connection (Radiated)

The following clauses, describes the downlink Physical Channels that are transmitted during a connection i.e., when measurements are done.

C.5.1 Measurement of Receiver Characteristics

Table C.5.1-1 is applicable for measurements in which uniform RS-to-EPRE boosting for all downlink physical channels, unless otherwise stated.

Table C.5.1-1: Downlink Physical Channels transmitted during a connection (TDD)

Parameter	Unit	Value (Note 2)					
SSS transmit power	W	Test specific					
EPRE ratio of PSS to SSS	dB	0					
EPRE ratio of PBCH to SSS	dB	0					
EPRE ratio of PBCH to PBCH DMRS	dB	0					
EPRE ratio of PDCCH to SSS	dB	0					
EPRE ratio of PDCCH to PDCCH DMRS	dB	0					
EPRE ratio of PDSCH to SSS	dB	0					
EPRE ratio of PDSCH to PDSCH DMRS	dB	Test specific (Note 1)					
EPRE ratio of 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					
		38.214 [12] based on "Number of DM-RS CDM					
		" parameters specified for each test.					
Note 2: The value is the energy of per RE for a single antenna port before pre-coding.							
Note 3: $L \in \{1,2,4,8\}$ is the CDM group size of NZP CSI-RS specified for each test.							
Note 4: Value is derived from Table 4.1 layers" and "epre-Ratio" parame		3 38.214 [12] based on "The number of PDSCH pecified for each test.					

Annex D (informative): Void

Annex E (normative): Environmental conditions

E.1 General

This annex specifies the environmental requirements of the UE. Within these limits the requirements of the present documents shall be fulfilled.

E.2 Environmental (Conducted)

The requirements in this clause apply to all types of UE(s).

E.2.1 Temperature

The UE shall fulfil all the requirements in the temperature range defined in Table E.2.1-1.

Table E.2.1-1: Temperature conditions

+15°C to +35°C	For normal conditions (with relative humidity of 25 % to 75 %)
----------------	--

Outside this temperature range the UE, if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in clause 6.2 of TS 38.101-1 [6] for extreme operation.

E.2.2 Voltage

The UE shall fulfil all the requirements in the voltage range defined in Table E.2.2-1.

Table E.2.2-1: Voltage conditions

Power source	Normal conditions voltage
AC mains	nominal
Regulated lead acid battery	1,1 * nominal
Non regulated batteries:	
Leclanché	Nominal
Lithium	1,1 * Nominal
Mercury/nickel & cadmium	Nominal

Outside this voltage range the UE if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in TS 38.101-1[6, Clause 6.2] for extreme operation. In particular, the UE shall inhibit all RF transmissions when the power supply voltage is below the manufacturer declared shutdown voltage.

E.2.3 Vibration

The UE shall fulfil all the requirements when vibrated at the following frequency/amplitudes.

Table E.2.3-1: Vibration conditions

Frequency	ASD (Acceleration Spectral Density) random vibration
5 Hz to 20 Hz	$0.96 \text{ m}^2/\text{s}^3$
20 Hz to 500 Hz	0,96 m ² /s ³ at 20 Hz, thereafter –3 dB/Octave

Outside the specified frequency range the UE, if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in TS 38.101-1[6] for extreme operation.

E.3 Environmental (Radiated)

The requirements in this clause apply to all types of UE(s).

E.3.1 Temperature

All requirements for UEs operating in FR2 are defined over the air and can only be tested in an OTA chamber.

The UE shall fulfil all the requirements in the temperature range defined in Table E.3.1-1.

Table E.3.1-1: Temperature conditions

+ 25 °C ± 10 °C	For normal (room temperature) conditions with relative
	humidity of 25% to 75%

Outside this temperature range the UE, if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in clause 6.2 of TS 38.101-2 [7] for extreme operation.

E.3.2 Voltage

< Editor's note: This requirement is incomplete. The following aspects are either missing or not yet determined:

Methodology to control the voltage in a case which a power cable is not connected to DUT is FFS since it is not agreed whether we can connect the power cable to DUT at the OTA measurement situation yet.

>

The UE shall fulfil all the requirements in the voltage range defined in Table E.3.2-1.

Table E.3.2-1: Voltage conditions

Power source	Normal conditions voltage
AC mains	nominal
Regulated lead acid battery	1,1 * nominal
Non regulated batteries:	
Leclanché	Nominal
Lithium	1,1 * Nominal
Mercury/nickel & cadmium	Nominal

Outside this voltage range the UE if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in clause 6.2 of TS 38.101-2 [7] for extreme operation. In particular, the UE shall inhibit all RF transmissions when the power supply voltage is below the manufacturer declared shutdown voltage.

E.3.3 Void

Annex G (informative): Void	
Annex H (informative): Void	
Annex I (informative): Void	
Annex J (informative): Void	
Annex K (informative): Void	

Annex L (informative): Change history

Date	Meeting	tDoc	CR	Rev	Cat	Change history Subject/Comment	New
Date	Meeting	iboc	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	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)	
					PDCCH R4-1902416 Draft CR for updating FR1 PDCCH performance	
					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	
					R4-1902418, Draft CR on FR2 CSI Reporting Tests (Qualcomm	
					Incorporated)	
					R4-1902419, Draft CR on FR1 CSI Reporting Tests (Qualcomm	
					Incorporated) R4-1900105, Draft CR on NR CSI reporting (Intel Corporation)	
					R4-1902058, Draft CR for update of FR1 CQI reporting test (Huawei,	
					HiSilicon)	
					R4-1902059, Draft CR for update of FR2 CQI reporting test (Intel)	
					R4-1902426, Draft CR for PMI test cases: 6.2, 8.2, A.3.2.2.2, A.3.2.2.5 (Samsung)	
					R4-1902425, Draft CR for FR1 and FR2 RI test cases (Qualcomm)	
					Annex	
					R4-1900369, Draft CR on PDSCH FRC (Intel Corporation)	
					R4-1900370, Draft CR on PDCCH FRC (Intel Corporation) R4-1902424, Corrections to 38.101-4 clause B.2.1 Delay profile	
					calculation (Huawei, HiSilicon)	
					R4-1902575, Draft CR on Beamforming Model (Qualcomm)	
					Additional modifications:	
					- Compared to endorsed CR R4-1902414, requirements for several	
					FR1 PDSCH test cases were modified to correct stat error	
					- Correct the format for Annex A.x	
					- Correct table number under PDSCH section 5.2.3.1.3 - Some minor editorial changes	
					2	
					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		R to TS 38.101-4: Implementation of endorsed draft CRs from AN4#90bis and RAN4#91	15.2.0
					dorsed draft CRs from RAN4#90bis	
					I-1902885, Draft CR on DL power allocation for TS 38.101-4	
					I-1903387, Draft CR for adding applicable rules on CSI test cases:	
					8, 10 I-1903471, Draft CR on PBCH requirements	
					I-1904750, draftCR on RMC for demod requirement for 38.101-4	
					I-1904751, Clarification on step 5 and step 6 for delay profiles	
					Iculation in B.2.1	
				R4	4-1904756, Draft CR on FR1 normal PDSCH demodulation	
					quirements	
					I-1904757, Draft CR on FR2 PDSCH Demodulation Performance	
				_	ests	
					I-1904758, Draft CR on EN-DC SDR requirements I-1904759, Addition of alternative TDD configuration for UE	
					modulation requirements	
					I-1904765, Draft CR on FR2 PDCCH demodulation requirements	
					I-1904766, draftCR: Updates to FR1 PDCCH demodulation	
					quirements	
					1-1904767, Draft CR for Beamforming model: Annex B.4.1	
					I-1904768, Draft CR for modification on CSI test cases: 6, 8, 10	
					I-1904776, Draft CR on FR1 SDR requirements I-1904777, Draft CR on FR2 SDR Requirements	
					I-1904777, Drait CR on PR2 SDR Requirements	
					I-1904779, Draft CR to TS38.101-4: Correction to FR1 CSI test	
					ses	
				R4	I-1904780, Draft CR to TS38.101-4: Correction to FR2 CSI test	
					ses	
					I-1904796, Draft CR to 38.101-4 on applicable SNR level for FR2	
				K4	I-1904833, Draft CR to TS 38.101-4 on SNR, Es and Noc setup	
				en	dorsed draft CRs from RAN4#91	
					I-1906069, Draft CR on PBCH requirements	
				R4	4-1906706, Editorial corrections for 38.101-4 PBCH tables	
					1-1907194, Draft CR on Noc and Es setup	
					I-1907293, Draft CR to TS38.101-4 for FR2 SDR test cases	
					I-1907294, draftCR: Introduce single-tap HST channel model in 38.101-4	
					I-1907295, draftCR: updates to FR2 PDSCH test parameters	
					I-1907296, draftCR: updates to FRC for demodulation	
				pe	rformance	
					I-1907297, draftCR: updates to FR1 CQI reporting test cases in	
					ction 6.2	
					I-1907298, Draft CR to 38.101-4 on Applicability of requirements	
				for	I-1907299, Draft CR to 38.101-4 on Demodulation requirements interworking	
					I-1907300, Draft CR to 38.101-4 on CSI requirements for	
					erworking	
					4-1907301, Draft CR on FR1 normal PDSCH demodulation	
					quirements	
					I-1907302, Draft CR on PDSCH FRC	
					I-1907303, Draft CR on FR2 CSI Reporting tests I-1907304, Editorial corrections for 38.101-4 PDCCH tables	
					I-1907304, Editorial corrections for 38.101-4 PDCCH tables I-1907307, draftCR: updates to FR1 PDSCH test parameters	
					I-1907308, Draft CR on EN-DC SDR requirements	
					I-1907309, Draft CR to TS38.101-4 on adding FRC for sub-band	
				CC	QI test cases	
					1-1907310, Draft CR to TS38.101-4: Environmental conditions	
					nnex E)	
					I-1907315, Draft CR on SDR requirements for NR CA between	
	ļ	L		ILK	A I AIIU I NZ	

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#05	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 RAN#86	RP-192998 RP-192998	0010 0011		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 15.4.0
						requirements (R15)	
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 RAN#86	RP-192998 RP-192998	0018	1	F	CR on corrections for FR2 CSI Reporting performance tests Editorial change on reference PDCCH payload size	15.4.0 15.4.0
2019-12	RAN#86	RP-192998	0013	1	F	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 testing	15.4.0
2019-12	RAN#86	RP-192998	0024		F	CR on demodulation performance requirements for EN-DC including FR1 and FR2 CCs	15.4.0
2019-12	RAN#86	RP-192998	0025		F	CR: Correction on NR PDCCH demodulation performance requirements	15.4.0
2019-12	RAN#86	RP-192998	0026		F	CR on CSI reporting requirements for EN-DC including FR1 and FR2 CCs	15.4.0
2019-12	RAN#86	RP-192998	0027	1	В	CR on NE-DC and NGEN-DC performance requirements	15.4.0
2019-12 2019-12	RAN#86 RAN#86	RP-192998 RP-192998	0028 0029	1	B F	CR on NR-DC performance requirements CR: Updates to NR RMC for UE performance requirements	15.4.0 15.4.0
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 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	0044		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	16.1.0
						section 4	
2020-06	RAN#88	RP-200985	0055		Α	CR: updates to NR CSI test	16.1.0
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		A	Update of DL physical channels definitions	16.1.0
2020-06	RAN#88	RP-200985	0057		A	CR: clarification on EPRE ratio definition	16.1.0
2020-09 2020-09	RAN#89 RAN#89	RP-201512 RP-201512	0059 0061		A	CR to ZP-CSI-RS configuration CR to 2Rx PDSCH mapping type B	16.2.0 16.2.0
2020-09	RAN#89	RP-201312	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
2020-09	RAN#89	RP-201499	0075		В	Addition of Rel-16 SP Type I PMI tests, FRCs, and spatial correlation matrices	16.2.0
2020-09	RAN#89	RP-201512	0078		Α	CR on Corrections in 38.101-4	16.2.0
2020-12	RAN#90	RP-202489	0080		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
2020-12	RAN#90	RP-202489	0084		Α	Correction to FR2 PMI Aperiodic CSI Reporting	16.3.0
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	0088		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 2020-12	RAN#90 RAN#90	RP-202423 RP-202423	0093 0094	1	B	Introduction of NR PDSCH FR1 CA 2Rx performance requirements CR: FR1 EN-DC power imbalance requirements	16.3.0 16.3.0
2020-12	RAN#90	RP-202423	0094	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
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2020-12	RAN#90	RP-202416			В	CR on FRC for UE Ultra-low BLER requirements	16.3.0
		RP-202416	1	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-202422	0113	1	В	CR to TS38.101-4: Addition of Rel-16 HST FRCs	16.3.0
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2021-03	RAN#91	RP-210064	0135	2	В	Introduction of PMI test cases with Rel-16 eType II codebook	16.4.0

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2021-03	RAN#91	RP-210065	0136	2	В	Introduction of PMI test cases with Rel-15 Type II codebook	16.4.0
2021-03	RAN#91	RP-210068	0137		F	CR to 38.101-4 on FRC table update for URLLC ultra low BLER requirements	16.4.0
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2021-03	RAN#91	RP-210067	0140	1	В	CR on simplified TDL-D channel model for FR2 DL 256QAM demodulation requirements	16.4.0
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2021-03	RAN#91	RP-210067	0145	1	<u>B</u>	CR on SDR requirements for DL 256QAM for FR2	16.4.0
2021-03	RAN#91	RP-210078	0146		F	CR on update TRS and CSI-RS transmission for HST DPS requirements	16.4.0
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2021-03	RAN#91	RP-210065	0149	1	В	CR for 38.101-4 Applicability of PMI reporting test with Tx ports larger than 8 and up to 32	16.4.0
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2021-03		RP-210065	0153		F	CR: Updates to power imbalance for CA	16.4.0
2021-03		RP-210066	0154	1	F	CR on Fixed reference channel for power saving performance	16.4.0
2021-03	RAN#91	RP-210065	0156		F	Correction of title on 16Tx port subband PMI reporting	16.4.0
2021-03	RAN#91	RP-210116	0158		Α	Correction of CQI test parameters and FRC for UE demodulation test	16.4.0
2021-03	RAN#91	RP-210064	0159	1	В	CR: FRC for eMIMO sDCI/mDCI-based PDSCH transmission	16.4.0
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2021-06	RAN#92e	RP-211103	0189	1	F	CR to TS 38.101-4: Performance requirements for single-DCl based multi-TRP Repetition Tx schemes (R16)	16.5.0
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2021-06		RP-211102	0193	1	F	Corrections to align the description of PMI test cases with TS 38.214	16.5.0
2021-06		RP-211104	0201		F	CR to 38.101-4 on URLLC requirements for PDSCH slot aggregation in FR2 - R16	16.5.0
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2021-06		RP-211104	0208		F	CR on HST-SFN requirements for TDD	16.5.0
2021-06	RAN#92e	RP-211101	0210		В	Big CR: Introduction of Rel-16 NR V2X demodulation performance requirements	16.5.0
2021-06			0213		F	Clear up CR for Rel-16 eMIMO PMI test cases	16.5.0
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2021-06		RP-211106	0217		F	CR on corrections of PDCCH-WUS requirements	16.5.0
2021-06		RP-211088	0220		A 	CR: Updates to PDSCH requirements and CSI requirements (Rel- 16)	16.5.0
2021-06		RP-211107	0224		<u></u>	CR on correction of FRC for HST (Rel-16)	16.5.0
2021-06		RP-211108	0226		<u>F</u>	CR on removal of square brackets for HST requirements	16.5.0
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2021-06	RAN#92e	RP-211100	0231		F	CR on correction of FR2 256QAM CQI applicability rules (Rel-16)	16.5.0
2021-06	RAN#92e	RP-211104	0233	1	F	CR to TS 38.101-4: Cleanup of UE performance requirements for	16.5.0
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						based transmission scheme	
2021-06	RAN#92e	RP-211088	0240		Α	Correction of variable name for PMI test metric	16.5.0
2021-06	RAN#92e	RP-211109	0242		F	CR: Correction of the applicability of requirements	16.5.0
2021-06	RAN#92e	RP-211103	0245	1	F	Finalization of URLLC pre-emption and mapping type B	16.5.0
						requirements	
2021-06	RAN#92	RP-211103	0249	1	F	CR for TS38.101-4, Editorial correction to UE performance	16.5.0
						requirements for FR1 pre-emption and FR2 PDSCH mapping Type	
						B R16	
						NOTE: The CR is was not implementable because it conflicted	
						with another CR	
2021-06			0251	1	F	CR on Applicability Rule for TDD LTE-NR Coexistence Tests	16.5.0
2021-06	RAN#92e	RP-211100	0252	1	F	CR on clarification of TDL-D channel model (R16)	16.5.0
2021-06	RAN#92e	RP-211091	0259		Α	CR to TS 38.101-4: Editorial corrections (R16)	16.5.0
2021-06	RAN#92e	RP-211102	0262	2	F	CR to TS 38.101-4: FRC index update and Editorial corrections	16.5.0
						(R16)	
2021-06	RAN#92e	RP-211100	0264		F	CR on finalization on the FR2 256QAM CQI report test case	16.5.0
2021-06	RAN#92e	RP-211094	0265		В	Big CR for the Introduction of NR-U UE Demodulation Requirements	16.5.0
						(PDSCH and CQI)	

History

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