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ETSI

650 Route des Lucioles F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

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Foreword

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

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

Version x.y.z

where:

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

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

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

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

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

should indicates a recommendation to do something

should not indicates a recommendation not to do something

may indicates permission to do something

need not indicates permission not to do something

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

can indicates that something is possiblecannot indicates that something is impossible

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

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

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

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

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

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

behaviour of which is outside the scope of the present document

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

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

In addition:

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

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

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

1 Scope

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

2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document in the same Release as the present document.
- 3GPP TR 21.905: "Vocabulary for 3GPP Specifications". [1] [2] 3GPP TS 38.521-4: "NR; User Equipment (UE) radio transmission and reception; Part 4: Performance requirements". Recommendation ITU-R M.1545: "Measurement uncertainty as it applies to test limits for the [3] terrestrial component of International Mobile Telecommunications-2000". [4] 3GPP TS 36.101: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception". 3GPP TR 38.901: "Study on channel model for frequencies from 0.5 to 100 GHz". [5] [6] 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone". [7] 3GPP TS 38.101-2: "NR; User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone". 3GPP TS 38.101-3: "NR; User Equipment (UE) radio transmission and reception; Part 3: Range 1 [8] and Range 2 Interworking operation with other radios". 3GPP TS 38.211: "NR; Physical channels and modulation". [9] 3GPP TS 38.212: "NR; Multiplexing and channel coding". [10]
- 3GPP TS 38.213: "NR; Physical layer procedures for control". [11]
- [12] 3GPP TS 38.214: "NR; Physical layer procedures for data".
- 3GPP TS 37.340: "Evolved Universal Terrestrial Radio Access (E-UTRA) and NR; Multi-[13] connectivity", Stage 2.
- 3GPP TS 38.306: "NR; User Equipment (UE) radio access capabilities". [14]
- 3GPP TS 36.211: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and [15] 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** Energy Per Resource Element **EPRE** E-UTRA-NR Dual Connectivity EN-DC

FR Frequency Range

FRC Fixed Reference Channel

Global Navigation Satellite System **GNSS HARO** Hybrid Automatic Repeat Request

HST High Speed Train

HST-SFN High Speed Train Single Frequency Network

Layer Indicator LI

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

New Radio NR

Non-Standalone Operation Mode **NSA OCNG** OFDMA Channel Noise Generator

OFDM Orthogonal Frequency Division Multiplexing Orthogonal Frequency Division Multiple Access **OFDMA**

Physical Broadcast Channel **PBCH**

Pcell Primary Cell

PMI

PDCCH Physical Downlink Control Channel Physical Downlink Shared Channel **PDSCH** Precoding Matrix Indicator

Physical Resource Block PRB **PRG** Physical resource block group **PSBCH** Physical Sidelink Broadcast Channel **PSCCH** Physical Sidelink Control Channel Physical Sidelink Feedback Channel **PSFCH PSS** Primary Synchronization Signal **PSSCH** Physical Sidelink Shared Channel Phase Tracking Reference Signal PTRS **PUCCH** Physical Uplink Control Channel Physical Uplink Shared Channel **PUSCH**

Quasi Co-location OCL RB Resource Block **RBG** Resource Block Group RE Resource Element Resource Element Group **REG**

RI Rank Indicator

RRC Radio Resource Control Standalone operation mode SA Sidelink Control Information SCI

SCS Subcarrier Spacing

Signal-to-Interference-and-Noise Ratio **SINR**

SL Sidelink

SLSS Sidelink Synchronization Signal

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

TDM Time division multiplexing TRxP Transmission and Reception Point Transmission Time Interval TTI

Uplink UL

Vehicle to Everything V2X **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.

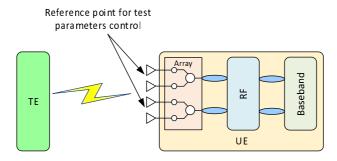


Figure 4.5.1-1: Reference point for radiated Demodulation and CSI requirements

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. Noc level is dependent on operating band and power class.

4.5.3.2 Noc for NR operating bands in FR2

Values for Noc according to operating band and power class for single carrier requirements are specified in Table 4.5.3.2-1 for $\Delta_{BB} = 1 dB$.

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

Operating band UE Power class				
	1	2	3	4
n257	-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	Test type	Test list	
UE supports only 2RX	PDSCH	All tests in Clause 5.2.2	
	PDCCH	All tests in Clause 5.3.2	
	PBCH	All tests in Clause 5.4.2	
UE supports only 4RX or both 2RX and 4RX	PDSCH	All tests in Clause 5.2.3 (Note 2)	
	PDCCH	All tests in Clause 5.3.3 (Note 2)	
	PBCH	All tests in Clause 5.4.2 or 5.4.3 (Note)	
Note 1: Requirements for PBCH with 4Rx is up to UE declaration Note 2: 'maxMIMO-Layers-r16' is not configured during the performance requirements testing for UE supporting Release 16 per-BWP MIMO layer adaptation.			

5.1.1.3 Applicability of requirements for optional UE features

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

Table 5.1.1.3-1: Requirements applicability for optional UE features

UE feature/capability [14]	Test	type	Test list	Applicability notes
SU-MIMO Interference Mitigation advanced receiver	FR1 FDD	PDSCH	Clause 5.2.2.1.1 (Test 3-1)	
			Clause 5.2.3.1.1 (Test 5-1)	
	FR1 TDD	PDSCH	Clause 5.2.2.2.1 (Test 3-1)	
			Clause 5.2.3.2.1 (Test 5-1)	
Alternative additional DMRS position for co-existence with	FR1 FDD	PDSCH	Clause 5.2.2.1.4 (Test 1-2)	
LTE CRS (additionalDMRS-DL-Alt)			Clause 5.2.3.1.4 (Test 1-2)	
,	FR1 TDD	PDSCH	Clause 5.2.2.2.4 (Test 1-2)	
			Clause 5.2.3.2.4 (Test 1-2)	
Basic DL NR-NR CA operation (supportedBandCombinationList)	NR CA	SDR	Clause 5.5A.1	1)Up to 16 DL carriers 2)Same numerology across carrier for data/control channel at a given time
Enhanced demodulation processing for HST-SFN joint	FR1 FDD	PDSCH	Clause 5.2.2.1.9 (Test 1-1)	
transmission scheme with velocity up to 500km/h			Clause 5.2.3.1.9 (Test 1-1)	
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	FR1 TDD	PDSCH	Clause 5.2.2.2.9 (Test 1-1)	
			Clause 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	
WOO-TableAll)	FR1 TDD	PDSCH	Clause 5.2.2.5	_
	11111100	1 20011	Clause 5.2.3.2.5	
			Clause 5.2.2.2.6	
			Clause 5.2.3.2.6	
CQI table with target BLER of 10^-5New CQI table (cqi-TableAlt)	FR1 FDD	PDSCH	Clause 5.2.2.1.5 Clause 5.2.3.1.5	
,	FR1 TDD	PDSCH	Clause 5.2.2.2.5 Clause 5.2.3.2.5	
PDSCH repetitions over multiple slots (pdsch- RepetitionMultiSlots)	FR1 FDD	PDSCH	Clause 5.2.2.1.6 Clause 5.2.3.1.6	
,	FR1 TDD	PDSCH	Clause 5.2.2.2.6 Clause 5.2.3.2.6	_
UE PDSCH processing	FR1 FDD	PDSCH	Clause 5.2.3.2.6	
capability #2 (pdsch- ProcessingType2)			Clause 5.2.3.1.7	
	FR1 TDD	PDSCH	Clause 5.2.2.2.7	
Pre-emption indication for DL (pre-EmptIndication-DL)	FR1 FDD	PDSCH	Clause 5.2.3.2.7 Clause 5.2.2.1.8 Clause 5.2.3.1.8	
(pro Emparidication-DE)	FR1 TDD	PDSCH	Clause 5.2.2.2.8 Clause 5.2.3.2.8	1
Single DCI based SDM	FR1 FDD	PDSCH	Clause 5.2.2.1.11	
transmission for multi-TRxP (singleDCI-SDM-scheme-r16)	FR1 TDD	PDSCH	Clause 5.2.3.1.11 Clause 5.2.2.2.11 Clause 5.2.3.2.11	
Multi DCI based multi-TRxP	FR1 FDD	PDSCH	Clause 5.2.2.1.12	
support (multiDCI-MultiTRP-r16)	FR1 TDD	PDSCH	Clause 5.2.3.1.12 Clause 5.2.2.2.12	
			Clause 5.2.3.2.12	
Single DCI based FDM Scheme- A for multi-TRxP(supportFDM-	FR1 FDD	PDSCH	Clause 5.2.2.1.13 Clause 5.2.3.1.13	
SchemeA-r16)	FR1 TDD	PDSCH	Clause 5.2.2.2.13 Clause 5.2.3.2.13	
	l .	I		L

Single DCI based inter-slot TDM	FR1 FDD	PDSCH	Clause 5.2.2.1.14	
for multi-TRxP (supportInter-	ED4 TDD	DDCCII	Clause 5.2.3.1.14	
slotTDM-r16)	FR1 TDD	PDSCH	Clause 5.2.2.2.14	
Maximum number of TCI states	FR1 FDD	PDSCH	Clause 5.2.3.2.14 Clause 5.2.2.1.14	The requirements
in Single-DCI based inter-slot	FRIFUU	PDSCH	Clause 5.2.3.1.14	The requirements
TDM (maxNumberTCI-states-	FR1 TDD	PDSCH	Clause 5.2.3.1.14	apply only when maxNumberTCI-
r16)	FRITUD	PDSCH	Clause 5.2.3.2.14	states-r16 = 2.
DRX Adaptation (<i>drx-Adaptation-</i>	FR1 FDD	PDCCH	Clause 5.3.2.1.3	If the Test 1 in
r16)				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 (<i>ul-Semi-StaticChAccess-r16</i>) 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 t	ype	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)	·
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.
	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 5.2.3.1.11 Clause 5.2.3.1.12 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 smaller bandwidth will be used for test.
- Among the bandwidth combinations selected, select the CA combination with largest aggregated bandwidth combination.

5.1.1.7 Applicability of CA requirements

5.1.1.7.1 Definition of CA capability

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

Table 5.1.1.7.1-1: Definition of CA capability

CA Capability	CA Capability Description	
CA_C	Intra-band contiguous CA	
CA_N	Intra-band non-contiguous CA	
CA_AX	Inter-band CA (X bands)	
NOTE 1: CA_C corresponds to NR CA configurations and bandwidth combination sets defined in Clause 5.5A.1 of TS 38.101-1 [6]. CA_N corresponds to NR CA configurations and bandwidth combination sets defined in Clause 5.5A.2 of TS 38.101-1 [6].		
	_AX corresponds to NR CA configurations and bandwidth combination 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	n scheme		Transmission scheme 1
Carrier configuration	Offset between Point A and the lowest usable subcarrier on this carrier (Note 2)	RBs	0
3	Subcarrier spacing	kHz	15 or 30
DL BWP configuration #1	Cyclic prefix		Normal
comigaration "	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	Gymbolo	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 ii, i2 combination, and with
			REG bundling granularity for number of Tx larger than 1
Cross carrier schedu			Not configured
CSI-RS for tracking	First subcarrier index in the PRB used for CSI-RS		k 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 21 for CSI-RS resource 3 and 4
	Frequency Occupation		Start PRB 0 Number of PRB = ceil(BWP size/4)*4
	QCL info		TCI state #0
NZP CSI-RS for CSI acquisition	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

i	[0: + DDD 0	
	Frequency Occ	cupation		Start PRB 0	
	001 : (Number of PRB = ceil(BWP size/4)*4	
7D 001 D0 (001	QCL info			TCI state #1	
ZP CSI-RS for CSI		index in the PRB used for		$k_0 = 4$	
acquisition	CSI-RS	1 1: 11 555			
		mbol in the PRB used for		I ₀ = 12	
	CSI-RS	DO 1 00			
	Number of CSI	-RS ports (X)		4	
	CDM Type			'FD-CDM2'	
	Density (ρ)	•		1	
	CSI-RS periodi	city	Slots	15 kHz SCS: 20	
	221 72 11			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 i	ndexes		{1000} for Rank 1 tests	
configuration				{1000, 1001} for Rank 2 tests	
				{1000-1002} for Rank 3 tests	
	5 11 (1	(; , DMD0 (, DD00))		{1000-1003} for Rank 4 tests	
		first DMRS for PDSCH		2	
	mapping type A	1		4/ 5 14 15 101	
		SCH DMRS CDM group(s)		1 for Rank 1 and Rank 2 tests	
	without data	1000		2 for Rank 3 and Rank 4 tests	
TCI state #0	Type 1 QCL	SSB index		SSB #0	
	information	201 =			
	T 0.001	QCL Type		Type C	
	Type 2 QCL	SSB index		N/A	
	information	001 7		N1/A	
TOI	T 4 001	QCL Type		N/A	
TCI state #1	Type 1 QCL	CSI-RS resource		CSI-RS resource 1 from 'CSI-RS for	
	information	001 7		tracking' configuration	
	T 0.001	QCL Type		Type A	
	Type 2 QCL	CSI-RS resource		N/A	
	information	001.7		N1/A	
DT DO " "		QCL Type		N/A	
PT-RS configuration		(A O) (/ A I A O) ((II I I		PT-RS is not configured	
		os for ACK/NACK feedback		1	
Maximum number of		sion		4	
HARQ ACK/NACK b				Multiplexed	
Redundancy version				{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	
Cumbola for all usus	ad DEa			PRB bundling granularity	
Symbols for all unus	eu KES			OP.1 FDD as defined in Annex A.5.1.1	
				OP.1 TDD as defined in Annex	
				A.5.2.1	
Dhysical signals, sha	annole manning a	nd proceding		As specified in Annex B.4.1	
Physical signals, cha			al to the T		
Note 1: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH					

Note 1: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH

transmission.

Note 2: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-1 [6] for tested channel bandwidth and subcarrier spacing.

Table 5.2-2: Number of PRBs in CORESET

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

5.2.1 1RX requirements

(Void)

5.2.2 2RX requirements

5.2.2.1 FDD

5.2.2.1.1 Minimum requirements for PDSCH Mapping Type A

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

The test purposes are specified in Table 5.2.2.1.1-1.

Table 5.2.2.1.1-1: Tests purpose

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

Table 5.2.2.1.1-2: Test parameters

	Parameter	Unit	Value
Duplex mode			FDD
Active DL BWP index	(1
PDSCH configuration	Mapping type		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 va	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	(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		l ₀ = 13
	CSI-RS periodicity	Slots	5
ZP CSI-RS for CSI Subcarrier index in the PRB used for CSI-acquisition 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			Correlation	Reference value	
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-7.1 FDD	10 / 15	QPSK, 0.30	TDLA30-10	4x2, ULA Low	70	-1.0
1-2	R.PDSCH.1-7.2 FDD	10 / 15	QPSK, 0.30	TDLA30-10	4x2, ULA Low	70	-1.0

5.2.2.1.5 Minimum requirements for PDSCH 0.001% BLER

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

The test purposes are specified in Table 5.2.2.1.5-1.

Table 5.2.2.1.5-1: Tests purpose

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

Table 5.2.2.1.5-2: Test parameters

	Parameter	Unit	Value
Duplex mode			FDD
Active DL BWP 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 condition	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%	3.2

5.2.2.1.6 Minimum requirements for PDSCH repetitions over multiple slots

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

The test purposes are specified in Table 5.2.2.1.6-1.

Table 5.2.2.1.6-1: Tests purpose

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

Table 5.2.2.1.6-2: Test parameters

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

Table 5.2.2.1.6-3: Minimum performance for Rank 1

Toot	Bandwidth (MHz) / Modulation		Duamanatian	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	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 index	X		1
PDSCH configuration	Mapping type		Туре В
	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)	Note 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
The number of slots between PDSCH and corresponding HARQ-ACK information			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) /	NA - ded ation		Correlation	Reference va	lue
Test num.	Reference channel	Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH. 1-2.6 FDD	10 / 15	16QAM 0.64	TDLA30-10	2x2, ULA Low	70	10.5

5.2.2.1.9 Minimum requirements for PDSCH HST-SFN

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

The test purposes are specified in Table 5.2.2.1.9-1.

Table 5.2.2.1.9-1: Tests purpose

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	DMRS Type		Type 1
configuration			
	Number of additional DMRS		2
	Maximum number of OFDM symbols for		1
	DL front loaded DMRS		
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			4
	between PDSCH and corresponding HARQ-		2
ACK information			

Table 5.2.2.1.9-3: Minimum performance for Rank 2

		Bandwidth		Correlation		Reference v	alue
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-8.3 FDD	10 / 15	16QAM, 0.48	HST-SFN	2x2	70	13.0

5.2.2.1.10 Minimum requirements for HST-DPS

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

The test purposes are specified in Table 5.2.2.1.10-1.

Table 5.2.2.1.10-1: Tests purpose

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
	Starting symbol (S	1		2
)		12
	Length (L)	an factor		
	PDSCH aggregation			1
	PRB bundling type			Static
	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 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		IWA
		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	Of the state of th		Sandwidth of Cor		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	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

	Darame	Mar.	Linit	Value		
	Parame	eter	Unit	TRxP #1(Note 1) TRxP #2(Note 1)		
Transmit TRxP of SS					P #1	
PDCCH configuration	_	Cl state			tate #1	
	(CORESETPoolIndex First subcarrier index in the)	
		PRB used for CSI-RS		k0=0 for CSI-RS resources 1,2,3,4	k0=1 for CSI-RS resources 5,6,7,8	
	<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	
		First OFDM symbol in the PRB		10 = 10 for CSI-	10 = 10 for CSI-	
		ised for 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	<u> </u>	Number of CSI-KS ports (X)		resource 1,2,3,4		
CSI-IXS for tracking		CDM Type			SI-RS resource	
					,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	
	(CSI-RS offset	Slots	11 for CSI-RS	resources 5 and 6 11 for CSI-RS	
					resources 7 and 8	
		QCL info			ate #0	
Duplex mode		202 11110			DD	
Active DL BWP index	X				1	
	Mapping typ	е		Тур	e A	
	k0			0		
	Starting sym	bol (S)		2		
	Length (L)				2	
PDSCH	PRB bundlin			Static		
configuration	PRB bundlir			2		
Comigaration		ocation type			pe 1	
	RBG size			Config2		
		8 mapping type		Non-interleaved		
	VRB-to-PRE	s mapping interleaver bundle		N	/A	
	Antenna por	t indoves		1000	1002	
	TCI state	t ilidexes		TCI State #1	TCI State #2	
PDSCH DMRS	DMRS Type			Type 1		
configuration		dditional DMRS			1	
comgaranon		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	CSI-NS resource		for tracking'	IN/A	
TCI State #1	Inionnation			configuration		
	T 000	QCL Type		Type A	N/A	
	Type 2 QCL information	CSI-RS resource	1	N/A N/A	N/A N/A	
	imonnation	QCL 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				Full-ove	erlapping	
Timing offset of the s	Timing offset of the second TRxP from the first TRxP				test 1-1	
			us		est 1-2	
Frequency offset of the	he second TR	RP from the first TRxP	Hz		test 1-1	
Number of HARQ Pro			+		est 1-2 4	
		CH and corresponding HARO-	+			
The number of slots between PDSCH and corresponding HARQ-ACK information					2	

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

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	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 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

	D			1121	Va	lue	
	Parar	neter	Unit	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 connigarance		CORESETPoolIndex			0		
			arrier index in the		k0=0 for CSI-RS	k0=1 for CSI-RS	
	ŀ	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	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 o	i Coi-Ro poits (A)		resource 1,2,3,4	resource 5,6,7,8	
CSI-KS for tracking		CDM Type	۵			SI-RS resource	
						,5,6,7,8	
		Density		01.4	3		
		CSI-RS po	eriodicity	Slots		0	
					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			Тур	e A	
	k0)	
	Starting sy	mbol (S)			2		
	Length (L)				12		
PDSCH	PRB bund				Static		
configuration	PRB bund					2	
garanen.	Resource allocation type				Type 1		
	RBG size					ifig2	
	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	UIT IIIUEAES			TCI State #1	TCI State #2	
PDSCH DMRS	DMRS Typ	ne .			Typ		
configuration		f additional	DMRS			1	
			OFDM symbols for			•	
		aded DMR					
					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	
	Type 2 OC	`1	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	n				configuration	
			QCL Type		N/A	Type A	
	Type 2 QC		CSI-RS resource		N/A	N/A	
	information	n	QCL Type	ļ	N/A	N/A	
Resource allocation		Marie 4 "	ret TDvD	us		erlapping	
Timing offset of the second TRxP from the first TRxP					-0		
Frequency offset of the second TRxP from the first TRxP Number of HARQ Processes						00	
		SCH and a	1		1		
The number of slots between PDSCH and corresponding HARQ-ACK information					2	2	
. tort information					SP Type I, inden	endent precoding	
Dropoding as of the continue of	ion				generation is appli		
Precoding configurat	IOU					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 5.2.2.1.12-3: 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 TCI state #1 TC		-	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			mbol (S)			_		
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						Non-interleaved		
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 Vision of HARQ Processes The number of slots between PDSCH and corresponding HARQ-ACK information Precoding configuration Precoding configuration CSI-RS resource N/A N/A N/A N/A N/A N/A N/A Type A N/A N/A N/A N/A Precoding offset of the second TRxP from the first TRxP Hz 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 Type A N/A N/A N/A 1				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 tra	ansmission is	s done fron	n both TRxPs		granu	ularity.	

Table 5.2.2.1.13-3: Minimum performance for Rank 2

		Bandwidth		B	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	Va	lue	
				TRxP #1 (Note 1)	TRxP #2 (Note 1)		
Transmit TRxP of SS	BB	T			TRx		
PDCCH configuration	n	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				0		
	Starting sy				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 3			N.	/A	
	Antenna p	na 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 QC	.i	CSI-RS resource		N/A N/A	N/A	
inform			QCL Type		N/A	N/A	
Timing offset of the s	Timing offset of the second TRxP from the first TRxP					2	
Frequency offset of the second TRxP from the first TRxP						00	
Number of HARQ Processes						1	
The number of slots between PDSCH and corresponding HARQ-					,	2	
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 1	: The propagation	n conditions a	pply to each of	TRxP #1 and TRx	P #2 and are statis	tically independen	t.	
Note 2	Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2.							
Note 3	te 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 5.2.2.2.1-1: Tests purpose

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

Table 5.2.2.2.1-2: Test parameters

	Parameter	Unit	Value
Duplex mode			TDD
Active DL BWP index	(1
PDSCH configuration	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		Specific to each Reference channel
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		4 for Tests 1-1, 1-8, 1-9 2 for other tests
	Resource allocation type		Test 1-2: Type 1 with start RB = 50, LRBs = 6 Other tests: Type 0
	RBG size		Test 1-2: N/A
	VDD to DDD manning true		Other tests: Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS configuration	DMRS Type		Type 1
-	Number of additional DMRS		2 for Tests 1-1, 1-7, 1-8, 1-9, 1-10, 1- 11 1 for other tests
	Maximum number of OFDM symbols for DL front loaded DMRS		1
CSI-RS for tracking	First OFDM symbol in the PRB used for CSI-RS		Tests 1-8, 1-9: $l_0 = 4$ for CSI-RS resource 1 and 3 $l_0 = 8$ for CSI-RS resource 2 and 4 Other tests; Table 5.2-1.
	CSI-RS periodicity	Slots	Test 1-7, 1-10, 1-11: 20 for CSI-RS resource 1,2,3,4.
	CSI-RS offset	Slots	Other tests: Table 5.2-1. Test 1-7, 1-10, 1-11: 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4. Other tests: Table 5.2-1.
	Frequency Occupation		Test 1-7, 1-10, 1-11: Start PRB 0 Number of PRB = 52 Other tests: Table 5.2-1.
Number of HARQ Pro	ocesses		16 for Test 1-4 10 for Test 1-9 8 for other tests
The number of slots I ACK information	between PDSCH and corresponding HARQ-		Specific to each TDD UL-DL pattern and as defined in Annex A.1.2

Table 5.2.2.2.1-3: Minimum performance for Rank 1

		Bandwidth				Correlation	Reference 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 5.2.2.2.1-4: 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 !!!		Correlation	Reference	value
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	TDD UL- DL pattern	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
3-1	R.PDSCH.2- 2.2 TDD	40 / 30	16QAM, 0.48	FR1.30-1	TDLA30-10	2x2, ULA Medium	70	18.0

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

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

The test purposes are specified in Table 5.2.2.2.1.

Table 5.2.2.2-1: Tests purpose

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

Table 5.2.2.2-2: Test parameters

	Parameter	Unit	Value
Duplex mode			TDD
Active DL BWP index	(1
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	Specific to spation factor ype size ation type apping type apping interleaver bundle itional DMRS ber of OFDM symbols for I DMRS is in the PRB used for CSI- city six in the PRB used for CSI- (k ₀ , I -RS ports (X) city Slots	Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS configuration	DMRS Type		Type 1
	Number of additional DMRS		1
	Maximum number of OFDM symbols for DL front loaded DMRS		1
NZP CSI-RS for CSI acquisition	OFDM symbols in the PRB used for CSI-RS		l 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			8
The number of slots ACK information	between PDSCH and corresponding HARQ-		Specific to each TDD UL-DL pattern and as defined in Annex A.1.2

Table 5.2.2.2-3: Minimum performance for Rank 2

		Bandwidth	Madulation	adulation TDD III	odulation TDD UL-	TDD III	Correlation	Reference v	/alue
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	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	between PDSCH and corresponding HARQ-		Specific to each TDD UL-DL pattern and as defined in Annex A.1.2

Table 5.2.2.3-3: Minimum performance for Rank 1

		Bandwidth (MHz)/	Modulation	TDD		Correlation			
Test num.	Reference channel	Subcarrier spacing (kHz)	format and code rate	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	1-1, 1-2
under 2 receive antenna conditions with CRS rate	
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 5.2.2.2.4-3: 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 inde	X		1
PDSCH	Mapping type		Type A
configuration			
	k0		0
	Starting symbol (S)		2
	Length (L)		12
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle		N/A
	size		
PDSCH DMRS	DMRS Type		Type 1
configuration			
	Number of additional DMRS		1
	Maximum number of OFDM symbols for		1
	DL front loaded DMRS		
Maximum number of HARQ transmission			1
Number of HARQ Processes			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 Subca space	Bandwidth (MHz) /	Modulation	TDD III DI	Propagation condition	Correlation matrix and antenna configuration	Reference value	
			format and code rate	TDD UL-DL pattern			Target BLER	SNR (dB)
1-1	R.PDSCH.2-1.4 TDD	40 / 30	QPSK, 0.59	FR1.30-1	AWGN	1x2, ULA Low	0.001%	3.3

5.2.2.2.6 Minimum requirements for PDSCH repetitions over multiple slots

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

The test purposes are specified in Table 5.2.2.2.6-1.

Table 5.2.2.2.6-1: Tests purpose

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

Table 5.2.2.2.6-2: Test parameters

	Parameter	Unit	Value			
Duplex mode			TDD			
Active DL BWP inde	ex		1			
PDSCH	3.71		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			
	VRB-to-PRB mapping interleaver bundle		N/A			
	size					
PDSCH DMRS configuration	DMRS Type		Type 1			
ooga.ao	Number of additional DMRS		1			
	Maximum number of OFDM symbols for DL front loaded DMRS		1			
Number of HARQ P			4			
			Specific to each TDD UL-DL pattern			
	between final repetition of PDSCH and					
corresponding HAR			and as defined in Annex A.1.2 (Note 1)			
Note 1: ACK/NACK feedback is generated for PDSCH on slot i, where mod(i,10) = {2, 4, 6}.						

Table 5.2.2.2.6-3: Minimum performance for Rank 1

Toot	Poforonoo	Bandwidth (MHz) /	Modulation	TDD UL-DL	Branagation	Correlation matrix and	Reference va	alue
Test num.	Reference channel	Subcarrier termat and	TDD UL-DL Propagation pattern condition		antenna configuration	Target BLER	SNR (dB)	
1-1	R.PDSCH.2-16.1 TDD	40 / 30	16QAM, 0.54	FR1.30-1	TDLA30-10	2x2, ULA Low	1% (Note 1)	1.4

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

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

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

The test purposes are specified in Table 5.2.2.2.7-1.

Table 5.2.2.2.7-1: Tests purpose

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

Table 5.2.2.2.7-2: Test parameters

	Parameter	Unit	Value	
Duplex mode			TDD	
Active DL BWP inde	X		1	
PDSCH	Mapping type		Type B	
configuration				
	k0		0	
	Starting symbol (S)		2	
	Length (L)		2	
	PDSCH aggregation factor		1	
	PRB bundling type		Static 2	
	PRB bundling size			
	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 DL front loaded DMRS		1	
Maximum number o	f HARQ transmission		1	
Number of HARQ P			2	
	between PDSCH and corresponding HARQ-		0	

Table 5.2.2.2.7-3: Minimum performance for Rank 1

Ī		Reference channel Su	channel Subcarrier format and UL-DL	TDD		Correlation	Reference value		
	Test num.			format and	nd UL-DL	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
	1-1	R.PDSCH.2- 17.1 TDD	40 / 30	QPSK, 0.30	FR1.30- 2	TDLA30-10	2x2, ULA Low	70	0.6

5.2.2.2.8 Minimum requirements for PDSCH pre-emption

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

The test purposes are specified in Table 5.2.2.2.8-1.

Table 5.2.2.2.8-1: Tests purpose

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

Table 5.2.2.2.8-2: Test parameters

	Parameter	Unit	Value	
Duplex mode			TDD	
Active DL BWP index	(1	
PDCCH	Symbols with PDCCH		0, 1	
configuration (Note	DCI format		2_1	
4)	timeFrequencySet		14x1	
	Mapping type		Type A	
	k0		0	
	Starting symbol (S)		2	
	Length (L)		12	
	PDSCH aggregation factor		1	
PDSCH	PRB bundling type		Static	
configuration	PRB bundling size		2	
	Resource allocation type		Type 0	
	RBG size		Config2	
	VRB-to-PRB mapping type		Non-interleaved	
	VRB-to-PRB mapping interleaver bundle size		N/A	
	DMRS Type		Type 1	
PDSCH DMRS	Number of additional DMRS		1	
configuration	Maximum number of OFDM symbols for DL front loaded DMRS		1	
Pre-emption	Starting symbol (S)		3	
configuration (Note	Length (L)		2	
2)	Pre-emption periodicity and offset	Slots	40/(1,12,23,34) (Note 3)	
Number of HARQ Pro	ocesses		8	
ACK information	petween PDSCH and corresponding HARQ-		FR1.30-1	
Note 1: Void				

Note 1: Void

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

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

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

Table 5.2.2.2.8-3: Minimum performance for Rank 1

	Test num.		Bandwidth (MHz) / Modulation			Correlation	Reference value		
		Reference Sub channel sp	Subcarrier spacing (kHz)	Subcarrier spacing format and code rate	TDD UL-DL pattern	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
Ī	1-1	R.PDSCH. 2-2.6 TDD	40 / 30	16QAM 0.64	FR1.30-1	TDLA30-10	2x2, ULA Low	70	12.5

5.2.2.2.9 Minimum requirements for HST-SFN

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

The test purposes are specified in Table 5.2.2.2.9-1.

Table 5.2.2.2.9-1: Tests purpose

Purpose	Test index
Verify PDSCH performance under 2 receive antenna conditions in the HST-SFN scenario defined in B.3.2 when <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 configuration	PRB bundling type		Static		
	PRB bundling size		2		
	Resource allocation type		Type 0		
	RBG size		Config2		
	VRB-to-PRB mapping type		Non-interleaved		
	VRB-to-PRB mapping interleaver bundle		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 (MHz) / Subcarrie	Bandwidth		Modulation TDD UL- format and DL code rate pattern	Propagation condition	Correlation matrix and antenna configuration	Reference value	
		Subcarrier fo spacing c	format and				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		l 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 + #0	PRB used for CSI-RS	Class	40
	Resource set #3	CSI-RS periodicity CSI-RS offset	Slots Slots	40 0
NZP CSI-RS for CSI		QCL info	31015	TCI state #0
acquisition		First OFDM symbol in the		
acquisition		PRB used for CSI-RS		10 = 13
	Resource set #4	CSI-RS periodicity	Slots	40
	Trooburoo oot ii 1	CSI-RS offset	Slots	0
		QCL info		TCI state #1
				CSI-RS resource 1 from 'CSI-RS
	Type 1 QCL	CSI-RS resource		for tracking Resource set #1'
			i	configuration
I TCI stata #0	information			
TCI state #0		QCL Type		Type A
TCI state #0	Type 2 QCL	CSI-RS resource		Type A N/A
TCI state #0				Type A N/A N/A
TCI state #0	Type 2 QCL information	CSI-RS resource QCL Type		Type A N/A N/A CSI-RS resource 5 from 'CSI-RS
TCI state #0	Type 2 QCL information Type 1 QCL	CSI-RS resource		Type A N/A N/A CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2'
TCI state #0 TCI state #1	Type 2 QCL information	CSI-RS resource QCL Type CSI-RS resource		Type A N/A N/A N/A CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration
	Type 2 QCL information Type 1 QCL information	CSI-RS resource QCL Type CSI-RS resource QCL Type		Type A N/A N/A N/A CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration Type A
	Type 2 QCL information Type 1 QCL information Type 2 QCL	CSI-RS resource QCL Type CSI-RS resource QCL Type CSI-RS resource		Type A N/A N/A N/A CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration Type A N/A
	Type 2 QCL information Type 1 QCL information Type 2 QCL information	CSI-RS resource QCL Type CSI-RS resource QCL Type CSI-RS resource QCL Type QCL Type		Type A N/A N/A N/A CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration Type A N/A N/A
TCI state #1	Type 2 QCL information Type 1 QCL information Type 2 QCL information Type 1 QCL	CSI-RS resource QCL Type CSI-RS resource QCL Type CSI-RS resource QCL Type SSB index		Type A N/A N/A N/A CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration Type A N/A N/A SSB #0
	Type 2 QCL information Type 1 QCL information Type 2 QCL information Type 1 QCL information	CSI-RS resource QCL Type CSI-RS resource QCL Type CSI-RS resource QCL Type SSB index QCL Type		Type A N/A N/A N/A CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration Type A N/A N/A SSB #0 Type C
TCI state #1	Type 2 QCL information Type 1 QCL information Type 2 QCL information Type 1 QCL information Type 2 QCL information Type 2 QCL	CSI-RS resource QCL Type CSI-RS resource QCL Type CSI-RS resource QCL Type SSB index QCL Type SSB index		Type A N/A N/A N/A CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration Type A N/A N/A SSB #0 Type C N/A
TCI state #1	Type 2 QCL information Type 1 QCL information Type 2 QCL information Type 1 QCL information Type 2 QCL information Type 2 QCL information	CSI-RS resource QCL Type CSI-RS resource QCL Type CSI-RS resource QCL Type SSB index QCL Type SSB index QCL Type SSB index QCL Type		Type A N/A N/A N/A CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration Type A N/A N/A SSB #0 Type C N/A N/A
TCI state #1 TCI state #2	Type 2 QCL information Type 1 QCL information Type 2 QCL information Type 1 QCL information Type 2 QCL information Type 2 QCL	CSI-RS resource QCL Type CSI-RS resource QCL Type CSI-RS resource QCL Type SSB index QCL Type SSB index		Type A N/A N/A N/A CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration Type A N/A N/A SSB #0 Type C N/A
TCI state #1	Type 2 QCL information Type 1 QCL information Type 2 QCL information Type 1 QCL information Type 2 QCL information Type 2 QCL information Type 1 QCL information Type 1 QCL	CSI-RS resource QCL Type CSI-RS resource QCL Type CSI-RS resource QCL Type SSB index		Type A N/A N/A N/A CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration Type A N/A N/A SSB #0 Type C N/A N/A SSB #1
TCI state #1 TCI state #2	Type 2 QCL information Type 1 QCL information Type 2 QCL information Type 1 QCL information Type 2 QCL information Type 2 QCL information Type 1 QCL information	CSI-RS resource QCL Type CSI-RS resource QCL Type CSI-RS resource QCL Type SSB index QCL Type		Type A N/A N/A N/A CSI-RS resource 5 from 'CSI-RS for tracking Resource set #2' configuration Type A N/A N/A SSB #0 Type C N/A N/A SSB #1 Type C

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

Note 1: SSB # (k mod 2) , 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, 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#

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

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				Number of		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.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-	
	us	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	
		CSI-RS resource QCL Type		N/A N/A	N/A N/A	
Resource allocation	I illioillatioil	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 second 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		Cor		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)			2 12		
		RB bundling type			Static		
PDSCH		PRB bundling size			2		
configuration		allocation t	уре		Тур	e 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	pe 1	
configuration		f additional			,	1	
		number of OFDM symbols for				1	
	DL front lo	aded DMR	S 		CSI-RS resource	<u> </u>	
					1 from 'CSI-RS		
	Type 1 QC		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	
	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 Hz		.25	
Frequency offset of the second TRxP from the first TRxP						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

Test num.	Referenc	ce channel	Bandwid th (MHz) / Subcarri er spacing (kHz)	Modula tion format and code rate	TDD UL-DL pattern	Propagati on condition(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.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	esponds 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	Transmit TRxP of SS	SB T	TOL				
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 used for First OFDM symbol in the PRB undiing generation is applied for both TRyPs or and as defined in Annax A.1.2 SPType I, Independent precoding operation in spiled for both TRyPs or and as defined in Annax A.1.2 SPType I, Independent precoding operation in spiled for bot							
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							
PRB bundling size						1	
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			a 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 Divince			CSI-RS resource	
TCI State #1 Information				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 OC	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.						-0.25	
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 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

Test num.	Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	TDD UL-DL pattern	Propagation condition (Note 1)	Correlation matrix and antenna configuration (Note 2)	Reference 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								

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.

5.2.2.2.14

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	1-1
same TB with two TCI states defined in clause 5.1 of TS 38.214 [12]	

Table 5.2.2.2.14-2: Test parameters

	Parai	meter	Unit	Value		
				TRxP #1 (Note 1)	TRxP #2 (Note 1)	
Transmit TRxP of SSB TCI state						P #1
PDCCH configuration	n	CORESETPoolIndex				ate #1 nfigured
			carrier index in the		k0=0 for CSI-RS	k0=1 for CSI-RS
			d 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
		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		<u>3</u> .0
		231 KO P	- Industry	Jioto	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
		QCL info				resources 7 and 8 ate #0
Duplex mode		QUL IIIIO				DD
Active DL BWP index	X					1
	Mapping t	уре			Тур	e A
	k0)
	Starting symbol (S)				2	
	Length (L) Repetition number				12	
PDSCH	PRB bundling type				Static	
configuration	PRB bund				2	
_	Resource	allocation t	уре			pe 0
	RBG size				Config2	
		VRB-to-PRB mapping type VRB-to-PRB mapping interleaver bundle			Non-interleaved	
	VRB-to-PI	To mapping interleaver bundle			N/A	
		ort indexes	3		1000	1000
	TCI state				TCI State #1	TCI State #2
PDSCH DMRS		DMRS Type Number of additional DMRS				pe 1
configuration	-				,	1
	Maximum number of OFDM symbols for DL front loaded DMRS				,	1
					CSI-RS resource	
	Type 1 Q0	CL	CSI-RS resource		1 from 'CSI-RS	N/A
TCI State #1	informatio				for tracking' configuration	
TOTOTALE #1			QCL Type		Type A	N/A
	Type 2 Q0	CL	CSI-RS resource		N/A	N/A
	informatio		QCL Type		N/A	N/A
						CSI-RS resource
	Type 1 Q0		CSI-RS resource		N/A	5 from 'CSI-RS for tracking'
TCI State #2	informatio	n				configuration
. 5. 5.0.0.0 112			QCL Type		N/A	Type A
	Type 2 Q0		CSI-RS resource		N/A	N/A
The in a 11 of 12	informatio		QCL Type		N/A	N/A
Timing offset of the s Frequency offset of the				us Hz		1 00
Number of HARQ Pr		IVYL, HOHI I	III III I I TXF	ПΖ		<u> </u>
		SCH and c	orresponding HARQ-			DD UL-DL pattern
ACK information	·				and as defined in A	nnex A.1.2 (Note 2)
Precoding configuration						endent precoding
					generation is applied for both TRxP random per slot with PRB bundling	
						vitn PRB bundling ilarity.
				<u> </u>	y grant	iidiity.

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

Table 5.2.2.2.14-3: Minimum performance for Rank 1

		Bandwidth				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 propagati	ion conditions	apply to each o	of TRxP #1 a	and TRxP #2 and	d are statistically	independent.		
Note 2	Note 2: Correlation matrix and antenna configuration parameters apply to each of TRxP #1 and TRxP #2.								
Note 3	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 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 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 (p _{LBT})		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			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 Trar	nsmission 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.2- 18.1 TDD	20 / 30	16QAM, 0.48	FR1.30-7	TDLA30-10	2x2, ULA Low	70	13.8
1-2	R.PDSCH.2- 18.2 TDD	40 / 30	16QAM, 0.48	FR1.30-7	TDLA30-10	2x2, ULA Low	70	14.1
1-3	R.PDSCH.2- 18.3 TDD	60 / 30	16QAM, 0.48	FR1.30-7	TDLA30-10	2x2, ULA Low	70	14.2
1-4	R.PDSCH.2- 18.4 TDD	80 / 30	16QAM, 0.48	FR1.30-7	TDLA30-10	2x2, ULA Low	70	14.5

5.2.3 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 I	between PDSCH and corresponding HARQ-		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		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			Correlation	Reference value	
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
2-1	R.PDSCH.1-3.1 FDD	10 / 15	64QAM, 0.50	TDLA30-10	2x4, ULA Low	70	13.5
2-2	R.PDSCH.2-1.1 FDD	20 / 30	64QAM, 0.50	TDLA30-10	2x4, ULA Low	70	13.7

Table 5.2.3.1.1-5: Minimum performance for Rank 3

		Bandwidth	Correlation				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	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)	
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	relation Reference value		
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)	
5-1	R.PDSCH.1-2.3 FDD	10 / 15	16QAM, 0.48	TDLA30-10	4x4, ULA Medium A	70	22.3	

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

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

The test purposes are specified in Table 5.2.3.1.2-1.

Table 5.2.3.1.2-1: Tests purpose

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

Table 5.2.3.1.2-2: Test parameters

	Parameter	Unit	Value
Duplex mode			FDD
Active DL BWP index	(1
	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		12
	PDSCH aggregation factor		1
PDSCH	PRB bundling type		Static
configuration	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle		N/A
	size		·
	DMRS Type		Type 1
PDSCH DMRS	Number of additional DMRS		1
configuration	Maximum number of OFDM symbols for DL front loaded DMRS		1
NZP CSI-RS for	OFDM symbols in the PRB used for CSI-RS		l ₀ = 13
CSI acquisition	CSI-RS periodicity	Slots	5
ZP CSI-RS for CSI	Subcarrier index in the PRB used for CSI-RS		$(k_0, k_1, k_2, k_3)=(2, 4, 6, 8)$
acquisition	Number of CSI-RS ports (X)		8
	CSI-RS periodicity	Slots	5
Number of HARQ Pr	ocesses		4
The number of slots ACK information	between PDSCH and corresponding HARQ-		2

Table 5.2.3.1.2-3: Minimum performance for Rank 2

Test	Reference	Bandwidth (MHz) / Subcarrier spacing	Modulation format and	Propagation condition	Correlation matrix and antenna configuration	Reference va	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 Pi	rocesses		4
The number of slots ACK information	between PDSCH and corresponding HARQ-		2

Table 5.2.3.1.3-3: Minimum performance for Rank 1

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

Table 5.2.3.1.4-2: Test parameters

	Parameter	Unit	Value
Duplex mode			FDD
Active DL BWP inde	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
DDCCII	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
0001	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) /	Madulation	Correlation		Reference value	
Test num.	Reference channel	Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-7.1 FDD	10 / 15	QPSK, 0.30	TDLA30-10	4x4, ULA Low	70	-4.0
1-2	R.PDSCH.1-7.2 FDD	10 / 15	QPSK, 0.30	TDLA30-10	4x4, ULA Low	70	-4.0

5.2.3.1.5 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		IV/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			4
The number of slots ACK information	between PDSCH and corresponding HARQ-		2

Table 5.2.3.1.5-3: Minimum performance for Rank 1

Test	Reference	Bandwidth (MHz) /	Modulation	Propagation	Correlation	Correlation Reference va	
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. 7

5.2.3.1.6 Minimum requirements for PDSCH repetitions over multiple slots

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

The test purposes are specified in Table 5.2.3.1.6-1.

Table 5.2.3.1.6-1: Tests purpose

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

Table 5.2.3.1.6-2: Test parameters

	Parameter	Unit	Value
Duplex mode			FDD
Active DL BWP inde	X		1
	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		12
	PDSCH aggregation factor		2
PDSCH	PRB bundling type		Static
configuration	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
	DMRS Type		Type 1
PDSCH DMRS	Number of additional DMRS		1
configuration	Maximum number of OFDM symbols for DL front loaded DMRS		1
Number of HARQ Pi	Number of HARQ Processes		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	Dranagation	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 conditions	1-1

Table 5.2.3.1.7-2: Test parameters

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

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

Symbols with PDCCH DCI format timeFrequencySet Mapping type		FDD 1 0, 1 2_1
DCI format timeFrequencySet Mapping type		
DCI format timeFrequencySet Mapping type		
timeFrequencySet Mapping type		2_1
Mapping type		
		14x1
		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
DMRS Type		Type 1
Number of additional DMRS		1
Maximum number of OFDM symbols for DL front loaded DMRS		1
Starting symbol (S)		3
Length (L)		2
Pre-emption periodicity and offset (Note 3)	Slots	10/1
esses		4
tween PDSCH and corresponding HARQ-		2
	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 DMRS Type Number of additional DMRS Maximum number of OFDM symbols for DL front loaded DMRS Starting symbol (S) Length (L) Pre-emption periodicity and offset (Note 3) esses	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 DMRS Type Number of additional DMRS Maximum number of OFDM symbols for DL front loaded DMRS Starting symbol (S) Length (L) Pre-emption periodicity and offset (Note 3) Slots esses

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) /	Meduletien		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. 1-2.6 FDD	10 / 15	16QAM 0.64	TDLA30-10	2x4, ULA Low	70	6. 6	

5.2.3.1.9 Minimum requirements for PDSCH HST-SFN

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

The test purposes are specified in Table 5.2.3.1.9-1.

Table 5.2.3.1.9-1: Tests purpose

Purpose	Test index
Verify PDSCH performance under 4 receive antenna conditions in the HST-SFN scenario defined in B.3.2	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	+	Tuna 4
DD0011 D14D0	DMRS Type	<u> </u>	Type 1
PDSCH DMRS	Number of additional DMRS		2
configuration	Maximum number of OFDM symbols for DL front loaded DMRS		1
	CSI-RS periodicity	Slots	10 for CSI-RS resource 1,2,3,4.
CSI-RS for tracking	CSI-RS offset	Slots	1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4.
Number of HARQ Processes			4
The number of slots I ACK information	petween PDSCH and corresponding HARQ-		2

Table 5.2.3.1.9-3: Minimum performance for Rank 2

	Bandwidth		No. 1 desta		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
	Starting symbol (S)			2
	Length (L)			12
	PDSCH aggregation	on factor		1
DDOOLL fi fi	PRB bundling type			Static
PDSCH configuration	PRB bundling size			2
	Resource allocatio			Type 0
	RBG size			Config2
	VRB-to-PRB mapp	ing type		Non-interleaved
		ing interleaver bundle size		N/A
	TCI state			Note 1
	DMRS Type			Type 1
PDSCH DMRS	Number of addition	nal DMRS		2
configuration		of OFDM symbols for DL		4
	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
			01015	2 for CSI-RS resource 3 and 4
CSI-RS for tracking		QCL info		TCI state #2
COI-NO IOI tracking		First OFDM symbol in		l ₀ = 6 for CSI-RS resource 5 and 6
	Resource set #2	the PRB used for CSI-		$l_0 = 10$ for CSI-RS resource 7 and 8
		RS		
		CSI-RS periodicity	Slots	10 for CSI-RS resource 5,6,7,8.
		CSI-RS offset	Slots	1 for CSI-RS resource 5 and 6
			01013	2 for CSI-RS resource 7 and 8
		QCL info		TCI state #3
	Resource set #3	First OFDM symbol in		$I_0 = 12$
		the PRB used for CSI-		
		RS	-	
		CSI-RS periodicity	Slots	20
N7D 001 D0 (001		CSI-RS offset	Slots	0
NZP CSI-RS for CSI		QCL info		TCI state #0
acquisition		First OFDM symbol in		$I_0 = 13$
	Resource set #4	the PRB used for CSI-		
		RS COLDO noniculiaitu	Clata	20
		CSI-RS periodicity	Slots	20
		CSI-RS offset	Slots	0 TCI state #1
		QCL info		CSI-RS resource 1 from 'CSI-RS for
	Type 1 OC	CSI-RS resource		tracking Resource set #1'
	Type 1 QCL information	COI-NO TESOUICE		configuration
TCI state #0	inionnation	QCL Type		Type A
	Type 2 QCL	CSI-RS resource		N/A
	information	QCL Type		N/A N/A
	miomation	QOL Type		CSI-RS resource 5 from 'CSI-RS for
	Type 1 QCL	CSI-RS resource		tracking Resource set #2'
	information	COLING TESOUICE		configuration
TCI state #1	omation	QCL Type		Type A
	Type 2 QCL	CSI-RS resource		N/A
	information	QCL Type		N/A
	Type 1 QCL	SSB index		SSB #0
	information	QCL Type		Type C
TCI state #2	Type 2 QCL	SSB index		N/A
	information	QCL Type		N/A
	Type 1 QCL	SSB index		SSB #1
	information	QCL Type		Type C
TCI state #3	<u> </u>	SSB index		N/A
	Type 2 QCL information	QCL Type		N/A N/A
	miomation	QOL TYPE	L	IW/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 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

	Parameter		Unit	Va	lue	
			Onit	TRxP #1(Note 1)	TRxP #2(Note 1)	
Transmit TRxP of SS					P #1	
PDCCH configuration		state			ate #1	
	COF	RESETPoolIndex subcarrier index in the		k0=0 for CSI-RS	k0=1 for CSI-RS	
		subcarrier index in the sused for CSI-RS		resources 1,2,3,4	resources 5,6,7,8	
	1100	daed for COLING		10 = 6 for CSI-RS	10 = 6 for CSI-RS	
		05514		resources 1 and 3	resources 5 and 7	
		OFDM symbol in the PRB of for CSI-RS		10 = 10 for CSI-	10 = 10 for CSI-	
	used	1 101 CSI-RS		RS resources 2	RS resources 6	
				and 4	and 8	
	Num	nber of CSI-RS ports (X)		1 for CSI-RS	1 for CSI-RS	
CSI-RS for tracking		,			resource 5,6,7,8 SI-RS resource	
	CDN	/I Туре			,5,6,7,8	
	Den	sitv			3	
		RS periodicity	Slots	2	.0	
		•		10 for CSI-RS	10 for CSI-RS	
	CSI	RS offset	Slots	resources 1 and 2	resources 5 and 6	
	001	TO Oliset	51013	11 for CSI-RS	11 for CSI-RS	
	0.01				resources 7 and 8	
Dunlay mada	QCL	info			ate #0	
Duplex mode Active DL BWP index				L L	DD 1	
Active DL DVVI IIIue	Mapping type			Tyr	e A	
	k0			0		
	Starting symbol	(S)		2		
	Length (L)			12		
PDSCH	PRB bundling ty	/pe		Sta	atic	
configuration	PRB bundling s				2	
Comigaration	Resource alloca	ation type			e 1	
	RBG size			Config2		
	VRB-to-PRB ma			Non-interleaved		
	size	apping interleaver bundle		N	/A	
	Antenna port inc	dexes		1000	1002	
	TCI state			TCI State #1	TCI State #2	
PDSCH DMRS	DMRS Type			Тур	e 1	
configuration	Number of addi			,	1	
		er of OFDM symbols for		,	1	
	DL front loaded	DMRS		001 00	· 	
				CSI-RS resource 1 from 'CSI-RS		
	Type 1 QCL	CSI-RS resource		for tracking'	N/A	
TCI State #1	information			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				configuration	
TOI State #2		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					rlapping	
Timing offset of the s	Timing offset of the second TRxP from the first TRxP				test 1-1	
ing onder or trie s		and mot mot	us		est 1-2	
Frequency offset of t	he second TRxP f	rom the first TRxP	Hz	200 for test 1-1		
Number of HARQ Pr					est 1-2 4	
		and corresponding HARQ-				
ACK information		, g		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:	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	ns apply to eac	h of TRxP #1 and	TRxP #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

Damamatan				1111	Va	lue	
Parameter			Unit	TRxP #1(Note 1)			
Transmit TRxP of SSB					TRxP #1		
PDCCH configuration	n	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 CSI-RS ports (X)			1 for CSI-RS	1 for CSI-RS	
CSI-RS for tracking					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	apping type			Тур	e 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			Non-interleaved		
	VRB-to-PF	RB mapping	g 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		·		
		aded DMR			1		
					CSI-RS resource		
	Type 1 QCL information		CSI-RS resource		1 from 'CSI-RS	N/A	
					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 QCL		CSI-RS resource		N/A	N/A	
	information QCL Typ		QCL Type	ļ	N/A	N/A	
Resource allocation		Marie 4 "	ret TDvD		Non-overlapping		
Timing offset of the second TRxP from the first TRxP Frequency 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 Number of HARQ Processes			Hz	200			
The number of slots between PDSCH and corresponding HARQ-			1				
ACK information				2			
Precoding configuration			<u> </u>	SP Type I, independent precoding			
				generation is appli			
				random per slot with 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

				Modula			Reference value	
Tes nun	Reterer	Reference channel		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		O.4 FDD	l nnlyto ooob o	,	_	-	lly indonor	

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

5.2.3.1.13 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	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

TRXP #1 (Note 1) TRXP #2 (Note 1) TRXP #1 TRXP #		Parar	neter		Unit	Value		
PDCCH configuration								
CORESETPOILINGEX Not configured	Transmit TRxP of SS	SB .						
First subcarrier index in the PRB used for CSI-RS Resources 5.2.3.4 resources 5.6.7.8	PDCCH configuration	n		TDIII				
PRB used for CSI-RS								
CSI-RS for tracking								
First OFDM symbol in the PRB used for CSI-RS		ŀ	I ND usec	1101 001-110				
Part Carre								
Number of CSI-RS ports (X)								
Number of CSI-RS ports (X)			used for C	791-K9		RS resources 2	RS resources 6	
CSI-RS for tracking								
CSI-RS for tracking			Number o	f CSI-RS ports (X)				
CDM Type	CSI-RS for tracking							
Density	3		CDM Type	е				
CSI-RS periodicity			Density					
CSI-RS offset		ŀ		eriodicity	Slots			
CSI-RS offset			our no p	onodioity	01010			
CSI-RS offiset			001.00		O			
Duplex mode			CSI-RS of	itset	Slots			
Duplex mode						resources 3 and 4	resources 7 and 8	
Mapping type			QCL info					
Mapping type						F	DD .	
PDSCH	Active DL BWP index						1	
Starting symbol (S)			ype					
Length (L)			mbal (C)					
PRB bundling type			/mboi (5)					
PRB bundling size			ling type					
Resource allocation type								
RBG size	configuration			vne				
VRB-to-PRB mapping type			anocation	, po				
VRB-to-PRB mapping interleaver bundle size			RB mapping	type				
Antenna port indexes		VRB-to-PF	RB mapping	g interleaver bundle		N	/Λ	
TCI state								
DMRS Type			ort indexes					
Number of additional DMRS	DD 0011 DMD0							
Maximum number of OFDM symbols for DL front loaded DMRS				DMDC		Тур	oe 1	
DL front loaded DMRS	Configuration						I	
Type 1 QCL Information CSI-RS resource 1 from 'CSI-RS for tracking' configuration QCL Type Type A N/A						•	1	
Type 1 QCL information CSI-RS resource for tracking' configuration QCL Type Type A N/A Type 2 QCL information CSI-RS resource N/A N/A Type 1 QCL Type Type 1 QCL information CSI-RS resource N/A N/A Type 1 QCL Type Type 1 QCL information CSI-RS resource N/A N/A CSI-RS resource 5 from 'CSI-RS 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 US 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.		DE HOIR IO	adea Divire	Ĭ		CSI-RS resource		
TCI State #1 Information		T 4 00	NI.	001 00			NI/A	
Consignration Consignration Consignration Type A N/A N/A				CSI-RS resource			N/A	
Type 2 QCL information QCL Type N/A N/A N/A Type 1 QCL information QCL Type N/A N/A N/A Type 2 QCL information CSI-RS resource S from 'CSI-RS for tracking' configuration QCL Type N/A Type A Type 2 QCL information QCL Type N/A N/A N/A Type 2 QCL information QCL Type 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 US Frequency offset of the second TRxP from the first TRxP US Time 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 #1	Iniomation	ı					
TCI State #2 TOI State #2 TO		_						
TCI State #2 Type 1 QCL information CSI-RS resource								
TCI State #2 Type 1 QCL information CSI-RS resource QCL Type Type 2 QCL information QCL Type Type 2 QCL information QCL Type CSI-RS resource Information QCL Type N/A Type A N/A N/A N/A Type 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 Type 1 QCL CSI-RS resource N/A N/A N/A N/A N/A N/A N/A N/A		intormation	1	QCL Type		N/A		
TCI State #2 Total State #2 Total S								
TCI State #2 Information QCL Type N/A Type A				CSI-RS resource		N/A		
QCL Type	TCI State #2	information	n					
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.				QCL Type		N/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 QC	L					
Frequency offset of the second TRxP from the first TRxP						N/A	N/A	
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.								
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.					Hz			
ACK information Precoding configuration SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity.						4	7	
Precoding configuration SP Type I, independent precoding generation is applied for both TRxPs, random per slot with PRB bundling granularity.							2	
Precoding configuration generation is applied for both TRxPs, random per slot with PRB bundling granularity.	ACK IIIIOIIIIation					SP Type Lindon	endent precoding	
random per slot with PRB bundling granularity.								
granularity.	Precoding configurat	ion						
	Note 1: PDSCH tr	ansmission i	s done fron	n both TRxPs				

Table 5.2.3.1.13-3: Minimum performance for Rank 2

		Bandwidth		Dropogotion	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.										

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

	Paramete	Ţ	Unit	Value		
				TRxP #1 (Note 1)	TRxP #2 (Note 1)	
Transmit TRxP of SS					P #1	
PDCCH configuration		state			tate #1	
1 Boot 1 configuration	CO	RESETPoolIndex			nfigured	
		t subcarrier index in the		k0=0 for CSI-RS	k0=1 for CSI-RS	
	PRI	B used for CSI-RS		resources 1,2,3,4	resources 5,6,7,8	
				10 = 6 for CSI-RS	10 = 6 for CSI-RS	
	Firs	t OFDM symbol in the PRB		resources 1 and 3 I0 = 10 for CSI-	resources 5 and 7 I0 = 10 for CSI-	
	use	d for CSI-RS		RS resources 2	RS resources 6	
				and 4	and 8	
				1 for CSI-RS	1 for CSI-RS	
001.00 (Nur	nber of CSI-RS ports (X)		resource 1,2,3,4		
CSI-RS for tracking	CD	M Turno			SI-RS resource	
	CD	М Туре		1,2,3,4	,5,6,7,8	
		nsity			3	
	CSI	-RS periodicity	Slots	_	20	
				10 for CSI-RS	10 for CSI-RS	
	CS	-RS offset	Slots	resources 1 and 2	resources 5 and 6	
				11 for CSI-RS	11 for CSI-RS	
	00	QCL info		resources 3 and 4	resources 7 and 8 rate #0	
Duplex mode	l QC	L INIO			DD	
Active DL BWP index	<i>'</i>			1 1	1	
Active DE DVVI IIIde.	Mapping type			Tyr	e A	
	k0				0	
	Starting symbo	I (S)			2	
	Length (L)	. (5)			2	
	Repetition num	ber			2	
PDSCH	PRB bundling t			Sta	atic	
configuration	PRB bundling	size			2	
	Resource alloc	ation type		Тур	oe 0	
	RBG size				nfig2	
	VRB-to-PRB m			Non-inte	erleaved	
		apping interleaver bundle		N	/A	
	size					
	Antenna port in	ort indexes		1000	1000	
PDSCH DMRS	TCI state DMRS Type			TCI State #1	TCI State #2	
configuration	Number of add	itional DMPS			oe 1 1	
comigaration		per of OFDM symbols for			<u> </u>	
	DL front loaded				1	
				CSI-RS resource		
	Type 1 OCL	CSI-RS resource		1 from 'CSI-RS	N/A	
	Type 1 QCL information	CSI-RS resource		for tracking'	IN/A	
TCI State #1	Illioilliation			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	
. Of Oldio #Z		QCL Type		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			us Hz		2	
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						
					endent precoding ed for both TRxPs,	
Precoding configurat	ion				vith PRB bundling	
				_	ularity.	
				grand		

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 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	• • • • • • • • • • • • • • • • • • • •									

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
PDSCH configuration	PRB bundling size		4 for Tests 1-1, 1-8, 1-9 wideband for Test 3-1 2 for other tests
	Resource allocation type		Test 1-2: Type 1 with start RB = 50, LRBs = 6 Other tests: Type 0
	RBG size		Test 1-2: N/A Other tests: Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
	DMRS Type		Type 1
PDSCH DMRS	Number of additional DMRS		2 for Tests 1-1, 1-7, 1-8, 1-9, 1-10, 1- 11
configuration			1 for other tests
	Maximum number of OFDM symbols for DL front loaded DMRS		1
	First OFDM symbol in the PRB used for CSI-RS		Tests 1-8, 1-9: l ₀ = 4 for CSI-RS resource 1 and 3 l ₀ = 8 for CSI-RS resource 2 and 4
			Other tests; Table 5.2-1.
	CSI-RS periodicity	Slots	Test 1-7, 1-10, 1-11: 20 for CSI-RS resource 1,2,3,4.
			Other tests: Table 5.2-1.
CSI-RS for tracking	CSI-RS offset	Slots	Test 1-7, 1-10, 1-11: 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4.
			Other tests: Table 5.2-1.
	Frequency Occupation		Test 1-7, 1-10, 1-11: Start PRB 0 Number of PRB = 52
		<u> </u>	Other tests: Table 5.2-1.
Number of HARQ Pro	ocesses		16 for Test 1-4 10 for Test 1-9 8 for other tests
The number of slots I ACK information	petween PDSCH and corresponding HARQ-		Specific to each TDD UL-DL pattern and as defined in Annex A.1.2

Table 5.2.3.2.1-3: Minimum performance for Rank 1

		Bandwidth				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

	Reference channel	Bandwidth	Madulation	TDD		Correlation matrix and antenna configuration	Reference value	
Test num.		(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	UL-DL pattern	Propagation condition		Fraction of maximum throughput (%)	SNR (dB)
2-1	R.PDSCH.2- 3.1 TDD	40 / 30	64QAM, 0.50	FR1.30- 1	TDLA30-10	2x4, ULA Low	70	13.6
2-2	R.PDSCH.2- 9.1 TDD	20 / 30	64QAM, 0.50	FR1.30- 4	TDLA30-10	2x4, ULA Low	70	13.7

Table 5.2.3.2.1-5: Minimum performance for Rank 3

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

Table 5.2.3.2.1-6: Minimum performance for Rank 4

		Bandwidth	Mandadatian	TDD III		Correlation	Reference	value
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	TDD UL- DL pattern	Propagation matrix and condition antenna	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	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 aggregation factor		1
PDSCH configuration	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle		N/A
	size		IN/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		Reference value			
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		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	1-1, 1-2
matching configured	

Table 5.2.3.2.4-2: Test parameters

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

Table 5.2.3.2.4-3: Minimum performance for Rank 1

	Bandwidth (MHz) /		(MHz) /			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		IVA		
	DMRS Type		Type 1		
PDSCH DMRS	Number of additional DMRS		1		
configuration	Maximum number of OFDM symbols for		1		
	DL front loaded DMRS		'		
Maximum number of HARQ transmission			1		
Number of HARQ 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 Propagation		Correlation	Reference	value
num.	num. channel 5	Subcarrier tormat and	pattern		matrix and antenna configuration	Target BLER	SNR (dB)	
1-1	R.PDSCH.2-1.4 TDD	40 / 30	QPSK, 0.59	FR1.30-1	AWGN	1x4, ULA Low	0.001%	0. 7

5.2.3.2.6 Minimum requirements for PDSCH repetitions over multiple slots

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

The test purposes are specified in Table 5.2.3.2.6-1.

Table 5.2.3.2.6-1: Tests purpose

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

Table 5.2.3.2.6-2: Test parameters

Parameter			Value
Duplex mode			TDD
Active DL BWP index	(1
	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		12
	PDSCH aggregation factor		2
PDSCH	PRB bundling type		Static
configuration	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle		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		l
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	K feedback is generated for PDSCH on slot i,	where mod	$d(i,10) = \{2, 4, 6\}.$

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.2-16.1 TDD	40 / 30	16QAM, 0.54	FR1.30-1	TDLA30-10	2x4, ULA Low	1% (Note 1)	-2.6

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

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

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

The test purposes are specified in Table 5.2.3.2.7-1.

Table 5.2.3.2.7-1: Tests purpose

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

Table 5.2.3.2.7-2: Test parameters

Parameter			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	IV/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	rocesses	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

	I	Bandwidth	Modulation	TDD III	TDD III	lation TDD UL-	20.111	Correlation	Reference v	alue
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	format and code rate	DL pattern	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)		
1-1	R.PDSCH.2- 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 Processes			8
The number of slots I ACK information	petween 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) /	Madulation				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. 2-2.6 TDD	40 / 30	16QAM 0.64	FR1.30-1	TDLA30-10	2x4, ULA Low	70	8.7	

5.2.3.2.9 Minimum requirements for HST-SFN

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

The test purposes are specified in Table 5.2.3.2.9-1.

Table 5.2.3.2.9-1: Tests purpose

Purpose	Test index
Verify PDSCH performance under 4 receive antenna conditions in the HST-SFN scenario defined in B.3.2 when <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	Mandadatian	TDD		Correlation	Reference value	
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	TDD UL-DL pattern	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
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		31013	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#

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

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 5.2.3.2.10-3: 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 SS			TRxP #1 TCI State #1			
PDCCH configuration	_	CI state				
	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	
	-	PRB used for CSI-RS		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 Pro					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:	PDSCH transmission is done from both TRxPs (PDSCH layer 1 is transmitted from TRxP #2)	Layer 0 is transmitted from TRxP #1 and PDSCH

Table 5.2.3.2.11-3: Minimum performance

		Bandwidt		TDD		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	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		1111	Va	lue		
	Parar	meter	Unit	TRxP #1(Note 1)	TRxP #2(Note 1)		
Transmit TRxP of SS	SB				TRxP #1		
PDCCH configuration	n	TCI state			TCI State #1	TCI State #2	
- 2 con connigations	-	CORESETPoolIndex			0.		
			arrier index in the I 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 bund						
configuration	PRB bund				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		·		
Timing offset of the s	econd TRxF	from the fi	rst TRxP	us	Non-overlapping -0.25		
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						in Annex A.1.2	
						endent precoding	
Precoding configurat	ion				generation is appli		
. 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											

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

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

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

The test purposes are specified in Table 5.2.3.2.13-1.

Table 5.2.3.2.13-1: Tests purpose

Purpose	Test index
Verify PDSCH performance under 4 receive antenna	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
		i 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	port indexes		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
information		QCL Type		N/A	N/A
Timing offset of the second TRxP from the first TRxP			us		25
Frequency offset of the second TRxP from the first TRxP			Hz	30	
	Number of HARQ Processes				<u> </u>
The number of slots between PDSCH and corresponding HARQ-ACK information					DD UL-DL pattern
ACK INIOIIIIalion					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

		Bandwidth (MHz) / Modulation TDD Propagati		D	Correlation	Reference value		
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	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	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-DCI based Inter-slot TDM scheme

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

The test purposes are specified in Table 5.2.3.2.14-1.

Table 5.2.3.2.14-1: Tests purpose

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

Table 5.2.3.2.14-2: Test parameters

	Param	eter		Unit	Value		
				TRxP #1 (Note 1) TRxP #2 (Note 1)			
Transmit TRxP of SS						P #1	
PDCCH configuration		TCI state				ate #1	
1 Deer 1 configuration			TPoolIndex		Not cor	nfigured	
			arrier index in the		k0=0 for CSI-RS	k0=1 for CSI-RS	
		PRB used	for CSI-RS		resources 1,2,3,4	resources 5,6,7,8	
		First OFDM symbol in the PRB			10 = 6 for CSI-RS	10 = 6 for CSI-RS	
					resources 1 and 3 I0 = 10 for CSI-	resources 5 and 7 I0 = 10 for CSI-	
		used for CSI-RS			RS resources 2	RS resources 6	
					and 4	and 8	
					1 for CSI-RS	1 for CSI-RS	
001.007		Number o	of CSI-RS ports (X)		resource 1,2,3,4		
CSI-RS for tracking		CDM Type	^		'No CDM' for C	SI-RS resource	
		СЫМ Тур	e 		1,2,3,4	,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	
	-	QCL info				resources 7 and 8 ate #0	
Duplex mode		QUL IIIIU				DD	
Active DL BWP index	v					1	
Active DL DWI IIIde	Mapping ty	ne				e A	
	k0	pc)	
	Starting symbol (S)					2	
	Length (L)				12		
		Repetition number			2		
PDSCH	PRB bundling type				Static		
configuration		PRB bundling size				2	
		Resource allocation type			Тур	oe 0	
	RBG size				Config2		
	VRB-to-PR				Non-interleaved		
		RB mapping interleaver bundle			N	/A	
	size						
		port indexes			1000	1000	
	TCI state				TCI State #1	TCI State #2	
PDSCH DMRS	DMRS Type		DMDO			pe 1	
configuration	Number of				,	1	
	DL front loa	number of OFDM symbols for			•	1	
	DE HOIR loa	aded DIVIT	<u> </u>		CSI-RS resource		
					1 from 'CSI-RS		
	Type 1 QCI		CSI-RS resource		for tracking'	N/A	
TCI State #1	information				configuration		
			QCL Type		Type A	N/A	
	Type 2 QCI		CSI-RS resource		N/A	N/A	
	information		QCL Type		N/A	N/A	
						CSI-RS resource	
	Type 1 QCI		CSI-RS resource		N/A	5 from 'CSI-RS	
	information		22.1.2.3000.00			for tracking'	
TCI State #2			001 T	1	>1/A	configuration	
	Tura 2 2 2 2	ı	QCL Type CSI-RS resource		N/A	Type A	
	Type 2 QCI information		QCL Type		N/A N/A	N/A N/A	
Timing offset of the s	Timing offset of the second TRxP from the first TRxP					<u> N/A</u> 1	
Frequency offset of the second TRXP from the first TRXP						00	
Number of HARQ Processes				Hz		4	
The number of slots between PDSCH and corresponding HARQ-				1		DD UL-DL pattern	
ACK information	201110011100	Ji i alia 0	on soponaing in ita	1		nnex A.1.2 (Note 2)	
						endent precoding	
Drocoding configurat	ion					ed for both TRxPs,	
Precoding configurat	เดน				random per slot v	vith PRB bundling	
]		ılarity.	

Note 1:	PDSCH transmission is done from both TRxPs
Note 2:	ACK/NACK feedback is generated for PDSCH on slot in where mod(in 10) = 12 / 1. 6)

Table 5.2.3.2.14-3: Minimum performance for Rank 1

		Bandwidth TDD III Branagation					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 1	Note 1: The propagation conditions apply to each of TRxP #1 and TRxP #2 and are statistically independent.								
Note 2	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,									
	independent	tly of the numb	er HARQ trans	smission(s) fo	r each transport	block.			
Note 4	: SNR corresp	oonds 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						

Table 5.2.3.2.15-3: Minimum performance for Rank 2

		Bandwidth		Madadatian TDD III		Correlation	Reference value	
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	TDD UL- DL pattern	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.2- 18.1 TDD	20 / 30	16QAM, 0.48	FR1.30-7	TDLA30-10	2x4, ULA Low	70	8.7
1-2	R.PDSCH.2- 18.2 TDD	40 / 30	16QAM, 0.48	FR1.30-7	TDLA30-10	2x4, ULA Low	70	8.7
1-3	R.PDSCH.2- 18.3 TDD	60 / 30	16QAM, 0.48	FR1.30-7	TDLA30-10	2x4, ULA Low	70	8.9
1-4	R.PDSCH.2- 18.4 TDD	80 / 30	16QAM, 0.48	FR1.30-7	TDLA30-10	2x4, ULA Low	70	9.1

5.2A 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
Corniguration	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
	DMRS Type		Type 1
PDSCH DMRS	Number of additional DMRS		1
configuration	Maximum number of OFDM symbols for DL front loaded DMRS		1
Number of HARQ Pr	ocesses		As defined in Table 5.2A-2
TDD UL-DL pattern			15kHz SCS: FR1.15-1 30kHz SCS: FR1.30-1
The number of slots between PDSCH and corresponding HARQ-ACK information			As defined in Table 5.2A-3
Number of PUCCH ResourceGroups			1
PUCCH format for HARQ-ACK feedback			PUCCH format 1 for cases with no more chan 2 DL CCs PUCCH format 3 for cases with more than 2 DL CCs

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

HARQ process number		CCs with the same duplex mode & SCS with Pcell	CCs with different duplex mode / SCS with Pcell
FDD 15 kHz +	FDD PCell	4	8
TDD 30 kHz CA	TDD PCell	8	8
FDD 15 kHz +	FDD PCell	4	4
TDD 15 kHz CA	TDD PCell	8	8
TDD 15 kHz +	15kHz PCell	8	12
TDD 30 kHz CA	30kHz PCell	8	8
FDD 15 kHz +	FDD PCell	4	N/A
FDD 15 kHz CA	FDD FCeii	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 s PDSCH and con HARQ-ACK in	rresponding	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

Danish of diffe	Deference	Modulation	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- 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

D. 1 1111	D. C.	Modulation		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 CA duplex mode		Minimum performance requirements					
1	FDD 15 kHz + FDD 15 kHz	As defined in Table 5.2A.2.1-1					
2	TDD 30 kHz + TDD 30 kHz	As defined in Table 5.2A.2.1-3					
3	FDD 15 kHz + TDD 30 kHz	As defined in Table 5.2A.2.1-1 and Table 5.2A.2.1-3 per CC					
4	FDD 15 kHz + TDD 15 kHz	As defined in Table 5.2A.2.1-1 and Table 5.2A.2.1-2 per CC					
5	TDD 15 kHz + TDD 30 kHz	As defined in Table 5.2A.2.1-2 and Table 5.2A.2.1-3 per CC					
Note 1: The applicability of requirements for different CA duplex modes, SCSs, CA configurations and bandwidth							
con	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			FDD and TDD	
Active DL BWP index	(1	
Propagation condition	n		Static propagation condition No external noise sources are applied	
Antenna configuratio	n		1x2	
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	channel		antenna Bm/Hz)	Referen Fraction of Through	
	PCell	SCell	PCell	SCell	\hat{E}_{s_PCell} for PCell	\hat{E}_{s_SCell} for Scell	PCell	SCell
1	bandwid	Channel 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	Bandwi	dth (MHz)	Reference	e channel	Power at antenna port (dBm/Hz)		Reference value Fraction of Maximum Throughput (%)	
	PCell	SCell	PCell	SCell	\hat{E}_{s_PCell} for PCell	\hat{E}_{s_SCell} for Scell	PCell	SCell
1	bandwid	d Channel dth as per n 5.1.1.6	Derived as per section 5.1.3.2 of TS 38.214 [12]	NA	-112	-106	85	NA

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

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

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

Table 5.2A.2.3-1: Tests purpose

Purpose	Test index
Verify the PDSCH performance of SCell for UE	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 Pr			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

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	D. C.	Modulation Correlation			Reference val	ue
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 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.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	Defense	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	As defined in Table 5.2A.3.1-2 and Table 5.2A.3.1-3 per CC			
Note 1: The applicability of requirements for different CA duplex modes, SCSs, CA configurations and bandwidth					
combination sets is defined in 5.1.1.5.					

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 Pro	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 I ACK information	between PDSCH and corresponding HARQ-		As defined in Table A.1.2-2 for FR1.30-
PUCCH format for HARQ-ACK feedback			PUCCH format 1
Overhead for TBS determination			0
SSB transmission			Slot#0 with periodicity 20ms
RB assignment			Full applicable test bandwidth as defined in Table 5.3.5-1 of TS 38.101-1 [6]

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

Test Number	Bandwidth (MHz)		Reference channel			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			Reference	Reference channel		antenna Bm/Hz)	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	bandwic	Channel Ith as per 5.1.1.6	Derived as per section 5.1.3.2 of TS 38.214 [12]	NA	-112	-106	85	NA

5.2A.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	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	between 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		een Point A and the		0
configuration	lowest usab	le subcarrier on this		
_	carrier (Note	e 1)		
DL BWP	Cyclic prefix	,		Normal
configuration #1	RB offset		RBs	0
Common	Physical Ce			0
serving cell	SSB position			1
parameters	SSB periodi		ms	20
		CCH monitoring PDCCH candidates		Each slot
PDCCH	Number of F	DCCH candidates		Start from RB = 0
configuration		domain resource		with contiguous RB
Comigaration	allocation fo	r CORESET		allocation
	TCI state			TCI state #1
		rier index in the PRB		
	used for CS			0
				CSI-RS resource 1:
				4 CSI-RS resource 2:
	First OFDM	symbol in the PRB		8
	used for CS	I-RS (I ₀)		CSI-RS resource 3:
		(10)		4
				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:
J				10 for CSI-RS
				resource 1 and 2
				11 for CSI-RS
				resource 3 and 4
	CSI-RS offs	et	Slots	20 141 - 000
				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 =
	001 : (ceil(BWP size /4)*4
	QCL info	CCD index		TCI state #0 SSB #0
	Type 1 QCL	SSB index		
TCI state #0	information	QCL Type		Type C
TCI 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			tracking'
	information	QCL Type		configuration
TCI state #1		QCL Type		Type A CSI-RS resource 1
	Type 2			from 'CSI-RS for
	QCL	CSI-RS resource		tracking'
	information			configuration
		QCL Type		Type D

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

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
DCCU DCI format 2 6 configuration	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: T _{minimumTimeGap} is signaled as	a part of drx-Adaptation-r1	6 UE ca	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. 2-1.3 TDD	TDLC300- 100	2x2 Low	1	-1.2

5.3.2.2.3 Minimum requirements for power saving

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

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

Table 5.3.2.2.3-1: Test Parameters

Parameter		Unit	1 Tx Antenna
TDD UL-DL pattern			FR1.30-1
CCE to REG mapping type		interleaved	
Interleaver size		3	
REG bundle size			2
Shift Index		0	
DRX cycle	ms	10	
ps-WakeUp-r16		absent	
Wake-up indication bit in DCI format 2_		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	value
Test numbe r	Bandw idth (MHz)	CORE SET RB	ET duratio n	Aggregati on level	Reference Channel	Propagation Condition			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			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			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 drx-Adaptation-ra	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

			CORES				Antenna	Reference value	
Test numbe r	Bandw idth (MHz)	CORE SET RB	ET duratio n	Aggregati on level	Reference Channel	Propagation Condition	configurat ion and correlatio n Matrix	Pm-dsg (%)	SNR (dB)
1	40	102	1	2	R.PDCCH. 2-1.1 TDD	TDLA30-10	1x4 Low	1	2.1
2	40	102	1	4	R.PDCCH. 2-1.2 TDD	TDLC300- 100	1x4 Low	1	-0.9
3	40	48	2	16	R.PDCCH. 2-2.1 TDD	TDLA30-10	1x4 Medium A	1	-3.6

5.3.3.2.2 2 Tx Antenna performances

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

Table 5.3.3.2.2-1: Minimum performance for PDCCH with 30 kHz SCS

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

5.3.3.2.3 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						

Table 5.3.3.2.3-2: 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 44	100	100 1	4	R.PDCCH. 2-1.2 TDD	TDLC300-	1,41,000	4	0.0
1 40	102	102 1	8	R.PDCCH. 2-1.4 TDD	100	1x4 Low	1	-0.9	

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		Referer	nce value	
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 numb		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			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
	Density (p)			15 kHz SCS: 20 for CSI-RS resource
	CSI-RS period	dicity	Slots	1,2,3,4 30 kHz SCS: 40 for CSI-RS resource
				1,2,3,4 15 kHz SCS: 10 for CSI-RS resource 1 and 2 11 for CSI-RS resource 3 and 4
	CSI-RS offset		Slots	30 kHz SCS:
				20 for CSI-RS resource 1 and 2 21 for CSI-RS resource 3 and 4 Start PRB 0
	Frequency Oc	ccupation		Number of PRB = ceil(BWP size /4)*4
	QCL info			TCI state #0
	CSI-RS	lexes in the PRB used for		k ₀ = 4
	RS	ls 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			'FD-CDM2'
CSI acquisition	Density (ρ)			1 15 kHz SCS: 20
	CSI-RS period	•		30 kHz SCS: 40
-	CSI-RS offset			0 Start PRB 0
	Frequency Oc	ccupation		Number of PRB = ceil(BWP size /4)*4
	QCL info			TCI state #1
	Subcarrier indexes in the PRB used for CSI-RS			k ₀ = 0
		ls in the PRB used for CSI-		l ₀ = 12
	Number of CS	SI-RS ports (X)		4
ZP CSI-RS for CSI	CDM Type			'FD-CDM2'
acquisition	Density (ρ)	P. W.		1 15 kHz SCS: 20
_	CSI-RS period	•		30 kHz SCS: 40
-	CSI-RS offset			0 Start PRB 0
	Frequency Oc	•		Number of PRB = ceil(BWP size/4)*4
	Type 1 QCL			SSB #0
TCI state #0	information	QCL Type		Type C
101 state #6	Type 2 QCL	SSB index		N/A
	information	QCL Type		N/A
	Type 1 QCL	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 o	code block grou	ups for ACK/NACK feedback		11
Maximum number of I		ssion	1	4
HARQ ACK/NACK bundling				Multiplexed
Redundancy version coding sequence				{0,2,3,1} 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	1			Static propagation condition No external noise sources are applied
Antenna	1 layer CCs			1x2 or 1x4
configuration	2 layers CCs			2x2 or 2x4
Joinigal addon	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	al 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			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	K1 value		Specific to each UL-DL pattern
TDD III DI sotto	* ***********************************		15 kHz SCS: FR1.15-1
TDD UL-DL pattern			30 kHz SCS: FR1.30-1
Note 1: PDSCH is scheduled only on full DL slots			

Table 5.5A-4: Number of PRBs in CORESET

SCS (kHz)	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	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	1
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	1
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 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-			Clause 6.3.2.1.2	apply only in case the
CSI-RS resources per CC			Clause 6.3.2.1.3	number of NZP-CSI-
(maxConfigNumberPortsAcross			Clause 6.3.2.1.4	RS ports in the test
NZP-CSI-RS-PerCC)			Clause 6.3.3.1.1	case satisfies UE
			Clause 6.3.3.1.2	capability on
			Clause 6.3.3.1.3	maximum number of
		DI	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 6.3.3.2.1	
			Clause 6.3.3.2.3	
			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
. 200	Offset between Point A and the		scheme 1
Actual carrier configuration	lowest usable subcarrier on this carrier (Note 3)	RBs	0
Corniguration	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 i			1
Common	Physical Cell ID		0 First CCD in Clat #0
serving cell parameters	SSB position in burst		First SSB in Slot #0
parameters	SSB periodicity Slots for PDCCH monitoring	ms	20 Each slot
	Symbols with PDCCH		0,1
PDCCH configuration	Number of PDCCH candidates and aggregation levels		1/AL8
Comigaration	DCI format		1 1
	TCI state		TCI state #1
Cross carrier sch			Not configured
	Mapping type		Type A
	kO		0
	Starting symbol (S)		2
	Length (L)		12
PDSCH	PDSCH aggregation factor		1
configuration	PRB bundling type		Static
3	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

	001 :=4=	1	TCI state #0	
	QCL info		TCI state #0 Start PRB 0	
NZP CSI-RS for	Frequency O	counation	Number of PRB =	
CSI acquisition	l requericy Of	Cupation	ceil(BWP size /4)*4	
Coracquisition	QCL info		TCI state #1	
	QUEIIIIU		Start PRB 0	
ZP CSI-RS for	Frequency Od	cunation	Number of PRB =	
CSI acquisition	1 requeries of	ocupation	ceil(BWP size /4)*4	
	Type 1 QCL	SSB index	SSB #0	
	information			
TCI state #0		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	001.00	from 'CSI-RS for	
	information	CSI-RS resource	tracking'	
TOI 04040 #4			configuration	
TCI state #1		QCL Type	Type A	
	Type 2 QCL	CSI-RS resource	N/A	
	information	QCL Type	N/A	
		71	4 For FDD	
Number of HARC) Processes		8 for TDD	
HARQ ACK/NAC	K bundling		Multiplexed	
Redundancy vers		uence	{0,2,3,1}	
			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	or)	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	
Symbols for unus	sed REs		in Annex A.5.1.1	
			OP.1 TDD as defined in Annex A.5.2.1	
Physical signals, channels mapping and precoding As specified in Annex B.4.1				
Note 1: PDSCI	H is not schedu	led on slots containing	CSI-RS or slots which are not full	
DL.				

UE assumes that the TCI state for the PDSCH is identical to the TCI state Note 2: 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	SNR		8	9	14	15	
Propagation channel			L	AWO			
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			
ZP CSI-RS configuration	CDM Type			FD-CDM2			
	Density (ρ)			1			
	First subcarrier index in the PRB			Row 5	5. (4)		
gg	used for CSI-RS (k ₀)				, (-)		
	First OFDM symbol in the PRB used			9			
	for CSI-RS (I ₀)						
	CSI-RS	slot		5/	1		
	periodicity and offset CSI-RS resource Type			Doric	dia		
	Number of CSI-RS ports (X)			Periodic 2			
	CDM Type				JM2		
	Density (p)			FD-CDM2 1			
NZP CSI-RS for	First subcarrier index in the PRB						
CSI acquisition	used for CSI-RS (k ₀)			Row 3	3,(6)		
	First OFDM symbol in the PRB used						
	for CSI-RS (I ₀)			13	3		
	NZP CSI-RS-timeConfig			F./-	4		
	periodicity and offset	slot		5/	1		
	CSI-IM resource Type			Perio	odic		
	CSI-IM RE pattern			0			
CSI-IM	CSI-IM Resource Mapping			(4,	۵)		
configuration	(kcsi-im,lcsi-im)			(4,	J)		
	CSI-IM timeConfig	slot		5/ ⁻	1		
D (0 # T	periodicity and offset	0.01					
ReportConfigType)			Perio			
CQI-table				Tabl			
reportQuantity	rChannelMeasurements			cri-RI-PI			
	rInterferenceMeasurements			Not cont			
cqi-FormatIndicate				Widek			
pmi-FormatIndicat				Widek			
Sub-band Size	loi	RB		8	Janu		
Csi-ReportingBand		ND ND		1111	111		
CSI-Report periodicity and offset		slot		5/0			
aperiodicTriggeringOffset		0.01		Not con			
aponodio miggeni	Codebook Type			typel-Sing			
	Codebook Mode			1	,		
Codebook configuration	(CodebookConfig-			N	e: ·		
	N1,CodebookConfig-N2)			Not conf	ngurea		
	CodebookSubsetRestriction			0100	000		
	RI Restriction			N/A			
Physical channel for CSI report				PUC	СН		
CQI/RI/PMI delay		ms		8			
Maximum number of HARQ transmission				1			
Measurement cha	nnel		As spe	cified in Tal		, TBS.2-	
model of the original				2			

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 chan	nel		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	
comgaration	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			
CSI acquisition	used for CSI-RS (k ₀ , k ₁)		Row 1,(0,-)	
Coracquisidon	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 niggonii	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		MHz	10
Subcarrier spacing		kHz	15
Duplex Mode			FDD
SNR		dB	6 7 12 13
Propagation chan	nel		TDLA30-5
Antenna configura			2×2
Correlation config			ULA 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 CCL DC	Density (ρ)		1
ZP CSI-RS	First subcarrier index in the PRB		D 5 (4)
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		5/4
	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
NZP CSI-RS for	First subcarrier index in the PRB		
CSI acquisition	used for CSI-RS (k ₀)		Row 3,(6)
	First OFDM symbol in the PRB used		
	for CSI-RS (I ₀)		13
	NZP CSI-RS-timeConfig		-4.
	periodicity and offset	slot	5/1
	CSI-IM resource Type		Periodic
	CSI-IM RE pattern		0
	CSI-IM Resource Mapping		
CSI-IM	(kcsi-im,lcsi-im)		(4, 9)
configuration	(,,		(, - ,
	CSI-IM timeConfig		5/4
	periodicity and offset	slot	5/1
ReportConfigType			Periodic
CQI-table			Table 2
reportQuantity			cri-RI-PMI-CQI
timeRestrictionFor	rChannelMeasurements		Not configured
	rInterferenceMeasurements		Not configured
cqi-FormatIndicate			Wideband
pmi-FormatIndicat			Wideband
Sub-band Size		RB	8
Csi-ReportingBan	d		111111
CSI-Report period		slot	5/0
aperiodicTriggeringOffset		0.01	Not configured
aponouio inggonii	Codebook Type		typel-SinglePanel
	Codebook Mode		1
Codebook	(CodebookConfig-	1	
configuration	N1,CodebookConfig-N2)		Not configured
2290.0001	CodebookSubsetRestriction		000001
	RI Restriction		N/A
Physical channel	Physical channel for CSI report		PUCCH
CQI/RI/PMI delay	or correport	ms	8
	of HARQ transmission	1113	1
waxiiiiuiii iiuiiibei	OF FICH CHAINSTINGSTOFF		As specified in Table A.4-2, TBS.2-
Measurement cha	nnel		As specified in Table A.4-2, TBS.2-

Table 6.2.2.1.2.1-2: Minimum requirements

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

6.2.2.1.2.2 Minimum requirement for sub-band CQI reporting

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

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

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

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

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

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

	Parameter	Unit	Test 1 Test 2
Bandwidth		MHz	10
Subcarrier spacin	g	kHz	15
Duplex Mode			FDD
SNR		dB	8 9 14 15
			Two tap model specified in Annex
Propagation chan	nel		B.2.4 with $a=1$, $f_D = 5$ Hz, and
. •			τ _d =0.45μs
Antenna configura	ation		2×2
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
	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
			Periodic
	CSI-RS resource Type Number of CSI-RS ports (X)		Periodic 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)		
	First OFDM symbol in the PRB used		13
	for CSI-RS (I ₀)		10
	NZP CSI-RS-timeConfig	slot	5/1
	periodicity and offset	3101	
	CSI-IM resource Type		Periodic
	CSI-IM RE pattern		0
CSI-IM	CSI-IM Resource Mapping		
	(kcsi-im,lcsi-im)		(4, 9)
configuration			, ,
	CSI-IM timeConfig	slot	5/1
	periodicity and offset	SIOL	5/1
ReportConfigType			Aperiodic
CQI-table			Table 2
reportQuantity			cri-RI-PMI-CQI
	rChannelMeasurements		Not configured
	rInterferenceMeasurements		Not configured
cqi-FormatIndicat			Subband
pmi-FormatIndica			Wideband
Sub-band Size	101	RB	8
csi-ReportingBand	4	IND.	1111111
CSI-Report period		slot	Not configured
Aperiodic Report		3101	Not configured
Apendaic Report	Siot Offset		1 in elete i where mod/i E) 1
CSI request			1 in slots i, where $mod(i, 5) = 1$,
-			otherwise it is equal to 0
reportTriggerSize			1
			One State with one Associated
001 4 : " -	0014		Report Configuration
CSI-AperiodicTriggerStateList			Associated Report Configuration
			contains pointers to NZP CSI-RS
			and CSI-IM
aperiodicTriggerin			Not configured
	Codebook Type		typel-SinglePanel
	Codebook Mode		1
Codebook	(CodebookConfig-		Not configured
configuration	N1,CodebookConfig-N2)		Ţ.
	CodebookSubsetRestriction		000001
	RI Restriction		N/A
Physical channel	for CSI report		PUSCH
CQI/RI/PMI delay		ms	8
Odi/Tti// Wil delay			•

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			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	del		As specified in Annex B.4.1
	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (X)		4
	CDM Type		FD-CDM2
ZP CSI-RS	Density (ρ)		1
configuration	First subcarrier index in the PRB used for CSI-RS (k 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
N70 001 00 (Density (ρ)		1
NZP CSI-RS for	First subcarrier index in the PRB		5 6 (0)
CSI acquisition	used for CSI-RS (k ₀)		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 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-PMI-CQI
	rChannelMeasurements		Not configured
	rInterferenceMeasurements		Not configured
cqi-FormatIndicate			Wideband
pmi-FormatIndicat	tor		Wideband
Sub-band Size		RB	16
Csi-ReportingBan	d		1111111
CSI-Report periodicity and offset		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
	of HARQ transmission		1
Measurement cha	nnel		As specified in Table A.4-2, TBS.2-
Measurement channel			4

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		MHz	40
Subcarrier spacin	g	kHz	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
timeRestrictionFo	rChannelMeasurements		Not configured
timeRestrictionFo	rInterferenceMeasurements		Not configured
cqi-FormatIndicat	or		Wideband
pmi-FormatIndica	tor		Wideband
Sub-band Size		RB	16
Csi-ReportingBar	nd		1111111
CSI-Report period	dicity and offset	slot	10/9
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	mission Model		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 duration	symbol	14
	Occupied OFDM symbols in the last slot set of the downlink duration	symbol	14
TDD UL-DL par			FR1.30-7
SNR		dB	8 9
$\widehat{E_s}$ for power off	set 1	dBm/Hz	-112
$\widehat{E_s}$ for power off		dBm/Hz	-106
Propagation ch			AWGN
Antenna config			2×2 with static channel specified in Annex B.1
Beamforming N	Model		As specified in Annex B.4.1
Dearmorning N	CSI-RS resource Type		As specified in Affrex B.4.1 Aperiodic
	Number of CSI-RS ports (X)		Aperiodic 4
	CDM Type		FD-CDM2
	Density (ρ)		1 D-CDIVI2
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, 10) = 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
NZP CSI-RS fo	Lugad for ('SI-RS (ka)		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	slot	0
	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		0
CSI-IM configuration	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(4, 9)
J	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	or		Wideband
pmi-FormatIndica	tor		Wideband
Sub-band Size		RB	8
csi-ReportingBan	d		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	gerStateList		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 comigared
	CodebookSubsetRestriction		010000
	RI Restriction		N/A
Physical channel	Physical channel for CSI report		PUSCH
CQI/RI/PMI delay		ms	9.5
Maximum numbe	Maximum number of HARQ transmission		1
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
Bandwidth		MHz	40
Subcarrier spacing		kHz	30
Duplex Mode			TDD
TDD UL-DL patte	rn		FR1.30-1
SNR		dB	6 7 12 13
Propagation chan			TDLA30-5
Antenna configura			2×2
Correlation config			ULA high
Beamforming Mod			As specified in Annex B.4.1
	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (X)		4
	CDM Type		FD-CDM2
ZP CSI-RS	Density (ρ) First subcarrier index in the PRB		1
configuration	used for CSI-RS (k ₀)		Row 5, (4)
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		9
	CSI-RS periodicity and offset	slot	10/1
	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (X)		2
	CDM Type		FD-CDM2
NZP CSI-RS for	Density (ρ)		1
CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k ₀)		Row 3,(6)
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		13
	NZP CSI-RS-timeConfig periodicity and offset	slot	10/1
	CSI-IM resource Type		Periodic
	CSI-IM RE pattern		0
CSI-IM configuration	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(4, 9)
	CSI-IM timeConfig periodicity and offset	slot	10/1
ReportConfigType			Periodic
CQI-table			Table 2
reportQuantity			cri-RI-PMI-CQI
	rChannelMeasurements		Not configured
timeRestrictionFo	rInterferenceMeasurements		Not configured
cqi-FormatIndicat	or		Wideband
pmi-FormatIndica	tor		Wideband
Sub-band Size		RB	16
Csi-ReportingBan	d	_	1111111
CSI-Report periodicity and offset		slot	10/9
aperiodicTriggerin			Not configured
	Codebook Type		typel-SinglePanel
0-4-5-1	Codebook Mode		1
Codebook configuration	(CodebookConfig- N1,CodebookConfig-N2)		Not configured
	CodebookSubsetRestriction		000001
RI Restriction			N/A
Physical channel	tor CSI report		PUCCH
CQI/RI/PMI delay	(IIABO)	ms	9.5
Maximum number	r of HARQ transmission		1
Measurement cha	nnel		As specified in Table A.4-2, TBS. 3

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

	Test 1 Test 2			
Bandwidth	Bandwidth		40	
Subcarrier spacin	Subcarrier spacing		30	
Duplex Mode			TDD	
TDD UL-DL patte	rn		FR1.30-1	
SNR		dB	8 9 14 15	
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		2×2	
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	
ZD COLDO	Density (ρ)		1	
ZP CSI-RS configuration	First subcarrier index in the PRB used for CSI-RS (k ₀)		Row 5, (4)	
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		9	
	CSI-RS periodicity and offset	slot	10/1	
	CSI-RS resource Type		Periodic	
	Number of CSI-RS ports (X)		2	
	CDM Type		FD-CDM2	
NZP CSI-RS for	Density (ρ)		1	
CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k ₀)		Row 3,(6)	
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		13	
	NZP CSI-RS-timeConfig periodicity and offset	slot	10/1	
	CSI-IM resource Type		Periodic	
	CSI-IM RE pattern		0	
CSI-IM configuration	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(4, 9)	
	CSI-IM timeConfig periodicity and offset	slot	10/1	
ReportConfigType	e		Aperiodic	
CQI-table			Table 2	
reportQuantity			cri-RI-PMI-CQI	
	rChannelMeasurements		Not configured	
timeRestrictionFo	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		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	
aperiodicTriggerir	ngOffset		Not configured	
p-05610 1 11990111	Codebook Type		typel-SinglePanel	
	Codebook Node		1	
Codebook	(CodebookConfig-			
configuration	N1,CodebookConfig-N2)		Not configured	
	CodebookSubsetRestriction		000001	
	RI Restriction	-	N/A	
Physical channel			PUSCH	

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

Table 6.2.2.2.2-2: Minimum requirements

Parameters	Test 1	Test 2
<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		MHz	1	Ö
Subcarrier spacing		kHz	1	5
Duplex Mode			FD)D
SNR		dB	5 6	11 12
Propagation chan	nel		AW	
Antenna configura	ation		2x4 with static characters Anne	
Beamforming Mod	del .		As specified in	
	CSI-RS resource Type		Peri	
	Number of CSI-RS ports (X)		4	
	CDM Type		FD-C	DM2
ZP CSI-RS	Density (ρ)		1	
configuration	First subcarrier index in the PRB used for CSI-RS (k ₀)		Row	5, (4)
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		9)
	CSI-RS periodicity and offset	slot	5/	1
	CSI-RS resource Type		Peri	ndic
	Number of CSI-RS ports (X)		7 011	
	CDM Type		FD-C	
N7D 001 D0 (Density (p)		1	
NZP CSI-RS for CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k ₀)		Row	3,(6)
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		13	
	NZP CSI-RS-timeConfig	slot	5/1	
	periodicity and offset CSI-IM resource Type		Periodic	
	CSI-IM RE pattern		0	
	CSI-IM Resource Mapping		<u> </u>	
CSI-IM configuration	(ксы-ім,Ісы-ім)		(4,	9)
	CSI-IM timeConfig periodicity and offset	slot	5/	1
ReportConfigType)		Peri	
CQI-table			Tab	
reportQuantity			cri-RI-P	
	rChannelMeasurements		Not con	
	rInterferenceMeasurements		Not con	
cqi-Formatindicate			Wide	
pmi-FormatIndicate Sub-band Size	UI	RB	Wide 8	
csi-ReportingBand	1	KD	1111	
CSI-Report period		slot	5/	
aperiodicTriggerin		3101	Not con	
aperiodic mggemi	Codebook Type		typel-Sin	
	Codebook Mode		1	g
Codebook configuration	(CodebookConfig- N1,CodebookConfig-N2)		Not con	figured
Comiguration	CodebookSubsetRestriction		010	000
	RI Restriction		N/	
Physical channel for CSI report			PUC	
CQI/RI/PMI delay		ms	8	
Maximum number of HARQ transmission		1110	1	
Measurement channel			As specified in Ta	ble A.4-2, TBS.2-
		i		-

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

	Parameter	Unit	Test 1
Bandwidth		MHz	10
	Subcarrier spacing		15
Duplex Mode	5		FDD
SNR		dB	-2 -1
Propagation chan	nel		AWGN
Antenna configura			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 (p)		1
ZP CSI-RS	First subcarrier index in the PRB		
configuration	used for CSI-RS (k ₀)		Row 5,4
J	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 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	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			Periodic
CQI-table			Table 3
reportQuantity			cri-RI-PMI-CQI
timeRestrictionFo	rChannelMeasurements		Not configured
timeRestrictionFo	rInterferenceMeasurements		Not configured
cqi-FormatIndicate			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	8
csi-ReportingBand			1111111
CSI-Report periodicity and offset		slot	5/0
aperiodicTriggeringOffset			Not configured
	Codebook Type		typel-SinglePanel
	Codebook Mode	<u> </u>	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	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 spacing		15
Duplex Mode	Duplex Mode		FDD
SNR		dB	3 4 9 10
Propagation chan			TDLA30-5
Antenna configura	ation		2×4
Correlation config	uration		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 CCL DC	Density (ρ)		1
ZP CSI-RS	First subcarrier index in the PRB		D 5 (4)
configuration	used for CSI-RS (k ₀)		Row 5, (4)
	First OFDM symbol in the PRB used		
	for CSI-RS (I ₀)		9
	CSI-RS		-14
	periodicity and offset	slot	5/1
	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (X)		2
	CDM Type		FD-CDM2
	Density (ρ)		1
NZP CSI-RS for	First subcarrier index in the PRB		
CSI acquisition	used for CSI-RS (k ₀)		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 Resource Mapping		0
CSI-IM	(kcsi-im,lcsi-im)		(4, 9)
configuration	(NCSI-IM,ICSI-IM)		(4, 9)
	CSI-IM timeConfig		
	periodicity and offset	slot	5/1
ReportConfigType			Periodic
CQI-table	5		Table 2
reportQuantity			cri-RI-PMI-CQI
	rChannelMeasurements		Not configured
	rInterferenceMeasurements		Not configured
cqi-FormatIndicat			Wideband
pmi-FormatIndica	IOI		Wideband
Sub-band Size		RB	8
csi-ReportingBan			111111
CSI-Report period	dicity and offset	slot	5/0
aperiodicTriggering	<u> </u>		Not configured
	Codebook Type		typel-SinglePanel
	Codebook Mode		1
Codebook	(CodebookConfig-		Not configured
configuration	N1,CodebookConfig-N2)		<u> </u>
	CodebookSubsetRestriction		000001
	RI Restriction		N/A
Physical channel for CSI report			PUCCH
CQI/RI/PMI delay		ms	8
	r of HARQ transmission		1
			As specified in Table A.4-2, TBS.2-
Measurement channel			

Table 6.2.3.1.2.1-2: Minimum requirements

Parameters	Test 1	Test 2
<i>α</i> [%]	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		MHz	10
Subcarrier spacing		kHz	15
Duplex Mode			FDD
SNR		dB	5 6 11 12
Propagation channel		30	Two tap model specified in Annex B.2.4 with a=1, f _D = 5Hz, and T _d =0.45µs
Antenna configura	ation		2×4
Correlation config			As per Annex B.1
Beamforming Mod	del		As specified in Annex B.4.1
	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (X)		4
	CDM Type		FD-CDM2
ZP CSI-RS	Density (ρ)		1
configuration	First subcarrier index in the PRB used for CSI-RS (k ₀)		Row 5, (4)
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		9
	CSI-RS periodicity and offset	slot	5/1
	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (X)		2
	CDM Type		FD-CDM2
N7D 001 D0 (Density (p)		1
NZP CSI-RS for CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k ₀)		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)		Aperiodic
CQI-table			Table 2
reportQuantity			cri-RI-PMI-CQI
	rChannelMeasurements		Not configured
	rInterferenceMeasurements		Not configured
cqi-FormatIndicate			Subband
pmi-FormatIndicat	tor		Wideband
Sub-band Size		RB	8
csi-ReportingBand			1111111
CSI-Report period		slot	Not configured
Aperiodic Report S	Slot Offset		1 in slots i, where $mod(i, 5) = 1$,
reportTriggerSize			otherwise it is equal to 0
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS
amadisTstee 1	apariodicTriggoringOffcot		and CSI-IM
aperiodicTriggeringOffset			Not configured
	Codebook Type		typel-SinglePanel
Cadaba-li	Codebook Mode		1
Codebook	(CodebookConfig-		Not configured
configuration	N1,CodebookConfig-N2) CodebookSubsetRestriction		
			000001 N/A
Dhysical shannel	RI Restriction Physical channel for CSI report		N/A PUSCH
	or correport	ma	
CQI/RI/PMI delay		ms	8

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

Table 6.2.3.1.2.2-2: Minimum requirements

Parameters	Test 1	Test 2
α [%]	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

Bandwidth	Parameter		Unit	Test 1	Test 2
Subcarrier spacing	Bandwidth		MHz	40)
TDD UL-DL pattern				30)
SNR	Duplex Mode	Duplex Mode		TD	D
Propagation channel	TDD UL-DL patter	rn		FR1.3	30-1
Antenna configuration	SNR		dB	5 6	11 12
Beamforming Model	Propagation chan	nel		AWO	3N
Beamforming Model	Antenna configura	ation			
CSI-RS resource Type	Beamforming Mod	del			
Number of CSI-RS ports (X)	<u> </u>				
Density (p)				4	
First subcarrier index in the PRB used for CSI-RS (ko) First OFDM symbol in the PRB used for CSI-RS (b) CSI-RS periodicity and offset Pensity (p) Number of CSI-RS ports (X) CSI-RS resource Type Density (p) NZP CSI-RS for CSI acquisition NZP CSI-RS for CSI acquisition NZP CSI-RS (ko) NZP CSI-M resource Mapping (CSI-IM Resource Mapping (CSI-RS (ko) CSI-IM Resource Mapping (CSI-RS (ko) CSI-IM Resource Mapping (CSI-RD (Kosi-Mic)) CSI-RD (Kosi-Mic) CSI-RD (Kosi-Mic) NO (CORITER) Reportion (CSI-RS (ko) Not configured Not configured Not configured Not configured Codebook Mode 1 10/9 Appriodic Type Codebook Mode 1 10/9 Physical channel for CSI report PUCCH CQI/RI/PMI delay Maximum number of HARQ transmission As specified in Table A.4-2, TBS.2-		CDM Type		FD-CI	DM2
Tirst subcarrier index in the PRB used for CSI-RS (lo) Periodic CSI-RS (lo) CSI-RS periodicity and offset periodicity and offset Slot	ZD CCL DC	Density (ρ)		1	
Used for CSI-RS (ko)				Da 5	. (4)
First OFDM symbol in the PRB used for CSI-RS (lo)	configuration	used for CSI-RS (k ₀)		Row 5	o, (4)
CSI-RS (Io) 9 10/1				0	
CSI-RS				9	
CSI-RS resource Type			-1-4	40	/4
CSI-RS resource Type Periodic			SIOT	10/	1
Number of CSI-RS ports (X) 2 CDM Type Density (p) 1 1				Perio	odic
NZP CSI-RS for CSI-RS for CSI-RS (Inc.) Tries subcarrier index in the PRB used for CSI-RS (Inc.) Tries to PDM symbol in the PRB used for CSI-RS (Inc.) Tries to PDM symbol in the PRB used for CSI-RS (Inc.) Tries to PDM symbol in the PRB used for CSI-RS (Inc.) Tries to PDM symbol in the PRB used for CSI-RS (Inc.) Tries to PDM symbol in the PRB used for CSI-RS (Inc.) Tries to PDM symbol in the PRB used for CSI-RS (Inc.) Tries to PDM symbol in the PRB used for CSI-RS (Inc.) Tries to PDM symbol in the PRB used for CSI-RS (Inc.) Tries to PDM symbol in the PRB used for CSI-RS (Inc.) Tries to PDM symbol in the PRB used for CSI-RS (Inc.) Tries to PDM symbol in the PRB used for CSI-RS (Inc.) Tries to PDM symbol in the PRB used for CSI-RS (Inc.) Tries to PDM symbol in the PRB used for CSI-RS (Inc.) Tries to PDM symbol in the PRB used for CSI-RD (Inc.) Tries to PDM symbol in the PRB used for					
Density (p)		. , ,		FD-CI	DM2
NZP CSI-RS for CSI acquisition First subcarrier index in the PRB used for CSI-RS (k ₀) First OFDM symbol in the PRB used for CSI-RS (k ₀) RESIDENT CSI-RS (k ₀) First OFDM symbol in the PRB used for CSI-RS (k ₀) NZP CSI-RS-timeConfig periodicity and offset CSI-IM resource Type CSI-IM Repattern COI-table Periodic COI-table Table 2 reportCuantity cir-RI-PMI-CQI timeRestrictionForChannelMeasurements Not configured timeRestrictionForInterferenceMeasurements Not configured timeRestrictionForInterferenceMeasurements Not configured cgi-FormatIndicator pmi-FormatIndicator Wideband Sub-band Size RB 16 CSI-Report periodicity and offset slot 10/9 aperiodicTriggeringOffset Codebook Mode RI Restriction RI Restriction N/A Physical channel for CSI report CQI/RI/PMI delay Measurement channel As specified in Table A.4-2, TBS.2-				1	
First subcarrier index in the PRB used for CSI-RS (k ₀) First OFDM symbol in the PRB used for CSI-RS (k ₀) First OFDM symbol in the PRB used for CSI-RS (l ₀) NZP CSI-RS-timeConfig periodicity and offset CSI-IM resource Type Periodic CSI-IM Resource Mapping (kcsI-MI, ICSI-IM) CSI-IM meconfig periodicity and offset CSI-IM Resource Mapping (kcsI-MI, ICSI-IM) CSI-IM timeConfig periodicity and offset ReportConfigType Periodic CQI-table Table 2 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasurements Not configured timeRestrictionForInterferenceMeasurements Not configured cqi-FormatIndicator Wideband Sub-band Size RB 16 csi-ReportingBand SID-InterferenceMeasurements SID-InterferenceMeasurements SID-InterferenceMeasurements SID-InterferenceMeasurements SID-InterferenceMeasurements SID-InterferenceMeasurements Not configured CSI-ReportingBand SID-InterferenceMeasurements SID-InterferenceMeasurements SID-InterferenceMeasurements SID-InterferenceMeasurements Not configured CSI-ReportingBand SID-InterferenceMeasurements SID-InterferenceMeasurements SID-InterferenceMeasurements Not configured CSI-ReportingBand SID-InterferenceMeasurements SID-InterferenceMeasurements SID-InterferenceMeasurements Not configured CSI-ReportingBand SID-InterferenceMeasurements SID-InterferenceMeasurements Not configured CSI-ReportingBand SID-InterferenceMeasurements SID-InterferenceMeasurements Not configured CSI-ReportingBand SID-InterferenceMeasurements SI	NZP CSI-RS for	Donoity (p)			
First OFDM symbol in the PRB used for CSI-RS (lo) NZP CSI-RS (Row 3,(6)	
periodicity and offset CSI-IM resource Type CSI-IM Report Configuration CSI-IM Resource Mapping (KcsI-IM, IcSI-IM) CSI-IM timeConfig periodicity and offset CQI-table ReportConfigType Periodic CQI-table Table 2 reportQuantity Cqi-ReportInerferenceMeasurements TimeRestrictionForChannelMeasurements TimeRestrictionForInterferenceMeasurements Not configured Cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Size RB 16 Csi-Report periodicity and offset Slot 10/9 aperiodicTriggeringOffset Codebook Codebook Codebook Configuration RI Restriction RI Restriction RI Restriction RI Restriction Restriction RI Restriction RI Restriction RI Restriction Restriction Restriction Ri		First OFDM symbol in the PRB used		13	
CSI-IM Resource Mapping (kcsi-IM, lcsi-IM) CSI-IM Resource Mapping (kcsi-IM, lcsi-IM) CSI-IM timeConfig periodicity and offset ReportConfigType CQI-table CQI-table Table 2 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasurements timeRestrictionForInterferenceMeasurements timeRestrictionForInterferenceMeasurements videband pmi-FormatIndicator pmi-FormatIndicator Sub-band Size CSI-ReportingBand CSI-ReportingBand CSI-ReportingBand COdebook Type Codebook Type Codebook Type Codebook Configuration COdebook Configuration RI Restriction RI Restriction RI Restriction RI Restriction RI Restriction Physical channel for CSI report CQI/RI/PMI delay Measurement channel CSI-IM Resource Mapping (4, 9) (6) (6) (6) (6) (7) (8) (9) (9) (9) (9) (9) (9) (9		periodicity and offset	slot		
CSI-IM configuration CSI-IM Resource Mapping (kcsi-im, lcsi-im) CSI-IM timeConfig periodicity and offset ReportConfigType CQI-table Table 2 reportQuantity timeRestrictionForChannelMeasurements timeRestrictionForInterferenceMeasurements Cqi-FormatIndicator pmi-FormatIndicator pmi-FormatIndicator pmi-FormatIndicator pmi-FormatIndicator Sub-band Size RB 16 csi-ReportingBand CSI-ReportingBand Sub-band Size RB 16 csi-ReportingBand T1111111 CSI-Report periodicity and offset aperiodicTriggeringOffset Soldebook Type Codebook Mode Codebook Configuration RI Restriction RI Res		CSI-IM resource Type		Periodic	
CSI-IM timeConfig periodicity and offset ReportConfigType CQI-table reportQuantity timeRestrictionForChannelMeasurements timeRestrictionForInterferenceMeasurements Cqi-FormatIndicator pmi-FormatIndicator Sub-band Size RB 16 Csi-Report periodicity and offset Slot Table 2 reportQuantity timeRestrictionForInterferenceMeasurements Not configured wideband pmi-FormatIndicator Wideband Sub-band Size RB 16 Csi-Report periodicity and offset slot 10/9 aperiodicTriggeringOffset Not configured typel-SinglePanel Codebook Type Codebook Mode 1 Codebook Config- N1, CodebookConfig- N1				0	
ReportConfigType Periodic CQI-table Table 2 reportQuantity Cri-RI-PMI-CQI timeRestrictionForChannelMeasurements Not configured timeRestrictionForInterferenceMeasurements Not configured cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 16 csi-ReportingBand 1111111 CSI-Report periodicity and offset slot 10/9 aperiodicTriggeringOffset Slot 10/9 aperiodicTriggeringOffset Not configured Codebook Configured typel-SinglePanel Codebook Node 1 CodebookConfig-N1, CodebookConfig-N2) CodebookSubsetRestriction N/A Physical channel for CSI report PUCCH CQI/RI/PMI delay ms 9.5 Maximum number of HARQ transmission 1 Measurement channel				(4, 9)	
CQI-table Table 2 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasurements Not configured timeRestrictionForInterferenceMeasurements Not configured cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 16 csi-ReportingBand 1111111 CSI-Report periodicity and offset slot 10/9 aperiodicTriggeringOffset Slot 10/9 aperiodicTriggeringOffset Not configured Codebook Type Typel-SinglePanel Codebook Mode 1 Codebook Config-N1, CodebookConfig-N2) CodebookSubsetRestriction 010000 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			slot	10/1	
reportQuantity timeRestrictionForChannelMeasurements timeRestrictionForInterferenceMeasurements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-Report periodicity and offset aperiodicTriggeringOffset Codebook configuration Codebook configuration RI Restriction RI Restriction Physical channel for CSI report CQI/RI/PMI delay Mot configured Not configured Not configured 1 Cri-RI-PMI-CQI Not configured Wideband RB 16 CBB 16 CBB 10/9 Slot 10/	ReportConfigType			Perio	odic
timeRestrictionForChannelMeasurements timeRestrictionForInterferenceMeasurements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-Report periodicity and offset aperiodicTriggeringOffset Codebook configuration Codebook configuration RI Restriction Physical channel for CSI report CQI/RI/PMI delay Measurement channel Not configured Not configured Not configured Slot 10/9 1111111 Not configured 10/9	CQI-table			Tabl	e 2
timeRestrictionForChannelMeasurements timeRestrictionForInterferenceMeasurements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-Report periodicity and offset aperiodicTriggeringOffset Codebook configuration Codebook configuration RI Restriction Physical channel for CSI report CQI/RI/PMI delay Measurement channel Not configured Not configured Not configured Slot 10/9 1111111 Not configured 10/9	reportQuantity			cri-RI-PI	ΛΙ-CQI
cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 16 csi-ReportingBand 1111111 CSI-Report periodicity and offset slot 10/9 aperiodicTriggeringOffset Not configured Codebook Type typel-SinglePanel Codebook Mode 1 Codebook Mode 1 Codebook Config-N2) Not configured N1,CodebookConfig-N2) Not configured CodebookSubsetRestriction 010000 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.4-2, TBS.2-	timeRestrictionFo	rChannelMeasurements		Not conf	figured
cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 16 csi-ReportingBand 1111111 CSI-Report periodicity and offset slot 10/9 aperiodicTriggeringOffset Not configured Codebook Type typel-SinglePanel Codebook Mode 1 Codebook Mode 1 Codebook Config-N2) Not configured N1,CodebookConfig-N2) Not configured CodebookSubsetRestriction 010000 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.4-2, TBS.2-				Not conf	figured
Sub-band Size RB 16 csi-ReportingBand 1111111 CSI-Report periodicity and offset slot 10/9 aperiodicTriggeringOffset Not configured Codebook Type typel-SinglePanel Codebook Mode 1 Codebook Config-N2) Not configured CodebookConfig-N2) Not configured CodebookSubsetRestriction 010000 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.4-2, TBS.2-	cqi-FormatIndicate	or			
Sub-band Size RB 16 csi-ReportingBand 1111111 CSI-Report periodicity and offset slot 10/9 aperiodicTriggeringOffset Not configured Codebook Type typel-SinglePanel Codebook Mode 1 Codebook Config-N2) Not configured CodebookConfig-N2) Not configured CodebookSubsetRestriction 010000 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.4-2, TBS.2-	pmi-FormatIndicat	tor		Widek	and
csi-ReportingBand 1111111 CSI-Report periodicity and offset slot 10/9 aperiodicTriggeringOffset Not configured Codebook typel-SinglePanel Codebook Mode 1 Codebook Config- configuration Not configured N1,CodebookConfig-N2) Not configured CodebookSubsetRestriction 010000 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.4-2, TBS.2-			RB		
CSI-Report periodicity and offset slot 10/9 aperiodicTriggeringOffset Not configured Codebook Type typel-SinglePanel Codebook Codebook Config-Configuration (CodebookConfig-N2) Not configured Not configured Not configured Not configured National CodebookSubsetRestriction 010000 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.4-2, TBS.2-		d		1111	111
aperiodicTriggeringOffset Not configured Codebook Type typel-SinglePanel Codebook Mode 1 Codebook Config- configuration Not configured N1,CodebookConfig- N1,CodebookSubsetRestriction 010000 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.4-2, TBS.2-			slot		
Codebook Type typel-SinglePanel Codebook Codebook Mode 1 Codebook Config-N1, Codebook Config-N2) Not configured Codebook SubsetRestriction 010000 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.4-2, TBS.2-					
Codebook Mode 1 Codebook configuration (CodebookConfig-N2) Not configured CodebookSubsetRestriction 010000 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.4-2, TBS.2-	1 330				
Codebook configuration (CodebookConfig-N2) Not configured N1,CodebookConfig-N2) 010000 CodebookSubsetRestriction 010000 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.4-2, TBS.2-					
CodebookSubsetRestriction 010000 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.4-2, TBS.2-		(CodebookConfig-		Not conf	figured
RI Restriction Physical channel for CSI report CQI/RI/PMI delay Maximum number of HARQ transmission Measurement channel RI Restriction N/A PUCCH PUCCH S 9.5 Maximum number of HARQ transmission 1 As specified in Table A.4-2, TBS.2-					
CQI/RI/PMI delay ms 9.5 Maximum number of HARQ transmission 1 Measurement channel As specified in Table A.4-2, TBS.2-				N//	4
CQI/RI/PMI delay ms 9.5 Maximum number of HARQ transmission 1 Measurement channel As specified in Table A.4-2, TBS.2-	Physical channel			PUC	CH
Maximum number of HARQ transmission 1 Measurement channel As specified in Table A.4-2, TBS.2-			ms		
Measurement channel As specified in Table A.4-2, TBS.2-					
				1	

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 resource Type		Periodic
CSI-IM configuration	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 CQI-table			Table 3
reportQuantity			cri-RI-PMI-CQI
timeRestrictionFo	rChannelMeasurements		Not configured
timeRestrictionFo	rInterferenceMeasurements		Not configured
cqi-FormatIndicat			Wideband
pmi-FormatIndica	tor		Wideband
Sub-band Size		RB	16
csi-ReportingBan	d		1111111
CSI-Report period	dicity 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	Physical channel for CSI report		PUCCH
CQI/RI/PMI delay		ms	9.5
Maximum numbe	Maximum number of HARQ transmission		1
Measurement cha	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. 3.2.1.3-1: 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	set 2	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, 10) = 1, otherwise it is equal to 0
	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (X)		2
	CDM Туре		FD-CDM2
	Density (ρ)		1
NZP CSI-RS fo	First subcarrier index in the PRB used for CSI-RS (k ₀)		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)
2398100011	CSI-IM timeConfig interval and offset	slot	Not configured

ReportConfigType			Aperiodic
CQI-table 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	d		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	gerStateList		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 comigared
	CodebookSubsetRestriction		010000
RI Restriction			N/A
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 $\geq \gamma$, where γ is specified in Table 6.2.3.2.2.1-2;
- c) When transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater than or equal to 0.02.

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

Parameter		Unit	Test 1		Tes	st 2
Bandwidth		MHz		4	0	
Subcarrier spacing	ubcarrier spacing		30			
Duplex Mode		TDD				
TDD UL-DL patter	ΓDD UL-DL pattern			FR1.	30-1	
SNR	SNR		3	4	9	10
Propagation chan				TDLA		
Antenna configura				2×		
Correlation config				XPI		
Beamforming Mod			As	specified in		3.4.1
	CSI-RS resource Type Number of CSI-RS ports (X)			Peri		
	. , ,			FD-C		
	CDM Type Density (ρ)			<u> </u>	DIVIZ	
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		10		
	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)			Row	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	
timeRestrictionFor	rChannelMeasurements			Not con	figured	
	rInterferenceMeasurements			Not con		
cqi-FormatIndicate				Wide		
pmi-FormatIndicat	tor			Wide		
Sub-band Size		RB	1	1		
csi-ReportingBand			1	1111		
CSI-Report period		slot		10		
aperiodicTriggerin		1	1	Not con		
	Codebook Type Codebook Mode		+	typeI-Sin 1		
Codebook	(CodebookConfig-		+			
configuration	N1,CodebookConfig-N2)			Not con		
	CodebookSubsetRestriction		1	000		
Dhysical shapes	RI Restriction Physical channel for CSI report		+	N/		
CQI/RI/PMI delay	ioi coi report	mo	+	PUC		
	of HARQ transmission	ms	+	9. 1		
waxiiiiuiii iiuiiibei	טו ו וחו/ע נומווטווווטטווו		As spo	cified in Ta		TRS 2.
Measurement cha	nnel		va she	3		, 100.2-

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		MHz	40
Subcarrier spacin	Subcarrier spacing		30
Duplex Mode			TDD
TDD UL-DL patte	rn		FR1.30-1
SNR		dB	5 6 11 12
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			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 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 (p)		1
CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k ₀)		Row 3,(6)
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		13
	NZP CSI-RS-timeConfig periodicity and offset	slot	10/1
	CSI-IM resource Type		Periodic
	CSI-IM RE pattern		0
CSI-IM configuration	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(4, 9)
	CSI-IM timeConfig periodicity and offset	slot	10/1
ReportConfigType	e		Aperiodic
CQI-table			Table 2
reportQuantity			cri-RI-PMI-CQI
	rChannelMeasurements		Not configured
	rInterferenceMeasurements		Not configured
cqi-FormatIndicat			Subband
pmi-FormatIndica	tor		Wideband
Sub-band Size		RB	16
csi-ReportingBan		-1-4	1111111
CSI-Report period Aperiodic Report		slot	Not configured
CSI request	Slot Oliset		1 in slots i, where mod(i, 10) = 1,
reportTriggerSize			otherwise it is equal to 0
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
aperiodicTriggerin			0
	Codebook Type		typel-SinglePanel
	Codebook Mode		1
Codebook	(CodebookConfig-		Not configured
configuration	N1,CodebookConfig-N2)		
	CodebookSubsetRestriction		000001
	RI Restriction		N/A
Physical channel	tor CSI report		PUSCH

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

Table 6.2.2.1.2.2-2: Minimum requirements

Parameters	Test 1	Test 2
α [%]	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
Antenna configur	Antenna configuration		1x2 with static channel specified in
Antenna comiguration			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
Corniguration	First subcarrier index in the PRB		Row 5, 4
	used for CSI-RS (k ₀)		11000 0, 1
	First OFDM symbol in the PRB used		9
	for CSI-RS (I ₀)		-
	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (X)		1
NZP CSI-RS for	CDM Type		No CDM
CSI acquisition	Density (p)		1
	First subcarrier index in the PRB		Row 2, 6
	used for CSI-RS (k ₀)		,
	First OFDM symbol in the PRB used		13
	for CSI-RS (I ₀)		Periodic
CSI-IM	CSI-IM resource Type		
	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
	rChannelMeasurements		Not configured
	rInterferenceMeasurements		Not configured
cgi-FormatIndicat			Wideband
pmi-FormatIndicator			Wideband
Csi-ReportingBand			1111111
aperiodicTriggeringOffset			Not configured
	Physical channel for CSI report		PUCCH
Maximum number of HARQ transmission			1
Measurement channel			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	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 ≥ 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 spacing		30
Duplex Mode			TDD
	Downlink Transmission Model		As specified in Annex B.5
	Downlink period	ms	5
	LBT failure probability (p _{LBT})		0.25
Downlink	Downlink transmission duration values	slot	{4,6,7}
Transmission	set	3101	(4,0,7)
Model Parameters	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	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 cha	annel		AWGN
Antenna config	uration		2x2 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
	CDM Type		FD-CDM2
70 001 00	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
NZP CSI-RS fo CSI acquisition	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
	NZP CSI-RS-timeConfig periodicity and offset	slot	Not configured
	aperiodicTriggeringOffset		0
CSI-IM configuration	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		0
	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(4, 9)
	CSI-IM timeConfig periodicity and offset	slot	Not configured
Codebook configuration	Codebook Type		typel-SinglePanel
	Codebook Mode		1
	(CodebookConfig- N1,CodebookConfig-N2)		Not configured
	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.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	8
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 ≥ 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	- aramotor	MHz	20
Subcarrier space	ing	kHz	30
Duplex Mode	<u> </u>		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	slot	{4,6,7}
Transmission	set	0.01	(1,0,1)
Model Parameters	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	14
TDD UL-DL pat	tern		FR1.30-7
SNR		dB	5 6
$\widehat{E_s}$ for power off		dBm/Hz	-112
$\widehat{E_s}$ for power off		dBm/Hz	-106
Propagation ch	annel		AWGN
Antenna config			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
	CDM Type		FD-CDM2
ZP CSI-RS configuration	Density (ρ) First subcarrier index in the PRB used for CSI-RS (k₀)		1 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
NZP CSI-RS fo CSI acquisition	used for CSI-RS (K ₀ , K ₁)		Row 3,(6,-)
oor acquicition	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		Aperiodic
CSI-IM configuration	CSI-IM RE pattern		0
	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(4, 9)
	CSI-IM timeConfig periodicity and offset	slot	Not configured
	Codebook Type		typel-SinglePanel
Codebook	Codebook Mode		1
Codebook configuration	(CodebookConfig- N1,CodebookConfig-N2)		Not configured
	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	8
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:

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

In the definition of γ , for 4TX, 8TX, 16TX, and 32TX 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.

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

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

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 Typel-SinglePanel Codebook

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

Table 6.3.2.1.1-1: Test parameters (single layer)

Pai	rameter	Unit	Test 1
Bandwidth		MHz	10
Subcarrier spaci	ng	kHz	15
Duplex Mode	1		FDD TDI A00 F
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
	First subcarrier		·
ZP CSI-RS	index in the PRB		D = 5 (4)
configuration	used for CSI-RS		Row 5,(4)
	(k ₀)		
	First OFDM		
	symbol in the PRB		(9)
	used for CSI-RS		()
	(l ₀) CSI-RS		
	periodicity and	slot	5/1
	offset	3101	3/1
	CSI-RS resource		Aperiodic
	Type		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 acquisition	(k ₀)		
acquisition	First OFDM		
	symbol in the PRB		(13)
	used for CSI-RS		(10)
	(l ₀) 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 ditom 0
CSI-IM	Mapping		(4,9)
configuration	(kcsi-im,lcsi-im)		() /
	CSI-IM timeConfig		
	periodicity and	slot	Not configured
Deposit ConfigT	offset		A so a si o ali o
ReportConfigTyr CQI-table	De		Aperiodic Table 1
reportQuantity			cri-RI-PMI-CQI
	orChannelMeasure		
ments			Not configured
timeRestrictionF	orInterferenceMeasu		Not configured
rements			-
cqi-FormatIndicator			Wideband
pmi-FormatIndicator		חח	Wideband
Sub-band Size		RB	8 1111111
csi-ReportingBa	odicity and offset	slot	Not configured
Aperiodic Report		ગાળા	4
L Aponodio Mepol	. Ciol Cilott		ਜ

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,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
PDSCH & PDSCH DMRS Precoding configuration for random Precoding			Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i ₁ , i ₂ combination, and with Wideband granularity
Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable i ₁ , i ₂ combination.			(1 ms granularity) with equal
Note 2: If the on Pl	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-3), this report		reporting instance at slot#n based of 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	anal .		FDD TDL A20 F
Propagation cha			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		Row 5,(4)
configuration	used for CSI-RS		10W 5,(4)
	(k ₀)		
	First OFDM		
	symbol in the PRB used for CSI-RS		(9)
	(l ₀)		
	CSI-RS		
	periodicity and	slot	5/1
	offset	0.01	G, .
	CSI-RS resource		Aperiodic
	Type		Aperiodic
	Number of CSI-RS		8
	ports (X) CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1 (FD2, TD2)
	First subcarrier		ı
N2D 001 D0	index in the PRB		5 ((5)
NZP CSI-RS for CSI	used for CSI-RS		Row 8, (4,6)
acquisition	(k_0, k_1)		
aoquisition	First OFDM		
	symbol in the PRB		(5)
	used for CSI-RS		(-)
	(l ₀) CSI-RS		
	periodicity and	slot	Not configured
	offset	3101	Not configured
	aperiodicTriggerin		0
	gOffset		0
	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	ре		Aperiodic
CQI-table			Table 1
reportQuantity	- 01 114		cri-RI-PMI-CQI
timeRestrictionForChannelMeasure			Not configured
ments timeRestrictionForInterferenceMeas			-
urements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	8
csi-ReportingBand			1111111
	CSI-Report periodicity and offset		Not configured
Aperiodic Repor	rt 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
	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 de	,	ms	8
Maximum number of HARQ transmission			4
Measurement	channel		R.PDSCH.1-6.2
PDSCH & PDSCH DMRS Precoding configuration for random Precoding			Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i ₁ , i ₂ combination, and with Wideband granularity
pre	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	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), tl		
Note 3: Rai	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 specifie 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)

Pai	rameter	Unit	Test 1
Bandwidth		MHz	10
Subcarrier space	cing	kHz	15
Duplex Mode			FDD
Propagation cha	annel		TDLC300-5
Antenna configu	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
	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, 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)
	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		(4,9)
	(K _{CSI-IM} , I _{CSI-IM}) CSI-IM timeConfig interval and offset	slot	Not configured

ReportConfigType				Aperiodic		
CQI-table				Table 1		
reportQua	ntity			cri-RI-PMI-CQI		
timeRestri	ctionF	orChannelMeasure				
ments	Otioiii	or or armonyloadarc		Not configured		
	ctionF	orInterferenceMeas				
urements	Otioiii	onneneronocivicas		Not configured		
cqi-Forma	tIndic	ator		Wideband		
pmi-Forma				Subband		
Sub-band		oatoi	RB	8		
csi-Report		nd	IND.	1111111		
		rval and offset	slot	Not configured		
		rt Slot Offset	3101	5		
		t olot oliset		1 in slots i, where mod(i, 5) = 1,		
CSI reque	st			otherwise it is equal to 0		
reportTrigg	ner9iz	'Δ		1		
reporting	geroiz			One State with one Associated		
				Report Configuration		
CSI-Aperio	odicTr	riggerStateList		Associated Report		
OO! Apon	Julott	iggorotatoList		Configuration contains pointers		
				to NZP CSI-RS and CSI-IM		
		Codebook Type		typel-SinglePanel		
		Codebook Mode		1		
		(CodebookConfig-		·		
		N1,CodebookConf		(4,2)		
		ig-N2)		(1,2)		
Codebook		(CodebookConfig-				
configurati		O1,CodebookCon		(4,4)		
Johngaran		fig-O2)		(', ',		
		CodebookSubset		0x		
		Restriction		FFFF FFFF FFFF		
				FFFF FFFF FFFF		
		RI Restriction		0000010		
Physical c	hanne	el for CSI report		PUSCH		
CQI/RI/PM	/II dela	ay	ms	8		
Maximum number of HARQ			-			
transmission				4		
Measurement channel			R.PDSCH.1-6.3			
		ured usina	random precoder selection, the			
				ot (1 ms granularity) with equal		
		ability of each applical				
Note 2:	If the	e UE reports in an available uplink reporting instance at slot#n				
		ased on PMI estimation at a downlink slot not later than slot#(n-4),				
		reported PMI cannot be applied at the gNB downlink before				
		(n+4).				
Note 3:				direction shall be used as		
	speci	cified 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)

Parameter		Unit	Test 1
Bandwidth		MHz	10
Subcarrier space	eing	kHz	15
Duplex Mode			FDD
Propagation cha	annel		TDLA30-5
Antenna configu	uration		High XP 32 x 2 (N1,N2) = (4,4)
Beamforming M	lodel		As specified in Annex B.4.1
	CSI-RS resource Type		Aperiodic
	Number of CSI- RS ports (X)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
ZP CSI-RS configuration	First subcarrier index in the PRB used for CSI-RS (k 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
	CSI-RS resource Type		Aperiodic
	Number of CSI- RS ports (X)		32
	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 17, (2, 4, 6, 8)
asquisine.	First OFDM symbol in the PRB used for CSI-RS (lo, l1)		(5, 12)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggerin gOffset		0
	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM configuration	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured

ReportConfigTy	'ne		Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
	ForChannelMeasure		
ments	Oronamiciwicasarc		Not configured
	ForInterferenceMeas		
urements	ommonoromodo		Not configured
cgi-FormatIndic	ator		Wideband
pmi-FormatIndio			Wideband
Sub-band Size	batoi	RB	8
csi-ReportingBa	and	IND	1111111
CSI-Report inte		slot	Not configured
Aperiodic Repo		3101	5
	it olot ollact		1 in slots i, where mod(i, 5) = 1,
CSI request			otherwise it is equal to 0
reportTriggerSiz	7A		1
reportinggeroiz			One State with one Associated
			Report Configuration
CSI-AperiodicT	ringerStatel ist		Associated Report
Ooi-Aperiodic i	nggerotateList		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)		(', ',
3	CodebookSubset		0x
	Restriction		FFFF FFFF FFFF
			FFFF FFFF FFFF
			FFFF FFFF FFFF
			FFFF FFFF FFFF
	RI Restriction		0000010
Physical channe			PUSCH
CQI/RI/PMI dela		ms	8
Maximum numb			4
transmission			4
Measurement c	hannel		R.PDSCH.1-6.3
			Single Panel Type I, Random
	CLLDMDC		precoder selection updated per
PDSCH & PDS			slot, with equal probability of
	guration for random		each applicable i ₁ , i ₂
Precoding			combination, and with
			Wideband granularity
Note 1: When Throughput is measured using random precoder selection, the			
precoder shall be updated in each slot (1 ms granularity) with equa			
probability of each applicable i ₁ , i ₂ combination. Note 2: If the UE reports in an available uplink reporting instance at slot#			
			nk slot not later than slot#(n-4),
	-	e applied a	at the gNB downlink before
	n+4).		
			direction shall be used as
specified in Annex B.2.3.2.3.			

Table 6.3.2.1.4-2: Minimum requirement

Parameter	Test 1
γ	5.0

6.3.2.1.5 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)

Parameter		Unit	Test 1
Bandwidth		MHz	10
Subcarrier spa	Subcarrier spacing		15
Duplex Mode			FDD
Propagation ch	nannel		TDLA30-5
Antenna config	uration		XP Medium 16 x 2 (N1,N2) = (4,2)
Beamforming N	Model		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	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		16
	ports (X)		16
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
NZP CSI-RS	First subcarrier index		
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		Aperiodic
	Type		•
CSI-IM	CSI-IM RE pattern		Pattern 0
configuration	CSI-IM Resource Mapping		(4.0)
Corniguration	імарріпу (k _{сsі-ім} ,І _{сsі-ім})		(4,9)
	CSI-IM timeConfig		
	interval and offset	slot	Not configured
ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasurem			Not configured
ents timeRestrictionForInterferenceMeasur			
ements			Not configured
	cqi-FormatIndicator		Wideband
	pmi-FormatIndicator Sub-band Size		Subband
		RB	8
csi-ReportingBand		olo+	1111111 Not configured
CSI-Report interval and offset		slot	Not configured 5
Aperiodic Report Slot Offset CSI request			1 in slots i, where $mod(i, 5) = 1$,
reportTriggerSi	ize		otherwise it is equal to 0
report riggersize			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 transmission			4
Measurement channel			R.PDSCH.1-6.3

Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable 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	Model		As specified in Annex B.4.1
	CSI-RS resource		Apariadia
	Type		Aperiodic
	Number of CSI-RS		4
	ports (X)		ED CDM3
	CDM Type Density (ρ)		FD-CDM2
	First subcarrier index		I
ZP CSI-RS	in the PRB used for		Row 5, (4,-)
configuration	CSI-RS (k ₀ , k ₁)		10w 3, (4,-)
	First OFDM symbol		
	in the PRB used for		(9,-)
	CSI-RS (I ₀ , I ₁)		, · · · ·
	CSI-RS	slot	Not configured
	interval and offset	SIUL	Ţ.
	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		10
	ports (X)		16
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
NZP CSI-RS	First subcarrier index		
for CSI	in the PRB used for		Row 12, (2, 4, 6, 8)
acquisition	CSI-RS (k ₀ , k ₁ , k ₂ , k ₃)		
acquioition	First OFDM symbol		
	in the PRB used for		(5, -)
	CSI-RS (I ₀ , I ₁)		
	CSI-RS	slot	Not configured
	interval and offset aperiodicTriggeringO		
	ffset		0
	CSI-IM resource		Aperiodic
	Type		•
001.114	CSI-IM RE pattern		Pattern 0
CSI-IM	CSI-IM Resource		(4.0)
configuration	Mapping		(4,9)
	(k _{CSI-IM} ,I _{CSI-IM}) CSI-IM timeConfig		
	interval and offset	slot	Not configured
ReportConfigT			Aperiodic
CQI-table			Table 1
reportQuantity	reportQuantity		cri-RI-PMI-CQI
timeRestrictionForChannelMeasurem			Not configured
ents			140t ooringared
timeRestrictionForInterferenceMeasur ements			Not configured
	cqi-FormatIndicator		Wideband
	pmi-FormatIndicator		Not configured
Sub-band Size		RB	4
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
reportTriggerSi	ize		1
reportringgeroize			

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(numberOfPMISub bandsPerCQISubban d-r16)		1
Codebook configuration	(CodebookConfig- N1,CodebookConfig- N2)		(4,2)
	(CodebookConfig- O1,CodebookConfig- O2)		(4,4)
	CodebookSubsetRes triction		0x 7FF FFFF FFFF FFFF
	RI Restriction (typeII- RI-Restriction-r16)		0010
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	8
Maximum number of HARQ			4
transmission			·
Measurement channel			R.PDSCH.1-6.3
			andom precoder selection, the (1 ms granularity) with equal
probability of each applicable is to combination. The random precoder			

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 '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 Typel-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)

Bandwidth	Parameter		Unit	Test 1
Duplex Mode				40
TDD DL-UL configuration Propagation channel Antenna configuration Antenna configuration Antenna configuration Antenna configuration Antenna configuration Antenna configuration Beamtorming 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 ((a)) CSI-RS periodicity and offset CSI-RS First OFDM Number of CSI-RS ((b)) CSI-RS periodicity and offset CSI-RS First OFDM Number of CSI- RS ports (X) CDM Type Density (p) First OFDM Symbol in the PRB used for CSI-RS ((c)) CSI-RS First OFDM Symbol in the PRB used for CSI-RS ((c)) CSI-RS First OFDM Symbol in the PRB used for CSI-RS ((c)) CSI-RS First OFDM Symbol in the PRB used for CSI-RS ((c)) CSI-RS	Subcarrier spacing		kHz	30
Propagation channel	Duplex Mode			TDD
Antenna configuration	TDD DL-UL configuration			1 · · · · · · · · · · · · · · · · · · ·
Remotorming Model	Propaga	ation channel		
CSI-RS resource Type	Antenna	configuration		
Type	Beamfo	rming Model		
Number of CSI-RS ports (X)				Periodic
RS ports (X)				
Density (p)				-
First subcarrier index in the PRB used for CSI-RS (ko)				FD-CDM2
Index in the PRB Index in th				1
Used for CSI-RS (k₀)				
User for CSI-RS (ko)				Row 5 (4)
First OFDM symbol in the PRB used for CSI-RS (lo)	configuration			10W 5,(4)
Symbol in the PRB Used for CSI-RS (lo)				
Used for CSI-RS (lo)				
CSI-RS periodicity and offset CSI-RS resource Type Number of CSI-RS periodic CSI-RS resource Type Number of CSI-RS periodic CDM Type FD-CDM2				(9)
CSI-RS periodicity and offset CSI-RS resource Type Number of CSI-RS RS ports (X) CDM Type Density (p) 1				(-)
periodicity and offset CSI-RS resource Type Number of CSI-RS ports (X) CDM Type Density (p) First subcarrier index in the PRB used for CSI-RS (ko) First OFDM symbol in the PRB used for CSI-RS (lo) CSI-RS periodicity and offset aperiodicTriggerin gOffset CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Type CSI-IM Resource Mapping (KCSI-IM, IcSI-IM) CSI-IM Resource Mapping (CSI-IM Resource) Mapping				
Offset CSI-RS resource Type Number of CSI-RS ports (X) 4 CDM Type Density (p) 1 First subcarrier index in the PRB used for CSI-RS (ko) First OFDM symbol in the PRB used for CSI-RS (lo) CSI-RS periodicity and offset CSI-IM Resource Type Aperiodic CSI-IM Resource Table 1			-1-4	40/4
CSI-RS resource Type			SIOT	10/1
Type				
Number of CSI-				Aperiodic
RS ports (X)				
CDM Type				4
Density (p) 1 First subcarrier index in the PRB used for CSI-RS (ko) First OFDM symbol in the PRB used for CSI-RS (lo) CSI-RS periodicity and offset aperiodicTriggerin gOffset CSI-IM resource Type Aperiodic Type Aperiodic yand offset aperiodicity and configuration CSI-IM Resource Mapping (kcsi-IM, Icsi-IM) CSI-IM timeConfig periodicity and offset aperiodicity and configuration ReportConfigType Aperiodic ReportConfigType Aperiodic CQI-table Table 1 reportQuantity Cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband Sub-band Size RB 16 csi-ReportingBand 11111111				ED-CDM2
First subcarrier index in the PRB used for CSI-RS (k ₀) acquisition First OFDM symbol in the PRB used for CSI-RS (k ₀) CSI-RS periodicity and offset aperiodicTriggerin gOffset CSI-IM resource Type Aperiodic Yupe CSI-IM Resource Mapping (kcsi-M,lcsi-IM) CSI-IM timeConfig periodicity and offset aperiodicity and configuration ReportConfigType Aperiodic ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband public wideband Size RB 16 csi-ReportingBand 11111111				1 D-CDIVIZ
Index in the PRB used for CSI-RS (ko) First OFDM symbol in the PRB used for CSI-RS (lo) CSI-RS periodicity and offset aperiodicTriggerin gOffset CSI-IM CSI-IM RE pattern CSI-IM Resource Type CSI-IM Resource Mapping (Kcsi-IM, Icsi-IM) CSI-IM timeConfig periodicity and offset ReportConfigType ReportConfigType ReportConfigType ReportQuantity ReportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Sub-band Size RB 16 Row 4, (0) Row 4, (0) Row 4, (0) (13) (13) (13) (13) (13) (14) Not configured Not configured Not configured Videband Videband Sub-band Size RB 16 csi-ReportingBand				'
for CSI acquisition Second Strict CSI				
CSI acquisition First OFDM symbol in the PRB used for CSI-RS (lo) CSI-RS periodicity and offset aperiodicTriggerin gOffset CSI-IM resource Type Aperiodic CSI-IM Resource Mapping (4,9) (6,9) (CSI-IM Resource Mapping (4,9) (4,9) (6,9) (Row 4, (0)
First OFDM symbol in the PRB used for CSI-RS (lo) CSI-RS periodicity and offset aperiodicTriggerin gOffset CSI-IM resource Type Aperiodic CSI-IM RE pattern Pattern 0 CSI-IM Resource Mapping (kcsi-im, lcsi-im) CSI-IM timeConfig periodicity and offset aperiodicity and offset State aperiodicity and offset Aperiodic ReportConfigType Aperiodic CQI-table Table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband Sub-band Size RB 16 csi-ReportingBand 11111111				
Symbol in the PRB used for CSI-RS (lo) 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 timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Sub-band Size RB 16 csi-ReportingBand Interval (13) (13) (13) (13) (13) (13) (13) (13) (13) (13) (13) (14) Not configured Not configured Aperiodic (4,9) (4,9) (4,9) (4,9) (4,9) (4,9) (4,9) (5) CSI-IM timeConfig periodicity and offset Not configured Not configured Wideband Wideband Sub-band Size RB 16 Table 1 Tab	acquisition	\ -/		
Used for CSI-RS (Io) 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 Trable 1 reportQuantity TimeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Sub-band Size RB 16 Not configured (Is) Not configured Not configured Videband Sub-band Size RB 16 CSI-IM Not configured Not configured ReportConfigType ReportConf				(12)
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 TimeRestrictionForChannelMeasure ments urements CSI-IM Resource Mapping (kcsi-IM,lcsi-IM) CSI-IM timeConfig periodicity and offset ReportQuantity Table 1 reportQuantity Tori-RI-PMI-CQI timeRestrictionForChannelMeasure ments Not configured Tori-RI-PMI-CQI timeRestrictionForInterferenceMeas urements Cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 16 csi-ReportingBand				(13)
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 Table 1 reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Sub-band Size RB Not configured Not configured Wideband Wideband Sub-band Size RB 16 csi-ReportingBand				
Offset		\ -/		
Offset		periodicity and	slot	Not configured
CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (kcsi-IM, lcsi-IM) CSI-IM timeConfig periodicity and offset CQI-table reportQuantity timeRestrictionForChannelMeasure ments 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) Slot Not configured Not configured Not configured Wideband Wideband Sub-band Size RB 16 csi-ReportingBand		offset		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 timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Sub-band Size csi-ReportingBand CSI-IM Resource Pattern 0 Aperiodic (4,9) Not configured Not configured Not configured Not configured Wideband Pile Pattern 0 Not configured Not configured ReportConfigType Aperiodic Not configured Not configured Not configured ReportConfigured				0
CSI-IM RE pattern CSI-IM Resource Mapping (kcsi-IM, lcsi-IM) CSI-IM timeConfig periodicity and offset ReportConfigType CQI-table reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Sub-band Size csi-ReportingBand CSI-IM Resource Mapping (k,9) (4,9) Not configured Not configured Not configured Not configured Wideband Wideband 1111111				
CSI-IM RE pattern CSI-IM Resource Mapping (kcsi-IM, Icsi-IM) CSI-IM timeConfig periodicity and offset ReportConfigType ReportQuantity CQI-table reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Sub-band Size CSI-IM RE pattern Pattern 0 (4,9) (4,9) Not configured Not configured Not configured Not configured Wideband Wideband Sub-band Size RB 16 csi-ReportingBand				Aperiodic
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 timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband Sub-band Size RB 16 csi-ReportingBand 11111111				Pottorn 0
CSI-IM configuration Mapping (kcsi-IM, lcsi-IM) CSI-IM timeConfig periodicity and offset ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband pmi-FormatIndicator RB 16 csi-ReportingBand 11111111				PalleIII 0
Collingulation (kcsi-IM, lcsi-IM) CSI-IM timeConfig periodicity and offset Not configured offset	CSI-IM			(4.0)
CSI-IM timeConfig periodicity and offset ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband Sub-band Size RB 16 csi-ReportConfigType Aperiodic Cqi-tonic Table 1 Table 1 Table 1 Not configured Not configured Wideband Wideband Table 1 Table 1 Table 1 Table 1 Table 1 Tonic Table 1 Tonic Table 1 Tonic Table 1 Table 1 Tonic Table 1 Table 1 Tonic Table 1 Tonic Table 1 Tonic Table 1 Tonic Table 1 Table 1 Tonic Tabl	configuration			(4,9)
ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments Not configured timeRestrictionForInterferenceMeas urements Not configured cqi-FormatIndicator Wideband Sub-band Size RB 16 csi-ReportingBand Slot Not configured		CSI-IM timeConfig		
ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband pmi-FormatIndicator RB 16 csi-ReportingBand 11111111			elot	Not configured
ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments Not configured timeRestrictionForInterferenceMeas urements Not configured verients Wideband pmi-FormatIndicator Wideband Sub-band Size RB 16 csi-ReportingBand 11111111		offeet	SIUL	Not configured
CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments Not configured timeRestrictionForInterferenceMeas urements Not configured cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 16 csi-ReportingBand 1111111	ReportConfigTv			Aperiodic
reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 16 csi-ReportingBand 11111111				
timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand Not configured Not configured Wideband Wideband Head Size RB 16 1111111				
timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand Not configured Wideband Wideband 1111111	timeRestrictionForChannelMeasure			
urementsNot configuredcqi-FormatIndicatorWidebandpmi-FormatIndicatorWidebandSub-band SizeRB16csi-ReportingBand1111111				-
pmi-FormatIndicatorWidebandSub-band SizeRB16csi-ReportingBand1111111	urements			-
Sub-band Size RB 16 csi-ReportingBand 1111111				
csi-ReportingBand 1111111	pmi-FormatIndicator			Wideband
	Sub-band Size		RB	
CSI-Report periodicity and offset slot Not configured				
	CSI-Report peri	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-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
	Codebook Type		typel-SinglePanel
	Codebook Mode		1
Codebook	(CodebookConfig- N1,CodebookConfig-N2)		(2,1)
configuration	fig-O2)		(4,1)
	CodebookSubset Restriction		11111111
	RI Restriction		0000001
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	5.5
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.2-8.1 TDD
PDSCH & PDSCH DMRS Precoding configuration for random Precoding			Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i ₁ , i ₂ combination, and with Wideband granularity
Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable i ₁ , i ₂ combination.			random precoder selection, the ot (0.5 ms granularity) with equal
Note 2: If the back this			k reporting instance at slot #n nk slot not later than slot#(n-4),
Note 3: Ra			

Table 6.3.2.2.1-2: Minimum requirement

Parameter	Test 1
γ	1.3

6.3.2.2.2 Single PMI with 8TX TypeI-SinglePanel Codebook

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

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

Parameter		Unit	Test 1
Bandwidth		MHz	40
Subcarrier spacing Duplex Mode		kHz	30 TDD
			FR1.30-1 as specified in Annex
TDD DL-UL configurations			A
Propaga	ation channel		TDLA30-5
Antenna	configuration		High XP 8 x 2 (N1,N2) = (4,1)
Beamfo	rming Model		As specified in Annex B.4.1
	CSI-RS resource		Periodic
	Type Number of CSI-		
	RS ports (X)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
ZP CSI-RS	First subcarrier index in the PRB		
configuration	used for CSI-RS		Row 5,(4)
Comigaration	(k ₀)		
	First OFDM		
	symbol in the PRB		(9)
	used for CSI-RS		(5)
	(l ₀) CSI-RS		
	periodicity and	slot	10/1
	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 (k ₀ , k ₁)		
acquisition	First OFDM		
	symbol in the PRB		(5)
	used for CSI-RS		(5)
	(l ₀)		
	CSI-RS periodicity and	slot	Not configured
	offset	3101	Not configured
	aperiodicTriggerin		0
	gOffset		Ü
	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM	CSI-IM Resource		
configuration	Mapping		(4,9)
Comigaration	(kcsi-im,lcsi-im)		
	CSI-IM timeConfig	alat	Not configured
	periodicity and offset	slot	Not configured
ReportConfigTy			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForlChannelMeasur			Not configured
ements timeRestrictionForInterferenceMeas			_
urements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size	and	RB	16 1111111
csi-ReportingBa		slot	Not configured
CSI-Report periodicity and offset		3101	140t Comiguieu

Aperiodic Rep	oort 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		typel-SinglePanel
	Codebook Mode		1
Codebook	(CodebookConfig- N1,CodebookConfig-N2)		(4,1)
configuration	(CodebookConfig- O1,CodebookCon fig-O2)		(4,1)
	CodebookSubset Restriction		0x FFFF
	RI Restriction		0000010
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	6.5
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.2-8.2 TDD
PDSCH & PDSCH DMRS Precoding configuration for random Precoding			Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i ₁ , i ₂ combination, and with Wideband granularity
Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable i ₁ , i ₂ combination.			ot (0.5 ms granularity) with equal mbination.
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).		sk slot not later than slot#(n-6), at the gNB downlink before	
	te 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.		

Table 6.3.2.2.2: Minimum requirement

Parameter	Test 1
γ	1.5

6.3.2.2.3 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
Bandwidth		MHz	40
Subcarrier spacing		kHz	30
Duplex Mode			TDD
	L configurations		FR1.30-1 as specified in Annex A
Propaga	ation channel		TDLC300-5
Antenna	configuration		High XP 16 x 2 (N1,N2) = (4,2)
Beamfo	rming Model		As specified in Annex B.4.1
	CSI-RS resource		Aperiodic
	Туре		Aponodio
	Number of CSI-		4
	RS ports (X)		·
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier		
7D 001 D0	index in the PRB		Row 5, (4,-)
ZP CSI-RS	used for CSI-RS		
configuration	(k ₀ , k ₁)		
	First OFDM		
	symbol in the PRB used for CSI-RS		(9,-)
	(l ₀ , l ₁)		
	CSI-RS		
	interval and offset	slot	Not configured
	7D 001 D0 triange		1 in slots i, where mod(i, 10) =
	ZP CSI-RS trigger		1, otherwise it is equal to 0
	CSI-RS resource		Aperiodic
	Туре		Aperiodic
	Number of CSI-		16
	RS ports (X)		_
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier		
NZP CSI-RS	index in the PRB		Row 12, (2, 4, 6, 8)
for CSI	used for CSI-RS		
acquisition	(k ₀ , k ₁ , k ₂ , k ₃) First OFDM		
	symbol in the PRB		
	used for CSI-RS		(5, -)
	(l_0, l_1)		
	CSI-RS		
	interval and offset	slot	Not configured
	aperiodicTriggerin		_
	gOffset		0
	CSI-IM resource		A = a = i = -i =
	Туре		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM	CSI-IM Resource		
configuration	Mapping		(4,9)
Ü	(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
timeRestrictionF	ForlChannelMeasur		Not configured
ements			Not configured
timeRestrictionF urements	ForInterferenceMeas		Not configured
cqi-FormatIndic	ator		Wideband
pmi-FormatIndio			Subband
Sub-band Size		RB	16
csi-ReportingBa	ınd		1111111
CSI-Report inte		slot	Not configured
Aperiodic Repor	rt Slot Offset		8
CSI request			1 in slots i, where mod(i, 10) = 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
	(CodebookConfig- N1,CodebookConfig-N2)		(4,2)
Codebook configuration	(CodebookConfig- O1,CodebookCon fig-O2)		(4,4)
	CodebookSubset Restriction		0x FFFF FFFF FFFF FFFF FFFF FFFF FFFF
	RI Restriction		0000010
Physical channe			PUSCH
CQI/RI/PMI dela	ay	ms	6.5
Maximum numb transmission	Maximum number of HARQ		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. Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-6), this reported PMI cannot be applied at the gNB downlink before			
slot#(n+6). Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.			

Table 6.3.2.2.3-2: 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)

Parameter		Unit	Test 1
Bandwidth		MHz	40
Subcarrier spacing		kHz	30
Duplex Mode			TDD
TDD DL-U	L configurations		FR1.30-1 as specified in Annex A
Propaga	ation channel		TDLA30-5
Antenna	configuration		High XP 32 x 2 (N1,N2) = (4,4)
Beamfo	rming Model		As specified in Annex B.4.1
	CSI-RS resource		Aperiodic
	Туре		Aperiodic
	Number of CSI-		4
	RS ports (X)		·
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier		
ZD CCL DC	index in the PRB		Row 5, (4,-)
ZP CSI-RS configuration	used for CSI-RS		
Corniguration	(k ₀ , k ₁) First OFDM		
	symbol in the PRB		
	used for CSI-RS		(9,-)
	(l ₀ , l ₁)		
	CSI-RS		
	interval and offset	slot	Not configured
	7D CCL DC triagor		1 in slots i, where mod(i, 10) =
	ZP CSI-RS trigger		1, otherwise it is equal to 0
	CSI-RS resource		Aperiodic
	Туре		Aperiodic
	Number of CSI-		32
	RS ports (X)		-
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier		
NZP CSI-RS	index in the PRB used for CSI-RS		Row 17, (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, 12)
	(l_0, l_1)		
	CSI-RS		N
	interval and offset	slot	Not configured
	aperiodicTriggerin		0
	gOffset		U
	CSI-IM resource		Aperiodic
	Туре		·
	CSI-IM RE pattern		Pattern 0
CSI-IM	CSI-IM Resource		
configuration	Mapping		(4,9)
	(kcsi-im,lcsi-im)		
	CSI-IM timeConfig	slot	Not configured
	interval and offset		

PenortConfig	-vne		Aperiodic
ReportConfigType CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForlChannelMeasur			
ements			Not configured
	ForInterferenceMeas		
urements	ii omnonononoomoao		Not configured
cgi-FormatInd	cator		Wideband
pmi-FormatIng			Wideband
Sub-band Size		RB	16
csi-Reporting		IND.	1111111
	erval and offset	slot	Not configured
Aperiodic Rep		3101	8
	ort olot olloot		1 in slots i, where mod(i, 10) =
CSI request			1, otherwise it is equal to 0
reportTriggerS	Size		1
Toportringgere			One State with one Associated
			Report Configuration
CSI-Aperiodic	TriggerStateList		Associated Report
	99		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
	RI Restriction		00000010
	nel for CSI report		PUSCH
CQI/RI/PMI de		ms	6.5
Maximum nun	nber of HARQ		4
transmission			D DDCCULO CO TDD
Measurement	cnannel	-	R.PDSCH.2-8.3 TDD
			Single Panel Type I, Random
PDSCH & PD	SCH DMRS		precoder selection updated per
	figuration for random		slot, with equal probability of
Precoding	-		each applicable i ₁ , i ₂ combination, and with
			Wideband granularity
Note 1: Wh	en Throughput is moss	ured 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 i ₁ , i ₂ combination.			
Note 2: If the UE reports in an available uplink reporting instance at slo			
based on PMI estimation at a downlink slot not later than slot#(n-6			
			at the gNB downlink before
	#(n+6).	11	5
		ciple beam	direction shall be used as
spe	cified 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	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
Antenna conf	iguration		XP Medium 16 x 2
Beamforming			(N1,N2) = (4,2) As specified in Annex B.4.1
Dearmonning	CSI-RS resource Type		Aperiodic
	Number of CSI-RS		4
	ports (X)		·
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index		5 - (1)
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-		(9,-)
	RS (I ₀ , I ₁) 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		
	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		1 ditorri c
configuratio	Mapping		(4,9)
n	(kcsi-im,lcsi-im)		(1,5)
	CSI-IM timeConfig	slot	Not configured
5 .0	interval and offset	3101	<u> </u>
ReportConfig	туре		Aperiodic
CQI-table			Table 1
time Postriction	reportQuantity timeRestrictionForlChannelMeasurem		cri-RI-PMI-CQI
ents			Not configured
timeRestrictionForInterferenceMeasur			
ements			Not configured
cqi-FormatInd	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, otherwise it is equal to 0

CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM	
Codebook configuratio n	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		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				

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		kHz	30
Duplex Mode			TDD
TDD DL-UL o	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
Doannonning	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 n	CSI-RS (k ₀ , k ₁) First OFDM symbol in		
''	the PRB used for CSI-		(0.)
	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)		
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
NIZD COL	First subcarrier index		D 40 (0 4 0 0)
NZP CSI- RS 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		
acquisition	the PRB used for CSI-		(5, -)
	RS (I ₀ , I ₁)		(0,)
	CSI-RS		
	interval and offset	slot	Not configured
	aperiodicTriggeringOff		0
	set		
	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM	CSI-IM Resource		(4.5)
configuratio	Mapping		(4,9)
n	(kcsi-im,lcsi-im) CSI-IM timeConfig		
	interval and offset	slot	Not configured
ReportConfigType			Aperiodic
CQI-table			Table 1
	reportQuantity		cri-RI-PMI-CQI
timeRestrictionForlChannelMeasurem			Not configured
ents	o Francisco AA		. Tot oomigarou
	timeRestrictionForInterferenceMeasur ements		Not configured
cqi-FormatIndicator			Wideband
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) =
reportTrigger	Sizo		1, otherwise it is equal to 0
reportrigger	OILU		I I

CSI-Aperiodio	cTriggerStateList		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- r16)		1
Codebook configuratio	(CodebookConfig- N1,CodebookConfig- N2)		(4,2)
l II	(CodebookConfig- O1,CodebookConfig- O2)		(4,4)
	CodebookSubsetRestri ction		0x 7FF FFFF FFFF FFFF
	RI Restriction (typell- RI-Restriction-r16)		0010
Physical char	nnel for CSI report		PUSCH
CQI/RI/PMI d	elay	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 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 6.3.2.2.3-1.

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
ν	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		MHz	10
Subcarrier space	cing	kHz	15
Duplex Mode			FDD
Propagation cha	annel		TDLA30-5
Antenna configu	uration		High XP 4 x 4
Beamforming M			(N1,N2) = (2,1) As specified in Annex B.4.1
Dearmonning iv	CSI-RS resource		
	Type		Periodic
	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		/(/
	(k ₀)		
	First OFDM symbol in the PRB		
	used for CSI-RS		(9)
	(l ₀)		
	CSI-RS		
	periodicity and	slot	5/1
	offset		
	CSI-RS resource		Aperiodic
	Туре		Aperiodic
	Number of CSI-		4
	RS ports (X)		ED ODINO
	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)		
acquisition	First OFDM		
	symbol in the PRB		(13)
	used for CSI-RS		(10)
	(l ₀)		
	CSI-RS periodicity and	slot	Not configured
	offset	SIOL	Not configured
	aperiodicTriggerin		_
	gOffset		0
	CSI-IM resource		Aperiodic
	Туре		·
	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	0.01	1101 0019404
ReportConfigTy	pe		Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasure			Not configured
ments			3
timeRestrictionForInterferenceMeas			Not configured
urements cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	8
csi-ReportingBa	and		1111111
	odicity and offset	slot	Not configured
Aperiodic Repo			4

CSI request			1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
reportTriggerSize			1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
	Codebook Type		typel-SinglePanel
	Codebook Mode		1
Codebook	(CodebookConfig- N1,CodebookConfig-N2)		(2,1)
configuration	(CodebookConfig- O1,CodebookCon fig-O2)		(4,1)
	CodebookSubset Restriction		11111111
	RI Restriction		0000001
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	6
Maximum number of HARQ transmission			4
Measurement	channel		R.PDSCH.1-6.1 FDD
PDSCH & PDSCH DMRS Precoding configuration for random Precoding			Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i ₁ , i ₂ combination, and with Wideband granularity
pred prol	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 bas this			k reporting instance at slot#n nk slot not later than slot#(n-3),
			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

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 space	ring	kHz	15
Duplex Mode			FDD
Propagation cha	annel		TDLA30-5
Antenna configu	uration		High XP 8 x 4
Beamforming M	lodel		(N1,N2) = (4,1) As specified in Annex B.4.1
<u> </u>	CSI-RS resource		
	Туре		Periodic
	Number of CSI-		4
	RS ports (X)		·
	CDM Type		FD-CDM2
	Density (ρ)		1
7D CCL DC	First subcarrier		
ZP CSI-RS	index in the PRB		Row 5,(4)
configuration	used for CSI-RS (k ₀)		
	First OFDM		
	symbol in the PRB		
	used for CSI-RS		(9)
	(l ₀)		
	CSI-RS		
	periodicity and	slot	5/1
	offset		
	CSI-RS resource		Aperiodic
	Туре		, iponodio
	Number of CSI-		8
	RS ports (X)		CDM4 (FD2, TD2)
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ) First subcarrier		I
	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		(5)
	used for CSI-RS		(3)
	(l ₀)		
	CSI-RS	-1-4	Not configured
	periodicity and offset	slot	Not configured
	aperiodicTriggerin		
	gOffset		0
	CSI-IM resource		A marria di a
	Туре		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM	CSI-IM Resource		
configuration	Mapping		(4,9)
	(kcsi-im,lcsi-im)		
	CSI-IM timeConfig	alat	Not configured
	periodicity and offset	slot	Not configured
ReportConfigTy			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasure			
ments			Not configured
timeRestrictionForInterferenceMeas			Not configured
urements			
cqi-FormatIndic			Wideband
pmi-FormatIndicator		5.5	Wideband
Sub-band Size	and a	RB	8
csi-ReportingBa		ol-+	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
	Codebook Type		typel-SinglePanel
	Codebook Mode		1
Codebook	(CodebookConfig- N1,CodebookConfig-N2)		(4,1)
configuration	(CodebookConfig- O1,CodebookCon fig-O2)		(4,1)
	CodebookSubset Restriction		0x FFFF
	RI Restriction		0000010
Physical 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
PDSCH & PDSCH DMRS Precoding configuration for random Precoding			Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i ₁ , i ₂ combination, and with Wideband granularity
pre			
Note 2: If t ba thi			k reporting instance at slot#n nk slot not later than slot#(n-4),
Note 3: Ra	· ,		direction shall be used as

Table 6.3.3.1.2-2: Minimum requirement

Parameter	Test 1
γ	1.5

6.3.3.1.3 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 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
	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,-)
3	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, 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		
Comiguration	Mapping (kcsi-im,lcsi-im)		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured

ReportConfigTy	pe		Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionF	orChannelMeasure		Not configured
ments			Not configured
timeRestrictionF urements	ForInterferenceMeas		Not configured
cqi-FormatIndic	ator		Wideband
pmi-FormatIndio			Subband
Sub-band Size		RB	8
csi-ReportingBa	ind		1111111
CSI-Report inte	rval and offset	slot	Not configured
Aperiodic Repor	rt Slot Offset		5
CSI request			1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
reportTriggerSiz	<u>re</u>		1
CSI-AperiodicTr	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
	(CodebookConfig- N1,CodebookConfig-N2)		(4,2)
Codebook configuration	(CodebookConfig- O1,CodebookCon fig-O2)		(4,4)
	CodebookSubset Restriction		0x FFFF FFFF FFFF FFFF FFFF FFFF FFFF
	RI Restriction		0000010
Physical channe			PUSCH
CQI/RI/PMI dela	ay	ms	8
Maximum numb transmission	er of HARQ		4
Measurement channel			R.PDSCH.1-6.3 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-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.			direction shall be used as

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	eing	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,-)
<i>J.</i>	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, 5) = 1, otherwise it is equal to 0
	CSI-RS resource Type		Aperiodic
	Number of CSI- RS ports (X)		32
	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 17, (2, 4, 6, 8)
	First OFDM symbol in the PRB used for CSI-RS (lo, l1)		(5, 12)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggerin gOffset		0
	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM configuration	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(4,9)
	CSI-IM, ICSI-IM) CSI-IM timeConfig interval and offset	slot	Not configured

ReportConfigTy	pe		Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
	timeRestrictionForChannelMeasure		Not configurate
ments			Not configured
timeRestrictionF urements	ForInterferenceMeas		Not configured
cqi-FormatIndic	ator		Wideband
pmi-FormatIndio			Wideband
Sub-band Size		RB	8
csi-ReportingBa	and		111111
CSI-Report inte		slot	Not configured
Aperiodic Repo		0.01	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
	(CodebookConfig- N1,CodebookConfig-N2)		(4,4)
Codebook configuration	(CodebookConfig- O1,CodebookCon fig-O2)		(4,4)
	CodebookSubset Restriction		0x FFFF
D	RI Restriction		00000010
Physical channe			PUSCH
CQI/RI/PMI dela		ms	8
transmission	er of HARQ		4
	hannel		R.PDSCH.1-6.3 FDD
PDSCH & PDSCH DMRS Precoding configuration for random Precoding			Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i ₁ , i ₂ combination, and with Wideband granularity
Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable 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			random precoder selection, the ot (1 ms granularity) with equal mbination. k reporting instance at slot#n k slot not later than slot#(n-4),
slot#(n+4). Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.			

Table 6.3.3.1.4-2: Minimum requirement

Parameter	Test 1
γ	7.0

6.3.3.1.5 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)

Parameter		Unit	Test 1
Bandwidth		MHz	10
Subcarrier spa	cing	kHz	15
Duplex Mode			FDD
Propagation channel			TDLA30-5
Antenna config			XP Medium 16 x 4 (N1,N2) = (4,2)
Beamforming N			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)		FD-CDIVIZ
	First subcarrier index		, , , , , , , , , , , , , , , , , , ,
ZP CSI-RS configuration	in the PRB used for CSI-RS (k ₀ , k ₁)		Row 5, (4,-)
3	First OFDM symbol in the PRB used for		(9,-)
	CSI-RS (I ₀ , I ₁)		
	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
NZD COL DO	First subcarrier index		-
NZP CSI-RS for CSI	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	slot	Not configured
ReportConfigT			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		,,,,,	111111
CSI-Report interval and offset		slot	Not configured
Aperiodic Repo	Aperiodic Report Slot Offset		5
CSI request			1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
reportTriggerSi	ize		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)
Configuration	(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 Throughput is measure		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 6.3.3.1.3-1.

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)

Bandwidth Subcarrier spacia Duplex Mode Propagation cha	ng	MHz kHz	10
Duplex Mode	ng	kHz	
			15
I Propagation cha			FDD
1 Topagation ona	Propagation channel		TDLA30-5
Antenna configu	ration		XP Medium 16 x 4 (N1,N2) = (4,2)
Beamforming Mo			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
	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
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)
	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
configuration	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfigTyp	oe		Aperiodic
CQI-table	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		slot	Not configured
Aperiodic Report Slot Offset CSI request			1 in slots i, where mod(i, 5) = 1,
reportTriggerSize	е		otherwise it is equal to 0

CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
	Codebook Type		typell-r16
	paramCombination-		6
	r16		$(L = 4, p_v = 1/2, \beta = 1/2)$
	R(numberOfPMISub bandsPerCQISubban d-r16)		1
Codebook configuration	(CodebookConfig- N1,CodebookConfig- N2)		(4,2)
	(CodebookConfig- O1,CodebookConfig- O2)		(4,4)
	CodebookSubsetRes triction		0x 7FF FFFF FFFF FFFF
	RI Restriction (typell- RI-Restriction-r16)		0010
Physical chann	el for CSI report		PUSCH
CQI/RI/PMI delay		ms	8
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.1-6.3
		ed using ra	andom precoder selection, the
	precoder shall be updated in		
			pination. The random precoder
			l' 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).

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)

Pai	rameter	Unit	Test 1
Bandwidth		MHz	10
Subcarrier spacing		kHz	15
Duplex Mode			FDD
Propagation channel			TDLA30-5
Antenna configu	ıration		High XP 8 x 4
_			(N1,N2) = (4,1)
Beamforming M			As specified in Annex B.4.1
	CSI-RS resource		Periodic
	Type Number of CSI-RS		
	ports (X)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier		
ZP CSI-RS	index in the PRB		Pow 5 (4)
configuration	used for CSI-RS		Row 5,(4)
	(k ₀)		
	First OFDM		
	symbol in the PRB used for CSI-RS		(9)
	(I ₀)		, ,
	CSI-RS		
	periodicity and	slot	5/1
	offset		
	CSI-RS resource		Aperiodic
	Type Number of CSI-RS		7.001100110
			8
	ports (X) CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier		
NZP CSI-RS	index in the PRB		Dow 9 (4.6)
for CSI	used for CSI-RS		Row 8, (4,6)
acquisition	(k ₀)		
	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		
	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
001.114	CSI-IM Resource		T diterrit
CSI-IM	Mapping		(4,9)
configuration	(kcsi-im,lcsi-im)		, ,
	CSI-IM timeConfig		
	periodicity and	slot	Not configured
offset			A mania dia
ReportConfigType CQI-table			Aperiodic Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasure			
ments			Not configured
timeRestrictionForInterferenceMeas			Not configured
urements			-
	cqi-FormatIndicator		Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	8
csi-ReportingBa	odicity and offset	slot	1111111 Not configured
		ગાળા	5
Aperiodic Report Slot Offset		<u> </u>	<u> </u>

CSI request			1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
reportTriggerSiz	œ.		1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI- RS and CSI-IM
	Codebook Type		typel-SinglePanel
	Codebook Mode		1
Codebook configuration	(CodebookConfig- N1,CodebookConfig-N2)		(4,1)
	(CodebookConfig- O1,CodebookConfig-O2)		(4,1)
	CodebookSubsetR estriction		0x FFFF
	RI Restriction		0000010
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	8
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.1-6.2 FDD
Note 4. Mhan Throughput is management using renders proceed a colonting the			

- Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable i₁, i₂ combination.
- Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-4), this reported PMI cannot be applied at the gNB downlink before slot#(n+4).
- Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.

Parameter		Unit	Test 1
Bandwidth		MHz	40
Subcarrier space	ing	kHz	30
Duplex Mode			TDD
TDD DL-UL con	figuration		FR1.30-1 as specified in Annex A
Propagation cha	annel		TDLA30-5
Antenna configu	ıration		High XP 4 x 4 (N1,N2) = (2,1)
Beamforming M	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
1	CDM Type		FD-CDM2
	Density (ρ)		1

	T	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 (lo, l1)		(13,-)
	CSI-RS interval and offset		Not configured
	aperiodicTriggerin gOffset		0
	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM configuration	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfigTy	pe		Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionF ments	orChannelMeasure		Not configured
timeRestrictionForInterferenceMeas urements			Not configured
cqi-FormatIndica	ator		Wideband
pmi-FormatIndio	ator		Wideband
Sub-band Size		RB	16
csi-ReportingBa	nd		1111111
CSI-Report inter		slot	Not configured
Aperiodic Repor	t Slot Offset		8
CSI request			1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
reportTriggerSiz	e		1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI- RS and CSI-IM
	Codebook Type		typel-SinglePanel
	Codebook Mode		1
Codebook	(CodebookConfig- N1,CodebookConfig-N2)		(2,1)
configuration	(CodebookConfig- O1,CodebookConfig-O2)		(4,1)
	CodebookSubsetR estriction		11111111
	RI Restriction		0000001
Physical channel for CSI report			PUSCH
CQI/RI/PMI dela	,	ms	5.5
Maximum numb transmission	er of HARQ		4
Measurement ch	nannel		R.PDSCH.2-8.1 TDD
PDSCH & PDSCH DMRS Precoding configuration for random Precoding			Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i ₁ , i ₂ combination, and with Wideband granularity

Note 1:	When Throughput is measured using random precoder selection, the
	precoder shall be updated in each slot (0.5 ms granularity) with equal
	probability of each applicable i1, i2 combination.
Note 2:	If the UE reports in an available uplink reporting instance at slot#n
	based on PMI estimation at a downlink slot not later than slot#(n-4), this
	reported PMI cannot be applied at the gNB downlink before slot#(n+4).
Note 3:	Randomization of the principle beam direction shall be used as specified
	in Annex B.2.3.2.3.

Table 6.3.3.2.1-2: 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 kHz	40
	Subcarrier spacing		30
Duplex Mode			TDD FR1.30-1 as specified in Annex
TDD DL-UL confi	gurations		A
Propagation char	nnel		TDLA30-5
Antenna configura	ation		High XP 8 x 4
_			(N1,N2) = (4,1) As specified in Annex B.4.1
Beamforming Mo	CSI-RS resource		
	Туре		Periodic
	Number of CSI-		4
	RS ports (X)		
	CDM Type Density (ρ)		FD-CDM2
	First subcarrier		'
	index in the PRB		Row 5,(4)
_	used for CSI-RS		10W 3,(4)
	(k ₀) First OFDM		
	symbol in the PRB		4-1
	used for CSI-RS		(9)
	(l ₀)		
	CSI-RS	-l-4	40/4
	periodicity and offset	slot	10/1
	CSI-RS resource		An ariadia
	Туре		Aperiodic
	Number of CSI-		8
	RS ports (X) CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier		
I NZP CSI-RS	index in the PRB		Row 8, (4,6)
for CSI	used for CSI-RS		, (1,0)
	(k ₀ , k ₁) First OFDM		
	symbol in the PRB		(5)
	used for CSI-RS		(5)
	(l ₀) CSI-RS		
	periodicity and	slot	Not configured
	offset	0.01	Trot cormigation
	aperiodicTriggerin		0
	gOffset		Ŭ
	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
L	CSI-IM Resource		
configuration	Mapping		(4,9)
	(kcsi-im,lcsi-im) CSI-IM timeConfig		
	periodicity and	slot	Not configured
	offset		Trot cormigation
ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity timeRestrictionFo	orChannnelMeasur		cri-RI-PMI-CQI
ements	, Chammonvieasur		Not configured
	orInterferenceMeas		Not configured
urements			-
cqi-FormatIndicat pmi-FormatIndica			Wideband Wideband
Sub-band Size	IIOI	RB	viideband 16
csi-ReportingBan	d	110	1111111
CSI-Report period		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
			One State with one Associated
CSI Aporiodi	cTriggerStateList		Report Configuration Associated Report
C31-Aperiodi	CTTIggetStateList		Configuration contains pointers
			to NZP CSI-RS and CSI-IM
	Codebook Type		typel-SinglePanel
	Codebook Mode		1
	(CodebookConfig-		
	N1,CodebookConf		(4,1)
Codebook	ig-N2)		, , ,
configuration	(CodebookConfig-		
Comigaration	O1,CodebookCon		(4,1)
	fig-O2)		
	CodebookSubset		0x FFFF
	Restriction		00000040
Dhusiaal sha	RI Restriction		00000010 PUSCH
Physical channel for CSI report		m.a	6.5
CQI/RI/PMI delay Maximum number of HARQ		ms	0.0
transmission			4
Measurement channel			R.PDSCH.2-8.2 TDD
Wedgerenien ename.			Single Panel Type I, Random
			precoder selection updated per
PDSCH & PDSCH DMRS			slot, with equal probability of
	nfiguration for random		each applicable i ₁ , i ₂
Precoding			combination, and with
			Wideband granularity
	Note 1: When Throughput is measured using random precoder selection, the		
			ot (0.5 ms granularity) with equal
	probability of each applicable i ₁ , i ₂ combination. If the UE reports in an available uplink reporting instance at slot#n		
	based on PMI estimation at a downlink slot not later than slot#(n-6),		
	nis reported PMI cannot be applied at the gNB downlink before		
	slot#(n+6). Randomization of the principle beam direction shall be used as		
1.1010 0. 110	specified in Annex B.2.3.2.3.		

Table 6.3.3.2.2-2: Minimum requirement

Parameter	Test 1
γ	1.5

6.3.3.2.3 Multiple PMI with 16TX TypeI-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)

Parameter		Unit	Test 1
Bandwidth		MHz	40
Subcarrier space	ring	kHz	30
Duplex Mode			TDD
TDD DL-UL cor	figurations		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
	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
	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)
	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		(4,9)
	(kcsi-im,lcsi-im) CSI-IM timeConfig interval and offset	slot	Not configured

ReportConfigTy	ре		Aperiodic
CQI-table			Table 1
	reportQuantity		cri-RI-PMI-CQI
	orChannnelMeasur		Not configured
ements			
timeRestrictionF urements	ForInterferenceMeas		Not configured
cqi-FormatIndic	ator		Wideband
pmi-FormatIndio			Subband
Sub-band Size		RB	16
csi-ReportingBa	ınd		1111111
CSI-Report inte	rval and offset	slot	Not configured
Aperiodic Repor	rt Slot Offset		8
CSI request			1 in slots i, where mod(i, 10) = 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
	(CodebookConfig- N1,CodebookConfig-N2)		(4,2)
Codebook configuration	(CodebookConfig- O1,CodebookCon fig-O2)		(4,4)
	CodebookSubset Restriction		0x FFFF FFFF FFFF FFFF FFFF FFFF FFFF
	RI Restriction		0000010
Physical channe			PUSCH
CQI/RI/PMI dela		ms	6.5
Maximum numb transmission	er of HARQ		4
	Measurement channel		R.PDSCH.2-8.3 TDD
Note 1: When	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			k reporting instance at slot#n k slot not later than slot#(n-6),
Note 3: Rand	slot#(n+6). Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.		

Table 6.3.3.2.3-2: Minimum requirement

Parameter	Test 1
γ	3.0

6.3.3.2.4 Single PMI with 32TX TypeI-SinglePanel Codebook

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

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

Parameter		Unit	Test 1
Bandwidth		MHz	40
	Subcarrier spacing		30
Duplex Mode			TDD
TDD DL-UL cor			FR1.30-1 as specified in Annex A
Propagation cha	annel		TDLA30-5
Antenna configu	uration		High XP 32 x 4 (N1,N2) = (4,4)
Beamforming M	lodel		As specified in Annex B.4.1
	CSI-RS resource Type		Aperiodic
	Number of CSI- RS ports (X)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
ZP CSI-RS configuration	First subcarrier index in the PRB used for CSI-RS (k 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
	CSI-RS resource Type		Aperiodic
	Number of CSI- RS ports (X)		32
	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 17, (2, 4, 6, 8)
	First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁)		(5, 12)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggerin gOffset		0
	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM configuration	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured

ReportConfigTy	pe		Aperiodic
CQI-table			Table 1
reportQuantity	·		cri-RI-PMI-CQI
	orChannnelMeasur		Not configurated
ements			Not configured
	orInterferenceMeas		Not configured
urements			Ţ.
cqi-FormatIndic			Wideband
pmi-FormatIndio	cator		Wideband
Sub-band Size		RB	16
csi-ReportingBa			1111111
CSI-Report inte		slot	Not configured
Aperiodic Repor	rt Slot Offset		8
CSI request			1 in slots i, where mod(i, 10) = 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
	(CodebookConfig- N1,CodebookConfig-N2)		(4,4)
Codebook configuration	(CodebookConfig- O1,CodebookCon fig-O2)		(4,4)
	CodebookSubset Restriction		0x FFFF
	RI Restriction		00000010
Physical channe			PUSCH
CQI/RI/PMI dela		ms	6.5
Maximum numb	er of HARQ		4
transmission	hannal		D DDCCH 2 9 2 TDD
PDSCH & PDSCH DMRS Precoding configuration for random Precoding			R.PDSCH.2-8.3 TDD Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i ₁ , i ₂ combination, and with Wideband granularity
Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable 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),			random precoder selection, the bt (0.5 ms granularity) with equal mbination. k reporting instance at slot#n lk slot not later than slot#(n-6),
this reported PMI cannot be applied at the gNB downlink before slot#(n+6). Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.			•

Table 6.3.3.2.4-2: Minimum requirement

Parameter	Test 1
γ	7.0

6.3.3.2.5 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			TDD
TDD DL-UL configurations			FR1.30-1 as specified in Annex A
Propagation channel			TDLA30-5
			XP Medium 16 x 4
Antenna configuration			(N1,N2) = (4,2)
Beamforming	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
	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-		(9,-)
	RS (I ₀ , I ₁) 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) CDM Type		CDM4 (FD2, TD2)
	Density (p)		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		
	interval and offset	slot	Not configured
	aperiodicTriggeringOff		0
	set		0
	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM	CSI-IM Resource		(4.0)
configuratio n	Mapping		(4,9)
11	(kcsi-im,lcsi-im) CSI-IM timeConfig		
	interval and offset	slot	Not configured
ReportConfig			Aperiodic
CQI-table			Table 1
reportQuantit	reportQuantity		cri-RI-PMI-CQI
timeRestrictionForlChannelMeasurem ents			Not configured
timeRestrictionForInterferenceMeasur			N
ements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Subband
Sub-band Size		RB	16
csi-ReportingBand CSI-Report interval and offset		slot	1111111 Not configured
Aperiodic Report Slot Offset		SIUL	Not configured 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 configuratio n	Codebook Type		typell
	L (numberOfBeams)		2
	Nesk		
	(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 (typeII- RI-Restriction)		10
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 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.			
	the LIE reports in an available unlink reporting instance at slottin based		

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 6.3.3.2.5-2: 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 spa	acing	kHz	30
Duplex Mode			TDD
TDD DL-UL co	onfigurations		FR1.30-1 as specified in Annex A
Propagation c	hannel		TDLA30-5
Antenna config	guration		XP Medium 16 x 4
Beamforming			(N1,N2) = (4,2) As specified in Annex B.4.1
2009	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 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)		CDM4 (ED2 TD2)
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
NZP CSI-	First subcarrier index in the PRB used for		Bow 12 (2 4 6 8)
RS for CSI	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-		(5, -)
	RS (I ₀ , I ₁)		(-, ,
	CSI-RS	-1-4	Not a self-several
	interval and offset	slot	Not configured
	aperiodicTriggeringOff		0
	set		
	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM	CSI-IM Resource		
configuratio	Mapping		(4,9)
n	(KCSI-IM, ICSI-IM)		
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfigT			Aperiodic
CQI-table	,,		Table 1
reportQuantity	,		cri-RI-PMI-CQI
timeRestriction ents	nForlChannelMeasurem		Not configured
	nForInterferenceMeasur		Not configured
cqi-FormatIndi	icator		Wideband
pmi-FormatInd			Not configured
Sub-band Size		RB	8
csi-ReportingE			1111111
	erval and offset	slot	Not configured
Aperiodic Rep			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 pointers			
	Codebook Type		to NZP CSI-RS and CSI-IM typell-r16			
			6			
	paramCombination-r16		(L =4, $p_v = 1/2$, $\beta = 1/2$)			
Codebook configuratio	R(numberOfPMISubba ndsPerCQISubband- r16)		1			
	(CodebookConfig- N1,CodebookConfig- N2)	(4,2)				
n	(CodebookConfig- O1,CodebookConfig- O2)		(4,4)			
	CodebookSubsetRestri		0x 7FF			
	ction		FFFF FFFF FFFF			
	RI Restriction (typeII- RI-Restriction-r16)		0010			
Physical cha	nnel for CSI report		PUSCH			
CQI/RI/PMI	delay	ms	6.5			
Maximum nu	mber of HARQ		4			
transmission			•			
Measuremer			R.PDSCH.2-8.3 TDD			
pr	ecoder shall be updated in	andom precoder selection, the (0.5 ms granularity) with equal				
	probability of each applicable i1, i2 combination. The random precoder					
			l' codebook configuration as			
	pecified 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
Dearmonning			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)				
	First OFDM symbol in the PRB		(9)	(9)	(9)
	used for CSI-RS (I ₀)		()	,	()
	CSI-RS	slot	5/1	5/1	5/1
	periodicity and offset		Doriodio	Doriodio	Periodic
	CSI-RS resource Type Number of CSI-RS ports (X)		Periodic 2	Periodic 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		I	l l	I
acquisition	PRB used for CSI-RS (k ₀)		Row 3 (6)	Row 3 (6)	Row 3 (6)
	First OFDM symbol in the PRB				
	used for CSI-RS (I ₀)		(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	-1-4	F /A	F/4	E /A
	periodicity and offset	slot	5/1	5/1	5/1
ReportConfig	Type		Periodic	Periodic	Periodic
CQI-table			Table 2	Table 2	Table 2
reportQuantity	J		cri-RI-PMI-CQI	cri-RI-PMI-	cri-RI-PMI-
reporteduring	,		OII IXI I WII OQI	CQI	CQI
timeRestrictio	nForChannelMeasurements		not configured	not	not
timortootnotio	THE CHAINTOINICE CONTOINES		not comigared	configured	configured
timeRestrictio	nForInterferenceMeasurements		not configured	not	not
				configured	configured
cqi-FormatInc			Wideband	Wideband	Wideband
pmi-FormatIn		DD	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- SinglePanel
	Codebook Mode		SinglePanel	SinglePanel	Jingleranel
	(CodebookConfig-		l l	l l	I
Codebook	N1,CodebookConfig-N2)		N/A	N/A	N/A
configuration	CodebookSubsetRestriction		010000 for	000011 for	000011 for
corniguration	Codebookodbsetrestriction		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
Physical char	nnel for CSI report		PUCCH	PUCCH	PUCCH
CQI/RI/PMI d		ms	8	8	8
Maximum nur	nber of HARQ transmission		1	1	1
			Fixed RI = 2	Fixed RI = 1	Fixed RI = 1
RI Configurati			and follow RI	and follow RI	and follow RI
Note 1: Me	asurements channels are specifie	d in Table			

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

Table 6.4.2.1-2: Minimum requirement (FDD)

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

6.4.2.2 TDD

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

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

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

Table 6.4.2.2-1: RI Test (TDD)

	Parameter	Unit	Test 1	Test 2	Test 3
Bandwidth		MHz	40	40	40
Subcarrier spa	acing	kHz	30	30	30
Duplex Mode			TDD	TDD	TDD
TDD Slot Con	figuration		FR1.30-1	FR1.30-1	FR1.30-1
SNR		dB	0	20	20
Propagation of			TDLA30-5	TDLA30-5	TDLA30-5
Antenna confi	guration		ULA Low 2x2	ULA Low 2x2	ULA High 2x2
Beamforming	Model		As defined in Annex B.4.1	As defined in Annex B.4.1	As defined in Annex B.4.1
	CSI-RS resource Type		Periodic	Periodic	Periodic
	Number of CSI-RS ports (X)		4	4	4
	CDM Type		FD-CDM2	FD-CDM2	FD-CDM2
ZP CSI-RS	Density (ρ)		1	1	1
configuratio n	First subcarrier index in the PRB used for CSI-RS (k ₀)		Row 5,(4)	Row 5,(4)	Row 5,(4)
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		(9)	(9)	(9)
	CSI-RS	slot	10/1	10/1	10/1
	periodicity and offset 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 D-0DIVIZ	1 D-0DIVIZ	1 D-0DIVIZ
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) First OFDM symbol in the PRB		1.0W 3 (0)	10W 3 (0)	10W 3 (0)
	used for CSI-RS (I ₀)		(13)	(13)	(13)
	NZP CSI-RS-timeConfig periodicity and offset	slot	10/1	10/1	10/1
	CSI-IM resource Type		Periodic	Periodic	Periodic
CSI-IM	CSI-IM RE pattern		Pattern 0	Pattern 0	Pattern 0
configuratio	CSI-IM Resource Mapping (k _{CSI-IM} , l _{CSI-IM})		(4,9)	(4,9)	(4,9)
"	CSI-IM timeConfig periodicity and offset	slot	10/1	10/1	10/1
ReportConfig			Periodic	Periodic	Periodic
CQI-table			Table 2	Table 2	Table 2
reportQuantity	1		cri-RI-PMI-CQI	cri-RI-PMI- CQI	cri-RI-PMI- CQI
timeRestrictio	nForChannelMeasurements		not configured	not configured	not configured
timeRestrictio	nForInterferenceMeasurements		not configured	not	not
cgi-FormatInd	licator		Wideband	configured Wideband	configured Wideband
pmi-FormatIn			Wideband	Wideband	Wideband
Sub-band Siz		RB	16	16	16
csi-Reporting		1,0	1111111	1111111	1111111
	eriodicity and offset	slot	10/9	10/9	10/9
33 topon pt	Codebook Type	3.00	typel-	typel-	typel-
			SinglePanel	SinglePanel	SinglePanel
	Codebook Mode		1	1	1
Codebasts	(CodebookConfig-		N/A	N/A	N/A
Codebook configuration	N1,CodebookConfig-N2) CodebookSubsetRestriction	1		000011 for	000011 for
configuration	CodebookSubsetRestriction		010000 for		
			fixed rank 2, 010011 for	fixed rank 1, 010011 for	fixed rank 1, 010011 for
		1	following rank	following rank	following rank
	RI Restriction		N/A	N/A	N/A
Physical chan	nel for CSI report		PUCCH	PUCCH	PUCCH
CQI/RI/PMI de		ms	9.5	9.5	9.5
	nber of HARQ transmission	1	1	1	1
			Fixed RI = 2	Fixed RI = 1	Fixed RI = 1
RI Configurati	On		and follow RI	and follow RI	and follow RI
Note 1. Me	aguramanta abannala ara anggifia	ملمام تالم	A 4 0 TDC 0 0 :-	used for Deals 4	acco 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
Doannenning			Annex B.4.1	Annex B.4.1	Annex B.4.1	Annex B.4.1
ļ	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 (1)
configuratio n	First subcarrier index in the PRB used for CSI-RS (k ₀)		Row 5,(4)	Row 5,(4)	Row 5,(4)	Row 5,(4)
''	First OFDM symbol in the PRB					
	used for CSI-RS (I ₀)		(9)	(9)	(9)	(9)
}	CSI-RS	_			_	
	periodicity and offset	slot	5/1	5/1	5/1	5/1
	CSI-RS resource Type		Periodic	Periodic	Periodic	Periodic
	Number of CSI-RS ports (X)		2	2	2	4
NZD OOL	CDM Type		FD-CDM2	FD-CDM2	FD-CDM2	FD-CDM2
NZP CSI-	Density (ρ)		1	1	1	1
RS for CSI acquisition	First subcarrier index in the		Dow 2 (6)	Dow 2 (6)	Dow 2 (6)	Doy 4 (0)
acquisition	PRB used for CSI-RS (k ₀)		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)		(13)	(13)	(13)	(13)
	NZP CSI-RS-timeConfig	slot	5/1	5/1	5/1	5/1
	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	(Kcsi-im, lcsi-im) CSI-IM timeConfig					
	periodicity and offset	slot	5/1	5/1	5/1	5/1
ReportConfig			Periodic	Periodic	Periodic	Periodic
CQI-table	урс		Table 2	Table 2	Table 2	Table 2
				cri-RI-PMI-	cri-RI-PMI-	cri-RI-PMI-
reportQuantity	1		cri-RI-PMI-CQI	CQI	CQI	CQI
time a Depatriation	nForChannelMeasurements		n at a anti-muna d	not	not	not
timeRestriction	nForChannelivieasurements		not configured	configured	configured	configured
timoPostriction	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	8	8	8	8
csi-Reporting		-1.1	1111111	1111111	1111111	1111111
CSI-Report pe	eriodicity and offset	slot	5/0	5/0	5/0	5/0
	Codebook Type		typel- SinglePanel	typel- SinglePanel	typel- SinglePanel	typel- SinglePanel
	Codebook Mode		1	1	1 3 11 19 15 16 16 16 16 16 16 16 16 16 16 16 16 16	3111916F al 161
	(CodebookConfig-		ı	ı	ı	ı
	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,	444444
configuration			010011 for	010011 for	010011 for	11111111
			following rank	following rank	following rank	
	RI Restriction					00000010 for
						fixed Rank 2
			N/A	N/A	N/A	and
						00001111 for
Dhysical -l-	not for CCI report		DUCCU	DITOCIT	DUCCU	follow RI
	nel for CSI report	ma	PUCCH	PUCCH	PUCCH	PUCCH
CQI/RI/PMI de	elay nber of HARQ transmission	ms	8	8	8	8
IVIANITIUITI TIUIT	IDOLOUTIANA HAHAHIISSIUN	ĺ	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 is used for Rank 2 case, TBS 3-1 is used.	e 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				

Table 6.4.3.1-2: Minimum requirement (FDD)

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

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	nfiguration		FR1.30-1	FR1.30-1	FR1.30-1	FR1.30-1
SNR		dB	-2	16	16	22
Propagation of	channel		TDLA30-5	TDLA30-5	TDLA30-5	TDLA30-5
Antenna confi			ULA Low 2x4	ULA Low 2x4	ULA High 2x4	ULA Low 4x4
	*		As defined in	As defined in	As defined in	As defined in
Beamforming	Model		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)					
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		(9)	(9)	(9)	(9)
	CSI-RS	slot	10/1	10/1	10/1	10/1
	periodicity and offset	5.51				
	CSI-RS resource Type		Periodic	Periodic	Periodic	Periodic
	Number of CSI-RS ports (X)		2	2	2	4
NIZD 00:	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)		- (-)	(-)	(-)	- (-)
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		(13)	(13)	(13)	(13)
	NZP CSI-RS-timeConfig periodicity and offset	slot	10/1	10/1	10/1	10/1
	CSI-IM resource Type		Periodic	Periodic	Periodic	Periodic
CSI-IM	CSI-IM RE pattern		Pattern 0	Pattern 0	Pattern 0	Pattern 0
configuratio n	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(4,9)	(4,9)	(4,9)	(4,9)
	CSI-IM timeConfig periodicity and offset	slot	10/1	10/1	10/1	10/1
ReportConfig ⁻	Type		Periodic	Periodic	Periodic	Periodic
CQI-table			Table 2	Table 2	Table 2	Table 2
reportQuantity	У		cri-RI-PMI-CQI	cri-RI-PMI- CQI	cri-RI-PMI- CQI	cri-RI-PMI- CQI
timeRestrictio	nForChannelMeasurements		not configured	not configured	not configured	not configured
timeRestrictio	nForInterferenceMeasurements		not configured	not configured	not configured	not configured
cqi-FormatInd	dicator		Wideband	Wideband	Wideband	Wideband
pmi-FormatIn	dicator		Wideband	Wideband	Wideband	Wideband
Sub-band Siz		RB	16	16	16	16
csi-Reportingl			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-
			SinglePanel	SinglePanel	SinglePanel	SinglePanel
	Codebook Mode		1	1	1	1
	(CodebookConfig-		N/A	N/A	N/A	(2,1)
	N1,CodebookConfig-N2)					` ' '
Codebook	CodebookSubsetRestriction		010000 for	000011 for	000011 for	
configuration			fixed rank 2, 010011 for	fixed rank 1, 010011 for	fixed rank 1, 010011 for	11111111
Comiguration			following rank	following rank	following rank	
	RI Restriction		TOTIOWING FAITK	TOTIOWING FAIR	TOTIOWING TALIK	00000010 for
	TA ROSUIGUOII					fixed Rank 2
			N/A	N/A	N/A	and
	1		13//	1 4// 1	13//	00001111 for
						follow RI
Physical chan	nnel for CSI report		PUCCH	PUCCH	PUCCH	follow RI PUCCH
Physical chan	nnel for CSI report	ms	PUCCH 9.5	PUCCH 9.5	PUCCH 9.5	

PI Configuration			Fixed RI = 2	Fixed RI = 1	Fixed RI = 1	Fixed RI = 2	
	RI Configuration			and follow RI	and follow RI	and follow RI	and follow RI
	Note 1: Measurements channels are specified in Table A.4-2 and Table A.4-3. TBS.2-3 is used for Rank 1 case. TBS.2-4						
	is used for Rank 2 case. 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 (drx-Adaptation-r16)	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
	FR2 TDD	PDSCH	Clause 7.2	
Support of PT-RS with one antenna port for DL reception (onePortsPTRS)		SDR	Clause 7.5.1 Clause 7.5A.1	
PCell operation on FR2 (<i>pCell-FR2</i>)	FR2 TDD	SDR	Clause 7.5A.1	
PDSCH mapping type B (pdsch-MappingTypeB)	FR2 TDD	PDSCH	Clause 7.2.2.2.3	

7.1.1.5 Applicability of CA requirements

7.1.1.5.1 Definition of CA capability

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

Table 7.1.1.5.1-1: Definition of CA capability

CA Capability	CA Capability Description			
CA_C	Intra-band contiguous CA			
CA_N	Intra-band non-contiguous CA			
CA_AX	Inter-band CA (X bands)			
NOTE 1: CA_C corresponds to NR CA configurations and bandwidth combination sets 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 test.						

7.2 PDSCH demodulation requirements

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

Table 7.2-1: Common Test Parameters

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

	,		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 (lo)		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 (ρ)		1
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 =
	First subcarrier index in the PRB used for CSI-RS		ceil(BWP size/4) *4 k ₀ =0 for CSI-RS resource 1,2
	NO .		I ₀ = 8 for CSI-RS
	First OFDM symbol in the PRB used for CSI-RS		resource 1 l ₀ = 9 for CSI-RS
	Number of CSI-RS ports (X)		resource 2 1 for CSI-RS resource
	CDM Type		1,2 'No CDM' for CSI-RS
	СЫМ Туре		resource 1,2
CSI-RS for beam refinement	Density (ρ)		3 for CSI-RS resource 1,2
Tomorio	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 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

	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 atata #1		QCL Type	Type A			
TCI state #1	Type 2 QCL information	CSI-RS resource	CSI-RS resource 1 from 'CSI-RS for tracking' configuration			
		QCL Type	Type D			
	Frequency den	sity (<i>K</i> _{PT-RS})	2			
PTRS configuration	Time density (1				
	Resource Elen	nent Offset	2			
Maximum number of	code block group	os for ACK/NACK feedback	1			
Maximum number of	HARQ transmiss	ion	4			
HARQ ACK/NACK bu	undling		Multiplexed			
Redundancy version	{0,2,3,1}					
PDSCH & PDSCH D	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 unuse	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					
Note 1: LIF assum	Note 1: LIE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH					

Note 1: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH transmission.

Note 2: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-2 [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)

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

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

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

7.2.2.2.2 Minimum requirements for PDSCH repetitions over multiple slots

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

The test purpose is specified in Table 7.2.2.2.1.

Table 7.2.2.2.1: Test purpose

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

Table 7.2.2.2.2-2: Test Parameters

	Parameter	Unit	Value
Duplex mode			TDD
Active DL BWP index			1
	Mapping type		Type A
	kO		0
	Starting symbol (S)		1
	Length (L)		13
	PDSCH aggregation factor		2
PDSCH configuration	PRB bundling type		Static
1 D3C(1 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 Proces	ses		2
The number of slots between final repetition of PDSCH and corresponding HARQ-ACK information			As defined in Annex A.1.3 (Note 1)
	edback is generated for PDSCH on slot i, whe	re 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	channel	Subcarrier spacing (kHz)	and code rate	DL pattern	condition	antenna configuration	Target BLER	SNR (dB)
1-1	R.PDSCH. 5-11.1 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 inde	ex		1	
PDCCH configuration	Number of PDCCH candidates and aggregation levels	1/AL8		
	Mapping type		Туре В	
	k0 Starting symbol (S)		0 1	
	Length (L)		2	
PDSCH	PDSCH aggregation factor PRB bundling type		1 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 P	rocesses		8	
The number of slots ACK information	The number of slots between PDSCH and corresponding HARQ-		Specific to each TDD UL-DL pattern and as defined in Annex A.1.3	

Table 7.2.2.3-3: Minimum performance for Rank 1

		Bandwidth	Mandadatian	TDD III		Correlation matrix and antenna configuration	Correlation Reference val		alue
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	TDD UL- DL pattern	Propagation condition		Fraction of maximum throughput (%)	SNR (dB)	
1-1	R.PDSCH. 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	Unit	Value	
Duplex mode			TDD	
Active DL BWP index	X		1	
	Mapping type		Type A	
	k0		0	
	Starting symbol (S)		1	
	Length (L)		Specific to each Reference channel	
	PDSCH aggregation factor		1	
PDSCH	PRB bundling type		Static	
configuration	PRB bundling size		2	
	Resource allocation type		Type 0	
	RBG size		Config2	
	VRB-to-PRB mapping type		Non-interleaved	
	VRB-to-PRB mapping interleaver bundle		N/A	
	size		IN/A	
	DMRS Type		Type 1	
PDSCH DMRS	Number of additional DMRS		1	
configuration	Maximum number of OFDM symbols for		1	
	DL front loaded DMRS		I.	
	Number of HARQ Processes		8	
TDD UL-DL pattern	TDD UL-DL pattern		120kHz SCS: FR2.120-1	
The number of slots ACK information	between PDSCH and corresponding HARQ-		As defined in Annex A.1.3	

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

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

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

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

7.3 PDCCH demodulation requirements

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

The parameters specified in Table 7.3-1 are valid for all PDCCH tests unless otherwise stated.

Table 7.3-1: Common test Parameters

	Parameter	Unit	Value
Carrier configuration	Offset between Point A and the lowest usable subcarrier on this		0
	carrier (Note 1)		
DL BWP configuration #1	Cyclic prefix		Normal
Common	Physical Cell ID		0
serving cell	SSB position in burst		1
parameters	SSB periodicity Slots for PDCCH monitoring	ms	20 Each slot
	Number of PDCCH candidates		1
PDCCH configuration	Frequency domain resource allocation for CORESET		Start from RB = 0 with contiguous RB allocation
	TCI state		TCI state #1
	First subcarrier index in the PRB used for CSI-RS (k0)		0
	First OFDM symbol in the PRB used for CSI-RS (I0)		CSI-RS resource 1: 4 CSI-RS resource 2: 8 CSI-RS resource 3: 4 CSI-RS resource 4:
CSI-RS for	Number of CSI-RS ports (X)		1
tracking	CDM Type		No CDM
	Density (ρ)		3
	CSI-RS periodicity	Slots	160
	CSI-RS offset	Slots	80 for CSI-RS resource 1 and 2 81 for CSI-RS resource 3 and 4
	Frequency Occupation		Start PRB 0 Number of PRB = ceil(BWP size/4)*4
	QCL info		TCI state #0
	First subcarrier index in the PRB used for CSI-RS (k0)		0
	First OFDM symbol in the PRB used for CSI-RS (I0)		CSI-RS resource 1: 8 CSI-RS resource 2: 9
	Number of CSI-RS ports (X)		1
	CDM Type		No CDM
NZP CSI-RS for	Density (ρ)		3
beam refinement	CSI-RS periodicity	Slots	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
PDCCH & PDCCH	I 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
TOL state #0	000 : 4		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 un	used REs		OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1		
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.

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	TDD UL-DL pattern FR2.120-1		20-1	
CCE to REG mapping type		Interleaved		
REG bundle size		2 for test 1-1 6 for test 1-2	2	
Interleaver size		3 for test 1-1 2 for test 1-2	3	
Shift index		0		

7.3.2.2.1 1 Tx Antenna performances

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

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

Test	Bandwidth	CORES	CORESET	Aggragation	Reference	Propagation	Antenna configuration		erence value
num ber	(MHz)	ET RB	duration	33 3 3 3 4		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	Panduridth.	Randwidth CORESE		Bandwidth CORESE CORESET Aggregation	Reference	Propagation	Antenna configuration	_	erence alue
num ber	(MHz)	TRB	duration	level	Channel	Condition	and correlation Matrix	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			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: TminimumTimeGap is signaled as a part of drx-Adaptation-r16 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 (MHz)	h CORESET CORESET Aggregation Reference Brone		RESET CORESET Aggregation Reference Propagat	Propagation	Antenna configuration		rence lue	
Test number		RB	duration	level	Channel	Condition	and correlation Matrix	Pm- dsg (%)	SNR _{BB} (dB)
3-1	100	60	1	4	R.PDCCH. 5-1.2 TDD	TDLA30-300	1x2 Low	1	3.0
3-1	100	100 60 1	'	8		1DLA30-300	TXZ LOW	·	3.0

7.4 PBCH demodulation requirements

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

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

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

7.4.1 1RX requirements

(Void)

7.4.2 2RX requirements

7.4.2.1 FDD

(Void)

7.4.2.2 TDD

Table 7.4.2.2-1: Test parameters for PBCH

Parameter	Unit	Single antenna port			
Physical Cell ID		0			
Cyclic prefix		Normal			
Number of SS/PBCH blocks within an SS burst set periodicity		1			
SS/PBCH block index Note1		0			
SS/PBCH block periodicity	ms	20			
TDD UL-DL pattern		FR2.120-1			
Note 1: as specified in clause 4.1 of TS 38.213 [11]					
Note 2: as specified in clause 11.1 of TS 38.213 [11]					

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

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

Test Bandwidth (MHz) /		Reference	Propagation	Antenna configuration	Reference value		
number	Subcarrier spacing (kHz)	channel	condition	and correlation matrix	Pm- bch (%)	SNR _{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	Test Bandwidth (MHz) /		Propagation	Antenna configuration	Reference 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 First DMRS position for Type A PDSCH	ms	20
	mapping		2
Cross carrier schedu			Not configured
Active DL BWP inde			1
Actual carrier	Offset between Point A and the lowest usable subcarrier on this carrier (Note 3)	RBs	0
configuration	Subcarrier spacing	kHz	60 or 120
	RB Offset		0
DL BWP configuration #1	Number of contiguous PRB		Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-2 [7] for tested channel bandwidth and subcarrier spacing
	Subcarrier spacing	kHz	60 or 120
	Cyclic prefix		Normal
	Slots for PDCCH monitoring		Each slot
	Symbols with PDCCH Number of PRBs in CORESET		Symbols #0 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 Single Panel Type I, Random per slot
	PDCCH &PDCCH DMRS Precoding configuration		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 PRB bundling size		Static wideband
PDSCH	Resource allocation type		Type 0
configuration	RBG size		Config2
3	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
	Starting symbol (S)		1
	Length (L)		13
	DMRS Type		Type 1
	Number of additional DMRS		1
PDSCH DMRS	Length		1 {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 configuration	Frequency density (<i>K</i> _{PT-RS}) Time density (<i>L</i> _{PT-RS})		2
- Jonnyaranon	Subcarrier indexes in the PRB used for		$k_0 = 3$ for CSI-RS resource 1,2,3,4
	CSI-RS OFDM symbols in the PRB used for CSI-		l ₀ = 6 for CSI-RS resource 1 and 3
CSI-RS for tracking	RS		l ₀ = 10 for CSI-RS resource 2 and 4
	Number of CSI-RS ports (X)		1 for CSI-RS resource 1,2,3,4 'No CDM' for CSI-RS resource
	CDM Type		1,2,3,4
	Density (ρ)		3 for CSI-RS resource 1,2,3,4

CSI-RS periodicity		Т			Tablus 200 201 201 20
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 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					
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)			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: 160 for CSI		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 Slots 1,2 120 kHz SCS: 160 for CSI-RS resource 1,2		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			ļ	
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	f code block arouns fo			
recubach	Maximum number of	i code block groups it			

Number of HARQ Pr	ocesses	10 for FR2.60-1 and 8 for FR2.120-1		
K1 value		Specific to each UL-DL pattern		
Maximum number of	HARQ transmission	4		
HARQ ACK/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, cha	Physical signals, channels mapping and precoding As specified in Annex B.4.1			
	s scheduled only on full DL slots not containing the sthat the TCI state for the PDSCH is identication.			

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

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

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

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

Maximum number of PDSCH MIMO layers	Maximum modulation format (Note 1)	Scaling factor	MCS (Note 2)
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.

.

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

UE feature/capability [14]	Test	type	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
Cupport of 1 port DTDC	FR2 TDD	CQI	Clause 8.2	
Support of 1 port PTRS (onePortsPTRS)		PMI	Clause 8.3	
(Olier Olisr TNS)		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

	1	T	1
	PDCCH & PDCCH DMRS Precoding configuration		Multi-path fading propagation conditions: Single Panel Type I, Random per slot with equal probability of each applicable i1, i2 combination, and with REG bundling granularity for number of Tx larger than 1
Cross carrier sch	nedulina		Not configured
	Mapping type		Type A
	kO		0
	Starting symbol (S)		2
	Length (L)		12
			1
DDCCH	PDSCH aggregation factor		
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
	Number of additional DMRS		1
	Number of additional Divino		{1000} for Rank1
	DMD0 a sate in decree		
BB0011 B14B0	DMRS ports indexes		{1000,1001} for
PDSCH DMRS			Rank2
configuration	Maximum number of OFDM symbols for DL front loaded DMRS		1
	Number of PDSCH DMRS CDM group(s) without data		2
	Frequency density (KPT-RS)		2
PTRS	Time density (<i>L_{PT-RS}</i>)		1
configuration	Resource Element Offset		2
	First subcarrier index in the PRB		0 for CSI-RS
	used for CSI-RS (k ₀)		resource 1,2,3,4
	First OFDM symbol in the PRB used for CSI-RS (<i>l</i> ₀)		4 for CSI-RS resource 1 and 3 8 for CSI-RS
			resource 2 and 4
	11 1 (00) 50 1 ()4		1 for CSI-RS
	Number of CSI-RS ports (X)		resource 1,2,3,4
			No CDM for CSI-RS
	CDM Type		resource 1,2,3,4
			3 for CSI-RS
CSI-RS for	Density (ρ)		resource 1,2,3,4
tracking	CSI-RS periodicity	slot	120kHz SCS: 160 for CSI-RS resource
	- Control parametry		1,2,3,4
	CSI-RS offset	slot	120 kHz SCS: 80 for CSI-RS resource 1 and 2 81 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
	QUE IIIIU		
NZP CSI-RS for CSI	Frequency Occupation		Start PRB 0 Number of PRB =
acquisition	OCL info		ceil(BWP size /4)*4
	QCL info	ļ	TCI state #1

Prequency Occupation	<u> </u>	T			
Frequency Occupation	ZP CSI-RS for	Fraguera	locupation .		Start PRB 0
First subcarrier index in the PRB used for CSI-RS resource 1.2 lo = 8 for CSI-RS resource 1.2 lo = 9 for CSI-RS resource 1.2 lo = 10 for CSI-RS lo = 10 for CSI		requency C	ccupation		
Used for CSI-RS		Firet subcarr	ier index in the PRR		
First OFDM symbol in the PRB used for CSI-RS resource 1 lo = 9 for CSI-RS resource 2 Number of CSI-RS ports (X) 1 for CSI-RS resource 1.2 1 for CSI-RS resource					
First OFDM symbol in the PRB used for CSI-RS used for CSI-RS used for CSI-RS 1 o = 9 for CSI-RS resource 1 1 o = 9 for CSI-RS resource 1.2		4004 101 001	1.0		
		First OFDM s	symbol in the PRB		
Number of CSI-RS ports (X)					
CSI-RS for beam refinement CSI-RS ports (x) resource 1,2 CDM Type TNO CDM for CSI-RS resource 1,2 To CSI-RS re					resource 2
CSI-RS for beam refinement CSI-RS periodicity CSI-RS periodicity CSI-RS periodicity Slots 120 kHz SCS: 160 Frequency Occupation Start PRB 0 Number of PRB = ceil(BWP size 4)14 CSI-RS periodicity CSI-RS periodicity CSI-RS periodicity Slots Slots CSI-RS periodicity Slots Slots CSI-RS periodicity Slots Slots CSI-RS periodicity Slots Prequency Occupation Slots Prequency Occupation Slots Slots Slots Slots Prequency Occupation Slots Slots Preparation Slots Slots Slots Slots Preparation Slots		Number of C	SI-RS ports (X)		
CSI-RS for beam refinement		14diliber of 0	or ito ports (x)		
Density (p)	COLDS for	CDM Type			
Testolicit 1.2		Density (p)			
CSI-RS periodicity		2 0 (P)			
CSI-RS offset		001.00	1: -1: -	01-4-	
CSI-RS offset		CSI-RS perio	Daicity	Siots	
TCI state #0 TCI state #0 Tol state #1 T					
Repetition		CSI-RS offse	et	Slots	
Repetition QCL info TCl state #1					
Repetition		Frequency C	ccupation		
TCI state #1 Type 1 QCL Type Type C Type C Type C QCL Information QCL Type Type D Type D Type D QCL Information QCL Type Type D Type D Type D QCL Information QCL Type Type A CSI-RS resource Type A					
TCI state #0 Type 1 QCL Information QCL Type Type C Type C		Repetition			ON
TCI state #0 Type 2 SSB index QCL Type Type D					TCI state #1
TCI state #0 Information Type 2 SSB index SSB #0 QCL Type Type D			SSB index		SSB #0
Type 2 QCL information Type 1 QCL Type Type 1 QCL Type Type 1 QCL Type Type 3 CSI-RS resource 1 from 'CSI-RS for tracking' configuration TCI state #1 Type 2 QCL information QCL Type Type 2 QCL information QCL Type Type A CSI-RS resource 1 from 'CSI-RS for tracking' configuration CSI-RS resource 1 from 'CSI-RS for tracking' configuration QCL Type Number of HARQ Processes HARQ ACK/NACK bundling Redundancy version coding sequence Number of HARQ Processes HARQ ACK/NACK bundling Redundancy version coding sequence K1 value (PDSCH-to-HARQ-timing-indicator) K1 value (PDSCH-to-HARQ-timing-indicator) Symbols for unused REs Physical signals, channels mapping and precoding Physical signals, channels mapping and precoding As specified in			QCL Type		Type C
TCI state #1 Tol state #1 For FR2 Rs resource 1 from 'CSI-RS for tracking' configuration Tol state #1 For FR2 Rs resource 1 from 'CSI-RS for tracking' configuration #8 Multiplexed #8 #8 #8 #8 ## ARQ ACK/NACK bundling ## Multiplexed ## For FR2.120-1: 3 if mod (i.5) = 0, 6 if mod(i.5) = 0, 6 if mod(i.5) = 2 For FR2.120-2: 11 if mod(i,8) = 0, 7 jif mod(i,8) = 4, 6 jif mod(i,8) = 5, where i is slot index per radio fame with values 0-79. OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1 Physical signals, channels manning and precoding As specified in	TCI state #0		SSB index		SSB #0
TCI state #1 Tol state #1 To		QCL			Type D
Type 1 QCL information TCI state #1 Type 2 QCL information Redundancy version coding sequence K1 value (PDSCH-to-HARQ-timing-indicator) Symbols for unused REs CSI-RS resource CSI-RS resource CSI-RS resource CSI-RS resource from 'CSI-RS for tracking' configuration Type A CSI-RS resource 1 from 'CSI-RS for tracking' configuration RCL Type Type D Multiplexed (Q.2,3,1) For FR2.120-1: 3 if mod (i.5) = 0, 6 if mod(i,5) = 2 For FR2.120-2: 11 if mod(i,8) = 0, 7 jif mod(i,8) = 5, where i is slot index per radio fame with values 0-79. OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1 Physical signals, channels mapping and precoding.		inomation			CSI-RS resource 1
TCI state #1 TCI state #1 Type 2 QCL QCL Information QCL Type Type 2 QCL Information QCL Type Type 2 QCL Information QCL Type Type D Number of HARQ Processes HARQ ACK/NACK bundling Redundancy version coding sequence Redundancy version coding sequence K1 value (PDSCH-to-HARQ-timing-indicator) For FR2.120-1: 3 if mod (i,5) = 2 For FR2.120-2: 11 if mod(i,8) = 5, where i is slot index per radio fame with values 0-79. OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1 Physical signals, channels mapping and precoding. As specified in		Type 1	001.00		
TCI state #1 Total table			CSI-RS resource		
Type 2 QCL information QCL Type Number of HARQ Processes HARQ ACK/NACK bundling Redundancy version coding sequence K1 value (PDSCH-to-HARQ-timing-indicator) CSI-RS resource 1 from 'CSI-RS for tracking' configuration Type D Multiplexed {0,2,3,1} For FR2.120-1: 3 if mod (i.5) = 0, 6 if mod(i,5) = 2 For FR2.120-2: 11 if mod(i,8) = 0, 7]if mod(i,8) = 4, 6]if mod(i,8) = 5, where i is slot index per radio fame with values 0-79. OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1 Physical signals, channels mapping and precoding. CSI-RS resource 1 from 'CSI-RS for tracking' configuration Reluction Type D Multiplexed {0,2,3,1} For FR2.120-1: 3 if mod (i,5) = 0, 6 if mod(i,5) = 2 For FR2.120-2: 11 if mod(i,8) = 5, where i is slot index per radio fame with values 0-79. OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1		information			
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CSI-RS resource tracking' configuration	101 State #1				
Number of HARQ Processes HARQ ACK/NACK bundling Redundancy version coding sequence Redundancy version coding sequence (0,2,3,1) For FR2.120-1: 3 if mod (i.5) = 0, 6 if mod(i,5) = 2 For FR2.120-2: 11 if mod(i,8) = 0, 7]if mod(i,8) = 4, 6]if mod(i,8) = 5, where i is slot index per radio fame with values 0-79. OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1 Physical signals, channels mapping and precoding. Redundancy version QCL Type Type D Type D Redundancy Allitplexed (0,2,3,1) For FR2.120-1: 3 if mod (i,5) = 0, 6 if mod(i,5) = 2 For FR2.120-2: 11 if mod(i,8) = 0, 7]if mod(i,8) = 5, where i is slot index per radio fame with values 0-79. OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1			CSI-RS resource		
Number of HARQ Processes HARQ ACK/NACK bundling Redundancy version coding sequence Redundancy version coding sequence Redundancy version coding sequence For FR2.120-1: 3 if mod (i.5) = 0, 6 if mod(i,5) = 2 For FR2.120-2: K1 value (PDSCH-to-HARQ-timing-indicator) (PDSCH-to-HARQ-timing-indicator) Tif mod(i,8) = 4, 6]if mod(i,8) = 5, where i is slot index per radio fame with values 0-79. OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1 Physical signals, channels mapping and precoding. As specified in			COLITIO 10000100		
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HARQ ACK/NACK bundling Redundancy version coding sequence Redundancy version coding sequence For FR2.120-1: 3 if mod (i.5) = 0, 6 if mod(i,5) = 2 For FR2.120-2: 11 if mod(i,8) = 0, 7]if mod(i,8) = 4, 6]if mod(i,8) = 5, where i is slot index per radio fame with values 0-79. OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1 Physical signals, channels mapping and precoding. As specified in	Number of HADC	Dragge	QCL Type		
Redundancy version coding sequence {0,2,3,1} For FR2.120-1: 3 if mod (i.5) = 0, 6 if mod(i,5) = 2 For FR2.120-2: 11 if mod(i,8) = 0, 7]if mod(i,8) = 4, 6]if mod(i,8) = 5, where i is slot index per radio fame with values 0-79. OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1 Physical signals, channels mapping and precoding. Redundancy version coding sequence {0,2,3,1} For FR2.120-1: 3 if mod (i.5) = 0, 6 if mod(i,5) = 2 For FR2.120-2: 11 if mod(i,8) = 5, where i is slot index per radio fame with values 0-79. OP.1 FDD as defined in Annex A.5.2.1 As specified in					
For FR2.120-1: 3 if mod (i.5) = 0, 6 if mod(i,5) = 2 For FR2.120-2: 11 if mod(i,8) = 0, 7]if mod(i,8) = 4, 6]if mod(i,8) = 5, where i is slot index per radio fame with values 0-79. OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1 Physical signals, channels mapping and precoding. For FR2.120-1: 3 if mod (i.5) = 0, 6 if mod(i,5) = 2 For FR2.120-1: 3 if mod (i.5) = 0, 6 if mod(i,5) = 0, 7 jif mod(i,8) = 0, 7			TUODOO.		
X1 value (PDSCH-to-HARQ-timing-indicator) K1 value (PDSCH-to-HARQ-timing-indicator) (PDSCH-to-HARQ-timing-indicator) X1 if mod(i,8) = 0, 7]if mod(i,8) = 4, 6]if mod(i,8) = 5, where i is slot index per radio fame with values 0-79. OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1 Physical signals, channels mapping and precoding. As specified in	Reduitdancy vers	sion county set	querice		
K1 value (PDSCH-to-HARQ-timing-indicator) K1 value (PDSCH-to-HARQ-timing-indicator) (PDSCH-to-HARQ-timing-indicator) (PDSCH-to-HARQ-timing-indicator) (PDSCH-to-HARQ-timing-indicator) (PDSCH-to-HARQ-timing-indicator) (PDSCH-to-HARQ-timing-indicator) (Pijif mod(i,8) = 0, 7]if mod(i,8) = 4, 6]if mod(i,8) = 0, 7]if mod(i,8) = 0, 8]if mod					
K1 value (PDSCH-to-HARQ-timing-indicator) For FR2.120-2: 11 if mod(i,8) = 0, 7]if mod(i,8) = 4, 6]if mod(i,8) = 5, where i is slot index per radio fame with values 0-79. OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1 Physical signals, channels mapping and precoding. For FR2.120-2: 11 if mod(i,8) = 0, 7]if mod(i,8) = 0, 7]if mod(i,8) = 4, 6]if mod(i,8) = 5, where i is slot index per radio fame with values 0-79. OP.1 FDD as defined in Annex A.5.2.1					
(PDSCH-to-HARQ-timing-indicator) 7]if mod(i,8) = 4, 6]if mod(i,8) = 5, where i is slot index per radio fame with values 0-79. OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1 Physical signals, channels mapping and precoding. Respectively.					
(PDSCH-to-HARQ-timing-indicator) 7 jif mod(i,8) = 4, 6 jif mod(i,8) = 5, where i is slot index per radio fame with values 0-79. OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1 Physical signals, channels mapping and precoding. As specified in	K1 value	K1 value			11 if $mod(i,8) = 0$,
where i is slot index per radio fame with values 0-79. OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1 Physical signals, channels mapping and precoding. Where i is slot index per radio fame with values 0-79. OP.1 FDD as defined in Annex A.5.2.1 As specified in	(PDSCH-to-HAR	Q-timing-indica	ator)		
per radio fame with values 0-79. OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1 Physical signals, channels mapping and precoding. As specified in					
Symbols for unused REs OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1 Physical signals, channels mapping and precoding Residues 0-79. A.5.2.1 As specified in					
Symbols for unused REs OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1 Physical signals, channels mapping and precoding As specified in					•
Symbols for unused REs defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1 Physical signals, channels mapping and precoding As specified in					
Symbols for unused REs A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1 Physical signals, channels mapping and precoding As specified in					
Symbols for unused REs OP.1 TDD as defined in Annex A.5.2.1 Physical signals, channels mapping and precoding. As specified in					
defined in Annex A.5.2.1 Physical signals, channels mapping and precoding As specified in	Symbols for unus	sed REs			_
Physical signals, channels mapping and precoding A.5.2.1 As specified in					
	Dhysical signals	channals me-	ning and proceding		As specified in
	rnysical signals,	channels map	ping and precoding		

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
Bandwidth		MHz		00
Subcarrier sp		kHz	120	
Duplex Mode				DD
TDD Slot Cor	nfiguration			Annex A.1.3
SNR _{BB}		dB	8 9	14 15
Propagation of	channel		AWGN	
Antenna conf	iguration			tatic channel n Annex B.1
Beamforming	Model			ed in Annex .4.1
	CSI-RS resource Type		Pei	riodic
	Number of CSI-RS ports (X)			4
	CDM Type		FD-	CDM2
ZP CSI-RS	Density (ρ)			1
configuratio n	First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁)			8
	First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁)			13
	CSI-RS periodicity and offset	slot	8	3/1
	CSI-RS resource Type		Pei	riodic
	Number of CSI-RS ports (X)			2
	CDM Type		fd-C	CDM2
NZP CSI-	Density (ρ)			1
RS for CSI	First subcarrier index in the			
	PRB used for CSI-RS (k ₀ , k ₁)			6
acquisition	First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁)			13
	NZP CSI-RS-timeConfig	slot	,	3/1
	periodicity and offset	3101		
	CSI-IM resource Type		Pei	riodic
CSI-IM	CSI-IM RE pattern			1
configuratio	CSI-IM Resource Mapping		(8.	, 13)
n	(KCSI-IM, ICSI-IM)		(0,	,
	CSI-IM timeConfig	slot	8	3/1
	periodicity and offset			
ReportConfig	Туре			riodic
CQI-table				ble 1
reportQuantity				PMI-CQI
	onForChannelMeasurements			nfigured
	nForInterferenceMeasurements			nfigured
cqi-FormatInd				eband
pmi-FormatIn			Wid	eband
Sub-band Siz		RB		8
csi-Reporting				11111
	eriodicity and offset	slot		3/3
aperiodicTrigg				nfigured
	Codebook Type		typel-Si	nglePanel
	Codebook Mode			1
Codebook	(CodebookConfig-	1	Not co	nfigured
configuration	N1,CodebookConfig-N2)	1		•
	CodebookSubsetRestriction			0000
<u></u>	RI Restriction			J/A
Physical char	nnel for CSI report	1		CCH
ļ., .	CQI/RI/PMI delay	ms	8.	375
Maximum nur	mber of HARQ transmission			1
Measurement	t channel			ed in Table TBS.1-2

8.2.2.2.2 CQI reporting under fading conditions

8.2.2.2.2.1 Minimum requirement for wideband CQI reporting

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

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

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

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

Table 8.2.2.2.1-1 Test parameters

	Parameter	Unit	Test 1 Test 2	Test 3 Test 4	
Bandwidth	1 di dillotoi	MHz	100	50	
Subcarrier sp	acing	kHz	12	20	
Duplex Mode			T)D	
TDD Slot Con	figuration		FR2.120-2		
SNR _{BB}		dB	6 7 12 13	7 8 20 21	
Propagation of	channel			30-35 <2	
Antenna confi	Antenna configuration			∢ ∠ High	
Beamforming			As specified in		
-	CSI-RS resource Type			iodic	
	Number of CSI-RS ports (X)			1 CDM2	
ZP CSI-RS	CDM Type Density (ρ)		Γυ-0		
configuratio	First subcarrier index in the			•	
n	PRB used for CSI-RS (k ₀ , k ₁)			3	
	First OFDM symbol in the PRB		1	3	
	used for CSI-RS (I ₀ , I ₁)			ა	
	CSI-RS	slot	8.	/1	
	periodicity and offset CSI-RS resource Type				
	Number of CSI-RS ports (X)		Aper	riodic	
	CDM Type			 DM2	
	Density (ρ)		, ,	1	
NZP CSI- RS for CSI	First subcarrier index in the		,	2	
acquisition	PRB used for CSI-RS (k ₀ , k ₁)		(5	
acquisition	First OFDM symbol in the PRB		1	3	
	used for CSI-RS (I ₀ , I ₁)		13		
	NZP CSI-RS-timeConfig	slot	Not configured		
	periodicity and offset aperiodicTriggeringOffset		0		
	CSI-IM resource Type		Aperiodic		
001.154	CSI-IM RE pattern		, , ,	1	
CSI-IM configuratio	CSI-IM Resource Mapping		/0	12)	
n	(ксы-ім,Ісы-ім)		(8, 13)		
	CSI-IM timeConfig	slot	Not cor	nfigured	
ReportConfig	periodicity and offset		Aperiodic		
CQI-table	туре		Table 1 Table 2		
reportQuantity	/		cri-RI-PMI-CQI		
	nForChannelMeasurements			nfigured	
timeRestrictio	nForInterferenceMeasurements		Not cor	nfigured	
cqi-FormatInd			Wideband		
pmi-FormatIn			Wideband		
Sub-band Siz		RB	8		
csi-Reporting	eriodicity and offset	slot	111111111 Not configured		
	port Slot Offset	SIUL			
	Soft Glot Glidet		6 1 in slots i, where mod(i, 8) = 1, otherwise i		
CSI request				I to 0	
reportTrigger	Size		One State with one	Associated Papert	
			Config	Associated Report	
CSI-Aperiodic	TriggerStateList			onfiguration contains	
			pointers to NZP CSI-RS and CSI-IM		
	Codebook Type		typel-Sin	glePanel	
	Codebook Mode		,	1	
Codebook	(CodebookConfig-		Not cor	nfigured	
configuration	N1,CodebookConfig-N2)				
	CodebookSubsetRestriction RI Restriction		000 N		
Physical chan	nel for CSI report			SCH	
. Hydrodi oridi	CQI/RI/PMI delay	ms		375	
Maximum nur	mber of HARQ transmission	0	,	l	
			As specified in Table	As specified in Table	
Measurement	. Unalliel		A.4-1, TBS.1-1	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 $CQI_{SCell} \ge 2$

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 Cor	nfiguration		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	r _e	RB	16 for 200MHz,
Oub band Oiz	Sub-barid Size		32 for 400MHz
csi-ReportingBand			111111111
CSI-Report periodicity and offset		slot	8/3
aperiodicTriggeringOffset		5.50	Not configured
Physical channel 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		ber	CA duplex mode and SCS combination	
1			TDD 120 kHz + TDD 120 kHz	
Note 1: The applicability 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_{md} is the throughput measured at SNR_{ue} with random precoding.

8.3.1 1RX requirements

(Void)

8.3.2 2RX requirements

8.3.2.1 FDD

(Void)

8.3.2.2 TDD

8.3.2.2.1 Single PMI with 2TX Typel-SinglePanel Codebook

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

Table 8.3.2.2.1-1: Test parameters (single layer)

Parameter		Unit	Test 1	Test 2
Bandwidth		MHz	100	100
Subcarrier spacing	ng	kHz	120	120
			FR2.120-2 as	FR2.120-1 as
TDD DL-UL conf	iguration		specified in	specified in
Drangation sho	anal		Annex A.1.3	Annex A.1.3
Propagation char			TDLA30-35	TDLA30-35
Antenna configur	Antenna configuration		2 x 2 ULA Low As specified in	2 x 2 ULA Low As specified in
Beamforming Model			Annex B.4.1	As specified in Annex B.4.1
	CSI-RS resource		Periodic	Periodic
	Type		1 Chould	1 Chodic
	Number of CSI-RS ports (X)		4	4
	CDM Type		FD-CDM2	FD-CDM2
	Density (ρ)		1	1
7D 001 D0	First subcarrier		1	'
ZP CSI-RS configuration	index in the PRB		D 4 (0)	D 4 (0)
Corniguration	used for CSI-RS		Row 4, (8,-)	Row 4, (8,-)
	(k_0, k_1)			
	First OFDM symbol		(40.)	(40.)
	in the PRB used for		(13,-)	(13,-)
	CSI-RS (I ₀ , I ₁)		8/1	5/1
	periodicity and	slot	0/1	3/1
	offset	0.01		
	CSI-RS resource		Aperiodic	Aperiodic
	Туре		Apenduic	Apenduic
	Number of CSI-RS		2	2
	ports (X)			
	CDM Type		FD-CDM2	FD-CDM2
	Density (ρ) First subcarrier		1	1
NZP CSI-RS	index in the PRB			
for CSI	used for CSI-RS		Row 3, (6,-)	Row 3, (6,-)
acquisition	(k ₀ , k ₁)			
	First OFDM symbol			
	in the PRB used for		(13,-)	(13,-)
	CSI-RS (I ₀ , I ₁)			
	CSI-RS periodicity and	slot	Not configured	Not configured
	offset	3101	Not configured	Not comigated
	aperiodicTriggering		0	0
	Offset		0	0
	CSI-IM resource Type		Aperiodic	Aperiodic
	CSI-IM RE pattern			
	COI III TE PAROITI		Pattern 1	Pattern 1
			T ditoiii i	T ditoill I
	CSI-IM Resource			
CSI-IM	Mapping			
configuration	(kcsi-im,lcsi-im)		(0.40)	(0.40)
			(8,13)	(8,13)
	001111111111111111111111111111111111111			
	CSI-IM timeConfig	ماء د	Not configurate	Not configurate
	periodicity and offset	slot	Not configured	Not configured
ReportConfigTyp			Aperiodic	Aperiodic
CQI-table			Table 1	Table 1
reportQuantity			cri-RI-PMI-CQI	cri-RI-PMI-CQI
	orChannelMeasureme		Not configured	Not configured
nts timePostrictionE	orlatorforonco\\\assu=		140t comigured	140t Corniguieu
timeRestrictionForInterferenceMeasur ements			Not configured	Not configured

cgi-FormatIndica	itor		Wideband	Wideband	
pmi-FormatIndica			Wideband	Wideband	
Sub-band Size		RB	8	8	
csi-ReportingBar	csi-ReportingBand		111111111	111111111	
CSI-Report perio		slot	Not configured	Not configured	
Aperiodic Report			6	8	
·			1 in slots i,	1 in slots i,	
CSI request			where mod(i, 8)	where mod(i, 5)	
Conrequest			= 1, otherwise it	= 1, otherwise	
. 			is equal to 0	it is equal to 0	
reportTriggerSize	e		1	1	
			One State with	One State with	
			one Associated	one Associated	
			Report	Report	
			Configuration Associated	Configuration Associated	
CSI-AperiodicTri	agor@totol.ict		Report	Report	
C31-Aperiodic III	ggerotateList		Configuration	Configuration	
			contains	contains	
			pointers to NZP	pointers to NZP	
			CSI-RS and	CSI-RS and	
			CSI-IM	CSI-IM	
	Codebook Type		typel-	typel-	
	,,,		SinglePanel	SinglePanel	
	Codebook Mode		1	1	
Codebook	(CodebookConfig-				
configuration	N1,CodebookConfi		N/A	N/A	
Corniguration	g-N2)				
	CodebookSubsetR		001111	001111	
	estriction				
RI Restriction			N/A	N/A	
Physical channel for CSI report			PUSCH	PUSCH	
CQI/RI/PMI delay		ms	1.375	1.75	
Maximum number of HARQ			4	4	
transmission					
Measurement ch	annel		R.PDSCH.5-8.1	R.PDSCH.5-	
		41	TDD	7.1 TDD	
	indom precoder selection	on, the prec	oder shall be updat	ed in each slot	
(0.125)	(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	acing	kHz	120	120	120
Duplex Mode			TDD	TDD	TDD
TDD Slot Cor			FR2.120-2	FR2.120-2	FR2.120-2
SNR	<u>g</u>	dB	0	16	16
Propagation of	channel		TDLA30-35	TDLA30-35	TDLA30-35
Antenna conf			ULA Low 2x2	ULA Low 2x2	XP High 2x2
			As defined in	As defined in	As defined in
Beamforming	Model		Annex B.4.1	Annex B.4.1	Annex B.4.1
	CSI-RS resource Type		Periodic	Periodic	Periodic
	Number of CSI-RS ports (X)		4	4	4
	CDM Type		FD-CDM2	FD-CDM2	FD-CDM2
ZP CSI-RS	Density (p)		1	1	1
configuratio	First subcarrier index in the				
n	PRB used for CSI-RS (k ₀ , k ₁)		Row 4, (8,-)	Row 4, (8,-)	Row 4, (8,-)
	First OFDM symbol in the PRB		4)	4 \	4
	used for CSI-RS (I ₀ , I ₁)		(13,-)	(13,-)	(13,-)
	CSI-RS		8/1	8/1	8/1
	periodicity and offset	slot	G, .	G/ .	3 , .
	CSI-RS resource Type		Aperiodic	Aperiodic	Aperiodic
	Number of CSI-RS ports (X)		2	2	2
	CDM Type		FD-CDM2	FD-CDM2	FD-CDM2
	Density (ρ)		1	1	1
NZP CSI-	First subcarrier index in the			·	·
RS for CSI	PRB used for CSI-RS (k ₀ , k ₁)		Row 3 (6,-)	Row 3 (6,-)	Row 3 (6,-)
acquisition	First OFDM symbol in the PRB				
	used for CSI-RS (I ₀ , I ₁)		(13,-)	(13,-)	(13,-)
	NZP CSI-RS-timeConfig	_	Not configured	Not	Not
	periodicity and offset	slot	1 tot oomigaroa	configured	configured
	aperiodicTriggeringOffset		0	0	0
	CSI-IM resource Type		Aperiodic	Aperiodic	Aperiodic
	CSI-IM RE pattern		Pattern 1	Pattern 1	Pattern 1
CSI-IM	CSI-IM Resource Mapping				
configuratio	(kcsi-im,lcsi-im)		(8,13)	(8,13)	(8,13)
n	CSI-IM timeConfig		Not configured	Not	Not
	periodicity and offset	slot	lgaa	configured	configured
ReportConfig			Aperiodic	Aperiodic	Aperiodic
CQI-table	- 7 -		Table 1	Table 1	Table 1
				cri-RI-PMI-	cri-RI-PMI-
reportQuantit	У		cri-RI-PMI-CQI	CQI	CQI
	5 OL 1M			not	not
timeRestriction	onForChannelMeasurements		not configured	configured	configured
	5 1			not	not
timeRestriction	onForInterferenceMeasurements		not configured	configured	configured
cqi-FormatInd	dicator		Wideband	Wideband	Wideband
pmi-FormatIndicator			Wideband	Wideband	Wideband
Sub-band Siz		RB	8	8	8
csi-ReportingBand			111111111	111111111	111111111
				Not	Not
CSI-Report periodicity and offset		slot	Not configured	configured	configured
Aperiodic Rea	port Slot Offset		6	6	6
, , , , , , , , , , , , ,	- -		1 in slots i,	1 in slots i,	1 in slots i,
			where mod(i,	where mod(i,	where mod(i,
CSI request			8) = 1,	8) = 1,	8) = 1,
25544001			otherwise it is	otherwise it is	otherwise it is
			equal to 0	equal to 0	equal to 0
reportTrigger	Size		1	1	1
		i	<u>'</u>	<u>'</u>	· · · · · · · · · · · · · · · · · · ·

CSI-Aperiodic	TriggerStateList		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: Massurements channels are specified in Table A 4.1. TRS 1.1 is used for Pank 1 case. TRS 1.2					

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

Table 8.4.2.2-2: Minimum requirement (TDD)

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

9 Demodulation performance requirements for interworking

9.1 General

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

9.1.1 Applicability of requirements

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

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

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

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

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

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

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

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

- For UEs supporting NR-DC including FR1 and FR2, if the FR2 requirements in Clause 7.2 and Clause 7.3 are tested, the test coverage can be considered fulfilled without executing requirements in Clause 9.2B.2 and Clause 9.3B.2.
- For UEs supporting NR-DC between FR1 and FR2, if requirements in Clause 9.4A.1 are tested under same or higher data rate as in Clause 9.4B.2, the test coverage can be considered fulfilled without executing the requirements in Clause 9.4B.2.
- For UEs supporting NE-DC and EN-DC, the test coverage of demodulation performance requirements can be considered fulfilled, if the demodulation requirements in Clause 5 and Clause 9.4B.1 are executed for UE under test in the standalone mode.
- For UEs supporting NE-DC and not supporting EN-DC, the test coverage of demodulation performance requirements can be considered fulfilled, if the demodulation requirements in Clause 5 and Clause 9.4B.3 are executed for UE under test.
- For UEs supporting NGEN-DC, the test coverage of demodulation performance requirements can be considered fulfilled, if the demodulation requirements in Clause 5 and Clause 9.4B.1 are executed for UE under test.
- 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: UE supports both intra-band contiguous and non-contiguous EN-DC requirements for supported interband EN-DC combinations.
- 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)		ownlir power cation	
-	, ,	$ ho_{\scriptscriptstyle A}$	$ ho_{\scriptscriptstyle B}$	σ
1	5	0	0	0
2	10	0	0	0
3	15	0	0	0
4	20	0	0	0

9.1.2.2 TDD

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

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

Table 9.1.2.2-1: Common Test Parameters (TDD)

Parameter	Unit	Value
UL DL configuration		2 (Note1)
Special subframe		7
configuration		1
Number of PDCCH	symbols	1
symbols		·
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
Note 1: The start of trar	nsmission of LTE fra	me is delayed by 2 LTE subframes with

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}$	٥	
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

Unit Value **Parameter**

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

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

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

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

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

9.4B.1.2 EN-DC including FR2 NR carrier

9.4B.1.2.1 SDR test

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

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

The test parameters are determined by the following procedure:

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

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

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

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

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

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

The test parameters are determined by the following procedure:

- Step 1: Calculate the NR FR1 data rate for EN-DC bandwidth combinations, using a procedure from clause 4.1.2 of TS 38.306 [14], for all supported EN-DC configurations and set of per NR component carrier (CC) UE capabilities among all supported UE capabilities:
 - Set of per NR CC UE capabilities includes a channel bandwidth, subcarrier spacing, number of PDSCH MIMO layers, modulation format and scaling factor as defined in clause 4.1.2 of TS 38.306 [14].
- Step 2: Calculate the NR FR2 data rate for EN-DC bandwidth combinations, using a procedure from Clause 7.5A, for all supported EN-DC configurations and set of per NR component carrier (CC) UE capabilities among all supported UE capabilities:
 - Set of per NR CC UE capabilities includes a channel bandwidth, subcarrier spacing, number of PDSCH MIMO layers, modulation format and scaling factor as defined in clause 4.1.2 of TS 38.306 [14].
- Step 3: Calculate the E-UTRA data rate for EN-DC bandwidth combinations, using a procedure from clause 4.1.2 of TS 38.306 [14], for all supported EN-DC configurations and set of per E-UTRA component carrier (CC) UE capabilities among all supported UE capabilities:
 - Set of per E-UTRA CC UE capabilities includes a channel bandwidth, number of PDSCH MIMO layers and modulation format as defined in clause 4.1.2 of TS 38.306 [14].

- Step 4: Select the EN-DC bandwidth combination among all supported EN-DC configurations that achieves the maximum total data rate in steps 1, 2 and 3 among all UE capabilities:
 - When there are multiple sets of EN-DC bandwidth combinations and UE capabilities with the same largest data rate, select a single set among sets with the smallest aggregated channel bandwidth.
- Step 5: For each NR FR2 CC in the selected EN-DC bandwidth combination, use MCS determined in step 2 for that EN-DC bandwidth combination based on test parameters and indicated UE capabilities.

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

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

9.4B.2 NR DC between FR1 and FR2

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

9.4B.3 NE-DC

9.4B.3.1 NE-DC within FR1

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

9.5B PDSCH demodulation for DC with power imbalance

9.5B.1 EN-DC

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

9.5B.1.1.1 PDSCH

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

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

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

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

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

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

Test Number	Bandwidth (MHz)	Reference channel		Power at 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-U7 EN-DC configuration				and and inte	r-band conti	guous

Table 9.5B.1.1.1-2: Minimum performance for TDD EN-DC with 30kHz 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 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-U	TRA MCG car	riers depend	on the intra-ba	and and inte	r-band non-o	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	
			Clause 11.1.9.1.1	

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
	Time resource bitmap		ones(1, 160)

channel bandwidth and subcarrier spacing.

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		Value		
Parameter		Unit	Test 1	Test 2	Test 3
Active cell	(s)			None	
	Sidelink transmissions		F	SCCH + PSS	CH
	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*Tc		
UE I	Frequency offset (Note 3)	Hz	+600		
	Synchronization		GNSS or GNSS-equivalent		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	Unit	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	e value
Test number	Reference 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)	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)	Hz	0	
	Synchronization source		SLSS	
	Antenna configuration		1x2 Low	
Note 1: Time of	lote 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: PSBCI	H transmits together with correspond	onding SLSS in	the same slot.	

Table 11.1.4.1.1-2: Minimum performance

	Bandwidth (MHz)				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	hal 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 (MU=) /	Dranagation	Reference valu	ie
Test num.	Bandwidth (MHz) / 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 1	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
Cidaliak LIF 2	Time offset (Note 2)	μs	0
Sidelink UE 2	Frequency offset (Note 3)	Hz	0
	Antenna configuration		1x2 Low
	PSFCH periodicity	Slots	4
	MinTimeGapPSFCH	Slots	3
Note 1: {x, y}:	x and y means the number of DMI	RS symbols	for slot with PSFCH transmission and without

PSFCH transmission, respectively.

Time offset of received signal by Sidelink UE with respect to GNSS reference timing.

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	
	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.							

HARQ buffer soft combining test 11.1.7

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:

Frequency offset of received signal by Sidelink UE with respect to GNSS reference frequency. Note 3:

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 Bandwidth (MHz) /		PSSCH Reference	Dropogotion	Referen	ce value
num.			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				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	
Cidalink UE :	Propagation Channel			Static propagation condition without external noise	
Sidelink UE i,	Antenna configuration			1x2 Low	
0 ≤ i ≤ 9 (Note 5)	PSSCH RMC			R.PSSCH.2-1.1	
3)	PSCCH RMC (Note 4)			R.PSCCH.2-1.1	
	Source ID			0	
	PSFCH periodicity		Slots	1	
	MinTimeGapPSFCH		Slots	2	
	DCCCU Decourse (Note 6)	RB index		10*i	
	PSFCH Resource (Note 6)	CS pair index		0	
	er ID is an identifier uniquely id				
	offset of received signal by Side				
Note 3: Freque	ency offset of Sidelink UE recei	ved signal by with	respec	t to GNSS reference	
freque					
transmission as per in Clause 8.4.1.3.2 of TS 38.211[9].					
	e 5: Each UE occupies one sub-channel so that all sub-channels are filled.				
	apping procedure of PSSCH re f TS 38.213 [11].	esource and PSF0	CH resou	urce is specified in Clause	

Table 11.1.8.1.1-2: Minimum performance

Test	Bandwidth (MHz) /	PSCCH Reference	Drangation 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 information			ACK or NACK		
Source ID of tested I	JE		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

	Randwidth (MHz) /		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
	Farameter	Offic	FR1.15-1
TDD Slot Configura	ation pattern (Note 1)		DDDSU
Special Slot Config	uration (Note 2)		10D+2G+2U
referenceSubcarrie	erSpacing	kHz	15
pattern1	dl-UL-TransmissionPeriodicity	ms	5
	nrofDownlinkSlots		3
	nrofDownlinkSymbols		10
	nrofUplinkSlot		1
	nrofUplinkSymbols		2
The number of slot	s between PDSCH and corresponding		4 if $mod(i,5) = 0$
HARQ-ACK inform	ation (Note 3)		3 if $mod(i,5) = 1$
			2 if $mod(i,5) = 2$
			6 if $mod(i,5) = 3$

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

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

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

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

			UL-DL pattern					
Paran	neter	Unit	FR1.30-1	FR1.30-2	FR1.30-3	FR1.30-4	FR1.30-5	FR1.30-6
TDD Slot Configuration pattern	(Note 1)		7DS2U	DDDSU	DDDSUDDSUU	DDDSUUDDDD	DSUU	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

Parame	otor	Unit	UL-DL pattern FR1.30-1A	
Parame				
TDD Slot Configuration pattern (N	Note 1)		7DS2U	
Special Slot Configuration (Note:		6D+4G+4U		
referenceSubcarrierSpacing		kHz	N/A	
pattern1 (Note 4)				
	dI-UL-	ms	N/A	
	TransmissionPeriodicity		•	
	nrofDownlinkSlots		N/A	
	nrofDownlinkSymbols		N/A	
	nrofUplinkSlot		N/A	
	nrofUplinkSymbols		N/A	
PDCCH DCI Configuration	DCI Format		1-1 for slot	
			indices with	
			mod(i,10) =	
			0,1,2,3,4,5,6,7	
	Scheduled Grant		Symbol 2-13 for	
			slot indices with	
			mod(i,10) =	
			0,1,2,3,4,5,6 and Symbol 2-5 for	
			slot indices with	
			mod(i,10) = 7	
The number of slots between PD	SCH and corresponding		8 if $mod(i, 10) = 0$	
HARQ-ACK information (Note 3)	oon and corresponding		7 if $mod(i, 10) = 0$	
(PDSCH-to-HARQ-timing-indicate	or)		6 if $mod(i,10) = 2$	
(,	,		5 if $mod(i,10) = 3$	
			5 if $mod(i,10) = 4$	
			4 if $mod(i,10) = 5$	
			3 if $mod(i,10) = 6$	
			2 if $mod(i,10) = 7$	
	all DL symbols; S denotes a slo			
guard symbols; U denotes a slot with all UL symbols. The field is for information.				
Note 2: D, G and U denote DL, guard and UL symbols, respectively. The field is for information.				
Note 3: i is the slot index per fr				
Note 4: Do not configure tdd-U	JL-DL-ConfigurationCommon ւ	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		I I m i t	UL-DL pattern
		Unit -	FR1.30-7
TDD Slot Configuration	n pattern (Note 1)		7DS2U
Special Slot Configura	tion (Note 2)		6D+4G+4U
referenceSubcarrierS _k	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 information	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		UL-DL pattern
	Parameter	Unit	FR2.60-1
TDD Slot Configuratio	n pattern (Note 1)		DDSU
Special Slot Configura	ition (Note 2)		11D+3G+0U
referenceSubcarrierSp	pacing	kHz	60
pattern1	dl-UL-	ms	1
	TransmissionPeriodicity		ı
	nrofDownlinkSlots		2
	nrofDownlinkSymbols		11
	nrofUplinkSlot		1
	nrofUplinkSymbols		0
The number of slots b	etween PDSCH and corresponding		3 if $mod(i,4) = 0$
HARQ-ACK information	on (Note 3)		2 if $mod(i,4) = 1$
			5 if $mod(i,4) = 2$

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

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

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

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.

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

В	arameter	Unit	UL-DL	pattern
Parameter		Onit	FR2.120-1	FR2.120-2
TDD Slot Configuration pat	tern (Note 1)		DDDSU	DDSU
Special Slot Configuration ((Note 2)		10D+2G+2U	11D+3G+0U
referenceSubcarrierSpacin	g	kHz	120	120
pattern1	dl-UL-	ms	0.625	0.5
	TransmissionPeriodicity		0.625	0.5
	nrofDownlinkSlots		3	2
	nrofDownlinkSymbols		10	11
	nrofUplinkSlot		1	1
	nrofUplinkSymbols		2	0
The number of slots between	en PDSCH and corresponding		4 if $mod(i,5) = 0$ 3 if $mod(i,5) = 1$	3 if $mod(i,4) = 0$
HARQ-ACK information(No	HARQ-ACK information(Note 3)			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		DDDSU			
Special S	Slot Configuration (Note 2	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	ber of slots between PDS CK information(Note 3)			4 if mod(i,5) = 0 3 if mod(i,5) = 1 2 if mod(i,5) = 2 6 if mod(i,5) = 3		
Note 1: D denotes a slot with all DL symbols; S denotes a slot with a mix of DL, UL and guard symbols; U denotes a slot with all UL symbols. The field is for information. Note 2: D, G and U denote DL, guard and UL symbols, respectively. The field is for						
Note 3: Note 4:	information. i is the slot index per frame; $i = \{0,,79\}$					

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

Reference measurement channels for SCS 15 kHz FR1 A.3.2.1.1

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

Parameter	Unit			Value			
Reference channel		R.PDSCH.1-	R.PDSCH.1-	R.PDSCH.1-	R.PDSCH.1-		
		1.1 FDD	1.2 FDD	1.3 FDD	1.4 FDD		
Channel bandwidth	MHz	10	10	10	10		
Subcarrier spacing	kHz	15	15	15	15		
Number of allocated resource blocks	PRBs	52	6	52	52		
Number of consecutive PDSCH symbols		12	12	7	12		
Allocated slots per 2 frames	Slots	19	19	19	19		
MCS table		64QAM	64QAM	64QAM	64QAMLowSE		
MCS index		4	4	4	14		
Modulation		QPSK	QPSK	QPSK	QPSK		
Target Coding Rate		0.30	0.30	0.30	0.59		
Number of MIMO layers		1	1	1	1		
Number of DMRS REs		18	12	12	12		
Overhead for TBS determination		0	0	0	0		
Information Bit Payload per Slot							
For Slot i = 0	Bits	N/A	N/A	N/A	N/A		
For Slots i = 1,, 19	Bits	3904	480	2280	8064		
Transport block CRC per Slot							
For Slot i = 0	Bits	N/A	N/A	N/A	N/A		
For Slots i = 1,, 19	Bits	24	16	16	24		
Number of Code Blocks per Slot							
For Slot i = 0	CBs	N/A	N/A	N/A	N/A		
For Slots i = 1,, 19	CBs	1	1	1	1		
Binary Channel Bits Per Slot							
For Slot i = 0	Bits	N/A	N/A	N/A	N/A		
For Slots i = 10, 11	Bits	12480	1512	6864	13104		
For Slots i =1,, 9, 12,, 19	Bits	13104	1584	7488	13728		
Max. Throughput averaged over 2 frames	Mbps	3.709	0.456	2.166	7.661		
Note 1: SS/PBCH block is transmitted in slot #0 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)

Parameter	Unit			Value			
Reference		R.PDSCH.1-	R.PDSCH.1-	R.PDSCH.1-	R.PDSCH.1-	R.PDSCH.1-	R.PDSCH.1-
channel		2.1 FDD	2.2 FDD	2.3 FDD	2.4 FDD	2.5 FDD	2.6 FDD
Channel bandwidth	MHz	10	10	10	10	10	10
Subcarrier spacing	kHz	15	15	15	15	15	15
Number of allocated resource blocks	PRBs	52	52	52	52	52	52
Number of consecutive PDSCH symbols		12	12	12	12	12	12
Allocated slots per 2 frames	Slots	19	19	19	19	19	19
MCS table		64QAM	64QAM	64QAM	64QAM	64QAM	64QAM
MCS index		13	13	13	13	16	16
Modulation		16QAM	16QAM	16QAM	16QAM	16QAM	16QAM
Target Coding Rate		0.48	0.48	0.48	0.48	0.64	0.64
Number of MIMO layers		1	2	3	4	1	1
Number of DMRS REs		12	12	24	24	12	12
Overhead for TBS determination		0	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	N/A
For Slots i = 1,, 19	Bits	13064	26120	35856	48168	17424	17424
Transport block CRC per Slot							
For Slot i = 0	Bits	N/A	N/A	N/A	N/A	N/A	N/A
For Slots i = 1,, 19	Bits	24	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	N/A
For Slots i = 1,, 19	CBs	2	4	5	6	3	3
Binary Channel Bits Per Slot							
For Slot i = 0	Bits	N/A	N/A	N/A	N/A	N/A	N/A
For Slots i = 10, 11	Bits	26208	52416	71136	94848	26208	26208
For Slots i = 1,, 9, 12,, 19	Bits	27456	54912	74880	99840	27456	27456
Max. Throughput averaged over 2 frames	Mbps	12.411	24.814	34.063	45.760	16.553	16.553

Note 2: Slot i is slot index per 2 frames

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

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

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

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

Parameter	Unit		Value
Deference showned		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			

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	Init 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 sharmal		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		
Deference channel		R.PDSCH.1-	R.PDSCH.1-	R.PDSCH.1-	R.PDSCH.1-	R.PDSCH.1-
Reference channel		9.1 FDD	9.2 FDD	9.3 FDD	9.4 FDD	9.5 FDD
Channel bandwidth	MHz	5	15	20	25	30
Subcarrier spacing	kHz	15	15	15	15	15
Number of allocated resource	PRBs	25	79	106	133	160
blocks	FKD5	25	79	106	133	160
Number of consecutive PDSCH		12	12	12	12	12
symbols						
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		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 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	Mhnc	11.924	37.939	50.624	64.205	75.901
over 2 frames	Mbps		37.939	50.624	04.200	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

Parameter	Unit			Value
Reference channel		R.PDSCH.1-	R.PDSCH.1-	
Reference channel		10.1 FDD	10.2 FDD	
Channel bandwidth	MHz	40	50	
Subcarrier spacing	kHz	15	15	
Number of allocated resource blocks	PRBs	216	270	
Number of consecutive PDSCH symbols		12	12	
Allocated slots per 2 frames	Slots	19	19	
MCS table		64QAM	64QAM	
MCS index		13	13	
Modulation		16QAM	16QAM	
Target Coding Rate		0.48	0.48	
Number of MIMO layers		2	2	
Number of DMRS REs		12	12	
Overhead for TBS		0	0	
determination		U	U	
Information Bit Payload per Slot				
For Slot i = 0	Bits	N/A	N/A	
For Slots i = 1,, 19	Bits	108552	135296	
Transport block CRC per Slot				
For Slot i = 0	Bits	N/A	N/A	
For Slots i = 1,, 19	Bits	24	24	
Number of Code Blocks per Slot				
For Slot i = 0	CBs	N/A	N/A	
For Slots i = 1,, 19	CBs	13	17	
Binary Channel Bits Per Slot				
For Slot i = 0	Bits	N/A	N/A	
For Slots i = 10, 11	Bits	217728	272160	
For Slots i =1,, 9, 12,, 19	Bits	228096	285120	
Max. Throughput averaged over 2 frames	Mbps	103.124	128.531	

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	MIND	(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 channel		12.1 FDD	
Channel bandwidth	MHz	10	
Subcarrier spacing	kHz	15	
Number of allocated resource	PRBs	52	
blocks	LIVD2	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	Value			
Reference channel		R.PDSCH.4-	R.PDSCH.4-	R.PDSCH.4-	R.PDSCH.4-
		3.1 FDD	3.2 FDD	3.3 FDD	3.4 FDD
Channel bandwidth	MHz	5	10	15	20
Allocated resource blocks		Note 6	Note 7	Note 8	Note 9
Allocated subframes per Radio Frame		10	10	10	10
Modulation		256QAM	256QAM	256QAM	256QAM
Coding Rate					
For Sub-Frames 3,4,8,9		0.85	0.85	0.88	0.85
For Sub-Frames 1,2,6,7		0.77	0.74	0.74	0.74
For Sub-Frame 5		0.79	0.77	0.77	0.75
For Sub-Frame 0		0.84	0.78	0.77	0.76
Information Bit Payload (Note 3)					
For Sub-Frames 3,4,8,9	Bits	24496	48936	75376	97896
For Sub-Frames 1,2,6,7	Bits	21384	42368	63776	84760
For Sub-Frame 5	Bits	19848	40576	61664	81176
For Sub-Frame 0	Bits	21384	42368	63776	84760
Number of Code Blocks					
(Notes 3 and 4)					
For Sub-Frames 3,4,8,9	CBs	4	8	13	16
For Sub-Frames 1,2,6,7	CBs	4	7	11	14
For Sub-Frame 5	CBs	4	7	11	14
For Sub-Frame 0	CBs	4	7	11	14
Binary Channel Bits (Note 3)					
For Sub-Frames 3,4,8,9	Bits	28800	57600	86400	115200
For Sub-Frames 1,2,6,7	Bits	28800	57600	86400	115200
For Sub-Frame 5	Bits	25344	52992	80640	109440
For Sub-Frame 0	Bits	25536	54336	83136	111936
Number of layers		2	2	2	2
Max. Throughput averaged over 1 frame (Note 3)	Mbps	22.475	44.816	68.205	89.656

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

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

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

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

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

Parameter	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}	050	14/71	14/71			
For Slot i, if $mod(i, 5) = \{0,1\}$ for i from	CBs	1	1			
{1,,19}	000	· ·	'			
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}		333.				
Max. Throughput averaged over 2	Mbps	0.865	1.134			
Note 1: SS/PBCH block is transmitted	-					
Note 1: SS/PBCH block is transmitted	ın sı∩t #() \	WITH DEFINALCITY 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		
		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	79	106	133
blocks	TINDS	20	32	7.5	100	100
Number of consecutive PDSCH						
symbols						
For Slot i, if $mod(i, 5) = 3$ for i		8	8	8	8	8
from {0,,19}		_	_	-	-	
For Slot i, if $mod(i, 5) = \{0,1,2\}$		12	12	12	12	12
for i from {1,,19}	Clata	4.5	4.5	45	45	4.5
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 Target Coding Rate		16QAM 0.48	16QAM 0.48	16QAM 0.48	16QAM 0.48	16QAM 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						
from $\{0,,19\}$		12	12	12	12	12
For Slot i, if $mod(i, 5) = \{0,1,2\}$						
for i from $\{1,,19\}$		12	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 Slot i, if $mod(i, 5) = 3$ for i						
from {0,,19}	Bits	8064	16896	25608	33816	43032
For Slot i, if $mod(i, 5) = \{0,1,2\}$	Bits	12552	26120	39936	52200	67584
for i from {1,,19}	DIIS	12552	20120	39930	53288	07364
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}	Dito		2 '			21
For Slot i, if $mod(i, 5) = \{0,1,2\}$	Bits	24	24	24	24	24
for i from {1,,19}						
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		IN/A	IN/A	IN/A	IN/A	IN/A
from $\{0,,19\}$	CBs	1	3	4	5	6
For Slot i, if mod(i, 5) = $\{0,1,2\}$						
for i from $\{1,,19\}$	CBs	2	4	5	7	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						
from {0,,19}	Bits	16800	34944	53088	71232	89376
For Slot i, if $mod(i, 5) = \{0,1,2\}$	Dito	26400	E4040	02424	111026	140440
for i from {1,,9,12,,19}	Bits	20400	54912	83424	111936	140448
Max. Throughput averaged	Mbps	8.516	17.745	27.086	36.072	45.778
over 2 frames	•			21.000	30.072	45.770
Note 1: SS/PBCH block is tran			eriodicity 20 ms			
Note 2: Slot i is slot index per :	2 frames					

Note 2: Slot i is slot index per 2 frames

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

Parameter	Unit			Value	
Reference channel		R.PDSCH.1-	R.PDSCH.1-	R.PDSCH.1-	
Reference channel		3.1 TDD	3.2 TDD	3.3 TDD	
Channel bandwidth	MHz	30	40	50	
Subcarrier spacing	kHz	15	15	15	
Number of allocated resource	PRBs	160	246	270	
blocks	PRDS	160	216	270	
Number of consecutive PDSCH					
symbols					
For Slot i, if $mod(i, 5) = 3$ for i		8	8	8	
from {0,,19}		0	0	0	
For Slot i, if $mod(i, 5) = \{0,1,2\}$		12	12	12	
for i from {1,,19}			12		
Allocated slots per 2 frames	Slots	15	15	15	
MCS table		64QAM	64QAM	64QAM	
MCS index		13	13	13	_
Modulation		16QAM	16QAM	16QAM	
Target Coding Rate		0.48	0.48	0.48	
Number of MIMO layers		2	2	2	
Number of DMRS REs					
For Slot i, if $mod(i, 5) = 3$ for i		10	40	10	
from {0,,19}		12	12	12	
For Slot i, if $mod(i, 5) = \{0,1,2\}$		40	40	40	
for i from {1,,19}		12	12	12	
Overhead for TBS		0	0	0	
determination		U	0	U	
Information Bit Payload per Slot					
For Slot i = 0	Bits	N/A	N/A	N/A	
For Slot i, if mod(i, 5) = 3 for i	Bits	51216	69672	86040	
from {0,,19}	DIIS	31210	09072	00040	
For Slot i, if $mod(i, 5) = \{0,1,2\}$	Bits	79896	108552	125206	
for i from {1,,19}	DIIS	79090	100002	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	Bits	24	24	24	
from {0,,19}	DIIS	24	24	24	
For Slot i, if $mod(i, 5) = \{0,1,2\}$	Bits	24	24	24	
for i from {1,,19}	Dita	24	24	27	
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}	ODS	,	J		
For Slot i, if $mod(i, 5) = \{0,1,2\}$	CBs	10	13	17	
for i from {1,,19}	050	10	10	1,7	
Binary Channel Bits Per Slot					
For Slot i = 0	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}	210	107020	110102	101770	
For Slot i, if $mod(i, 5) = \{0,1,2\}$	Bits	168960	228096	285120	
for i from {1,,9,12,,19}	210	100000	220000	200120	
Max. Throughput averaged	Mbps	54.186	73.638	91.621	
over 2 frames					
Note 1: SS/PBCH block is tran		•	eriodicity 20 ms		
Note 2: Slot i is slot index per :	2 frames				

Note 2: Slot i is slot index per 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				
Deference channel		R.PDSCH.2-	R.PDSCH.2-	R.PDSCH.2-	R.PDSCH.2-			
Reference channel		1.1 TDD	1.2 TDD	1.3 TDD	1.4 TDD			
Channel bandwidth	MHz	40	40	40	40			
Subcarrier spacing	kHz	30	30	30	30			
Allocated resource blocks	PRBs	106	6	106	106			
Number of consecutive PDSCH								
symbols								
For Slot i, if mod(i, 10) = 7 for i from		4	4	N/A	N/A			
{0,,39}		·	•		. 47.			
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	<u> </u>	31	31	27	27			
MCS table	<u> </u>	64QAM	64QAM	64QAM	64QAMLowSE			
MCS index		4 QPSK	4	4	14			
Modulation Towart Coding Date			QPSK	QPSK	QPSK			
Target Coding Rate		0.30	0.30	0.30 1	0.59			
Number of MIMO layers Number of DMRS REs		1	1	1	i i			
For Slot i, if mod(i, 10) = 7 for i from								
$\{0,,39\}$		6	6	N/A	N/A			
For Slot i, if mod(i, 10) =								
{0,1,2,3,4,5,6} for i from {1,,39}		18	12	12	12			
Overhead for TBS determination		0	0	0	0			
Information Bit Payload per Slot		Ŭ	•	·	Ŭ			
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	D::	2224		21/2	21/2			
{0,,39}	Bits	2664	144	N/A	N/A			
For Slot i, if mod(i, 10) =	D:4-	0004	400	4000	40000			
{0,1,2,3,4,5,6} for i from {1,,39}	Bits	8064	480	4608	16392			
Transport block CRC per Slot								
For Slots 0 and Slot i, if mod(i, 10)	Bits	N/A	N/A	N/A	N/A			
$= \{8,9\}$ for i from $\{0,,39\}$	Dita	IN//A	IN//A	IN//A	14/74			
For Slot i, if $mod(i, 10) = 7$ for i from	Bits	16	16	N/A	N/A			
{0,,39}	Dito	10	10	14/71	14/71			
For Slot i, if mod(i, 10) =	Bits	24	16	24	24			
{0,1,2,3,4,5,6} for i from {1,,39}								
Number of Code Blocks per Slot								
For Slots 0 and Slot i, if mod(i, 10)	CBs	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 $\{0,,39\}$	CBs	1	1	N/A	N/A			
For Slot i, if mod(i, 10) =								
$\{0,1,2,3,4,5,6\}$ for i from $\{1,,39\}$	CBs	1	1	1	2			
Binary Channel Bits Per Slot								
For Slots 0 and Slot i, if mod(i, 10)								
$= \{8,9\}$ for i from $\{0,,39\}$	Bits	N/A	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								

Note 2: Slot i is slot index per 2 frames

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

Parameter	Unit			Value			
Reference		R.PDSCH.2	R.PDSCH.2	R.PDSCH.2	R.PDSCH.2	R.PDSCH.2-	R.PDSCH.2
Channel		-2.1 TDD	-2.2 TDD	-2.3 TDD	-2.4 TDD	2.5 TDD	-2.6 TDD
Channel bandwidth	MHz	40	40	40	40	40	40
Subcarrier spacing	kHz	30	30	30	30	30	30
Allocated resource blocks	PRB s	106	106	106	106	106	106
Number of consecutive PDSCH symbols							
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}		N/A	N/A	N/A	N/A	N/A	N/A
For Slot i, if $mod(i, 10) = 7$ for i from $\{0,,39\}$		4	4	4	4	4	4
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ for i from $\{1,,39\}$		12	12	12	12	12	12
Allocated slots per 2 frames		31	31	31	31	31	31
MCS table		64QAM	64QAM	64QAM	64QAM	64QAMLowS E	64QAM
MCS index		13	13	13	13	19	16
Modulation		16QAM	16QAM	16QAM	16QAM	16QAM	16QAM
Target Coding Rate		0.48	0.48	0.48	0.48	0.54	0.64
Number of MIMO layers		1	2	3	4	2	1
Number of DMRS REs							
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}		N/A	N/A	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 10) = 7 for i from {0,,39}		6	6	12	12	6	6
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39}		12	12	24	24	12	12
Overhead for TBS determination		0	0	0	0	0	0
Information Bit Payload per Slot							
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}	Bits	N/A	N/A	N/A	N/A	N/A	N/A
For Slot i, if $mod(i, 10) = 7$ for i from $\{0,,39\}$	Bits	8456	16896	22032	29192	19464	11528
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39}	Bits	26632	53288	73776	98376	60456	35856
Transport block CRC per Slot							

		7	,	,	,		
For Slots 0 and						N/A	
Slot i, if mod(i,	Bits	N/A	N/A	N/A	N/A		N/A
10) = {8,9} for i	Dito	14/73	14/73	14/73	14/73		14/73
from {0,,39}							
For Slot i, if						24	
mod(i, 10) = 7 for	Bits	24	24	24	24		24
i from {0,,39}							
For Slot i, if						24	
mod(i, 10) =	Dito	24	24	24	24		24
{0,1,2,3,4,5,6}for	Bits	24	24	24	24		24
i from {1,,39}							
Number of Code							
Blocks per Slot							
For Slots 0 and						N/A	
Slot i, if mod(i,	0.5	N1/A	21/2				
$10) = \{8,9\}$ for i	CBs	N/A	N/A	N/A	N/A		N/A
from {0,,39}							
For Slot i, if						3	
mod(i, 10) = 7 for	CBs	2	3	3	4		2
i from {0,,39}	-	_			-		_
For Slot i, if						8	
mod(i, 10) =		_	_	_			_
{0,1,2,3,4,5,6} for	CBs	4	7	9	12		5
i from {1,,39}							
Binary Channel							
Bits Per Slot							
For Slots 0 and						N/A	
Slot i, if mod(i,						14//	
$10) = \{8,9\}$ for i	Bits	N/A	N/A	N/A	N/A		N/A
from {0,,39}							
For Slots $i = 20$,						101760	
21	Bits	53424	106848	144008	193344	101700	53424
For Slot i, if						35616	
mod(i, 10) = 7 for	Bits	17808	35616	45792	61056	33010	17808
i from {0,,39}	Dita	17000	33010	43732	01030		17000
For Slot i, if						111936	
mod(i, 10) =						111930	
$\{0,1,2,3,4,5,6\}$ for							
i from	Bits	55968	111936	152640	203520		55968
{1,,19,22,,39							
\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \							
Max. Throughput						85.508	
averaged over 2	Mbps	37.644	75.318	104.004	138.646	00.000	50.711
	INIDA2	31.044	15.510	104.004	130.040		30.711
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms							
			ii siot #0 with p	enouldity 20 ms	•		
Note 2: Slot i is slot index per 2 frames							

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

Parameter	Unit			Value	
Deference channel		R.PDSCH.2-	R.PDSCH.2-	R.PDSCH.2-	R.PDSCH.2-
Reference channel		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}		1 47 1			
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) =		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			12	12	12
{0,,39}		6	12	12	12
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39}		12	24	24	24
Overhead for TBS determination		0	0	0	0
Information Bit Payload per Slot		Ü	Ŭ	Ŭ	
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) =	Dito	24	24	24	24
{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	N/A	N/A	N/A
For Slot i, if $mod(i, 10) = 7$ for i from $\{0,,39\}$	CBs	4	3	2	2
For Slot i, if mod(i, 10) =		4 -	10	5	5
{0,1,2,3,4,5,6} for i from {1,,39}	CBs	10			0
Binary Channel Bits Per Slot			N1/A	N1/0	N1/A
For Slots 0 and Slot i, if $mod(i, 10) = \{8,9\}$ for i from $\{0,,39\}$	Bits	N/A	N/A	N/A	N/A
For Slots i = 20, 21	Bits	160272	137376	68688	68688
For Slot i, if mod(i, 10) = 7 for i from $\{0,,39\}$	Bits	53424	45792	22896	22896
For Slot i, if mod(i, 10) =	1		152640	76320	76320
{0,1,2,3,4,5,6} for i from {1,,19,22,,39}	Bits	167904	102040	7 0020	7 0020
Max. Throughput averaged over 2			109.768	54.869	54.869
frames	Mbps	118.796	103.700	J - .003	37.003
Note 1: SS/PBCH block is transmitte	ed in slot	#0 with periodic	rity 20 ms	I.	<u> </u>

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

Note 2: Slot i is slot index per 2 frames

Note 3: PDSCH is scheduled in PRB numbers from 0 to 52. Note 4: PDSCH is scheduled in PRB numbers from 53 to 105.

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

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

Parameter	Unit		Value	
Reference channel		R.PDSCH.2- 6.1 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, 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}		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 Modulation		4 QPSK		
Target Coding Rate		0.30		
Number of MIMO layers		1		
Number of DMRS REs		ı		
For Slot 0 and Slot i, if mod(i, 10) =		21/0		
{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				
For Slot 0 and Slot i, if mod(i, 10) = {4,8,9} for i from {0,,39}	Bits	N/A		
For Slot i, if $mod(i, 10) = \{3,7\}$ for i from $\{0,,39\}$	Bits	5376		
For Slot i, if mod(i, 10) = $\{0,1,2,5,6\}$ for i from $\{1,,39\}$	Bits	8456		
Transport block CRC per Slot				
For Slot 0 and Slot i, if mod(i, 10) = {4,8,9} for i from {0,,39}	Bits	N/A		
For Slot i, if mod(i, 10) = $\{3,7\}$ for i from $\{0,,39\}$	Bits	24		
For Slot i, if $mod(i, 10) = \{0,1,2,5,6\}$ for	Bits	24		
i from {1,,39}				
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	Bits	27984		
i from {1,,19,22,,39} Max. Throughput averaged over 2	Mbps	10.184		
frames	<u> </u>		\	
Note 1: SS/PBCH block is transmitted i Note 2: Slot i is slot index per 2 frames	n siot #0 v	vitn periodicity 20	o ms	

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

Parameter	Unit		Value	
Reference channel		R.PDSCH.2-		
	8.41.1	7.1 TDD		
Channel bandwidth	MHz	40		
Subcarrier spacing Allocated resource blocks	kHz PRBs	30 106		
Number of consecutive PDSCH	FKD9	100		
symbols				
For Slots 0 and Slot i, if mod(i, 10) =				
{8,9} for i from {0,,39}		N/A		
For Slot i, if mod(i, 10) = 7 for i from		4		
{0,,39}		4		
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 index		13		1
Modulation		16QAM		
Target Coding Rate		0.48		
Number of MIMO layers 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		_		1
{0,,39}		6		
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$		40		
for i from {1,,39}		12		
Overhead for TBS determination		0		
Information Bit Payload per Slot				
For Slots 0 and Slot i, if mod(i, 10) =	Bits	N/A		
{8,9} for i from {0,,39}	Dito	14//		
For Slot i, if $mod(i, 10) = 7$ for i from	Bits	16896		
{0,,39}				
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$	Bits	53288		
for i from {1,,39} Transport block CRC per Slot				+
For Slots 0 and Slot i, if mod(i, 10) =				
{8,9} for i from {0,,39}	Bits	N/A		
For Slot i, if $mod(i, 10) = 7$ for i from	D.:			
{0,,39}	Bits	24		
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$	Dito	24		
for i from {1,,39}	Bits	24		
Number of Code Blocks per Slot				
For Slots 0 and Slot i, if mod(i, 10) =	CBs	N/A		
{8,9} for i from {0,,39}		. 47.		
For Slot i, if $mod(i, 10) = 7$ for i from	CBs	3		
$\{0,,39\}$ For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,6\}$				+
For Slot I, if $mod(1, 10) = \{0, 1, 2, 3, 4, 5, 6\}$ for i from $\{1,, 39\}$	CBs	7		
Binary Channel Bits Per Slot		+		
For Slots 0 and Slot i, if mod(i, 10) =				1
{8,9} for i from {0,,39}	Bits	N/A		
For Slot i, if $mod(i, 10) = \{0,5\}$ for i from	D:t-	100450		
{1,,19,22,,39}	Bits	103456		
For Slots i = 20	Bits	98368		
For Slots i = 21	Bits	106848		1
For Slot i, if $mod(i, 10) = 7$ for i from	Bits	35616		1
{0,,39}	20	300.0		-
For Slot i, if mod(i, 10) = $\{1,2,3,4,6\}$ for	Bits	111936		
i from {1,,19,22,,39}		+		-
Max. Throughput averaged over 2 frames	Mbps	75.318		
Note 1: SS/PBCH block is transmitted i	n slot #0 v	vith periodicity 20		1
Note 2: Slot i is slot index per 2 frames	510t #U V	THE POSITIONION 20	, 1110	
1.1010 Z. Olot 110 Slot index per Z 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		12	12	12	
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) =	D.:	N1/A	N1/A	N1/2	
{7,8,9} for i from {0,,39}	Bits	N/A	N/A	N/A	
For CSI-RS Slot i, if mod(i,10) =1 for i			21/4	2.74	
from {0,,39}	Bits	N/A	N/A	N/A	
For Slot i = 20	Bits	24576	49176	83976	
For Slot i, if $mod(i, 10) = \{0,2,3,4,5,6\}$					
for i from {1,,19,22,,39}	Bits	24576	49176	83976	
Transport block CRC per Slot					
For Slots 0 and Slot i, if mod(i, 10) =	5	21/2	21/2	21/2	
{7,8,9} for i from {0,,39}	Bits	N/A	N/A	N/A	
For CSI-RS Slot i, if mod(i,10) =1 for i	D:4-	NI/A	NI/A	N1/A	
from {0,,39}	Bits	N/A	N/A	N/A	
For Slot i = 20	Bits	24	24	24	
For Slot i, if $mod(i, 10) = \{0,2,3,4,5,6\}$	D:1-	0.4	0.4	0.4	
for i from {1,,19,22,,39}	Bits	24	24	24	
Number of Code Blocks per Slot					
For Slots 0 and Slot i, if mod(i, 10) =	OD-	NI/A	NI/A	N1/A	
{7,8,9} for i from {0,,39}	CBs	N/A	N/A	N/A	
For CSI-RS Slot i, if mod(i,10) =1 for i	CD-	NI/A	NI/A	NI/A	
from {0,,39}	CBs	N/A	N/A	N/A	
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}	CBS	3	6	10	
Binary Channel Bits Per Slot					
For Slots 0 and Slot i, if mod(i, 10) =	Dito	N/A	N/A	NI/A	
{7,8,9} for i from {0,,39}	Bits	IN/A	IN/A	N/A	
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}	DIIS	30000	101760	132040	
Max. Throughput averaged over 2	Mbps	28.2624	56.5524	96.5724	
frames	·			30.5724	
Note 1: SS/PBCH block is transmitted	in slot #0	with periodicity	/ 20 ms		· · · · · · · · · · · · · · · · · · ·

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-	01	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		ith periodicity 2) 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}						
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> </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,						
$10) = \{8,9\}$ for i from $\{0,,39\}$	Bits	N/A	N/A	N/A	N/A	N/A
For Slot i, if $mod(i, 10) = 7$ for i						
from {0,,39}	Bits	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}						0=1.10
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 $\{0,,39\}$	DIIS	IN/A	IN/A	IN/A	IN/A	IN/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,	CBs	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 $\{0,,39\}$	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}	CDS	'			_	7
Binary Channel Bits Per Slot						
For Slots 0 and Slot i, if mod(i,	5	21/2	21/2	21/2	21/2	21/2
$10) = \{8,9\}$ 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						
from {0,,39}	Bits	3696	8064	12768	17136	21840
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
	INIDAS	1.190	17.022	20.020	30.209	+0.340
over 2 frames Note 1: SS/PBCH block is trar						

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

14.1 TDD	Parameter	Unit			Value		
14,11 10	Deference channel		R.PDSCH.2-	R.PDSCH.2-	R.PDSCH.2-	R.PDSCH.2-	R.PDSCH.2
Subcarrier spacing	Reference channel		14.1 TDD	14.2 TDD	14.3 TDD	14.4 TDD	14.5 TDD
Allocated resource blocks Number of consecutive PDSCH symbols Sy	Channel bandwidth		30	50	60	80	90
Number of Consecutive PDSCH symbols For Slot I, if mod(i, 10) = 7 for i from (0,,39) For Slot I, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (1,,39) Allocated slots per 2 frames MCS table G4QAM G4	Subcarrier spacing	kHz	30	30	30	30	
Symbols For Slot i, if mod(i, 10) = 7 for i 4 4 4 4 4 4 4 4 4	Allocated resource blocks	PRBs	78	133	162	217	245
For Stot i, if mod(i, 10) = 7 for i from [039]	Number of consecutive PDSCH						
	symbols						
Trom (0,,39)	For Slot i, if $mod(i, 10) = 7$ for i		4	1	1	1	1
(0,1,2,3,4,5,6) for i from 12 12 12 12 12 12 13 13	from {0,,39}		4	4	7	4	-
(139)	For Slot i, if $mod(i, 10) =$						
Allocated slots per 2 frames Allocated slots per 2 frames GADAM MCS table GADAM G	{0,1,2,3,4,5,6} for i from		12	12	12	12	12
MCS table	{1,,39}						
MCS index MCS in							
Modulation							
Target Coding Rate							
Number of MIMO layers 2 2 2 2 2 2 2 2 2							
Number of DMRS RES							
For Slot i, if mod(i, 10) = 7 for i from (0,,39) For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (1,,39) Coverhead for TBS determination Information Bit Payload per Slot For Slot i, if mod(i, 10) = 7 for i from (1,,39) For Slot i, if mod(i, 10) = 7 for i from (0,,39) For Slot i, if mod(i, 10) = 8 for Slot i, if mod(2	2	2	2	2
from (0,39)							
			6	6	6	6	6
12 12 12 12 12 12 12 12			Ů	Ů			
Comparison Com							
Overhead for TBS determination 0 0 0 0 0 0 0 0 0			12	12	12	12	12
Determination Determinatio							
Determination Determinatio			0	0	0	0	0
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39} For Slot i, if mod(i, 10) = {8,0} for i from {0,,39} For Slot i, if mod(i, 10) = {1,0,1,2,3,4,5,6} for i from {0,,39} For Slot i, if mod(i, 10) = {1,0,1,2,3,4,5,6} for i from {0,,39} For Slot i, if mod(i, 10) = {1,0,1,2,3,4,5,6} for i from {0,,39} For Slot i, if mod(i, 10) = {1,0,1,2,3,4,5,6} for i from {0,,39} For Slot i, if mod(i, 10) = {1,0,1,2,3,4,5,6} for i from {0,,39} For Slot i, if mod(i, 10) = {1,0,1,2,3,4,5,6} for i from {0,,39} For Slot i, if mod(i, 10) = {1,0,1,2,3,4,5,6} for i from {0,,39} For Slot i, if mod(i, 10) = {1,0,1,2,3,4,5,6} for i from {0,,39} For Slot i, if mod(i, 10) = {1,0,1,2,3,4,5,6} for i from {0,,39} For Slot i, if mod(i, 10) = {1,0,1,2,3,4,5,6} for i from {0,,39} For Slot i, if mod(i, 10) = {1,0,1,2,3,4,5,6} for i from {0,,39} For Slot i, if mod(i, 10) = {1,0,1,2,3,4,5,6} for i from {0,,39} For Slot i, if mod(i, 10) = {1,0,1,2,3,4,5,6} for i from {0,,39} For Slot i, if mod(i, 10) = {1,0,1,2,3,4,5,6} for i from {0,,39} Bits N/A				-	-	-	_
10 = {8,9} for i from {0,,39} Bits N/A	Information Bit Payload per Slot						
10 = (8,9) for i from (0,,39) For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) Bits 12552 21504 26120 34816 38936 For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) Bits N/A		Bits	N/A	N/A	N/A	N/A	N/A
From (0,,39) Bits 12332 21304 26120 34616 36336 For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from Bits 38936 67584 81976 110632 122976 (1,,39) Transport block CRC per Slot For Slots 0 and Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slot 0 and Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slot 0 and Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slot 0 and Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slot i, if mod(i, 10) = 7 for i from (0,,39) For Slot i, if mod(i, 10) = 7 for i from (0,,39) For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,1,39) Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) Bits N/A							
For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (1,,39) Transport block CRC per Slot For Slots 0 and Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slots 0 and Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slots 0 and Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slots 0 and Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slots i = 20, 21 Bits 78624 134064 163296 218736 246960 For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) For Slot i, if mod(i		Bits	12552	21504	26120	34816	38936
Site	For Clat : it mod (i. 40)	1					
1,,39		Dito	20026	67504	04076	110622	122076
Transport block CRC per Slot For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Number of Code Blocks per Slot For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} Number of Code Blocks per Slot For Slots 0 and Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} For Slots 0 and Slot i, if mod(i, 10) = 8,9) for i from {0,,39} Binary Channel Bits Per Slot For Slots i = 20, 21 Bits For Slots i = 20, 21 Bits For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 8 Bits For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 8 Bits For Slot i, if mod(i, 10) = 1 Bits For Slot i, if mod(i, 10) = 1 Bits For Slot i, if mod(i, 10) = 1 Bits For Slot i, if mod(i, 10) = 1 Bits For Slot i, if mod(i, 10) = 1 Bits For Slot i, if mod(i, 10) = 1 Bits For Slot i		DIIS	30930	6/364	01976	110032	122976
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 8 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Bits							
10 = {8,9} for i from {0,,39}							
For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39} Number of Code Blocks per Slot For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Bits N/A N/A N/A N/A N/A N/A N/A For Slots i = 20, 21 Bits 78624 Bits 7		Bits	N/A	N/A	N/A	N/A	N/A
from {0,,39} Bits 24							
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39} Bits 24 24 24 24 24 24 24 24 24 24 24 24 24		Bits	24	24	24	24	24
{0,1,2,3,4,5,6} for i from {1,,39} Bits 24 24 24 24 24 {1,,39} Number of Code Blocks per Slot N/A	For Slot i if mod(i 10) –						
Number of Code Blocks per Slot		Rite	24	24	24	24	24
Number of Code Blocks per Slot For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,1,1,2,3,4,5,6} for i from {0,1,1,2,2,1,39} Max. Throughput averaged over 2 frames		Dito	24		2-7	2-7	2-7
Slot For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39} CBs N/A N/A </td <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>							
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,1,1,2,3,4,5,6} for	•						
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) = {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 {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6} for i from {0,1,1,39} Bits N/A N							
For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {CBs} 5 9 10 14 15 {1,39} Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39} For Slots i = 20, 21 Bits 78624 134064 163296 218736 246960 For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 826208 44688 54432 72912 82320 For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6}		CBs	N/A	N/A	N/A	N/A	N/A
from {0,,39} CBS Z 3 4 5 5 For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39} CBS 5 9 10 14 15 Hanary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = {1,,39} Bits N/A N/A <td></td> <td></td> <td>_</td> <td>_</td> <td>_</td> <td>_</td> <td>_</td>			_	_	_	_	_
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6} for i from {1,1,1,39}		CBs	2	3	4	5	5
{0,1,2,3,4,5,6} for i from {1,,39} CBs 5 9 10 14 15 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							
Sinary Channel Bits Per Slot Slot Sinary Channel Bits Per Slot Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39} Bits N/A		CBs	5	9	10	14	15
Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39} Bits N/A N							
10) = {8,9} for i from {0,,39} Bits N/A <	Binary Channel Bits Per Slot						
For Slots i = 20, 21 Bits 78624 134064 163296 218736 246960 For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from Bits 82368 140448 171072 229152 258720 {1,,19,22,,39} Max. Throughput averaged over 2 frames Mbps 55.074 95.539 115.892 156.316 173.805	For Slots 0 and Slot i, if mod(i,	Dito	NI/A	NI/A	NI/A	NI/A	NI/A
For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6} for i from {0,1,2,2,,39} Max. Throughput averaged over 2 frames Mbps 55.074 95.539 115.892 72912 82320 82320 173.805	$10) = \{8,9\}$ for i from $\{0,,39\}$	Bits	IN/A	IN/A	IN/A	IN/A	IN/A
For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6} for i	For Slots i = 20, 21	Bits	78624	134064	163296	218736	246960
from {0,,39} Bits 26208 44688 54432 72912 82320 For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,19,22,,39} Bits 82368 140448 171072 229152 258720 Max. Throughput averaged over 2 frames Mbps 55.074 95.539 115.892 156.316 173.805							
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6} for	from {0,,39}	DIIS	20208	44000	04432	12912	02320
{0,1,2,3,4,5,6} for i from {1,,19,22,,39} Bits 82368 140448 171072 229152 258720 2587	For Slot i, if mod(i, 10) =						
\[\frac{\(1,,19,22,,39\)}{\(\text{Max. Throughput averaged over 2 frames} \] \[\text{Mbps} \] \[55.074 \] \[95.539 \] \[115.892 \] \[156.316 \] \[173.805 \]	{0,1,2,3,4,5,6} for i from	Bits	82368	140448	171072	229152	258720
over 2 frames MIDPS 55.074 95.539 115.892 156.316 173.805	{1,,19,22,,39}						
over 2 frames	Max. Throughput averaged	Mhns	55.074	05 520	115 802	156 316	173 905
	over 2 frames	IVIUPS	55.074	90.039	110.092	130.310	173.803

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

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

Reference channel	Parameter	Unit		Value)	
15,1 DU			R.PDSCH.2-			
Subcarrier spacing						
Allocated resource blocks PRBS 273						
Number of consecutive PDSCH symbols						
Symbols For Slot i, if mod(i, 10) = 7 for i from (0,39)		PRBs	273			
For Slot i, if mod(i, 10) = 7 for i from (039)						
from (0,, 39)	symbols					
For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39)			4			
(0,1,2,3,4,5,6) for i from (1,39)						
Allocated slots per 2 frames 31			12			
Allocated slots per 2 frames 31			12			
MCS table 640AM MCS index 13 Modulation 16QAM Target Coding Rate 0.48 Number of MIMO layers 2 Number of MIMO layers 2 For Slot i, if mod(i, 10) = 7 for i from (0,,39) 6 For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (1,2,3,4,5,6) for i from			31			
MCS index 13 Modulation 16QAM Target Coding Rate 0.48 Number of MIMO layers 2 Number of DMRS REs 5 For Slott i, if mod(i, 10) = (0,1,2,3,4,56) for i from (1,,39) 6 For Slott i, if mod(i, 10) = (0,1,2,3,4,56) for i from (1,,39) 12 Verhead for TBS determination 0 Information Bit Payload per Slot 6 For Slots and Slott i, if mod(i, 10) = (8,9) for i from (0,,39) 6 For Slot, i, if mod(i, 10) = 7 for i from (0,,39) 6 For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) 8 For Slot i, if mod(i, 10) = (0,1,2,3,4,5,6) for i from (0,,39) 8 For Slot i, if mod(i, 10) = 7 for i from (0,,39) 6 For Slot i, if mod(i, 10) = 7 for i from (0,,39) 6 For Slot i, if mod(i, 10) = 7 for i from (0,,39) 6 For Slot i, if mod(i, 10) = 7 for i from (0,,39) 6 For Slot i, if mod(i, 10) = 7 for i from (0,,39) 6 For Slot i, if mod(i, 10) = 7 for i from (0,,39) 6 For Slot i, if mod(i, 10) = 7 for i from (0,,39) 6 For Slot i, if mod(i,						
Modulation						
Target Coding Rate						
Number of MIMO layers						
For Slot i, if mod(i, 10) = 7 for i from (039)			2			
from (0,,39) 0 For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39} 12 (1,1,2,3,4,5,6) for i from {1,,39} 0 Overhead for TBS determination 0 Information Bit Payload per Slot For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Bits For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39} Bits For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Bits For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Bits For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Bits For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} CBs For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} CBs For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} CBs For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Bits For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Bits For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Bits For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,1,,39} Bits For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6} for i from {0,1,2,3,						
From (U39) Too (U	For Slot i, if $mod(i, 10) = 7$ for i		6			
12 12 13 14 15 15 16 16 16 16 16 16	from {0,,39}		U			
139 Overhead for TBS						
Overhead for TBS determination 0 Information Bit Payload per Slot For Slots 0 and Slot i, if mod(i, 10) = for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} Bits For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39} Bits Transport block CRC per Slot Bits For Slots 0 and Slot i, if mod(i, 10) = 7 for i from {0,,39} Bits For Slot i, if mod(i, 10) = 7 for i from {0,,39} Bits For Slot i, if mod(i, 10) = 7 for i from {0,,39} Bits For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from Bits 24 {1,,39} Number of Code Blocks per Slot Slot Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} CBs For Slot, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} CBs For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Bits For Slots i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Bits For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Bits For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6} fo			12			
Information Bit Payload per Slot For Slots 0 and Slot i, if mod(i, 10) = (8,9) for i from (0,,39) Bits N/A	{1,,39}					
Information Bit Payload per Slot For Slots 0 and Slot i, if mod(i, 10) = (8,9) for i from (0,,38) Bits N/A			0			
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 8 lits						
10 = (8,9) for i from (0,,39) Bits N/A						
For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,39376} {1,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,0 = {8,9} for i from {0,,39}} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Number of Code Blocks per Slot For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Binary Channel Bits Per Slot For Slots i and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Binary Channel Bits Per Slot For Slots i = 20, 21 Bits For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 8 lits Albertal Bits Bits Bits Bits Bits N/A Bits Alone Bits Bits Bits Alone Bits Bits Bits Alone Bits Bits Bits Alone Bits Bits Bits Bits Alone Bits Bits Bits Bits Bits Alone Bits Bits Bits Bits Bits Bits Bits Bits	,	Bits	N/A			
from {0,,39}	For Slot i if mod/i 10) = 7 for i					
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39} Transport block CRC per Slot For Slots 0 and Slot i, if mod(i, 10) = 7 for i from {0,,39}. For Slot 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}. For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}. For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}. For Slot i, if mod(i, 10) = 7 for i from {0,,39}. For Slot i, if mod(i, 10) = 7 for i from {0,,39}. For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}. For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}. Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}. Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39}. For Slots i = 20, 21 Bits 275184 For Slot i, if mod(i, 10) = 7 for i from {0,,39}. For Slot i, if mod(i, 10) = 7 for i from {0,,39}. For Slot i, if mod(i, 10) = 8 Bits 288288 {1,,9,22,,39}. Max. Throughput averaged over 2 frames		Bits	44040			
(0,1,2,3,4,5,6) for i from {1,,39}	For Slot i, if mod(i, 10) =					
(1,,39) Transport block CRC per Slot For Slots 0 and Slot i, if mod(i, 10) = (8,9) for i from {0,,39} Bits		Bits	139376			
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39}	{1,,39}					
10) = {8,9} for i from {0,,39} Bits N/A						
10 = {8,9} for from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Sits 24		Rits	N/A			
from {0,,39} Bits 24 For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39} Bits 24 Number of Code Blocks per Slot N/A N/A For Slots 0 and Slot i, if mod(i, 10) = {0,,39} CBs N/A For Slot i, if mod(i, 10) = 7 for i from {0,,39} CBs 6 For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39} CBs 17 Binary Channel Bits Per Slot Bits N/A For Slots 0 and Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Bits N/A For Slots i = 20, 21 Bits 275184 For Slot i, if mod(i, 10) = 7 for i from {0,,39} Bits 91728 For Slot i, if mod(i, 10) = 80 for i from {0,,39} Bits 288288 For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Bits 288288 For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Bits 288288 {1,,19,22,,39} Mbps 196.966	$10) = \{8,9\}$ for i from $\{0,,39\}$	Dito	14// (
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39} Number of Code Blocks per Slot For Slots 0 and Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {1,,39} Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = {1,,39} Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = {1,,39} Birs N/A For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 8 John Slot i, if mo		Bits	24			
{0,1,2,3,4,5,6} for i from {1,,39} Bits 24 Number of Code Blocks per Slot Slot N/A For Slots 0 and Slot i, if mod(i, 10) = {6,9} for i from {0,,39} CBs N/A For Slot i, if mod(i, 10) = 7 for i from {0,,39} CBs 6 For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39} CBs 17 Binary Channel Bits Per Slot Bits N/A For Slots 0 and Slot i, if mod(i, 10) = {1,0,,39} Bits N/A For Slots i = 20, 21 Bits 275184 For Slot i, if mod(i, 10) = 7 for i from {0,,39} Bits 91728 For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Bits 288288 4],,19,22,,39} Mbps 196.966						
\{1,,39\} \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \		Dito	24			
Number of Code Blocks per Slot		DIIS	24			
Slot For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39} CBs N/A CBs For Slot i, if mod(i, 10) = 7 for i from {0,,39} CBs 6 CBs C	Number of Code Blocks per					
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = CBs For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39} Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39} For Slots i = 20, 21 For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 8 for Slot i, if mod(i, 10) = 7 for i from {1,,39} For Slot i, if mod(i, 10) = 8 for Slot i, if mod(i, 10) = 10 for Slot	•					
10) = {8,9} for i from {0,,39} CBS For Slot i, if mod(i, 10) = {0,,39} CBS For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39} CBS Binary Channel Bits Per Slot Bits For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39} Bits For Slots i = 20, 21 Bits For Slot i, if mod(i, 10) = 7 for i from {0,,39} Bits For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6} for i from {1,2,2,,39} Bits Max. Throughput averaged over 2 frames Mbps		05	N/A			
For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39} Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39} For Slots i = 20, 21 For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,19,22,,39} Max. Throughput averaged over 2 frames		CBs				
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,39} Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39} For Slots i = 20, 21 For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 8 lits For Slot i, if mod(i, 10) = 8 lits For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,,39} Max. Throughput averaged over 2 frames		CDo	6			
{0,1,2,3,4,5,6} for i from {1,,39} Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39} For Slots i = 20, 21 For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 8	from {0,,39}	CDS	О			
{1,,39} Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39} Bits N/A For Slots i = 20, 21 Bits 275184 For Slot i, if mod(i, 10) = 7 for i from {0,,39} Bits 91728 For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,19,22,,39} Bits 288288 Max. Throughput averaged over 2 frames Mbps 196.966	For Slot i, if mod(i, 10) =					
Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39} Bits N/A For Slots i = 20, 21 Bits 275184 For Slot i, if mod(i, 10) = 7 for i from {0,,39} Bits 91728 For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,19,22,,39} Bits 288288 Max. Throughput averaged over 2 frames Mbps 196.966	{0,1,2,3,4,5,6} for i from	CBs	17			
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39} For Slots i = 20, 21 For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6} for i from {1,,19,22,,39} Max. Throughput averaged over 2 frames						
10) = {8,9} for i from {0,,39} For Slots i = 20, 21 For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6} for i from {1,,19,22,,39} Max. Throughput averaged over 2 frames						
For Slots i = 20, 21 Bits 275184 For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6} for i from {1,,19,22,,39} Max. Throughput averaged over 2 frames Bits 288288		Bits	N/A			
For Slot i, if mod(i, 10) = 7 for i from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {0,1,2,3,4,5,6} for i from {1,,19,22,,39} Max. Throughput averaged over 2 frames Bits 91728 91728		Dito				
from {0,,39} For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,,19,22,,39} Max. Throughput averaged over 2 frames Bits 91728 91728 91728 91728		טונט				
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from	$from \{0, 30\}$	Bits	91728			
{0,1,2,3,4,5,6} for i from Bits 288288 {1,,19,22,,39} Max. Throughput averaged over 2 frames Mbps 196.966	For Slot i if mod(i 10) –					
{1,,19,22,,39} Max. Throughput averaged over 2 frames Mbps 196.966	{0.1.2.3.4.5.6} for i from	Bits	288288			
Max. Throughput averaged over 2 frames Mbps 196.966						
over 2 frames		N #1	400.000			
		ivibps	196.966			
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms		smitted i	n slot #0 with pe	riodicity 20 ms	· · · · · · · · · · · · · · · · · · ·	
Note 2: Slot i is slot index per 2 frames				· 		

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

Parameter	Unit		V	/alue	
Reference channel		R.PDSCH.2-	R.PDSCH.2-		
Reference charmer		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		N/A	N/A		
from {0,,39}		14/7 (
For Slot i, if mod(i, 10) =		12	12		
{1,2,3,4,5,6} for i from {1,,39}					
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		N/A	N/A		
from {0,,39}		14/7 (
For Slot i, if mod(i, 10) =		12	12		
{0,1,2,3,4,5,6} for i from {1,,39}					
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}	5.1.0	1471			
For Slot i, if $mod(i, 10) =$	Bits	30216	30216		
{1,2,3,4,5,6} for i from {1,,39}					
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}					
For Slot i, if mod(i, 10) =	Bits	24	24		
{1,2,3,4,5,6} for i from {1,,39}					
Number of Code Blocks per Slot			21/2		
For Slot i, if $mod(i, 10) = \{0,7,8,9\}$	CBs	N/A	N/A		
for i from {0,,39}			4		
For Slot i, if mod(i, 10) =	CBs	4	4		
{1,2,3,4,5,6} for i from {1,,39}					
Binary Channel Bits Per Slot			NI/A		
For Slot i, if mod(i, 10) = $\{0,7,8,9\}$	Bits	N/A	N/A		
for i from {0,,39}		E2424	E0000		
For Slot i = 21	Bits	53424	50880		
For Slot i, if mod(i, 10) = {1,2,3,4,5,6} for i from	Bits	55968	55968		
{1,2,3,4,5,6} for Firon	DIIS	33900			
Max. Throughput averaged over 2		18.130	18.130		
frames	Mbps	(NOTE 3)	(NOTE 4)		
Note 1: CC/DDCH block is transmit	 				

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

Note 2:

Throughput is calculated under assumption of aggregation factor 2. Throughput is calculated under assumption of repetition number 2 Note 3: Note 4:

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.2- 17.1 TDD					
Channel bandwidth	MHz	40					
Subcarrier spacing	kHz	30					
Allocated resource blocks	PRBs	106					
Number of consecutive PDSCH							
symbols							
For Slot i, if mod(i, 5) = 3 for i from $\{0,,39\}$		2					
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,39\}$		N/A					
Allocated slots per 2 frames		8					
MCS table							
MCS index		4					
Modulation		QPSK					
Target Coding Rate		0.3					
Number of MIMO layers		1					
Number of DMRS REs							
For Slot i, if mod(i, 5) = 3 for i from $\{0,,39\}$		6					
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,39\}$		N/A					
Overhead for TBS determination		0					
Information Bit Payload per Slot							
For Slot i, if mod(i, 5) = 3 for i from $\{0,,39\}$	Bits	1160					
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,39\}$	Bits	N/A					
Transport block CRC per Slot							
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$	Bits	16					
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,39\}$	Bits	N/A					
Number of Code Blocks per Slot							
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$	CBs	1					
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,39\}$	CBs	N/A					
Binary Channel Bits Per Slot							
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$	Bits	3816					
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,39\}$	Bits	N/A					
Max. Throughput averaged over 2 frames	Mbps	0.464					
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms							

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

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	Value					
Reference channel		R.PDSCH.2-	R.PDSCH.2-	R.PDSCH.2-	R.PDSCH.2-		
Reference channel		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} (Note 3, 5)	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} (Note 5)	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} (Note 3, 5)	symb ol	{6, 6,12,12}	{6, 6,12,12}	{6, 6,12,12}	{6, 6,12,12}		
For Slot i, if mod(i, 10) = {0, 1, 2, 4} for i from {1,,39} (Note 5)	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} (Note 3, 5)	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} (Note 5)	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} (Note 5)	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} (Note 3, 5)	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} (Note 5)	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} (Note 3, 5)	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} (Note 5)	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 symbols is 6,9,12,14 respectively. It applies only to the last slot within the Downlink Transmission duration (specified in Annex B.5). For all other slots the setup when the number of OFDM symbols is 14 should apply.

Note 4: The slot i, mod (i,10)=9 is idle slot with no UL transmission.

Note 5: The per Slot value applies only to slots included within the Downlink Transmission duration. For all other slots not included in the Downlink Transmission Duration, N/A should apply

- 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 shannel		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		
		1			
MCS table		64QAM 4	64QAM 4		
MCS index Modulation		QPSK	QPSK		
Target Coding Rate		0.30	0.30		
Number of MIMO layers		1	1		
Number of DMRS REs			N1/A		
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		0	U		
			N/A		
For Slots 0 and Slot i, if $mod(i, 5) = 4$	Bits	N/A	IN/A		
for i from $\{0,,159\}$ For Slot i, if mod(i, 5) = 3 for i from	Bits	3624	736		
{0,, 159} For Slot i, if mod(i, 5) = {0,1,2} for i	Bits	5504	736		
from {1,,159}	Dita	3304			
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 $mod(i, 5) = 4$			N/A		
for i from {0,,159}	CBs	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			2310		
{0,, 159}	Bits	12210			
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 frames	Mbps	31.942	4.673		
Note 1: SS/PBCH block is transmitted	in slot #0	with periodicity	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

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

Parameter	Unit			Value		
	- Cinc	R.PDSCH.5-	R.PDSCH.5-	R.PDSCH.5-		
Reference channel		2.1 TDD	2.2 TDD	2.3 TDD		
Channel bandwidth	MHz	100	100	200		
Subcarrier spacing	kHz	120	120	120		
Allocated resource blocks	PRBs	66	66	132		
Number of consecutive PDSCH						
symbols						
For Slots 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,159\}$		N/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		
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	İ	1	2	2		
Number of DMRS REs	İ					
For Slots 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,159\}$		N/A	N/A	N/A		
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 159\}$		12	12	12		
For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i from $\{1,,159\}$		12	12	12		
Overhead for TBS determination		6	6	6		
Information Bit Payload per Slot		Ŭ	Ŭ	Ŭ		
For Slots 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,159\}$	Bits	N/A	N/A	N/A		
For Slot i, if $mod(i, 5) = 3$ for i from	Bits	11272	22536	45096		
$\{0,, 159\}$ For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i	Bits	17424	34816	69672		
from {1,,159} Transport block CRC per Slot						
For Slots 0 and Slot i, if $mod(i, 5) = 4$						
for i from {0,,159}	Bits	N/A	N/A	N/A		
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 159\}$	Bits	24	24	24		
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,159\}$	Bits	24	24	24		
Number of Code Blocks per Slot	İ					
For Slots 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,159\}$	CBs	N/A	N/A	N/A		
For Slot i, if mod(i, 5) = 3 for i from $\{0,, 159\}$	CBs	2	3	6		
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i	CBs	3	5	9		
from {1,,159} Binary Channel Bits Per Slot						
For Slots 0 and Slot i, if mod(i, 5) = 4	_					
for i from {0,,159}	Bits	N/A	N/A	N/A		
For Slots i = 80, 81	Bits	36564	69960	139920		
For Slots i = 82	Bits	34980	73128	146256		
For Slots i = 83	Bits	22308	48840	97680		
For Slot i, if mod(i, 5) = 3 for i from $\{0,, 159\}$	Bits	24420	48840	97680		
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,79,84,,159\}$	Bits	36564	73128	146256		
Max. Throughput averaged over 2 frames	Mbps	100.799	201.434	403.096		
Note 1: SS/PBCH block is transmitted	in slot #0) with periodicity	/ 20 ms	<u> </u>		
Note 2: Slot i is slot index per 2 frames						

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

Parameter	Unit		Value	
Reference channel		R.PDSCH.5-		
Channel bandwidth	MHz	3.1 TDD 100		
	kHz	120		
Subcarrier spacing Allocated resource blocks	PRBs	66		
Number of consecutive PDSCH	PKD5	00		
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		9		
{0,, 159}				
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		NI/A		
i from {0,,159}		N/A		
For Slot i, if $mod(i, 5) = 3$ for i from		40		
{0,, 159}		12		
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i		12		
from {1,,159}				
Overhead for TBS determination		6		
Information Bit Payload per Slot				
For Slots 0 and Slot i, if $mod(i, 5) = 4$	Bits	N/A		
for i from {0,,159}	Dito			
For Slot i, if $mod(i, 5) = 3$ for i from	Bits	16136		
$\{0,, 159\}$ For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i				
from {1,,159}	Bits	25104		
Transport block CRC per Slot				
For Slots 0 and Slot i, if $mod(i, 5) = 4$	Dita	N/A		
for i from {0,,159}	Bits			
For Slot i, if $mod(i, 5) = 3$ for i from	Bits	24		
{0,, 159}	DIIS	24		
For Slot i, if $mod(i, 5) = \{0, 1, 2\}$ for i	Bits	24		
from {1,,159}	Dito	27		
Number of Code Blocks per Slot				
For Slots 0 and Slot i, if $mod(i, 5) = 4$	CBs	N/A		
for i from {0,,159}				
For Slot i, if $mod(i, 5) = 3$ for i from	CBs	2		
$\{0,, 159\}$ For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i	1			
For Slot I, If $mod(1, 5) = \{0, 1, 2\}$ for I from $\{1,, 159\}$	CBs	3		
Binary Channel Bits Per Slot	 			
For Slots 0 and Slot i, if $mod(i, 5) = 4$	1	N/A		
for i from $\{0,,159\}$	Bits	1 1 1 / / 1		
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	D:4	F 40 40		
from {1,,79,82,,159}	Bits	54846		
Max. Throughput averaged over 2	Mhna	145.062		
frames	Mbps			
Note 1: SS/PBCH block is transmitted		vith periodicity 20	0 ms	
Note 2: Slot i is slot index per 2 frames				

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

Parameter	Unit		Valu	ie		
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 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 $\{1,,79,82,,159\}$	Bits	3324				
Max. Throughput averaged over 2 frames	Mbps	5.548				
	in slot #0 w	ith periodicity 20) ms			
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms Note 2: Slot i is slot index per 2 frames						

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

Parameter	Unit			Value	
Reference channel		R.PDSCH.5-	R.PDSCH.5-		
		5.1 TDD	5.2 TDD		
Channel bandwidth	MHz	100	50		
Subcarrier spacing Allocated resource blocks	kHz PRBs	120 66	120 32		
Number of consecutive PDSCH	PKD5	00	32		
symbols					
For Slots 0 and Slot i, if $mod(i, 4) = 3$.	21/2		
for i from {0,,159}		N/A	N/A		
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		
Number of DMRS REs					
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				1	
For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$	Bits	N/A	N/A		
For Slot i = 80, 81	Bits	69960	33920	1	
For Slot i, if $mod(i, 4) = 2$ for i from	Bits	54912	26624		
$\{4,, 159\}$ For Slot i, if mod(i, 4) = $\{0,1\}$ for i from	Bits	73128	35456		
{1,,79,82,,159} Max. Throughput averaged over 2					
frames	Mbps	188.739	91.843		
Note 1: SS/PBCH block is transmitted Note 2: Slot i is slot index per 2 frames		with periodicity	20 ms		

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

Parameter	Unit		Value				
Reference channel		R.PDSCH.5-					
Channel bandwidth	MHz	6.1 TDD 100					
Subcarrier spacing	kHz	120	+ + + + + + + + + + + + + + + + + + + +				
Allocated resource blocks	PRBs	66					
Number of consecutive PDSCH	TILDO	00					
symbols							
For Slots 0 and Slot i, if mod(i, 4) = 3		N/A					
for i from {0,,159}		14//					
For Slot i, if mod(i, 4) = 2 for i from {1,, 159}		10					
For Slot i, if $mod(i, 4) = \{0,1\}$ for i from $\{1,,159\}$		13					
Allocated slots per 2 frames		119					
MCS table		64QAM					
MCS index		17					
Modulation		64QAM					
Target Coding Rate		0.43	 				
Number of MIMO layers		2	 				
Number of DMRS REs							
For 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	CBs	6					
{1,,159} Binary Channel Bits Per Slot							
For Slots 0 and Slot i, if mod(i, 4) = 3	Bits	N/A					
for i from {0,,159}		114940	 				
For Slot $i = 80, 81$ For Slot i , if mod $(i, 4) = 2$ for i from	Bits	114940	+ + + + + + + + + + + + + + + + + + + +				
{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	ith periodicity 20					
Note 2: Slot i is slot index per 2 frames							

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

Parameter	Unit		Value
Reference channel		R.PDSCH.5-	
Reference channel		7.1 TDD	
Channel bandwidth	MHz	100	
Subcarrier spacing	kHz	120	
Allocated resource blocks	PRBs	66	
Number of consecutive PDSCH symbols		12	
Allocated slots per 2 frames		63	
MCS table		64QAM	
MCS index		13	
Modulation		16QAM	
Target Coding Rate		0.48	
Number of MIMO layers		1	
Number of DMRS REs (Note 3)		24	
Overhead for TBS determination		6	
Information Bit Payload per Slot			
For Slots 0 and Slot i, if mod(i, 5) = {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		N./ 2	
from {0,,159}	CBs	N/A	
For Slot i = 80	CBs	2	
For Slot i, if $mod(i, 5) = \{0,2\}$ for i from		İ	
{1,,79,82,,159}	CBs	2	
Binary Channel Bits Per Slot			
For Slots 0 and Slot i, if mod(i, 5) =	D:4-	NI/A	
{3,4} for i from {0,,159}	Bits	N/A	
For CSI-RS Slot i, if mod(i,5) =1 for i	D:+-	NI/A	
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	Mhna	15 1926	
frames	Mbps	45.1836	
Note 1: SS/PBCH block is transmitted in	slot #0 w	ith periodicity 20	0 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: Number of DMRS REs includes the overhead of the DM-RS CDM groups without data

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 charmer		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		40	40	40	40			
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		12	12	12	12			
from {1,,159}								
Overhead for TBS determination		6	6	6	6			
Information Bit Payload per Slot								
For Slots 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,159\}$	Bits	N/A	N/A	N/A	N/A			
For Slot i, if $mod(i, 5) = 3$ for i from	Bits	7680	15880	31752	63528			
{0,, 159}	Dita	7000	13000	31732	03320			
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) =	Bits	N/A	N/A	N/A	N/A			
4 for i from {0,,159}	Dito	14// (14/71	14// (14/71			
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	Bits	24	24	24	24			
from {1,,159}	DIIS	24	24	24	24			
Number of Code Blocks per Slot								
For Slots 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,159\}$	CBs	N/A	N/A	N/A	N/A			
For Slot i, if $mod(i, 5) = 3$ for i from	05		6	4				
{0,, 159}	CBs	1	2	4	8			
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i	CBs	2	3	6	12			
from {1,,159}	OBO		Ŭ	Ů	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				2.0.001	333.555			
Note 1: SS/PBCH block is transmitted Note 2: Slot i is slot index per 2 fram		#U with periodic	city 20 ms					
Note 2. Slot its slot lindex per 2 frames								

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- 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 $\{0,, 159\}$		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		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 $\{0,, 159\}$		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		0				
For Slots 0 and Slot i, if $mod(i, 5) = 4$		N/A				
for i from {0,,159}	Bits	14//				
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	Dito	10000				
from $\{1,,159\}$	Bits	23568				
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	CBs	3				
from {1,,159}						
Binary Channel Bits Per Slot		NI/A				
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	33920				
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 159\}$	Bits	23680				
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,79,82,,159\}$	Bits	35456				
Max. Throughput averaged over 2 frames	Mbps	136.537				
	in slot #0 w	ith periodicity 20	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.3.2.2.5-11: PDSCH Reference Channel for TDD UL-DL pattern FR2.120-2

Parameter	Unit		Value	
Reference channel		R.PDSCH.5-11.1 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	Į.	
$= \{2,3\}$ for i from $\{0,,159\}$	Dita	IN/A		
For Slot i, if $mod(i, 4) = \{0,1\}$ for i	Bits	24	Į.	
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	14/71		
For Slot i, if $mod(i, 4) = \{0,1\}$ for i	CBs	2		
from {2,,159}	020	_		
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}	Dit	•		
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		Valu	е	
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		Valu	е	
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 carrier		10	10	10	
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			Valu	ıe	
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		R.PDCCH.	R.PDCCH.	R.PDCCH.	R.PDCCH.	R.PDCCH.	R.PDCCH.	R.PDCCH.
channel		1-2.1 FDD	1-2.2 FDD	1-2.3 FDD	1-2.4 FDD	1-2.5 FDD	1-2.6 FDD	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			Valu	ıe	
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	ıe	
Reference		R.PDCCH.1-	R.PDCCH.1-	R.PDCCH.1-		
channel		1.1 TDD	1.2 TDD	1.3 TDD		
Subcarrier	kHz	15	15	15		
spacing						
CORESET		48	48	48		
frequency domain						
allocation						
CORESET time		1	1	1		
domain allocation						
Aggregation level		4	4	8		
DCI Format		1_0	1_1	1_1		
Payload (without	Bits	39	52	52		
CRC)						

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

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

A.3.3.2.2 Reference measurement channels for SCS 30 kHz FR1

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

Parameter	Unit	Value							
Reference		R.PDCCH.2-	R.PDCCH.2-	R.PDCCH.2-	R.PDCCH.2-				
channel		1.1 TDD	1.2 TDD	1.3 TDD	1.4 TDD				
Subcarrier	kHz	30	30	30	30				
spacing									
CORESET		102	102	90	102				
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 CRC)	Bits	41	53	53	12				

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

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

A.3.4 Reference measurement channels for PBCH demodulation requirements

A.3.4.1 Reference measurement channels for FR1

Table A.3.4.1-1: PBCH Reference Channel

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

A.3.4.2 Reference measurement channels for FR2

Table A.3.4.2-1: PBCH Reference Channel

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

A.4 CSI reference measurement channels

This clause defines the DL signal applicable to the reporting of channel 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 a	llocated PDS	CH resource	olocks	66	66				
Number of c	onsecutive PI	DSCH symbo	ls	12	12				
Number of PDSCH MIMO layers			1	2					
Number of DMRS REs (Note 1)				24	24				
Overhead for TBS determination				6	6				
Available RE-s				7590	7590				
CQI index Spectral MCS Modulatio					Infor	mation Bit	Payload po	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	QPSK	2856	5640				
4	0.6016	4	QFSN	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	04QAIVI	33816	67584				
14	5.1152	26		38936	77896				
15	5.5547	28		42016	83976				
Note 1: Number of DMRS REs includes the overhead of the DM-RS CDM groups without data Note 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	TBS.2	TBS.2	TBS.2	TBS.2	TBS.2	TBS.2	TBS.2
MCS table	Δ			-1	-2	-3	-4 256QAM	-5	-6	-7	-8
	of allocated F	PDSCH res	OUICO	52	52	106	106	8	16	32	51
blocks	or anocated i	DOOM	Juice	02	02	100	100		10	02	31
	of consecutiv	e PDSCH s	symbols	12	12	12	12	12	12	12	12
	Number of PDSCH MIMO layers			1	2	1	2	1	1	1	2
	of DMRS RE	-		24	24	24	24	24	24	24	24
	for TBS de			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 8	2.7305	11 13		16896	33816	34816	69672	2600	5248	9992	33816
9	3.3223	15	-	20496 24576	40976 49176	42016 49176	83976 98376	3240 3752	6400 7424	12040 14344	40976 48168
10	3.9023 4.5234	17	64QAM	28168	56368	57376	11477	4352	8712	16392	55304
10	4.5254	17	04QAIVI	20100	30300	3/3/0	6	4332	0/12	10392	33304
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
- 10	0.0000			00000		70000	6	0040	10010	00500	75700
13	6.2266	23	05004	38936	77896	79896	15988	6016	12040	22536	75792
14	6.9141	25	256QA M	43032	86040	88064	0 17620	6656	13320	25104	83976
14	0.9141	25	IVI	43032	00040	00004	8	0000	13320	25104	03970
15	7.4063	27		46104	92200	94248	18857	7040	14088	27144	90176
Note 1: Number of DMRS REs includes the overhead of the DM-RS CDM groups without data											
Note 2: PDSCH is not scheduled on slots containing CSI-RS 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:			based on Mo								
11000 11	Spectrur or.	11010110 1 10 1		22 1 4010	Solinou I	1 4010 5		1 15 50.2	[]		l

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

TBS Schem	е			TBS.3-1	TBS.3-2	TBS.3-3	TBS.3-4		
MCS table						2560	QAM		
Number of a	Illocated PDS	CH resource	blocks	52	52	106	106		
Number of c	onsecutive PI	DSCH symbo	ls	12	12	12	12		
Number of F	PDSCH MIMO		3	4	3	4			
Number of D	24	24	24	24					
Overhead for	r TBS determ	ination		0	0	0	0		
Available R	E-s for PDSCH	1		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									
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]								
Note 4: S	pectral efficie	ncy is based o	on MCS Table	defined in	Table 5.1.3	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						64QAN	/ILowSE		
Number of a	Illocated PDS	CH resource	olocks	52	106				
Number of c	onsecutive PI	DSCH symbo	ls	12	12				
Number of PDSCH MIMO layers				1	1				
Number of DMRS REs (Note 1)				24	24				
Overhead for TBS determination				0	0				
Available RE-s for PDSCH			6240	12720					
CQI index	Spectral	MCS	Modulatio		Infor	mation Bit	Payload po	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	64001	20496	42016				
14	3.9023	26	64QAM	24576	49176				
15	4.5234 28		28168	57376					
			des the overhe slots containir					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.
Reference channel			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	S		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 H transmissions	ARQ		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

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

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:	ote 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	$R_{UE} = \begin{pmatrix} 1 & \boldsymbol{\beta} \\ \boldsymbol{\beta}^* & 1 \end{pmatrix}$	$R_{UE} = \begin{pmatrix} 1 & \beta^{\frac{1}{9}} & \beta^{\frac{4}{9}} & \beta \\ \beta^{\frac{1}{9}^*} & 1 & \beta^{\frac{1}{9}} & \beta^{\frac{4}{9}} \\ \beta^{\frac{4}{9}^*} & \beta^{\frac{1}{9}^*} & 1 & \beta^{\frac{1}{9}} \\ \beta^* & \beta^{\frac{4}{9}^*} & \beta^{\frac{1}{9}^*} & 1 \end{pmatrix}$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

1x2 case	$R_{high} = \begin{pmatrix} 1 & 0.9 \\ 0.9 & 1 \end{pmatrix}$							
2x1 case	$R_{high} = \begin{pmatrix} 1 & 0.9 \\ 0.9 & 1 \end{pmatrix}$							
2x2 case	$R_{high} = \begin{pmatrix} 1 & 0.9 & 0.9 & 0.81 \\ 0.9 & 1 & 0.81 & 0.9 \\ 0.9 & 0.81 & 1 & 0.9 \\ 0.81 & 0.9 & 0.9 & 1 \end{pmatrix}$							
4x2 case	$R_{high} = \begin{bmatrix} 1.0000 & 0.8999 & 0.9883 & 0.8894 & 0.9542 & 0.8587 & 0.8999 & 0.8099 \\ 0.8999 & 1.0000 & 0.8894 & 0.9883 & 0.8587 & 0.9542 & 0.8099 & 0.8999 \\ 0.9883 & 0.8894 & 1.0000 & 0.8999 & 0.9883 & 0.8894 & 0.9542 & 0.8587 \\ 0.8894 & 0.9883 & 0.8999 & 1.0000 & 0.8894 & 0.9883 & 0.8587 & 0.9542 \\ 0.9542 & 0.8587 & 0.9883 & 0.8894 & 1.0000 & 0.8999 & 0.9883 & 0.8894 \\ 0.8587 & 0.9542 & 0.8894 & 0.9883 & 0.8999 & 1.0000 & 0.8894 & 0.9883 \\ 0.8999 & 0.8099 & 0.9542 & 0.8587 & 0.9883 & 0.8894 & 1.0000 & 0.8999 \\ 0.8099 & 0.8999 & 0.8587 & 0.9542 & 0.8894 & 0.9883 & 0.8999 & 1.0000 \end{bmatrix}$							
4x4 case	$R_{high} = \begin{bmatrix} 1.0000 \ 0.9882 \ 0.9541 \ 0.8999 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.8894 \ 0.9541 \ 0.9430 \ 0.9105 \ 0.8887 \ 0.8999 \ 0.8894 \ 0.8587 \ 0.8099 \\ 0.9882 \ 1.0000 \ 0.9882 \ 0.9541 \ 0.9767 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.9541 \ 0.9430 \ 0.9541 \ 0.9430 \ 0.8587 \ 0.8894 \ 0.8999 \ 0.8894 \ 0.8587 \\ 0.9541 \ 0.9882 \ 1.0000 \ 0.9882 \ 0.9767 \ 0.9882 \ 0.9767 \ 0.9105 \ 0.9430 \ 0.9541 \ 0.9430 \ 0.8587 \ 0.8894 \ 0.8999 \ 0.8894 \\ 0.8999 \ 0.9541 \ 0.9882 \ 1.0000 \ 0.8894 \ 0.9430 \ 0.9767 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.9541 \ 0.8999 \ 0.8587 \ 0.8894 \ 0.8999 \\ 0.9882 \ 0.9767 \ 0.9430 \ 0.8894 \ 1.0000 \ 0.9882 \ 0.9541 \ 0.8999 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.9430 \ 0.9541 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.9882$							

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 0.9882 0.9541 0.8999 0.8747 0.8645 0.8347 0.7872 0.5855 0.5787 0.5588 0.5270 0.3000 0.2965 0.2862 0.2700								

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

1x4 case						R _{mediu}		1 0.9000 0.6561 0.3874	0.9000 1 0.9000 0.6561	0.90 0 1	00 0. 0.	3874 6561 9000 1					
					0.9000 0.9000	1.00	000 0	.9000	0.3874 0.6561		0 0.3	8000	0.1968 0.2700	0.1162	3		
2x4			R	₄ =	0.656	4 0.65	561 (.9000	0.9000 1.0000	0.116	62 0.1	968	0.3000 0.2700	0.2700)		
case		$R_{mediumA} =$		num A	0.3000	0.30	000	0.1968	0.1162 0.1968	0.900	00 1.0	0000	0.6561	0.3874	1		
					0.196			0.3000	0.2700 0.3000		51 0.9 74 0.		1.0000 0.9000	0.9000			
													2 0.2269				
													0.3842 0.5270				
													0.5856				
		0.8748	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	0.2269
		0.7873	0.8748	0.7873	0.5739	0.9000	1.0000	0.9000	0.6561	0.7873	0.8748	0.7873	0.5739	0.5270	0.5856	0.5270	0.3842
													0.7873				
4x4	$R_{medium\ A} =$												0.8748				
case													0.3874 0.6561				
													0.9000				
		0.2269	0.3842	0.5270	0.5856	0.3389	0.5739	0.7873	0.8748	0.3874	0.6561	0.900	0 1.0000	0.3389	0.5739	0.7873	0.8748
		0.3000	0.2700	0.1968	0.1162	0.5856	0.5270	0.3842	0.2269	0.8748	0.7873	0.573	9 0.3389	1.0000	0.9000	0.6561	0.3874
		0.2700	0.3000	0.2700	0.1968	0.5270	0.5856	0.5270	0.3842	0.7873	0.8748	0.787	3 0.5739	0.9000	1.0000	0.9000	0.6561
													8 0.7873				
	l	0.1162	0.1968	0.2700	0.3000	0.2269	0.3842	2 0.5270	0.5856	0.3389	0.5739	0.787	3 0.8748	0.3874	0.6561	0.9000	1.0000)

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:

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

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

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

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

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

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

where

- $R_{\!U\!E}$ is the spatial correlation matrix at the UE with same polarization,
- R_{oNB} is the spatial correlation matrix at the gNB with same polarization,
- Γis 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,

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

- 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.,

$$R_{\rm gNB}\!=\!R_{\rm gNB_Dim,l}$$

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 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.

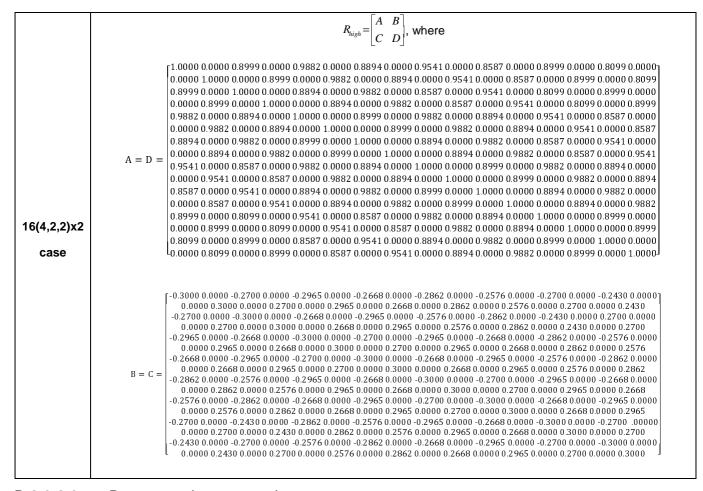
Table B.2.3.2.2-2: MIMO correlation matrices for high spatial correlation (1D cross polarized antenna array at gNB side)

				Γ 1	0000	0.0000	0.00	200 (0000	0.20	200	0000	0.00	700 0		1	
						0.0000	0.90		0.0000	-0.30		0.0000	-0.27		0.0000		
				0	.0000	1.0000	0.00	000 (0.9000	0.00	000 (0.3000	0.0	000).2700		
				0	.9000	0.0000	1.00	000	0.0000	-0.27	00 0	0000.	- 0.30	000	.0000		
4(2,1,2)x2				0	.0000	0.9000	0.00	000	0000.1	0.00	000 0	.2700	0.00	000	0.3000		
case			$R_{high} =$:		0.0000	-0.2		0.0000	1.00		0.0000	0.90		0.0000		
				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	000 0	0.0000		
				0	.0000	0.2700	0.0	000	0.3000	0.00	00 0	.9000	0.00	000 1	.0000		
				Γ1.	.0000	0.9000	0.0	000	0.0000	-0.30	000 -(0.2700	0.00	00 0.0	0000		
					.9000	1.0000			0.0000	-0.27		0.3000	0.00		0000		
					.0000	0.0000		000	0.9000			.0000	0.300		700		
2(1,1,2)x4			R_{high}	=	.0000	0.0000		000	1.0000			.0000	0.270		000		
case			nıgn	-0	.3000	-0.270	0.0	000	0.0000	0 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	.0000	0.000	0.3	000	0.2700	0.00	000 0	.0000	1.000	0.9	000		
				0	.0000	0.0000	0.2	700	0.3000	0.00	000 0	.0000	0.900	00 1.0	000		
		1.0000	0.9000		0.0000	0.9000	0.8100	0.0000		-0.3000	-0.2700	0.0000	0.0000	-0.2700	-0.2430	0.0000	0.0000
		0.9000		0.0000		0.8100	0.9000	0.0000	0.0000	-0.2700	-0.3000	0.0000	0.0000	-0.2430	-0.2700	0.0000	0.0000
		0.0000	0.0000	1.0000	0.9000	0.0000	0.0000	0.9000	0.8100	0.0000	0.0000	0.3000	0.2700	0.0000	0.0000	0.2700	0.2430
		0.0000		0.9000		0.0000	0.0000	0.8100	0.9000	0.0000	0.0000	0.2700	0.3000	0.0000	0.0000	0.2430	0.2700
		0.9000		0.0000		1.0000	0.9000	0.0000	0.0000	-0.2700	-0.2430	0.0000	0.0000	-0.3000	-0.2700	0.0000	0.0000
		0.8100 0.0000		0.0000		0.9000 0.0000	1.0000 0.0000	0.0000 1.0000	0.0000 0.9000	-0.2430 0.0000	-0.2700 0.0000	0.0000 0.2700	0.0000 0.2430	-0.2700 0.0000	-0.3000 0.0000	0.0000	0.0000 0.2700
4(2,1,2)x4		0.0000		0.8100		0.0000	0.0000	0.9000	1.0000	0.0000	0.0000	0.2430	0.2700	0.0000	0.0000	0.2700	0.3000
case	$R_{ m high}$ $=$	-0.3000		0.0000		-0.2700	-0.2430	0.0000	0.0000	1.0000	0.9000	0.0000	0.0000	0.9000	0.8100	0.0000	0.0000
				0.0000		-0.2430	-0.2700	0.0000	0.0000	0.9000	1.0000	0.0000	0.0000	0.8100	0.9000	0.0000	0.0000
		0.0000		0.3000		0.0000	0.0000	0.2700	0.2430	0.0000	0.0000	1.0000	0.9000	0.0000	0.0000	0.9000	0.8100
		0.0000 -0.2700		0.2700 0.0000		0.0000	0.0000	0.2430 0.0000	0.2700 0.0000	0.0000	0.0000 0.8100	0.9000	1.0000	0.0000 1.0000	0.0000	0.8100	0.9000
				0.0000		-0.2700	-0.3000	0.0000	0.0000	0.8100	0.9000	0.0000	0.0000	0.9000	1.0000	0.0000	0.0000
		0.0000	0.0000	0.2700	0.2430	0.0000	0.0000	0.3000	0.2700	0.0000	0.0000	0.9000	0.8100	0.0000	0.0000	1.0000	0.9000
		0.0000	0.0000	0.2430	0.2700	0.0000	0.0000	0.2700	0.3000	0.0000	0.0000	0.8100	0.9000	0.0000	0.0000	0.9000	1.0000
		1.0000	0.0000	0.988	3 0.000	0.9542	0.0000	0.8999	0.0000	-0.3000	0.0000	-0.2965	0.0000	-0.2862	0.0000	-0.2700	0.0000
		0.0000	1.0000	0.000	0.988	3 0.0000	0.9542	0.0000	0.8999	0.0000	0.3000	0.0000	0.2965	0.0000	0.2862	0.0000	0.2700
		0.9883	0.0000	1.000	0.000	0.9883	0.0000	0.9542	0.0000	-0.2965	0.0000	-0.3000	0.0000	-0.2965	0.0000	-0.2862	0.0000
		0.0000	0.9883	0.000	0 1.000	0.0000	0.9883	0.0000	0.9542	0.0000	0.2965	0.0000	0.3000	0.0000	0.2965	0.0000	0.2862
		0.9542	0.0000	0.988	3 0.000	0 1.0000	0.0000	0.9883	0.0000	-0.2862	0.0000	-0.2965	0.0000	-0.3000	0.0000	-0.2965	0.0000
		0.0000	0.9542	0.000	0.988	3 0.0000	1.0000	0.0000	0.9883	0.0000	0.2862	0.0000	0.2965	0.0000	0.3000	0.0000	0.2965
		0.8999	0.0000	0.954	2 0.000	0.9883	0.0000	1.0000	0.0000	-0.2700	0.0000	-0.2862	0.0000	-0.2965	0.0000	-0.3000	0.0000
8(4,1,2)x2	$R_{high} =$	0.0000	0.8999	0.000	0.954	2 0.0000	0.9883	0.0000	1.0000	0.0000	0.2700	0.0000	0.2862	0.0000	0.2965	0.0000	0.3000
case	0.000	-0.3000				0 -0.2862											
		0.0000				5 0.0000							0.9883	0.0000	0.9542	0.0000	0.8999
		-0.2965				0 -0.2965					0.0000	1.0000	0.0000	0.9883		0.9542	0.0000
		0.0000	0.2965	0.000	0.300	0.0000	0.2965	0.0000	0.2862	0.0000	0.9883	0.0000	1.0000	0.0000	0.9883	0.0000	0.9542
		-0.2862	0.0000	-0.290	55 0.000	0 -0.3000	0.0000	-0.2965	0.0000	0.9542	0.0000	0.9883	0.0000	1.0000	0.0000	0.9883	0.0000
		0.0000				5 0.0000							0.9883	0.0000		0.0000	0.9883
		-0.2700				0 -0.2965											
		0.0000	0.2700	0.000	0 0.286	2 0.0000	0.2965	0.0000	0.3000	0.0000	0.8999	0.0000	0.9542	0.0000	0.9883	0.0000	1.0000

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

2(1,1,2)x2	$ \begin{bmatrix} 1.0000 & 0.0000 & -0.2000 & 0.0000 \\ 0.0000 & 1.0000 & 0.0000 & 0.2000 \end{bmatrix} $
case	$\frac{\Lambda_{medium}}{\Lambda_{medium}} = \begin{bmatrix} -0.2000 & 0.0000 & 1.0000 & 0.0000 \end{bmatrix}$
	$\begin{bmatrix} 0.0000 & 0.2000 & 0.0000 & 1.0000 \end{bmatrix}$

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,

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

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

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

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

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

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

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

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

$$D_{\theta_{k,i}}(4) = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & e^{j\theta_{k,i}} & 0 & 0 \\ 0 & 0 & e^{j2\theta_{k,i}} & 0 \\ 0 & 0 & 0 & e^{j3\theta_{k,i}} \end{bmatrix}.$$

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

- $\theta_{k,i}$ controls the phase variation in first dimension and second dimension respectively, and the phase for k-th subframe is denoted by $\theta_{k,i} = \theta_{0,i} + \Delta \theta \cdot k$, where $\theta_{0,i}$ is the random start value with the uniform distribution, i.e., $\theta_{0,i} \in [0,2\pi]$, $\Delta \theta$ is the step of phase variation, which is defined in Table B.2.3.2.3-1, 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, $\Delta f = 2^{μ} \cdot 15 [\text{kHz}]$

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.2.3.2.3-1: 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
- $D_{\theta_{1}}(N_{1})$ is the steering matrix in first dimension with same polarization,
- $D_{\theta_{k,2}}(N_2)$ is the steering matrix in second dimension with same polarization,
- N_1 is the number of antenna elements 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, $D_{\theta_{n}}(1) = 1$.

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, $\Delta f = 2^{\mu} \cdot 15 [\text{kHz}]$

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.2.3.2.3A-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)

$$\cos\theta(t) = \cos\theta(t \mod(2D_s/v)), t > 2D_s/v \tag{B.3.1.4}$$

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 300 km/h 500 km/h 300 km/h 500 km/h 750 Hz for 15 kHz SCS 972 Hz for 15 kHz SCS 1000 Hz for 30 kHz 1667 Hz for 30 kHz f_d test SCS 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) .

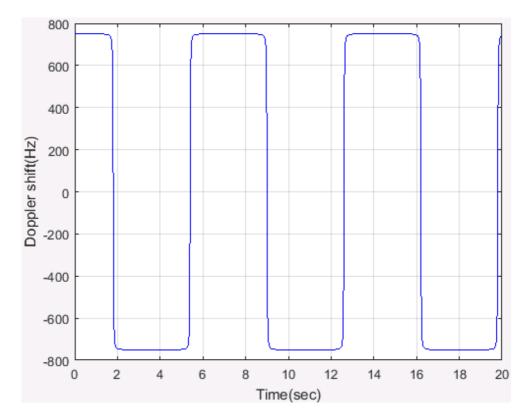


Figure B.3.1-1: Doppler shift trajectory ($f_{\scriptscriptstyle d}$



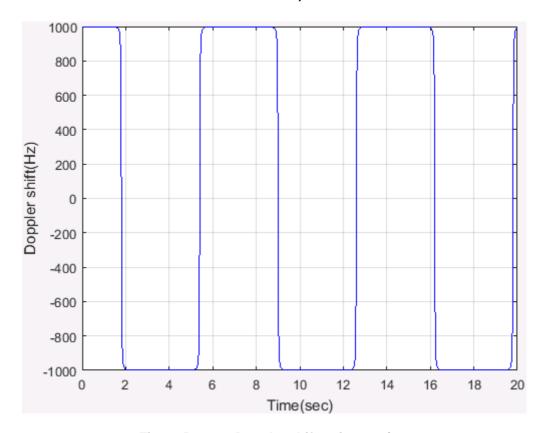


Figure B.3.1-2: Doppler shift trajectory ($f_{\scriptscriptstyle d}$

= 1000 Hz)

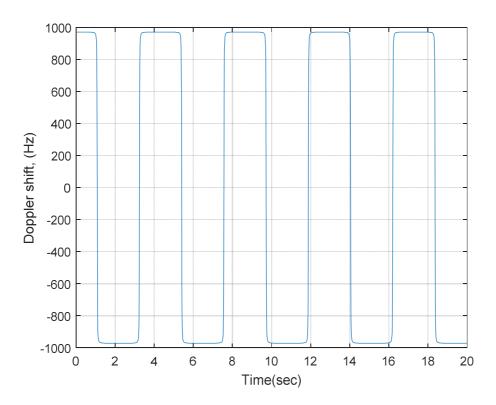


Figure B.3.1-3: Doppler shift trajectory (f_d = 972 Hz)

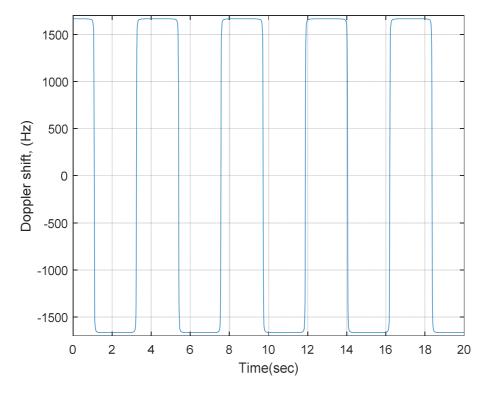


Figure B.3.1-4: Doppler shift trajectory (f_d = 1667 Hz)

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.

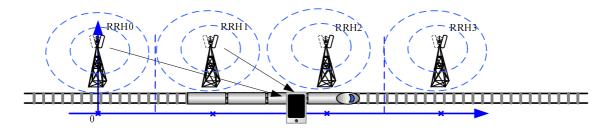


Figure B.3.2-1: Deployment of HST-SFN

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 $F_{D,k}(\mathrm{Hz})$ 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^{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;

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.

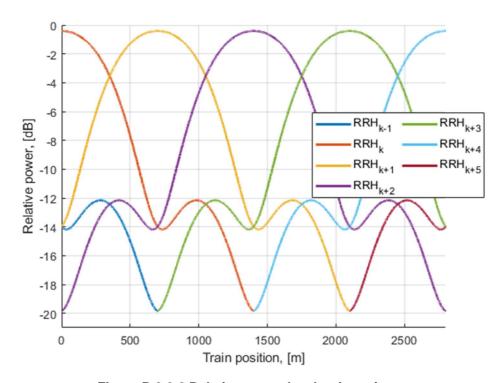


Figure B.3.2-2 Relative power level trajectories

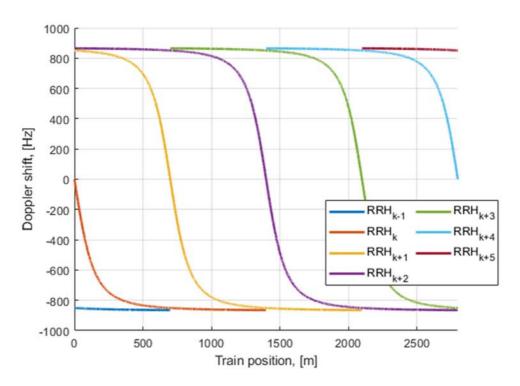


Figure B.3.2-3 Doppler shift trajectories (f_d = 870 Hz)

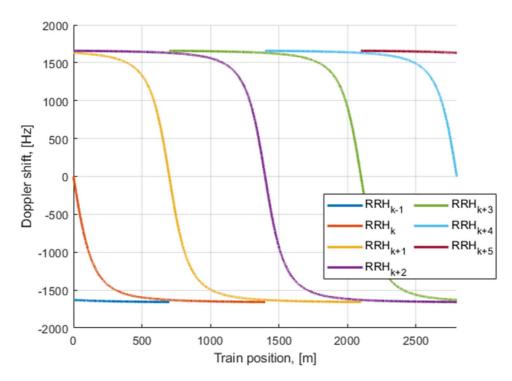


Figure B.3.2-4 Doppler shift trajectories (f_d = 1667 Hz)

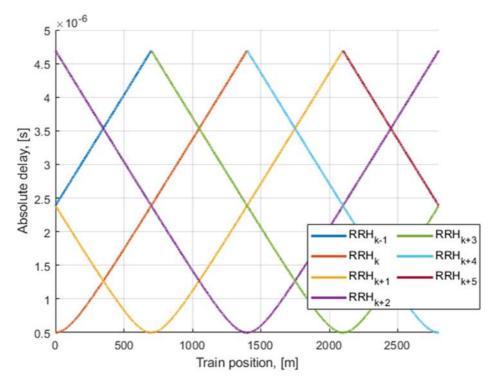


Figure B.3.2-5 Absolute delay trajectories

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.

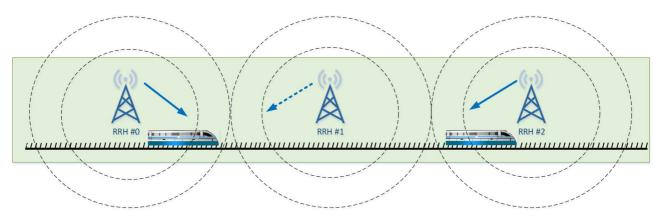


Figure B.3.3-1: Deployment of HST-DPS

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:

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

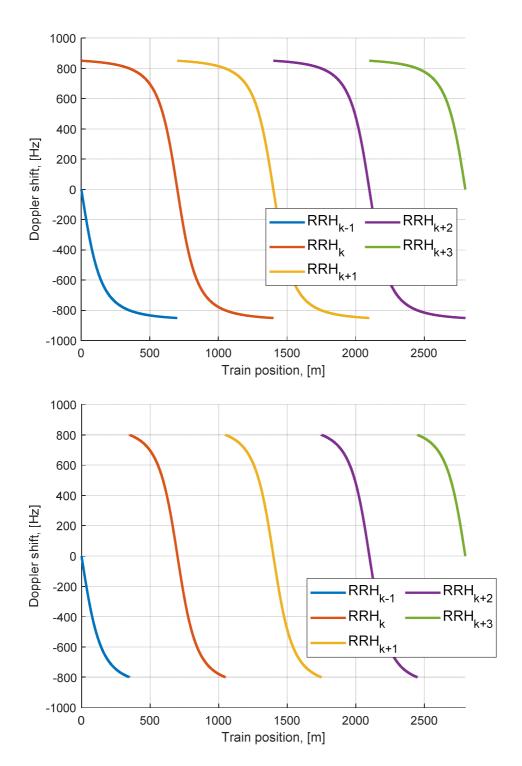


Figure B.3.3-2 Doppler shift trajectory (f_d = 870 Hz)

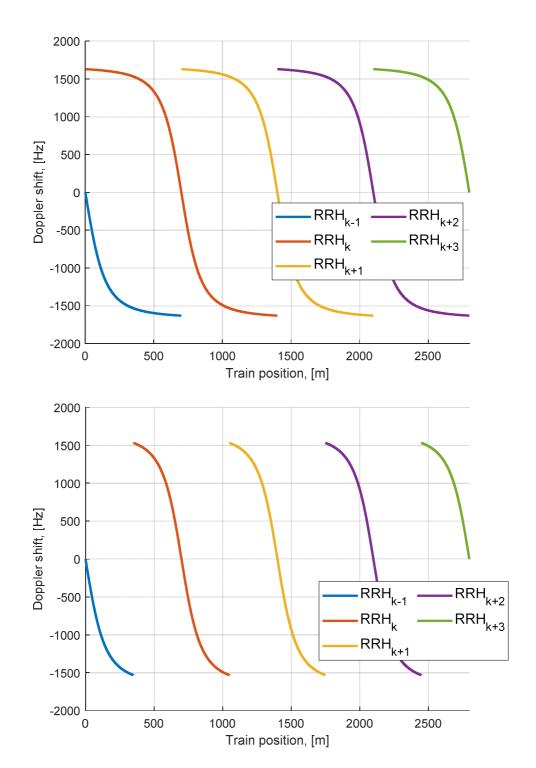


Figure B.3.3-3 Doppler shift trajectory (f_d = 1667 Hz)

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

 $\left[y^{(p_0)}(i)\ y^{(p_0+1)}(i)\ ...\ y^{(p_0+N_p-1)}(i)\right]^T$, $i=0,1,...,M_{\mathrm{symb}}^{\mathrm{ap}}-1$, with $M_{\mathrm{symb}}^{\mathrm{ap}}$ being the number of modulation symbols per antenna port including the reference signal symbols, and generates a block of signals $y_{bf}^{(q)}(i)=$

 $\left[y_{bf}^{(0)}(i)\ y_{bf}^{(1)}(i)\ ...\ y_{bf}^{(N_{ANT}-1)}(i)\right]^T$ 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:

$$y_{hf}^{(q)}(i) = W(i)y^{(p)}(i)$$

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

C.4 Setup (Radiated)

Note 4:

Table C.4-1 describes the downlink Physical Channels that are required for connection set up.

It is only applicable to LTE-NR coexistence tests.

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		
Note 1: Value is derived from Table 4.1-1 in TS 38.214 [12] based on "Number of DM-RS CDM groups without data" and "DMRS Type" parameters specified for each test.				
Note 2: The value is the energy of per RE for a single antenna port before pre-coding.				
Note 3: $L \in \{1,2,4,8\}$ is the CDM group size of NZP CSI-RS specified for each test.				
Note 4: Value is derived from Table 4.1		3 38.214 [12] based on "The number of PDSCH becified 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

Data	Maatina	4D	CD	Davi	0-4	Change history	Nous
Date	Meeting	tDoc	CR	Rev	Cat	Subject/Comment	New version
2018-07	RAN4	R4-				Draft skeleton	0.0.1
0010.00	AH18-07	1809554					0.00
2018-08	RAN4#88	R4- 1811357				Skeleton update	0.0.2
2018-10	RAN4#88	R4-				Approved Text Proposal in RAN4#88bis:	0.1.0
	bis	1814237				R4-1814053, "TP on performance specification 38.101-4 Chapter 4 general part"	
						R4-1814054, "TP to TS 38.101-4: FR1 PDSCH demodulation	
						requirements (5.2)"	
						R4-1813924, "TP for introducing FR1 PDCCH requirements in TS 38.101-4 clause 5.3"	
						R4-1814058, "TP for 38.101-4 section 6.3 FR1 PMI test cases"	
						R4-1814060, "Draft TP on FR1 Rank Indication Reporting	
						Performance Requirements" R4-1814055, "Draft TP on FR2 PDSCH Demodulation Performance	
						Requirements"	
						R4-1814022, "TP to TS38.101-4 Section 7.3: PDCCH demodulation requirements"	
						R4-1814059, "TP for 38.101-4 section 8.3 FR2 PMI test cases"	
						R4-1814061, "Draft TP on FR2 Rank Indication Reporting	
						Performance Requirements" R4-1813925, "TP for introducing demodulation performance	
						requirements for interworking TS 38.101-4 section 9"	
						R4-1814052, "TP for 38.101-4 section 10 CSI test cases of	
						interworking" R4-1814066, "TP on channel models for TS38.101-4"	
						R4-1814023, "TP to TS38.101-4 Annex C: Downlink physical	
						channels" R4-1814024, "TP to TS38.101-4 Annex E: Environmental	
						conditions"	
2018-11	RAN4#89	R4-				Approved Text Proposal in RAN4#89:	0.2.0
		1816559				R4-1814053, "TP on performance specification 38.101-4 Chapter 4 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"	
				1		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)"	
				1		R4-1816703, "Draft TP on FR1 Rank Indication Reporting"	
						Performance Requirements" R4-1816704, "Draft TP on FR2 Rank Indication Reporting	
						Performance Requirements"	
				1		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) "	
				1		R4-1816713, "TP to TS38.101-4 Section 7.3: PDCCH demodulation	
						requirements" P4-1816714 "TP for propagation conditions in TS 38 104-4(Appex	
						R4-1816714, "TP for propagation conditions in TS 38.104-4(Annex B)"	
2018-12	RAN#82	RP-182408				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	1.0.1
2018-12	RAN#82					Approved by plenary – Rel-15 spec under change control	15.0.0

2019-03	RAN#83	RP-190403	0001	В	CR on UE demodulation and CSI requirements for 38.101-4	15.1.0
					This CR comboines all the endorsed draft CRs as list below: General sections	
					R4-1902427, Draft CR on NR UE demodulation requirements	
					applicability (Intel Corporation)	
					R4-1902576, Draft CR on General Applicability of Requirements (Qualcomm Incorporated)	
					R4-1902412, Editorial cleanup of FR2 Radiated Requirements	
					General section (ANRITSU)	
					PDSCH	
					R4-1902414, Draft CR on FR1 normal PDSCH demodulation requirements (Intel Corporation)	
					R4-1902415, Draft CR on FR2 PDSCH Requirements (Qualcomm	
					Incorporated)	
					R4-1902411, Draft CR on FR1 SDR requirements (Intel Corporation)	
					R4-1902416 Draft CR for updating FR1 PDCCH performance	
					requirements in TS38.101-4Huawei, HiSilicon	
					R4-1902423 Draft CR for updating FR2 PDCCH performance	
					requirements in TS38.101-4 section 7.3 CATT PBCH	
					R4-1902420, Draft CR on 2Rx PBCH demodulation requirement for	
					FR1 (CMCC)	
					R4-1902421, Draft CR on 4Rx PBCH demodulation requirements for FR1 (CMCC)	
					R4-1902422, Draft CR on 2Rx PBCH demodulation requirement for	
					FR2 (CMCC)	
					CSI P4.4003448 Proft CB on FB3 CSI Reporting Tests (Overlands)	
					R4-1902418, Draft CR on FR2 CSI Reporting Tests (Qualcomm Incorporated)	
					R4-1902419, Draft CR on FR1 CSI Reporting Tests (Qualcomm	
					Incorporated)	
					R4-1900105, Draft CR on NR CSI reporting (Intel Corporation) R4-1902058, Draft CR for update of FR1 CQI reporting test (Huawei,	
					HiSilicon)	
					R4-1902059, Draft CR for update of FR2 CQI reporting test (Intel)	
					R4-1902426, Draft CR for PMI test cases: 6.2, 8.2, A.3.2.2.2, A.3.2.2.5 (Samsung)	
					R4-1902425, Draft CR for FR1 and FR2 RI test cases (Qualcomm)	
					Annex	
					R4-1900369, Draft CR on PDSCH FRC (Intel Corporation) R4-1900370, Draft CR on PDCCH FRC (Intel Corporation)	
					R4-1900370, Draft CR on PDCCH FRC (Intel Corporation) R4-1902424, Corrections to 38.101-4 clause B.2.1 Delay profile	
					calculation (Huawei, HiSilicon)	
					R4-1902575, Draft CR on Beamforming Model (Qualcomm)	
					Additional modifications:	
					- Compared to endorsed CR R4-1902414, requirements for several	
					FR1 PDSCH test cases were modified to correct stat error	
					Correct the format for Annex A.x Correct table number under PDSCH section 5.2.3.1.3	
					- Some minor editorial changes	
					Editorial changes after RAN#83	
					To align the annex numbering with other specifications (TS 38.101-x	
					series), annexes J and K were added and Change history was	
					numbered as annex L.	

endorsed draft CRs from RAN4#90bis R4-1902885, Draft CR on DL power allocation for TS 38.101-4 R4-1902387, Draft CR or adding applicable rules on CSI test cases: 6, 8, 10 R4-1903471, Draft CR on PBCH requirements R4-1904750, draftCR on RNC for demod requirement for 38.101-4 R4-1904750, Carlicia on on step 5 and step 6 for delay profiles calculation in B 2.1 R4-1904750, Draft CR on FR1 normal PDSCH demodulation sequence of the control of	2019-06	RAN#84	RP-191240	0002		to TS 38.101-4: Implementation of endorsed draft CRs from N4#90bis and RAN4#91	15.2.0
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2019-09	RAN#85	RP-192022	8000		F	CR to TS 38.101-4: Implementation of endorsed draft CRs from	15.3.0
2019-09	KAN#03	KF-192022	0008		Ī	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	
2019-12	RAN#86	RP-192998	0009	2	F	R4-1910563, Updates to NR PDCCH test parameters CR to TS 38.101-4: Corrections for applicability rules (R15)	15.4.0
2019-12	RAN#86	RP-192998	0010		F	CR to TS 38.101-4: Editorial corrections for PDSCH RMC (R15)	15.4.0
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2019-12	RAN#86	RP-192998	0014	1	F	CR on corrections for MIMO Correlation Matrices	15.4.0
2019-12	RAN#86	RP-192998	0015	1	F	CR on corrections for FR1 PDSCH demodulation performance tests	15.4.0
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2019-12	RAN#86	RP-192998	0018	1	F	CR on corrections for FR2 CSI Reporting performance tests	15.4.0
2019-12	RAN#86	RP-192998	0019	1	F	Editorial change on reference PDCCH payload size	15.4.0
2019-12 2019-12	RAN#86 RAN#86	RP-192998 RP-192998	0021 0023	1	F	Editorial CR to correct PMI test cases CR for TS38.101-4: Angle of arrival for radiated UE demodulation	15.4.0 15.4.0
						testing	
2019-12	RAN#86	RP-192998	0024		F	CR on demodulation performance requirements for EN-DC including FR1 and FR2 CCs	15.4.0
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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
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2019-12 2020-03	RAN#86 RAN#87	RP-192998 RP-200397	0030	1	F	CR: Updates to NR EN-DC SDR tests Clarification of Random PMI when testing	15.4.0 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	1	F	CR to TS 38.101-4: Editorial corrections (R15) CR on number of NZP CSI-RS ports for RI reporting test in a TDD	15.5.0 15.5.0
						4Rx test case	
2020-03	RAN#87	RP-200397	0038		F	CR: Updates to NR PDSCH test parameters (Rel-15)	15.5.0

2020-03	RAN#87	RP-200379	0035		В	CR to TS 38.101-4: LTE-NR coexistence requirements for TDD mode (R16)	16.0.0
2020-06	RAN#88	RP-200985	0040		Α	CR to Aperiodic Report Slot Offset for CQI report	16.1.0
2020-06	RAN#88	RP-200985	0044		Α	CR to TS 38.101-4: Beamforming clarification (R16)	16.1.0
2020-06	RAN#88	RP-201043	0045		F	CR to TS 38.101-4: CR on TDD LTE-NR coexistence requirements finalization	16.1.0
2020-06	RAN#88	RP-200985	0047		Α	CR to TS 38.101-4: MIMO correlation matrices definition (R16)	16.1.0
2020-06	RAN#88	RP-200985	0054		Α	CR for correction of Angle of Arrival for Radiated Requirements in section 4	16.1.0
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		Α	Update of DL physical channels definitions	16.1.0
2020-06	RAN#88	RP-200985	0057		Α	CR: clarification on EPRE ratio definition	16.1.0
2020-09	RAN#89	RP-201512	0059		Α	CR to ZP-CSI-RS configuration	16.2.0
2020-09	RAN#89	RP-201512	0061		A	CR to 2Rx PDSCH mapping type B	16.2.0
2020-09	RAN#89	RP-201499	0074		В	CR for TS 38.101-4: Applicability for NR PMI requirements with Tx ports larger than 8 and up to 32	16.2.0
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		0800		A	Update of Noc for NR operating bands in FR2	16.3.0
2020-12	RAN#90	RP-202489	0082		A	Correction to FR1 Aperiodic CSI Reporting	16.3.0
2020-12 2020-12	RAN#90 RAN#90	RP-202489 RP-202416	0084 0085	1	A B	Correction to FR2 PMI Aperiodic CSI Reporting CR on requirements with slot aggregation in FR2	16.3.0 16.3.0
2020-12	RAN#90	RP-202416	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	RAN#90	RP-202423	0093	1	В	Introduction of NR PDSCH FR1 CA 2Rx performance requirements	16.3.0
2020-12	RAN#90	RP-202423	0094	1	В	CR: FR1 EN-DC power imbalance requirements	16.3.0
2020-12	RAN#90	RP-202422	0097	1	В	CR on HST DPS requirements	16.3.0
2020-12	RAN#90	RP-202422	0098	1	В	CR on HST single-tap and HST multi-path fading requirements	16.3.0
2020-12	RAN#90	RP-202422	0099	1	В	CR on applicability rules for HST scenarios	16.3.0
2020-12	RAN#90	RP-202416	0100	1	В	CR to TS 38.101-4: Addition of UE performance requirements for FR1 URLLC PDSCH repetitions over multiple slots	16.3.0
2020-12	RAN#90	RP-202416	0102	1	В	CR to TS 38.101-4: Applicability rules for URLLC UE demodulation requirements	16.3.0
2020-12	RAN#90	RP-202423	0103	1	В	CR: Introduction of performance requirements for NR FR1 PDSCH CA with 4Rx	16.3.0
2020-12	RAN#90	RP-202423	0105	1	В	CR: Addition of power imbalance requirements for intra-band contiguous CA and intra-band EN-DC	16.3.0
2020-12	RAN#90	RP-202423	0108	1	В	CR on Applicability rules for Normal NR CA demodulation requirements	16.3.0
2020-12	RAN#90	RP-202416	0109		В	CR on FRC for UE Ultra-low BLER requirements	16.3.0
	RAN#90	RP-202416		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
2020-12	RAN#90	RP-202416	0112	1	В	CR to TS 38.101-4: Performance requirements for URLLC PDSCH 0.001% BLER	16.3.0
2020-12	RAN#90	RP-202422	0113	1	В	CR to TS38.101-4: Addition of Rel-16 HST FRCs	16.3.0
2020-12	RAN#90	RP-202489	0117		Α	CR: Updates OCNG pattern reference (Rel-16)	16.3.0
2020-12	RAN#90	RP-202489	0119	1	Α	CR: Correction on OCNG pattern	16.3.0
2020-12	RAN#90	RP-202422	0120	2	В	CR on FDD HST Single-Tap and Multipath Fading Requirements	16.3.0
2020-12	RAN#90	RP-202416	0121	2	В	CR on FR1 PDSCH Mapping Type B and Processing Capability 2 Requirements	16.3.0
2020-12	RAN#90	RP-202423	0122		В	CR on FR2 PDSCH CA Requirements	16.3.0
2020-12	RAN#90	RP-202423	0123		F	CR to TS 38.101-4: on gamma values for SP Type I PMI requirements	16.3.0
2021-03	RAN#91	RP-210078	0124	1	F	CR on FDD HST Single-Tap and Multipath Fading Requirements	16.4.0
2021-03	RAN#91	RP-210068	0126	1	В	CR to 38-101-4 on CQI reporting requirements for URLLC	16.4.0
2021-03	RAN#91	RP-210068	0127	1	F	CR to 38.101-4 on requirements with slot aggregation in FR2	16.4.0
2021-03	RAN#91	RP-210064	0128	1	В	CR to 38.101-4 for eMIMO demod requirements - General and Applicability rule	16.4.0
2021-03	RAN#91	RP-210066	0129	1	В	CR for TS38.101-4, test for FR2 PDCCH DCI format 2_6 demodulation	16.4.0
2021-03	RAN#91	RP-210065	0130	<u> </u>	F	CR for NR PDSCH FR1 CA 2Rx performance requirements	16.4.0
2021-03	RAN#91	RP-210066	0131	1	В	CR for TS38.101-4, test for FR1 TDD PDCCH DCI format 2_6 demodulation	16.4.0
2021-03	RAN#91	RP-210067	0133	1	В	CR on adding applicability, requirements and measurement channel for FR2 DL 256QAM CQI reporting test under fading condition	16.4.0
2021-03	RAN#91	RP-210065	0134		В	CR: Adding applicability and requirements for FR1 and FR2 CA CQI reporting test	16.4.0
		RP-210064	0135	2	В	Introduction of PMI test cases with Rel-16 eType 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 BL requirements F CR to 38.101-4 on FRC table update for URLLC ultra low BL requirements F CR on demodulation performance requirements F CR on demodulation performance requirements F CR on fRC for URLLC UE Higher BLER requirements F CR on simplified TDL-D channel model for FR2 DL 256QAM demodulation requirements F CR on simplified TDL-D channel model for FR2 DL 256QAM CQI requirements F CR on applicability rules and FRC for FR2 DL 256QAM CQI requirements F CR on applicability rules for Normal NR CA requirements F CR on applicability rules for Normal NR CA requirements F CR on applicability rules for Normal NR CA requirements F CR on applicability rules for Normal NR CA requirements F CR on applicability rules for Normal NR CA requirements F CR on applicability rules for Normal NR CA requirements F CR on applicability rules for Normal NR CA requirements F CR on applicability rules for Normal NR CA requirements F CR on applicability rules for Normal NR CA requirements F CR on applicability rules for Normal NR CA requirements F CR on applicability rules for Normal NR CA requirements F CR on applicability rules for Normal NR CA requirements F CR on applicability rules for Normal NR CA requirements F CR on applicability rules for Normal NR CA requirements F CR on applicability rules for Normal NR CA requirements F CR on applicability rules for Normal NR CA requirements F CR on applicability rules for Normal NR CA requirements F CR on applicability rules for Normal NR CA requirements F CR on applicability rules for Normal NR CA requirements F CR on SA NAM91 RP-210067 O145 F CR on SA NAM91 RP-210066 O146 F CR on SA NAM91 RP-210066 O146 F CR on SA NAM91 RP-210066 O146 F CR on SA NAM91 RP-210066 O150 F CR on SA NAM91 RP-210066 O150 F CR on F CR on F CR on F CR on	16.4.0 16.4.0
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2021-06 RAN#92e RP-211103 0215 1 F Correction on PMI test cases with Rel-15 Type I, TypeII code	nance 16.5.0 16.5.0
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RAN#92e	RP-211103	0236	1	F	CR for 38.101-4: Updates on PDSCH requirement with Multi-DCI	16.5.0
					based transmission scheme	
RAN#92e	RP-211088	0240		Α	Correction of variable name for PMI test metric	16.5.0
RAN#92e	RP-211109	0242		F	CR: Correction of the applicability of requirements	16.5.0
RAN#92e	RP-211103	0245	1	F	Finalization of URLLC pre-emption and mapping type B	16.5.0
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RAN#92	RP-211103	0249	1	F	CR for TS38.101-4, Editorial correction to UE performance	16.5.0
					B R16	
					NOTE: The CR is was not implementable because it conflicted	
					with another CR	
RAN#92e	RP-211110	0251	1	F	CR on Applicability Rule for TDD LTE-NR Coexistence Tests	16.5.0
RAN#92e	RP-211100	0252	1	F	CR on clarification of TDL-D channel model (R16)	16.5.0
RAN#92e	RP-211091	0259		Α	CR to TS 38.101-4: Editorial corrections (R16)	16.5.0
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RAN#92e	RP-211100	0264		F	CR on finalization on the FR2 256QAM CQI report test case	16.5.0
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History

	Document history							
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