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

3 Definitions, symbols and abbreviations

3.1 Definitions

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

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

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

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

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

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

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

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

3.2 Symbols

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

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

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

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

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

4.4.3 for conducted requirements and Clause 4.5.3 for radiated requirements

3.3 Abbreviations

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

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

CP Cyclic Prefix

CSI Channel-State Information
CSI-IM CSI Interference Measurement

CSI-RS CSI Reference Signal

CW Codeword

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

DC Dual Connectivity

DCI Downlink Control Information

DL Downlink

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

FR Frequency Range

FRC Fixed Reference Channel

HARQ Hybrid Automatic Repeat Request

LI Layer Indicator

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

NR New Radio

NSA Non-Standalone Operation Mode OCNG OFDMA Channel Noise Generator

OFDM Orthogonal Frequency Division Multiplexing
OFDMA Orthogonal Frequency Division Multiple Access

PBCH Physical Broadcast Channel

Pcell Primary Cell

PDCCH Physical Downlink Control Channel PDSCH Physical Downlink Shared Channel

PMI Precoding Matrix Indicator
PRB Physical Resource Block
PRG Physical resource block group
PSS Primary Synchronization Signal
PTRS Phase Tracking Reference Signal
PUCCH Physical Uplink Control Channel
PUSCH Physical Uplink Shared Channel

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

RI Rank Indicator

RRC Radio Resource Control SA Standalone operation mode

SCS Subcarrier Spacing

SINR Signal-to-Interference-and-Noise Ratio

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

TDM Time division multiplexing TTI Transmission Time Interval

UL Uplink

VRB Virtual Resource Block

4 General

4.1 Relationship between minimum requirements and test requirements

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

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

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

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

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

4.2 Applicability of minimum requirements

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

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

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

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

4.3 Specification suffix information

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

Clause suffix

None
Single Carrier

A
Carrier Aggregation (CA)

B
Dual-Connectivity (DC)

C
Supplement Uplink (SUL)

Table 4.3-1: Definition of suffixes

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

4.4 Conducted requirements

4.4.0 Introduction

The requirements are defined for the following modes:

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

4.4.1 Reference point

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

4.4.2 SNR definition

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

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

Where

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

4.4.3 Noc

4.4.3.1 Introduction

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

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

4.4.3.2 Noc for NR operating bands in FR1

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

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

4.4.3.2.1 Derivation of Noc values for NR operating bands in FR1

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

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

where

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

- SNR_{REFSENS} = -1 dB is the SNR used for simulation of REFSENS
- Δ_{thermal} is the amount of dB that the wanted noise is set above UE thermal noise, giving a defined rise in total noise. $\Delta_{\text{thermal}} = 16 \text{dB}$, giving a rise in total noise of 0.1dB, regarded as insignificant.

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

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

4.4.4 Es

4.4.4.1 Introduction

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

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

4.4.4.2 Es for NR operating bands in FR1

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

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

4.4.4.2.1 Derivation of Es values for NR operating bands in FR1

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

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

- REFSENS_{Band_X, SCS_Y, CBW_Z} is the REFSENS value in dBm for Band X, SCS Y and CBW Z specified in Table 7.3.2-1 of TS 38.101-1 [6]
- 12 is the number of subcarriers in a PRB
- SCS Y is the subcarrier spacing associated with the REFSENS value
- nPRB is the maximum number of PRB for SCS Y and CBW Z associated with the REFSENS value, and is specified in Table 5.3.2-1 of TS 38.101-1 [6]
- D is diversity gain equal to 3 dB
- SNR_{REFSENS} = -1 dB is the SNR used for simulation of REFSENS
- dB_{EVM} is the SNR of the applied signal due to EVM impairment on the wanted Es. An allowed EVM of 3% gives a dB_{EVM} of 30.5dB, derived as 20*log10(1/0.03).
- $\Delta_{thermal}$ is the amount of dB that the impairment due to EVM on the wanted Es is set above UE thermal noise, giving a defined rise in total impairment. $\Delta_{thermal} = 7.6$ dB, giving a rise in total impairment of 0.7dB, regarded as acceptable.

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

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

4.5 Radiated requirements

4.5.0 Introduction

The requirements are defined for the following modes:

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

4.5.1 Reference point

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

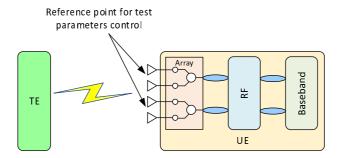


Figure 4.5.1-1: Reference point for radiated Demodulation and CSI requirements

4.5.2 SNR definition

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

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

where Δ_{BB} is specified in clause 4.5.3.

The reference point SNR is defined as:

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

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

4.5.3 Noc

4.5.3.1 Introduction

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

4.5.3.2 Noc for NR operating bands in FR2

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

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

Operating band	UE Power class				
	1	2	3	4	
n257	-167.3	-161. 8	-158.1	-166. 8	
n258	-167.3	-161. 8	-158.1	-166. 8	
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:

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

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} . $\Delta_{\text{thermal}} = -10\text{Log}_{10}(10^{(\Delta_{BB}/10)-1}) = 5.87\text{dB}$, 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.

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	Test type	Test list	
antenna ports			
UE supports only	PDSCH	All tests in Clause 5.2.2	
2RX	PDCCH	All tests in Clause 5.3.2	
	PBCH	All tests in Clause 5.4.2	
UE supports only	PDSCH	All tests in Clause 5.2.3	
4RX or both 2RX	PDCCH	All tests in Clause 5.3.3	
and 4RX	PBCH	All tests in Clause 5.4.2 or 5.4.3 (Note)	
Note: Requirements for PBCH with 4Rx is up to UE declaration			

5.1.1.3 Applicability of requirements for optional UE features

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

Table 5.1.1.3-1: Requirements applicability for optional UE features

UE feature/capability [14]	Test ty	/ре	Test list	Applicability notes
SU-MIMO Interference Mitigation advanced receiver	FR1 FDD	PDSCH	Clause 5.2.2.1.1 (Test 3-1)	
			Clause 5.2.3.1.1 (Test 5-1)	
	FR1 TDD	PDSCH	Clause 5.2.2.2.1 (Test 3-1)	
			Clause 5.2.3.2.1 (Test 5-1)	
Alternative additional DMRS position for co-existence with LTE CRS (additionalDMRS-DL-	FR1 FDD	PDSCH	Clause 5.2.2.1.4 (Test 1-2)	
Alt)			Clause 5.2.3.1.4 (Test 1-2)	
Basic DL NR-NR CA operation (supportedBandCombinationList)	NR CA	SDR	Clause 5.5A.1	1)Up to 16 DL carriers 2)Same numerology across carrier for data/control channel at a given time

5.1.1.4 Applicability of requirements for mandatory UE features with capability signalling

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

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

UE feature/capability [14]	Test t	уре	Test list	Applicability notes
256QAM modulation scheme	FR1 FDD	PDSCH	Clause 5.2.2.1.1 (Test 1-3)	
for PDSCH for FR1 (pdsch-			Clause 5.2.3.1.1 (Test 1-3)	
256QAM-FR1)	FR1 TDD	PDSCH	Clause 5.2.2.2.1 (Test 1-3)	
			Clause 5.2.3.2.1 (Test 1-3)	
PDSCH mapping type B	FR1 FDD	PDSCH	Clause 5.2.2.1.3	
(pdsch-MappingTypeB)			Clause 5.2.3.1.3	
	FR1 TDD	PDSCH	Clause 5.2.2.2.3	
			Clause 5.2.3.2.3	
	FR1 FDD	PDSCH	Clause 5.2.2.1.4	For UEs supporting
			Clause 5.2.3.1.4	"Alternative
				additional DMRS
				position for co-
				existence with LTE
Rate-matching around LTE				CRS", if Test 1-2 is
CRS (rateMatchingLTE-CRS)				tested, the test
erro (raternaterning=r= erro)				coverage can be
				considered fulfilled
				without executing
				Test 1-1. Otherwise,
				only Test 1-1 is
	ED4 EDD	DD 0011	OI 50044/T + 44	tested.
Supported maximum number of	FR1 FDD	PDSCH	Clause 5.2.2.1.4 (Tests 1-1,	The requirements
ports across all configured			1-2)	apply only in case the number of NZP-
NZP-CSI-RS resources per CC (maxConfigNumberPortsAcros			Clause 5.2.3.1.1 (Tests 3-1, 4-1, 5-1)	CSI-RS ports in the
sNZP-CSI-RS-PerCC)			Clause 5.2.3.1.4 (Tests 1-1,	test case satisfies UE
31/27-031-13-76100)			1-2)	capability on
	FR1 TDD	PDSCH	Clause 5.2.3.2.1 (Test 3-1,	maximum number of
	TRITOD	I Doci i	4-1, 5-1)	NZP-CSI-RS ports
Supported maximum number of	FR1 FDD	PDSCH	Clause 5.2.2.1.1 (Tests 2-1,	The requirements
PDSCH MIMO layers	TRITOD	1 00011	2-2, 3-1)	apply only in case
(maxNumberMIMO-			Clause 5.2.2.1.2	the PDSCH MIMO
LayersPDSCH)			Clause 5.2.3.1.1 (Tests 2-1,	rank in the test case
			2-2, 3-1, 4-1, 5-1)	does not exceed UE
			Clause 5.2.3.1.2	PDSCH MIMO layers
	FR1 TDD	PDSCH	Clause 5.2.2.2.1 (Tests 2-1,	capability
			2-2, 3-1)	
			Clause 5.2.2.2	
			Clause 5.2.3.2.1 (Tests 2-1,	
			2-2, 3-1, 4-1, 5-1)	
			Clause 5.2.3.2.2	

5.2 PDSCH demodulation requirements

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

Table 5.2-1: Common test parameters

	Parameter	Unit	Value
PDSCH transmission			Transmission scheme 1
Carrier	Offset between Point A and the lowest usable subcarrier on this carrier (Note 2)	RBs	0
configuration	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
Common serving	Physical Cell ID		0
cell parameters	SSB position in burst		First SSB in Slot #0
ocii paramotoro	SSB periodicity	ms	20
	Slots for PDCCH monitoring		Each slot
	Symbols with PDCCH	Symbols	0, 1
	Number of PRBs in CORESET		Table 5.2-2 for tested channel bandwidth and subcarrier spacing
	Number of PDCCH candidates and aggregation levels		1/AL8
PDCCH	CCE-to-REG mapping type		Non-interleaved
configuration	DCI format		1_1
	TCI state		TCI state #1
	PDCCH & PDCCH DMRS Precoding configuration		Single Panel Type I, Random per slot with equal probability of each applicable i ₁ , i ₂ combination, and with REG bundling granularity for number of Tx larger than 1
Cross carrier schedu	ling		Not configured
	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 for tracking	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	1	TCI state #0
	First subcarrier index in the PRB used for CSI-RS		$k_0 = 0$
	First OFDM symbol in the PRB used for CSI-RS		I ₀ = 12
	Number of CSI-RS ports (X)		Same as number of transmit antenna
NZP CSI-RS for	CDM Туре		'No CDM' for 1 transmit antenna 'FD-CDM2' for 2 and 4 transmit antenna
CSI acquisition	Density (ρ)		1
	CSI-RS periodicity	Slots	15 kHz SCS: 20 30 kHz SCS: 40
	CSI-RS offset	Slots	0
	Frequency Occupation		Start PRB 0 Number of PRB = ceil(BWP size/4)*4
	QCL info		TCI state #1

	Final autor 1	tinders in the DDD If		1
	CSI-RS	index in the PRB used for		k ₀ = 4
	First OFDM syr	mbol in the PRB used for		I ₀ = 12
	Number of CSI	-RS ports (X)		4
ZP CSI-RS for CSI	CDM Type			'FD-CDM2'
acquisition	Density (ρ)			1
	CSI-RS periodi	city	Slots	15 kHz SCS: 20 30 kHz SCS: 40
	CSI-RS offset		Slots	0
	Frequency Occ	cupation		Start PRB 0 Number of PRB = ceil(BWP size/4)*4
PDSCH DMRS	Antenna ports indexes			{1000} for Rank 1 tests {1000, 1001} for Rank 2 tests {1000-1002} for Rank 3 tests {1000-1003} for Rank 4 tests
configuration	Position of the mapping type A	first DMRS for PDSCH		2
	Number of PDS	SCH DMRS CDM group(s)		1 for Rank 1 and Rank 2 tests
	without data	OOD in day		2 for Rank 3 and Rank 4 tests
	Type 1 QCL	SSB index		SSB #0
TCI state #0	information Type 2 QCL	QCL Type SSB index		Type C N/A
	information	QCL Type		N/A N/A
	IIIIOIIIIalioii	QCL Type		CSI-RS resource 1 from 'CSI-RS for
	Type 1 QCL information	CSI-RS resource		tracking' configuration
TCI state #1		QCL Type		Type A
	Type 2 QCL	CSI-RS resource		N/A
	information	QCL Type		N/A
PT-RS configuration	•	71		PT-RS is not configured
	code block group	os for ACK/NACK feedback		1
Maximum number of				4
HARQ ACK/NACK b	undling			Multiplexed
Redundancy version		Э		{0,2,3,1}
PDSCH & PDSCH DMRS Precoding configuration				Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i ₁ , i ₂ combination, and with PRB bundling granularity
Symbols for all unused REs				OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1
Physical signals, cha	innels mapping a	nd precoding		As specified in Annex B.4.1

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

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

Table 5.2-2: Number of PRBs in CORESET

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

5.2.1 1RX requirements

(Void)

5.2.2 2RX requirements

5.2.2.1 FDD

5.2.2.1.1 Minimum requirements for PDSCH Mapping Type A

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

The test purposes are specified in Table 5.2.2.1.1-1.

Table 5.2.2.1.1-1: Tests purpose

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

Table 5.2.2.1.1-2: Test parameters

	Parameter	Unit	Value
Duplex mode			FDD
Active DL BWP index			1
	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		12
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		4 for Test 1-1
PDSCH	PRB building size		2 for other tests
configuration			Test 1-2: Type 1 with start RB = 23,
	Resource allocation type		$L_{RBs} = 6$
			Other tests: Type 0
	RBG size		Test 1-2: N/A
			Other tests: Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
	DMRS Type		Type 1
PDSCH DMRS	Number of additional DMRS		2 for Tests 1-1, 1-5
configuration	Number of additional Diviks		1 for other tests
configuration	Maximum number of OFDM symbols for DL front loaded DMRS		1
			Test 1-5:
	CSI-RS periodicity	Slots	10 for CSI-RS resource 1,2,3,4.
			Other tests: Table 5.2-1.
CSI-RS for tracking			Test 1-5:
3			1 for CSI-RS resource 1 and 2
	CSI-RS offset	Slots	2 for CSI-RS resource 3 and 4.
			Other tests: Table 5.2-1.
Number of HARQ Processes			8 for Test 1-4
			4 for other tests
The number of slots I ACK information	between PDSCH and corresponding HARQ-		2

Table 5.2.2.1.1-3: Minimum performance for Rank 1

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

Table 5.2.2.1.1-4: Minimum performance for Rank 2

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

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

		Bandwidth		Correlation	Reference value		
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.1-2.2 FDD	10 / 15	16QAM, 0.48	TDLA30-10	2x2, ULA Medium	70	17.6

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

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

The test purposes are specified in Table 5.2.2.1.2-1.

Table 5.2.2.1.2-1: Tests purpose

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

Table 5.2.2.1.2-2: Test parameters

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

Table 5.2.2.1.2-3: Minimum performance for Rank 2

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

5.2.2.1.3 Minimum requirements for PDSCH Mapping Type B

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

The test purposes are specified in Table 5.2.2.1.3-1.

Table 5.2.2.1.3-1: Tests purpose

Purpose	Test index
Verify PDSCH mapping Type B performance under 2	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
	Mapping type		Type B
	k0		0
	Starting symbol (S)		5
	Length (L)		7
	PDSCH aggregation factor		1
PDSCH	PRB bundling type		Static
configuration	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
	DMRS Type		Type 1
PDSCH DMRS	Number of additional DMRS		1
configuration	Maximum number of OFDM symbols for DL front loaded DMRS		1
Number of HARQ P	rocesses		4
The number of slots ACK information	between PDSCH and corresponding HARQ-		2

Table 5.2.2.1.3-3: Minimum performance for Rank 1

	Bandwidth			Correlation	Reference value		
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-1.3 FDD	10 / 15	QPSK, 0.30	TDLA30-10	2x2, ULA Low	70	1-1

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

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

The test purposes are specified in Table 5.2.2.1.4-1.

Table 5.2.2.1.4-1: Tests purpose

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

Table 5.2.2.1.4-2: Test parameters

	Parameter	Unit	Value
Duplex mode			FDD
Active DL BWP index			1
NR UL transmission	with a 7.5 kHz shift to the LTE raster		true
PDCCH configuration	Symbols with PDCCH		Symbol# 2
_	Mapping type		Type A
	k0		0
	Starting symbol (S)		3
	Length (L)		9 for Test 1-1 11 for Test 1-2
PDSCH	PDSCH aggregation factor		1
	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
	Position of the first DM-RS for downlink		3
PDSCH DMRS	Number of additional DMRS		1
configuration	Maximum number of OFDM symbols for DL front loaded DMRS		1
	LTE carrier centre subcarrier location		Same as NR carrier centre subcarrier location
CRS for rate	LTE carrier BW	MHz	10
matching (Note 1)	Number of antenna ports		4
	v-shift		0
Number of HARQ Processes			4
The number of slots between PDSCH and corresponding HARQ-ACK information			2
	N is configured on LTE carrier		

Table 5.2.2.1.4-3: Minimum performance for Rank 1

		Bandwidth			Correlation	Reference value	
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-7.1 FDD	10 / 15	QPSK, 0.30	TDLA30-10	4x2, ULA Low	70	-1.0
1-2	R.PDSCH.1-7.2 FDD	10 / 15	QPSK, 0.30	TDLA30-10	4x2, ULA Low	70	-1.0

5.2.2.2 TDD

5.2.2.2.1 Minimum requirements for PDSCH Mapping Type A

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

The test purposes are specified in Table 5.2.2.2.1-1.

Table 5.2.2.2.1-1: Tests purpose

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

Table 5.2.2.2.1-2: Test parameters

Parameter	Unit	Value
		TDD
(1
Mapping type		Type A
k0		0
Starting symbol (S)		2
		Specific to each Reference channel
		1
		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, L _{RBs} = 6 Other tests: Type 0
RBG size		Test 1-2: N/A Other tests: Config2
VRB-to-PRB mapping type		Non-interleaved
VRB-to-PRB mapping interleaver bundle size		N/A
DMRS Type		Type 1
Number of additional DMRS		2 for Tests 1-1, 1-7, 1-8, 1-9 1 for other tests
Maximum number of OFDM symbols for DL front loaded DMRS		1
First OFDM symbol in the PRB used for CSI-RS		Tests 1-8, 1-9: l ₀ = 4 for CSI-RS resource 1 and 3 l ₀ = 8 for CSI-RS resource 2 and 4
		Other tests; Table 5.2-1.
CSI-RS periodicity	Slots	Test 1-7: 20 for CSI-RS resource 1,2,3,4.
		Other tests: Table 5.2-1.
CSI-RS offset	Slots	Test 1-7: 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4.
		Other tests: Table 5.2-1.
Frequency Occupation		Test 1-7: Start PRB 0 Number of PRB = 52
		Other tests: Table 5.2-1.
ocesses		16 for Test 1-4 10 for Test 1-9
petween PDSCH and corresponding HARQ-		8 for other tests Specific to each TDD UL-DL pattern and as defined in Annex A.1.2
	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 DMRS Type Number of additional DMRS Maximum number of OFDM symbols for DL front loaded DMRS First OFDM symbol in the PRB used for CSI-RS CSI-RS periodicity CSI-RS offset Frequency Occupation	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 DMRS Type Number of additional DMRS Maximum number of OFDM symbols for DL front loaded DMRS First OFDM symbol in the PRB used for CSI-RS CSI-RS periodicity Slots CSI-RS offset Slots

Table 5.2.2.2.1-3: Minimum performance for Rank 1

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

Table 5.2.2.2.1-4: Minimum performance for Rank 2

Test num.	Reference (MHz) /	Bandwidth	Modulation format and code rate TDD UL-DL pattern			Correlation	Reference value	
		Subcarrier spacing			Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
2-1	R.PDSCH.2- 3.1 TDD	40 / 30	64QAM, 0.50	FR1.30- 1	TDLA30-10	2x2, ULA Low	70	19.8
2-2	R.PDSCH.2- 9.1 TDD	20 / 30	64QAM, 0.50	FR1.30- 4	TDLA30-10	2x2, ULA Low	70	19.8

Table 5.2.2.2.1-5: Minimum performance for Rank 2 and Enhanced Receiver Type 1

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

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

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

The test purposes are specified in Table 5.2.2.2.1.

Table 5.2.2.2-1: Tests purpose

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

Table 5.2.2.2-2: Test parameters

Parameter			Value
Duplex mode			TDD
Active DL BWP index	(1
	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		Specific to each Reference channel
	PDSCH aggregation factor		1
PDSCH	PRB bundling type		Static
configuration	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle		N/A
	size		·
	DMRS Type		Type 1
PDSCH DMRS	Number of additional DMRS		1
configuration	Maximum number of OFDM symbols for DL front loaded DMRS		1
NZP CSI-RS for	OFDM symbols in the PRB used for CSI-RS		I ₀ = 13
CSI acquisition	CSI-RS periodicity	Slots	5
ZP CSI-RS for CSI	Subcarrier index in the PRB used for CSI-RS		(k ₀ , k ₁ , k ₂ , k ₃)=(2, 4, 6, 8)
acquisition	Number of CSI-RS ports (X)		8
	CSI-RS periodicity	Slots	5
Number of HARQ Processes			8
The number of slots between PDSCH and corresponding HARQ-			Specific to each TDD UL-DL pattern
ACK information			and as defined in Annex A.1.2

Table 5.2.2.2-3: Minimum performance for Rank 2

		Bandwidth	Madulation	TDD		Correlation	Reference v	/alue
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	TDD UL- DL pattern	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.2- 7.1 TDD	40 / 30	16QAM, 0.48	FR1.30-1	TDLC300- 100	2x2, ULA Low	70	14.8

5.2.2.2.3 Minimum requirements for PDSCH Mapping Type B

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

The test purposes are specified in Table 5.2.2.2.3-1.

Table 5.2.2.2.3-1: Tests purpose

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

Table 5.2.2.3-2: Test parameters

Parameter		Unit	Value
Duplex mode			TDD
Active DL BWP inde	Active DL BWP index		1
PDSCH configuration	Mapping type		Type B
	k0		0
	Starting symbol (S)		5
	Length (L)		7
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
	DMRS Type		Type 1
PDSCH DMRS configuration	Number of additional DMRS	umber of additional DMRS	
	Maximum number of OFDM symbols for DL front loaded DMRS		1
Number of HARQ Pi	ocesses		8
The number of slots between PDSCH and corresponding HARQ-ACK information			Specific to each TDD UL-DL pattern and as defined in Annex A.1.2

Table 5.2.2.3-3: Minimum performance for Rank 1

		Bandwidth		Correlation	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	2x2, ULA Low	70	-0.9

5.2.3 4RX requirements

5.2.3.1 FDD

5.2.3.1.1 Minimum requirements for PDSCH Mapping Type A

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

The test purposes are specified in Table 5.2.3.1.1-1.

Table 5.2.3.1.1-1: Tests purpose

Purpose	Test index
Verify the PDSCH mapping Type A normal performance	1-1, 1-2, 1-3, 1-5, 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
	Resource allocation type		Test 1-2: Type 1 with start RB = 23, $L_{RBs} = 6$ Other test: Type 0
	RBG size		Test 1-2: N/A Other tests: Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
	DMRS Type		Type 1
PDSCH DMRS	Number of additional DMRS		2 for Test 1-1, 1-5 1 for other tests
configuration	Maximum number of OFDM symbols for DL front loaded DMRS		1
	CSI-RS periodicity	Slots	Test 1-5: 10 for CSI-RS resource 1,2,3,4.
CSI-RS for tracking	CSI-RS offset	Slots	Other tests: Table 5.2-1. Test 1-5: 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4.
Number of HARQ Processes			Other tests: Table 5.2-1. 8 for Test 1-4 4 for other tests
The number of slots between PDSCH and corresponding HARQ-ACK information			2

Table 5.2.3.1.1-3: Minimum performance for Rank 1

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

Table 5.2.3.1.1-4: Minimum performance for Rank 2

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

Table 5.2.3.1.1-5: Minimum performance for Rank 3

		Bandwidth (MHz) /	Modulation		Correlation	Reference value		
Test num.	Reference channel	Subcarrier spacing (kHz)	format and code rate	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)	
3-1	R.PDSCH.1-2.3 FDD	10 / 15	16QAM, 0.48	TDLA30-10	4x4, ULA Low	70	11.0	

Table 5.2.3.1.1-6: Minimum performance for Rank 4

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

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

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

The test purposes are specified in Table 5.2.3.1.2-1.

Table 5.2.3.1.2-1: Tests purpose

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

Table 5.2.3.1.2-2: Test parameters

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

Table 5.2.3.1.2-3: Minimum performance for Rank 2

Test	Reference	Bandwidth (MHz) / Subcarrier spacing	Modulation format and	Propagation condition	Correlation matrix and antenna configuration	Reference va	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 index	x		1
	Mapping type		Type B
	k0		0
	Starting symbol (S)		5
	Length (L)		7
	PDSCH aggregation factor		1
PDSCH	PRB bundling type		Static
configuration	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
	DMRS Type		Type 1
PDSCH DMRS	Number of additional DMRS		1
configuration	Maximum number of OFDM symbols for DL front loaded DMRS		1
Number of HARQ Pr	ocesses		4
The number of slots ACK information	between PDSCH and corresponding HARQ-		2

Table 5.2.3.1.3-3: Minimum performance for Rank 1

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

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

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

The test purposes are specified in Table 5.2.3.1.4-1.

Table 5.2.3.1.4-1: Tests purpose

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

Table 5.2.3.1.4-2: Test parameters

	Parameter	Unit	Value
Duplex mode			FDD
Active DL BWP index	(1
NR UL transmission	with a 7.5 kHz shift to the LTE raster		true
PDCCH configuration	Symbols with PDCCH		Symbol# 2
	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
	Position of the first DM-RS for downlink		3
PDSCH DMRS	Number of additional DMRS		1
configuration	Maximum number of OFDM symbols for DL front loaded DMRS		1
	LTE carrier centre subcarrier location		Same as NR carrier centre subcarrier location
CRS for rate	LTE carrier BW	MHz	10
matching (Note 1)	Number of antenna ports		4
	v-shift		0
Number of HARQ Pro	ocesses		4
The number of slots between PDSCH and corresponding HARQ-ACK information			2
	N is configured on LTE carrier		

Table 5.2.3.1.4-3: Minimum performance for Rank 1

		Bandwidth (MHz) /	Madalatian		Correlation	Reference value		
Test num.	Reference channel	Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)	
1-1	R.PDSCH.1-7.1 FDD	10 / 15	QPSK, 0.30	TDLA30-10	4x4, ULA Low	70	-4.0	
1-2	R.PDSCH.1-7.2 FDD	10 / 15	QPSK, 0.30	TDLA30-10	4x4, ULA Low	70	-4.0	

5.2.3.2 TDD

5.2.3.2.1 Minimum requirements for PDSCH Mapping Type A

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

The test purposes are specified in Table 5.2.3.2.1-1.

Table 5.2.3.2.1-1: Tests purpose

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

Table 5.2.3.2.1-2: Test parameters

	Parameter	Unit	Value
Duplex mode			TDD
Active DL BWP index	(1
	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		Specific to each Reference channel
	PDSCH aggregation factor		1
	PRB bundling type		Static
PDSCH configuration	PRB bundling size		4 for Tests 1-1, 1-8, 1-9 wideband for Test 3-1 2 for other tests
Comiguration	Resource allocation type		Test 1-2: Type 1 with start RB = 50, L _{RBs} = 6 Other tests: Type 0
	RBG size		Test 1-2: N/A Other tests: Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
	DMRS Type		Type 1
PDSCH DMRS	Number of additional DMRS		2 for Tests 1-1, 1-7, 1-8, 1-9 1 for other tests
configuration	Maximum number of OFDM symbols for DL front loaded DMRS		1
	First OFDM symbol in the PRB used for CSI-RS		Tests 1-8, 1-9: l_0 = 4 for CSI-RS resource 1 and 3 l_0 = 8 for CSI-RS resource 2 and 4 Other tests; Table 5.2-1.
CSI-RS for tracking	CSI-RS periodicity	Slots	Test 1-7: 20 for CSI-RS resource 1,2,3,4. Other tests: Table 5.2-1.
	CSI-RS offset	Slots	Test 1-7: 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4. Other tests: Table 5.2-1.

Frequency Occupation	Test 1-7: Start PRB 0 Number of PRB = 52
	Other tests: Table 5.2-1.
	16 for Test 1-4
Number of HARQ Processes	10 for Test 1-9
	8 for other tests
The number of slots between PDSCH and corresponding HARQ-	Specific to each TDD UL-DL pattern
ACK information	and as defined in Annex A.1.2

Table 5.2.3.2.1-3: Minimum performance for Rank 1

		Bandwidth	Madulation	TDD		Correlation	Reference	value
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	TDD UL-DL pattern	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.2- 1.1 TDD	40 / 30	QPSK, 0.30	FR1.30- 1A	TDLB100- 400	2x4, ULA Low	70	-4.1
1-2	R.PDSCH.2- 1.2 TDD	40 / 30	QPSK, 0.30	FR1.30- 1	TDLC300- 100	2x4, ULA Low	70	-2.7
1-3	R.PDSCH.2- 4.1 TDD	40 / 30	256QAM, 0.82	FR1.30- 1	TDLA30-10	2x4, ULA Low	70	21.6
1-4	R.PDSCH.2- 2.1 TDD	40 / 30	16QAM, 0.48	FR1.30- 1	TDLC300- 100	2x4, ULA Low	30	-1.2
1-5	R.PDSCH.2- 5.1 TDD	40 / 30	QPSK, 0.30	FR1.30- 2	TDLA30-10	2x4, ULA Low	70	-3.8
1-6	R.PDSCH.2- 6.1 TDD	40 / 30	QPSK, 0.30	FR1.30- 3	TDLA30-10	2x4, ULA Low	70	-3.6
1-7	R.PDSCH.2- 10.1 TDD	40 / 30	16QAM, 0.48	FR1.30- 1	HST-1000	1x4	70	3.4
1-8	R.PDSCH.2- 11.1 TDD	40 / 30	QPSK, 0.30	FR1.30- 5	TDLB100- 400	2x4, ULA Low	70	-4.0
1-9	R.PDSCH.2- 12.1 TDD	40 / 30	QPSK, 0.30	FR1.30- 6	TDLB100- 400	2x4, ULA Low	70	-4.0

Table 5.2.3.2.1-4: Minimum performance for Rank 2

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

Table 5.2.3.2.1-5: Minimum performance for Rank 3

		Bandwidth					Correlation matrix and antenna configuration	Reference value	
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	TDD UL- DL pattern	Fraction of maximum throughput (%)			SNR (dB)	
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			Correlation	Reference value		
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	TDD UL- DL pattern	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
4-1	R.PDSCH.2- 2.4 TDD	40 / 30	16QAM, 0.48	FR1.30- 1	TDLA30-10	4x4, ULA Low	70	15.4

Table 5.2.3.2.1-7: Minimum performance for Rank 3 and Enhanced Receiver Type 1

		Bandwidth		TDD III			Correlation	Reference	/alue
Test num.	Reference channel	(MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	TDD UL- DL pattern	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)	
5-1	R.PDSCH.2- 2.3 TDD	40 / 30	16QAM, 0.48	FR1.30-1	TDLA30-10	4x4, ULA Medium A	70	22.9	

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

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

The test purposes are specified in Table 5.2.3.2.2-1.

Table 5.2.3.2.2-1: Tests purpose

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

Table 5.2.3.2.2-2: Test parameters

	Parameter	Unit	Value
Duplex mode			TDD
Active DL BWP index	X		1
	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		12
	PDSCH aggregation factor		1
PDSCH	PRB bundling type		Static
configuration	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle		N/A
	size		IN/A
	DMRS Type		Type 1
PDSCH DMRS	Number of additional DMRS		1
configuration	Maximum number of OFDM symbols for		1
	DL front loaded DMRS		*
NZP CSI-RS for	OFDM symbols in the PRB used for CSI-RS		I ₀ = 13
CSI acquisition	CSI-RS periodicity	Slots	5
	Subcarrier index in the PRB used for CSI-		(1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1
ZP CSI-RS for CSI 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 Processes			8
The number of slots between PDSCH and corresponding HARQ-			Specific to each TDD UL-DL pattern
ACK information			and as defined in Annex A.1.2

Table 5.2.3.2.2-3: Minimum performance for Rank 2

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

5.2.3.2.3 Minimum requirements for PDSCH Mapping Type B

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

The test purposes are specified in Table 5.2.3.2.3-1.

Table 5.2.3.2.3-1: Tests purpose

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

Table 5.2.3.2.3-2: Test parameters

	Parameter	Unit	Value		
Duplex mode			TDD		
Active DL BWP inde	ex		1		
	Mapping type		Type B		
	k0		0		
	Starting symbol (S)		5		
	Length (L)		7		
	PDSCH aggregation factor		1		
PDSCH	PRB bundling type		Static		
configuration	PRB bundling size		2		
	Resource allocation type		Type 0		
	RBG size		Config2		
	VRB-to-PRB mapping type		Non-interleaved		
	VRB-to-PRB mapping interleaver bundle size		N/A		
	DMRS Type		Type 1		
PDSCH DMRS	Number of additional DMRS		1		
configuration	Maximum number of OFDM symbols for DL front loaded DMRS		1		
Number of HARQ P	rocesses		8		
The number of slots ACK information	between PDSCH and corresponding HARQ-		Specific to each TDD UL-DL pattern and as defined in Annex A.1.2		

Table 5.2.3.2.3-3: Minimum performance for Rank 1

		Bandwidth (MHz) / Modulation TDD UL-		Correlation	Reference value			
Test num.	Reference channel	Subcarrier spacing (kHz)	format and code rate	DL pattern	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH,2- 1.3 TDD	40 / 30	QPSK, 0.30	FR1.30- 1	TDLA30-10	2x4, ULA Low	70	-3.9

5.3 PDCCH demodulation requirements

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

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

Table 5.3-1: Common test Parameters

	Paramete	er	Unit	Value
Carrier		een Point A and the		0
configuration		le subcarrier on this		
	carrier (Note	,		
DL BWP	Cyclic prefix		DD-	Normal
configuration #1	RB offset	ILID	RBs	0
Common serving cell	Physical Ce SSB position			0
parameters	SSB position		ms	20
paramotoro		CCH monitoring	1113	Each slot
		PDCCH candidates		1
PDCCH				Start from RB = 0
configuration		lomain resource r CORESET		with contiguous RB
		TOOKLOLT		allocation
	TCI state			TCI state #1
	First subcari used for CS	rier index in the PRB I-RS (k_0)		0
				CSI-RS resource 1:
	First OFDM	symbol in the PRB		CSI-RS resource 2:
	used for CS	I-RS (I ₀)		CSI-RS resource 3:
				CSI-RS resource 4:
		CSI-RS ports (X)		1
	CDM Type			No CDM
	Density (ρ)			3
CSI-RS for	CSI-RS peri	odicity	Slots	15 kHz SCS: 20 30 kHz SCS: 40
tracking				15 kHz SCS: 10 for CSI-RS
				resource 1 and 2
				11 for CSI-RS
	001.00 -#-	-4	01-4-	resource 3 and 4
	CSI-RS offs	et	Slots	30 kHz SCS:
				20 for CSI-RS
				resource 1 and 2
				21 for CSI-RS
				resource 3 and 4
				Start PRB 0
	Frequency (Occupation		Number of PRB =
	QCL info			ceil(BWP size /4)*4 TCI state #0
	Type 1	SSB index		SSB #0
	QCL information	QCL Type		Type C
TCI state #0	Type 2	SSB index		SSB #0
	QCL information	QCL Type		Type D
				CSI-RS resource 1
	Type 1 QCL	CSI-RS resource		from 'CSI-RS for tracking'
	information			configuration
	Institution	QCL Type		Type A
TCI state #1	†			CSI-RS resource 1
	Type 2	CSI DS recourses		from 'CSI-RS for
	QĊL	CSI-RS resource		tracking'
	information			configuration
	1	QCL Type		Type D

	1
PDCCH Precoding configuration	Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i ₁ , i ₂ combination with REG bundling granularity for number of Tx larger than 1
Symbols for all unused REs	OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1
Physical signals, channels mapping and precoding	As specified in Annex B.4.1
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 from TS 38 101-1 [6] for tested channel band	

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

1RX requirements 5.3.1

(Void)

2RX requirements 5.3.2

5.3.2.1 **FDD**

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

Table 5.3.2.1-1: Test Parameters

Parameter	Unit	1 Tx Antenna	2 Tx Antenna
CCE to REG mapping type		nonInter	leaved
REG bundle size		6	
Shift index		0	

5.3.2.1.1 1 Tx Antenna performances

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

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

			CORES				Antenna	Reference	value
Test numbe r	Bandw idth (MHz)	CORE SET RB	ET duratio n	Aggregati on level	Reference Channel	Propagation Condition	configurat ion and correlatio n Matrix	Pm-dsg (%)	SNR (dB)
1	10	24	2	2	R.PDCCH. 1-2.1 FDD	TDLA30-10	1x2 Low	1	8.1
2	10	24	2	2	R.PDCCH. 1-2.3 FDD	TDLC300- 100	1x2 Low	1	8.2
3	10	48	2	4	R.PDCCH. 1-2.4 FDD	TDLA30-10	1x2 Low	1	5.5
4	10	48	1	4	R.PDCCH. 1-1.1 FDD	TDLA30-10	1x2 Low	1	4.4
5	10	48	2	16	R.PDCCH. 1-2.6 FDD	TDLA30-10	1x2 Low	1	-2.1

5.3.2.1.2 2 Tx Antenna performances

For the parameters specified in Table 5.3.2.1-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 5.3.2.1.2-1. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.3.2.1.2-1: Minimum performance for PDCCH with 15 kHz SCS

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

5.3.2.2 TDD

The parameters specified in Table 5.3.2.2-1 are valid for all TDD tests unless otherwise stated.

Table 5.3.2.2-1: Test Parameters

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

5.3.2.2.1 1 Tx Antenna performances

For the parameters specified in Table 5.3.2.2-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 5.3.2.2.1-1. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.3.2.2.1-1: Minimum performance for PDCCH with 30 kHz SCS

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

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

5.3.3 4RX requirements

5.3.3.1 FDD

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

Table 5.3.3.1-1: Test Parameters

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

5.3.3.1.1 1 Tx Antenna performances

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

Table 5.3.3.1.1-1: Minimum performance for PDCCH with 15 kHz SCS

			CORES				Antenna	Reference	value
Test numbe r	Bandw idth (MHz)	CORE SET RB	ET duratio n	Aggregati on level	Reference Channel	Propagation Condition	configurat ion and correlatio n Matrix	Pm-dsg (%)	SNR (dB)
1	10	24	2	2	R.PDCCH. 1-2.1 FDD	TDLA30-10	1x4 Low	1	2.2
2	10	24	2	2	R.PDCCH. 1-2.3 FDD	TDLC300- 100	1x4 Low	1	2.7
3	10	48	2	4	R.PDCCH. 1-2.4 FDD	TDLA30-10	1x4 Low	1	0.2
4	10	48	1	4	R.PDCCH. 1-1.1 FDD	TDLA30-10	1x4 Low	1	-0.4
5	10	48	2	16	R.PDCCH. 1-2.6 FDD	TDLA30-10	1x4 Medium A	1	-3.2

5.3.3.1.2 2 Tx Antenna performances

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

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

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

5.3.3.2 TDD

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

Table 5.3.3.2-1: Common Test Parameters

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

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) /	Bandwidth (MHz) / Reference		Antenna configuration	Reference value	
number	Subcarrier spacing (kHz)	channel	condition	and correlation matrix	Pm- bch (%)	SNR (dB)
1	10 / 15	R.PBCH.1	TDLC300-100	1 x 2 Low	1	-8.3

5.4.2.2 TDD

Table 5.4.2.2-1: Test parameters for PBCH

Parameter	Unit	Single antenna port
Physical Cell ID		0
Cyclic prefix		Normal
Number of SS/PBCH blocks within an SS burst set periodicity		1
SS/PBCH block index Note1		0
SS/PBCH block periodicity	ms	20
TDD UL-DL pattern		FR1.30-1
Note 1: as specified in clause 4.1 of TS 38.213 [11]		
Note 2: as specified in clause 11.1 of TS 38.213 [11]		

For the parameters specified in Table 5.4.2.2-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified values in Table 5.4.2.2-2 in case SS/PBCH block index is not known and below the specified values in Table.5.4.2.2-3 in case SS/PBCH block index is known. The downlink physical setup is in accordance with Annex C.3.1.

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

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

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

Test number	Bandwidth (MHz) / Subcarrier spacing	Reference channel	Propagation condition	Antenna configuration and correlation matrix	Refer val	
	(kHz)				Pm- bch (%)	SNR (dB)
1	40 / 30	R.PBCH.2	TDLA30-10	1 x 2 Low	1	-6.5

5.4.3 4RX requirements

5.4.3.1 FDD

Table 5.4.3.1-1: Test parameters for PBCH

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

For the parameters specified in Table 5.4.3.1-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified values in Table 5.4.3.1-2 in case SS/PBCH block index is not known and below the specified values in Table.5.4.3.1-3 in case SS/PBCH block index is known. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.4.3.1-2: Minimum performance PBCH in case SS/PBCH block index is not known

Test number	Bandwidth (MHz) / Subcarrier spacing	Reference channel	Propagation condition	Antenna configuration and correlation matrix	Refer val	
	(kHz)				Pm- bch (%)	SNR (dB)
1	10 / 15	R.PBCH.1	TDLC300-100	1 x 4 Low	1	-8.9

Table 5.4.3.1-3: Minimum performance PBCH in case SS/PBCH block index is known

Test number	Bandwidth (MHz) / Subcarrier spacing	Reference channel	Propagation condition	Antenna configuration and correlation matrix	Refei va	rence lue
	(kHz)				Pm- bch (%)	SNR (dB)
1	10 / 15	R.PBCH.1	TDLC300-100	1 x 4 Low	1	-10.9

5.4.3.2 TDD

Table 5.4.3.2-1: Test parameters for PBCH

Parameter	Unit	Single antenna port
Physical Cell ID		0
Cyclic prefix		Normal
Number of SS/PBCH blocks within an SS burst set periodicity		1
SS/PBCH block index Note1		0
SS/PBCH block periodicity	ms	20
TDD UL-DL pattern		FR1.30-1
Note 1: as specified in clause 4.1 of TS 38.213 [11]	•	
Note 2: as specified in clause 11.1 of TS 38.213 [11]		

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

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

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

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

Test number	Bandwidth (MHz) / Subcarrier spacing	Reference channel	Propagation condition	Antenna configuration and correlation matrix	Refer val	
	(kHz)				Pm- SNR bch (dB)	
1	40 / 30	R.PBCH.2	TDLA30-10	1 x 4 Low	1	-9.6

5.5 Sustained downlink data rate provided by lower layers

5.5.1 FR1 single carrier requirements

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

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

5.5A Sustained downlink data rate provided by lower layers

5.5A.1 FR1 CA requirements

< Editor's note: Open issues to be resolved:

Whether same requirements apply for FR1 DC>

The Sustained Data Rate (SDR) requirements in this clause are applicable to the FR1 CA.

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

The test parameters are determined by the following procedure:

- Select one CA bandwidth combination among all supported CA configurations and set of per component carrier (CC) UE capabilities among all supported UE capabilities that provides the largest data rate in accordance with clause 4.1.2 of TS 38.306 [14].
 - Set of per CC UE capabilities includes channel bandwidth, subcarrier spacing, number of PDSCH MIMO layers, modulation format and scaling factor in accordance with clause 4.1.2 of TS 38.306 [14].
 - When there are multiple sets of CA bandwidth combinations and UE capabilities (channel bandwidth, subcarrier spacing, number of MIMO layer, modulation format, scaling factor) with same largest data rate, select one among sets with the smallest aggregated channel bandwidth.
- For each CC in CA bandwidth combination, use Table 5.5A-5 to determine MCS based on test parameters and indicated UE capabilities.

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

The TB success rate is defined as $100\%*N_{DL_correct_rx}/(N_{DL_newtx} + N_{DL_retx})$, where N_{DL_newtx} is the number of newly transmitted DL transport blocks, N_{DL_retx} is the number of retransmitted DL transport blocks, and $N_{DL_correct_rx}$ is the number of correctly received DL transport blocks.

The common test parameters are specified in Table 5.5A-1. The parameters specified in Table 5.5A-2 are applicable for tests on FDD CCs and parameters specified in Table 5.5A-3 are applicable for tests on TDD CCs.

Unless otherwise stated, no user data is scheduled on slot #0, 10 and 11 within 20 ms for SCS 15 kHz.

Unless otherwise stated, no user data is scheduled on slot #0, 20 and 21 within 20 ms for SCS 30 kHz.

Table 5.5A-1: Common test parameters for FDD and TDD component carriers

	Parameter	Unit	Value
PDSCH transmission	scheme		Transmission scheme 1
EPRE ratio of PTRS	to PDSCH	dB	N/A
Channel bandwidth		MHz	Channel bandwidth from selected CA bandwidth combination
	Physical Cell ID		0
Common serving	SSB position in burst		First SSB in Slot #0
cell parameters	SSB periodicity First DMRS position for Type A PDSCH	ms	20
	mapping		2
Cross carrier schedu	ů .		Not configured
Active DL BWP index			1
Actual carrier configuration	Offset between Point A and the lowest usable subcarrier on this carrier (Note 2)	RBs	0
- comigaration	Subcarrier spacing	kHz	15 or 30
	RB offset	RBs	0
DL BWP configuration #1	Number of contiguous PRB		Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-1 [6] for tested channel bandwidth and subcarrier spacing
	Subcarrier spacing	kHz	15 or 30
	Cyclic prefix		Normal
	Slots for PDCCH monitoring		Each slot
	Symbols with PDCCH		Symbols #0
	Number of PRBs in CORESET		Table 5.5A-4
	Number of PDCCH candidates and aggregation levels		1/AL 1 for 30 kHz / 5 MHz 1/AL4 for 15 kHz / 5 MHz, 30 kHz / 10 MHz and 30 kHz / 15 MHz 1/AL 8 for other combinations
	CCE-to-REG mapping type		Non-interleaved
	DCI format		1_1
PDCCH	TCI State		TCI state #1
configuration	PDCCH & PDCCH DMRS Precoding configuration		For 2Tx: Single Panel Type I, Random precoder chosen from precoder index 0 and 2, selection updated per slot For 4Tx: Single Panel Type I, Random precoder chosen from precoders with i_1,1 in {1,2,3,5,6,7} and i_2 in {0,2}, selection updated per slot
	Mapping type		Type A
	k0		0
	PDSCH aggregation factor	+	1
PDSCH	PRB bundling type 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 inc	lexes in the PRB used for		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 bu				Multiplexed
Redundancy version of	coaing sequen	ce		{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 unuse	d 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
- John garadion	4 layers CCs			4x4

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

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

	Parameter	Unit	Value
Duplex mode			TDD
PDSCH	Starting symbol (S)		1
configuration	Length (L)		13
Number of HARQ	Processes		8
K1 value			Specific to each UL-DL pattern
TDD UL-DL patter	in.		15 kHz SCS: FR1.15-1
TOD OL-DL patter	П		30 kHz SCS: FR1.30-1
Note 1: PDSCH	l is scheduled only on full DL slots		

Table 5.5A-4: Number of PRBs in CORESET

S (k	CS (Hz)	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	100MHz
	15	24	48	78	102	132	156	216	270	N/A	N/A	N/A
- ;	30	6	24	36	48	60	78	102	132	162	216	270

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

1 1 1 1 1 1 1 1 1 1 1 1 1	8 8 8 8 6 6 6 6 4 4 4 4	1 0.8 0.75 0.4 1 0.8 0.75 0.4 1 0.8	26 21 20 11 27 23 22 14
1 1 1 1 1 1 1 1 1 1	8 8 6 6 6 6 4 4 4	0.75 0.4 1 0.8 0.75 0.4 1 0.8	20 11 27 23 22 14 16
1 1 1 1 1 1 1 1 1	8 6 6 6 4 4 4	0.4 1 0.8 0.75 0.4 1	11 27 23 22 14 16
1 1 1 1 1 1 1 1	6 6 6 4 4 4	1 0.8 0.75 0.4 1 0.8	27 23 22 14 16
1 1 1 1 1 1 1	6 6 6 4 4 4	0.8 0.75 0.4 1 0.8	23 22 14 16
1 1 1 1 1	6 6 4 4 4	0.75 0.4 1 0.8	22 14 16
1 1 1 1 1	6 4 4 4	0.4 1 0.8	14 16
1 1 1 1	4 4 4	1 0.8	16
1 1 1	4	0.8	
1	4		4.0
1		0.75	16
	4	0.75	16
1	7	0.4	10
	2	1	9
1	2	0.8	9
1	2	0.75	9
1	2	0.4	4
2	8	1	26
2	8	0.8	21
2	8	0.75	20
2	8	0.4	11
2	6	1	27
2	6	0.8	23
2	6	0.75	22
2	6	0.4	14
2	4	1	16
2	4	0.8	16
2	4	0.75	16
2	4	0.4	10
2	2	1	9
2	2	0.8	9
2	2	0.75	9
2	2	0.4	4
4	8	1	26
4	8	0.8	23
4	8	0.75	22
4	8	0.4	12
4	6	1	27
4	6	0.8	24
4	6	0.75	23
4	6	0.4	14
4	4	1	16
4	4	0.8	16
4	4	0.75	16
4	4	0.4	11
4	2	1	9
4	2	0.8	9
4	2	0.75	9
4	2	0.4	5

Note 1: MCS Index for maximum modulation format 2,4 and 6 is based on MCS index Table 1 defined in clause 5.1.3.1 of TS 38.214 [12]

Note 2: MCS Index for maximum modulation format 8 is based on MCS index Table 2 defined in clause 5.1.3.1 of TS 38.214 [12]

6 CSI reporting requirements (Conducted requirements)

6.1 General

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

6.1.1 Applicability of requirements

6.1.1.1 General

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

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

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 All tests in Clause 6.2.2 UE supports only 2RX PMI All tests in Clause 6.3.2 RI All tests in Clause 6.4.2 UE supports only All tests in Clause 6.2.3 CQI 4RX or both 2RX All tests in Clause 6.3.3 PMI and 4RX RΙ All tests in Clause 6.4.3

Table 6.1.1.2-1: Requirements applicability

6.1.1.3 Applicability of requirements for optional UE features

6.1.1.4 Applicability of requirements for mandatory UE features with capability signalling

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

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

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

6.1.2 Common test parameters

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

Table 6.1.2-1: Test parameters for CSI test cases

	Parameter	Unit	Value
PDSCH transmis	sion scheme		Transmission
T DOCTT (Taristills			scheme 1
Actual carrier configuration	Offset between Point A and the lowest usable subcarrier on this carrier (Note 3)	RBs	0
o o	Subcarrier spacing	kHz	15 or 30
	Cyclic prefix		Normal
	RB offset	RBs	0
DL BWP configuration #1	Number of contiguous PRB	PRBs	Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-1 [6] for tested channel bandwidth and subcarrier spacing
Active DL BWP in	ndex		1
Common	Physical Cell ID		0
serving cell	SSB position in burst		First SSB in Slot #0
parameters	SSB periodicity	ms	20
	Slots for PDCCH monitoring		Each slot
	Symbols with PDCCH		0,1
	Number of PDCCH candidates		1/AL8
	and aggregation levels		I/ALO
	DCI format		1_1
	TCI state		TCI state #1
PDCCH configuration	PDCCH & PDCCH DMRS Precoding configuration		Multi-path fading propagation conditions: Single Panel Type I, Random per slot with equal probability of each applicable i1, i2 combination, and with REG bundling granularity for number of Tx larger than 1 Static propagation conditions: Single Panel Type I, Random precoder chosen from
Additional PDCCH Configuration for Aperiodic Reporting (Note	Slots for PDCCH monitoring Symbols with PDCCH Number of PDCCH candidates and aggregation levels DCI format		precoder index 0 and 2, selection updated per slot Each slot 0,1 1/AL8 0_1
4)	TCI state		TCI state #1

	T	ľ	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	eduling		Not configured
	Mapping type		Type A
	kO		0
	Starting symbol (S)		2
	Length (L)		12
DDCCH	PDSCH aggregation factor		1
PDSCH	PRB bundling type		Static
configuration	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
	DMRS Type		Type 1
	Number of additional DMRS		1
	Maximum number of OFDM symbols for DL front loaded DMRS		1
PDSCH DMRS configuration	DMRS ports indexes		{1000} for Rank1 {1000,1001} for Rank2 {1000,1001,1002} for Rank3 {1000,1001,1002,100 3} for Rank4
	Number of PDSCH DMRS CDM group(s) without data		2
PTRS	Frequency density (K _{PT-RS})		N/A
configuration	Time density (L _{PT-RS})		N/A
	First subcarrier index in the PRB		0 for CSI-RS
	used for CSI-RS (k ₀)		resource 1,2,3,4
CSI-RS for tracking	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 periodicity	slot	15 kHz SCS: 20 for CSI-RS resource 1,2,3,4 30 kHz SCS: 40 for CSI-RS resource

				15 kHz SCS: 10 for CSI-RS	
			resource 1 and 2		
		ļ	11 for CSI-RS		
	CSI-RS offset		slot	resource 3 and 4	
			SIOL	30 kHz SCS:	
				20 for CSI-RS	
				resource 1 and 2	
				21 for CSI-RS	
				resource 3 and 4 Start PRB 0	
	Frequency Od	ccupation		Number of PRB =	
	00111			ceil(BWP size /4)*4	
	QCL info			TCI state #0 Start PRB 0	
NZP CSI-RS for	Frequency Od	ccupation		Number of PRB =	
CSI acquisition		o apanon		ceil(BWP size /4)*4	
	QCL info			TCI state #1	
ZP CSI-RS for	Fraguenov O	ounation		Start PRB 0 Number of PRB =	
CSI acquisition	Frequency Od	cupation		BWP size	
	Type 1 QCL	SSB index		SSB #0	
	information	QCL Type		Type C	
TCI state #0	Type 2 QCL	SSB index		N/A	
	information	QCL Type		N/A	
		QCL Type		CSI-RS resource 1	
	Type 1 QCL information			from 'CSI-RS for	
		CSI-RS resource		tracking'	
TCI state #1		201 =		configuration	
	Type 2 QCL information	QCL Type CSI-RS resource		Type A N/A	
		QCL Type		N/A	
	_	, , , , , , , , , , , , , , , , , , ,		4 For FDD	
Number of HARC	Q Processes			8 for TDD	
HARQ ACK/NAC				Multiplexed	
Redundancy vers	sion coding sequ	uence		{0,2,3,1}	
				2 for FDD For FR1.30-1:	
				8 if mod(i,10) = 0	
				6 if $mod(i,10) = 2$	
K1 value				5 if mod(i,10) = 3	
(PDSCH-to-HAR	Q-timing-indicat	or)		5 if $mod(i,10) = 4$	
,	3	,		4 if mod(i,10) = 5	
				3 if mod(i,10) = 6 Where i is slot index	
				per radio frame with	
	OP.1 FDD as defined				
Symbols for unused REs			in Annex A.5.1.1 OP.1 TDD as defined		
				in Annex A.5.2.1	
			As specified in Annex		
D.4.1					
Note 1: PDSCH is not scheduled on slots containing CSI-RS or slots which are not full DL.					
Note 2: UE as		TCI state for the PDS	CH is identic	al to the TCI state	
	d for the PDCCI			1: T.I. 500.44	
		minimum guard banc sted channel bandwid		d in Table 5.3.3-1 from	
		nfiguration for aperiod			
with aperiodic CSI reporting configured.					

6.2 Reporting of Channel Quality Indicator (CQI)

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

6.2.1 1RX requirements

(Void)

6.2.2 2RX requirements

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

6.2.2.1 FDD

6.2.2.1.1 CQI reporting definition under AWGN conditions

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

6.2.2.1.1.1 Minimum requirement for periodic CQI reporting

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

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

Table 6.2.2.1.1.1-1: CQI reporting definition test

	Parameter	Unit	Te	est 1	Те	st 2
Bandwidth	h MHz 10					
Duplex Mode			FDD			
Subcarrier spacing	g	kHz	15			
SNR		dB	8	9	14	15
Propagation chan	nel			AW	GN	
Antenna configura			2×2 wi	th static cha		ecified in
				Anne		
Beamforming Mod			As	specified in		3.4.1
	CSI-RS resource Type			Perio		
	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	5, (4)	
	First OFDM symbol in the PRB used for CSI-RS (I ₀)			9	١	
	CSI-RS	alat		5/	4	
	periodicity and offset	slot		5/	ı	
	CSI-RS resource Type			Perio	odic	
	Number of CSI-RS ports (X)			2		
	CDM Type			FD-C	DM2	
NZP CSI-RS for	Density (ρ)			1		
CSI acquisition	First subcarrier index in the PRB			Row	3 (6)	
Coracquisition	used for CSI-RS (k ₀)			NOW .	3,(0)	
	First OFDM symbol in the PRB used for CSI-RS (I ₀)			13	3	
	NZP CSI-RS-timeConfig					
	periodicity and offset	slot		5/	1	
	CSI-IM resource Type			Perio	odic	
	CSI-IM RE pattern			0		
CSI-IM	CSI-IM Resource Mapping			(4,		
configuration	(KCSI-IM, ICSI-IM)			(- ,		
	CSI-IM timeConfig	slot		5/	1	
periodicity and offset				Dorie	ndia	
ReportConfigType CQI-table			Periodic Table 2			
				cri-RI-P		
reportQuantity	rChannelMeasurements			Not con		
	rInterferenceMeasurements					
cqi-FormatIndicate			Not configured Wideband			
pmi-FormatIndicat				Widel		
Sub-band Size	toi	RB		8		
Csi-ReportingBand		IND.		1111		
CSI-Report periodicity and offset		slot		5/		
aperiodicTriggeringOffset		SIUL	+	Not con		
apendulernggeni	Codebook Type			typel-Sing		
	Codebook Node		+	typer-ont	gioi ali c i	
Codebook	(Codebook Config-			ı		
configuration	N1,CodebookConfig-N2)			Not con	figured	
	CodebookSubsetRestriction			0100		
	RI Restriction			N/		
Physical channel for CSI report				PUC	CH	
CQI/RI/PMI delay		ms		8		
Maximum number	of HARQ transmission			1		
Measurement channel			As spe	cified in Tal 2		, TBS.2-

6.2.2.1.2 CQI reporting under fading conditions

6.2.2.1.2.1 Minimum requirement for wideband CQI reporting

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

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

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

- a) A CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least 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 ≥ γ, 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

Bandwidth		Parameter	Unit	Test 1 Test 2
Duplex Mode	Bandwidth		MHz	10
Duplex Mode			kHz	15
Propagation channel				FDD
Antenna configuration Cay			dB	6 7 12 13
Antenna configuration	Propagation chan	nel		TDLA30-5
Correlation configuration				2×2
CSI-RS resource Type				ULA high
Number of CSI-RS ports (X)	Beamforming Mod	del		As specified in Annex B.4.1
Number of CSI-RS ports (X)		CSI-RS resource Type		Periodic
CDM Type				4
Density (p)				FD-CDM2
First subcarrier index in the PRB	7D CCL DC	Density (p)		1
Used for CSI-RS (Rg)				D 5 (4)
First OFDM symbol in the PRB used for CSI-RS (lo)	configuration	used for CSI-RS (k ₀)		Row 5, (4)
CSI-RS CSI-RS CSI-RS periodicity and offset Slot S/1				
CSI-RS				9
Defiolating and offset			-1-4	E /A
Number of CSI-RS ports (X) 2 CDM Type		periodicity and offset	SIOT	5/1
Number of CSI-RS ports (X) 2 CDM Type				Periodic
NZP CSI-RS for CSI acquisition First subcarrier index in the PRB used for CSI-RS (kg) First subcarrier index in the PRB used for CSI-RS (kg) First OFDM symbol in the PRB used for CSI-RS (kg) NZP CSI-RS-timeConfig periodicity and offset SIot				2
NZP CSI-RS for CSI acquisition				FD-CDM2
First subcarrier index in the PRB used for CSI-RS (ko) First OFDM symbol in the PRB used for CSI-RS (ko) First OFDM symbol in the PRB used for CSI-RS (ko) First OFDM symbol in the PRB used for CSI-RS (ko) First OFDM symbol in the PRB used for CSI-RS (ko) To CSI-RS (NIZD OOL DO (1
CSI acquisition used for CSI-RS (k ₀) Row 3,(b) First OFDM symbol in the PRB used for CSI-RS (l ₀) 13 NZP CSI-RS-timeConfig periodicity and offset slot CSI-IM resource Type Periodic CSI-IM Repattern 0 CSI-IM Resource Mapping (kcsi-IM, lcsi-IM) (4, 9) CSI-IM timeConfig periodicity and offset slot 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 CSi-Report periodicity and offset slot Sci-Report periodicity and offset slot Codebook Type typel-SinglePanel Codebook Mode 1 Codebook Mode 1 Codebook Wode 1 Codebook Wode 1 Codebook Wode 1 Codebook SubsetRestriction				5 0 (0)
First OFDM symbol in the PRB used for CSI-RS (lo) NZP CSI-RS-timeConfig periodicity and offset CSI-IM resource Type Periodic	CSI acquisition			Row 3,(6)
for CSI-RS (Io) NZP CSI-RS-timeConfig periodicity and offset Slot 5/1		First OFDM symbol in the PRB used		40
NZP CSI-RS-timeConfig		for CSI-RS (I ₀)		13
Deriodicity and offset				5/4
CSI-IM resource Type		periodicity and offset	SIOT	5/1
CSI-IM ReportConfiguration CSI-IM Resource Mapping (kcsi-iM, Icsi-iM) CSI-IM timeConfig periodicity and offset slot 5/1 ReportConfigType Periodicity and offset Table 2 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasurements Not configured timeRestrictionForInterferenceMeasurements Not configured wideband pmi-FormatIndicator Wideband Sub-band Size RB 8 CSi-ReportIngBand 1111111 CSI-Report periodicity and offset slot 5/0 aperiodicTriggeringOffset Slot 5/0 aperiodicTriggeringOffset Not configured typei-SinglePanel Codebook Configuration RI Restriction NI/CodebookConfig-N1, CodebookConfig-N1, CodebookConfig-N1, CodebookConfig-N2) Codebook SubsetRestriction NI/A Physical channel for CSI report PUCCH CQI/RI/PMI delay ms 8 Maximum number of HARQ transmission 1 Measurement channel				Periodic
CSI-IM timeConfig periodicity and offset Slot S/1		CSI-IM RE pattern		0
configuration CSI-IM timeConfig periodicity and offset Slot S/1	CCLIM	CSI-IM Resource Mapping		
CSI-IM timeConfig periodicity and offset ReportConfigType		(kcsi-im,lcsi-im)		(4, 9)
ReportConfigType Periodic CQI-table Table 2 reportQuantity Cri-RI-PMI-CQI timeRestrictionForChannelMeasurements Not configured timeRestrictionForInterferenceMeasurements Not configured timeRestrictionForInterferenceMeasurements Not configured timeRestrictionForInterferenceMeasurements Not configured cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 8 Csi-ReportingBand 11111111 CSI-Report periodicity and offset slot 5/0 aperiodicTriggeringOffset Slot 5/0 aperiodicTriggeringOffset Not configured Codebook Type typel-SinglePanel Codebook (CodebookConfig- N1,CodebookConfig- N1,CodebookConfig- N1,CodebookConfig-N2) CodebookSubsetRestriction N/A Physical channel for CSI report PUCCH CQI/RI/PMI delay ms 8 Maximum number of HARQ transmission 1 Measurement channel	Comiguration			
ReportConfigType			clot	5/1
CQI-table Table 2 reportQuantity Cri-RI-PMI-CQI timeRestrictionForChannelMeasurements Not configured timeRestrictionForInterferenceMeasurements Not configured cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 8 Csi-ReportingBand 1111111 CSI-Report periodicity and offset slot 5/0 aperiodicTriggeringOffset Not configured Codebook Type typel-SinglePanel Codebook Mode 1 Codebook Mode 1 Codebook Config-N1, CodebookConfig-N2) Not configured N1, CodebookConfig-N2) Not configured Codebook SubsetRestriction 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.4-2, TBS.2-			5101	3/1
reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasurements Not configured timeRestrictionForInterferenceMeasurements Not configured cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 8 Csi-ReportingBand 1111111 CSI-Report periodicity and offset slot 5/0 aperiodicTriggeringOffset Not configured Codebook Type typel-SinglePanel Codebook Mode 1 Codebook Mode 1 Codebook Config- N1, 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.4-2, TBS.2-)		
timeRestrictionForChannelMeasurements timeRestrictionForInterferenceMeasurements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size Sub-band Size RB Csi-ReportingBand CSI-Report periodicity and offset aperiodicTriggeringOffset Codebook Type Codebook Mode Codebook Configuration COdebook Configuration RI Restriction RI Restriction Physical channel for CSI report Mot configured Codebook Configured RI Resurrement channel Mot configured Not configured				
timeRestrictionForInterferenceMeasurements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size Csi-ReportingBand CSI-Report periodicity and offset aperiodicTriggeringOffset Codebook Type Codebook Mode Codebook Configuration CodebookSubsetRestriction RI Restriction Physical channel for CSI report Measurement channel Cqi-FormatIndicator Wideband Wideband Sub-band Size RB 8 8 8 8 11111111 CSI-Report periodicity and offset slot 5/0 Not configured typel-SinglePanel Codebook Mode 1 Not configured As specified in Table A.4-2, TBS.2-	reportQuantity			
cqi-FormatIndicator 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 1 Codebook Mode 1 CodebookConfig-N2) Not configured 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 As specified in Table A.4-2, TBS.2-				
pmi-FormatIndicator Wideband Sub-band Size RB 8 Csi-ReportingBand 1111111 CSI-Report periodicity and offset aperiodicTriggeringOffset slot 5/0 AperiodicTriggeringOffset Not configured Codebook Type typel-SinglePanel Codebook Mode 1 Codebook Mode 1 CodebookConfig-N2) Not configured 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.4-2, TBS.2-				
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 1 Codebook Config-N2) Not configured 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 As specified in Table A.4-2, TBS.2-				Wideband
Csi-ReportingBand 1111111 CSI-Report periodicity and offset slot 5/0 aperiodicTriggeringOffset Not configured Codebook Type typel-SinglePanel Codebook Mode 1 Codebook Config-N2) Not configured 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.4-2, TBS.2-		tor		Wideband
CSI-Report periodicity and offset slot 5/0 aperiodicTriggeringOffset Not configured Codebook Type typel-SinglePanel Codebook Mode 1 Codebook Config- configuration Not configured 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.4-2, TBS.2-			RB	-
aperiodicTriggeringOffset Not configured Codebook Type typel-SinglePanel Codebook Mode 1 Codebook Config- configuration Not configured 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.4-2, TBS.2-	Csi-ReportingBand			1111111
Codebook Type	CSI-Report periodicity and offset		slot	
Codebook Configuration Codebook Mode 1 Codebook Configuration (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.4-2, TBS.2-	aperiodicTriggeringOffset			Not configured
Codebook configuration (CodebookConfig-N1, CodebookConfig-N2) Not configured CodebookSubsetRestriction RI Restriction 000001 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.4-2, TBS.2-		Codebook Type		typel-SinglePanel
Configuration N1,CodebookConfig-N2) Not corrigured 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.4-2, TBS.2-				1
N 1, Codebook Conlig-N2 Codebook Conlig-N2 Codebook SubsetRestriction 000001	Codebook			Not configured
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.4-2, TBS.2-	configuration			Not configured
Physical channel for CSI report CQI/RI/PMI delay Maximum number of HARQ transmission Measurement channel PUCCH ms 8 Maximum number of HARQ transmission 1 As specified in Table A.4-2, TBS.2-		CodebookSubsetRestriction		000001
CQI/RI/PMI delay ms 8 Maximum number of HARQ transmission 1 Measurement channel As specified in Table A.4-2, TBS.2-				N/A
CQI/RI/PMI delay ms 8 Maximum number of HARQ transmission 1 Measurement channel As specified in Table A.4-2, TBS.2-				PUCCH
Maximum number of HARQ transmission 1 Measurement channel As specified in Table A.4-2, TBS.2-			ms	8
Measurement channel				1
Measurement channel	Magauramantaha	nnal		As specified in Table A.4-2, TBS.2-
	ivieasurement cha	measurement channel		1

Table 6.2.2.1.2.1-2: Minimum requirements

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

6.2.2.1.2.2 Minimum requirement for sub-band CQI reporting

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

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

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

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

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

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

Parameter		Unit	Test 1	Test 2
Bandwidth		MHz	10	
Subcarrier spacing		kHz	15	
Duplex Mode	5		FDD	
SNR		dB	8 9 14	15
Propagation chan			Two tap model specified in Anne B.2.4 with $a=1$, $f_D=5$ Hz, and $t_d=0.45\mu$ s	
Antenna configura			2×2	
Correlation config			As per Annex E	
Beamforming Mod			As specified in Anne	x 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	
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	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	9		Aperiodic	
CQI-table			Table 2	
reportQuantity			cri-RI-PMI-CC	
	rChannelMeasurements		Not configure	
	rInterferenceMeasurements		Not configure	<u>d</u>
cqi-FormatIndicate			Subband	
pmi-FormatIndica	tor	DD	Wideband	
Sub-band Size		RB	8	
csi-ReportingBand		slot	1111111 Not configure	<u></u>
Aperiodic Report		3101	5	<u>u</u>
CSI request	olot onset		1 in slots i, where mod otherwise it is equa	
reportTriggerSize			1	<u> </u>
reportringgeroize			One State with one As	
CSI-AperiodicTriggerStateList			Report Configura Associated Report Cor contains pointers to NZ and CSI-IM	nfiguration
aperiodicTriggerin	ngOffset		Not configure	d
Sp 55 dio i liggolii	Codebook Type		typel-SinglePar	
	Codebook Mode		1	
Codebook	(CodebookConfig-		NI=4 C	
configuration	N1,CodebookConfig-N2)		Not configure	a
	CodebookSubsetRestriction		000001	
	RI Restriction		N/A	
Physical channel	for CSI report		PUSCH	<u> </u>
CQI/RI/PMI delay	CQI/RI/PMI delay		8	

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

Table 6.2.2.1.2.2-2: Minimum requirements

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

6.2.2.2 TDD

6.2.2.2.1 CQI reporting definition under AWGN conditions

6.2.2.2.1.1 Minimum requirement for periodic CQI reporting

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

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

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

Table 6.2.2.2.1.1-1: CQI reporting definition test

	Parameter	Unit	Test 1 Test 2
Bandwidth		MHz	40
Subcarrier spacing	g	kHz	30
Duplex Mode	Duplex Mode		TDD
TDD UL-DL patter	'n		FR1.30-1
SNR		dB	8 9 14 15
Propagation chan	nel		AWGN
Antenna configura	ation		2x2 with static channel specified in Annex B.1
Beamforming Mod			As specified in Annex B.4.1
	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (X)		4
	CDM Type		FD-CDM2
ZP CSI-RS	Density (ρ)		1
configuration	First subcarrier index in the PRB		Row 5, (4)
oormgaration	used for CSI-RS (k ₀)		110W 5, (4)
	First OFDM symbol in the PRB used		9
	for CSI-RS (I ₀)		ű
	CSI-RS	slot	10/1
	periodicity and offset		
	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (X)		2
	CDM Type		FD-CDM2
NZP CSI-RS for	Density (ρ)		1
CSI acquisition	First subcarrier index in the PRB		Row 3,(6)
·	used for CSI-RS (k ₀)		, ,
	First OFDM symbol in the PRB used		13
	for CSI-RS (I ₀)		-
	NZP CSI-RS-timeConfig periodicity and offset	slot	10/1
	CSI-IM resource Type		Periodic
	CSI-IM RE pattern		0
	CSI-IM Resource Mapping		Ŭ
CSI-IM	(kcsi-im,lcsi-im)		(4, 9)
configuration	(Noor Impoor Imp		(', ")
	CSI-IM timeConfig		40/4
	periodicity and offset	slot	10/1
ReportConfigType			Periodic
CQI-table			Table 2
reportQuantity			cri-RI-PMI-CQI
timeRestrictionFo	rChannelMeasurements		Not configured
timeRestrictionFo	rInterferenceMeasurements		Not configured
cqi-FormatIndicate	or		Wideband
pmi-FormatIndicat	tor		Wideband
Sub-band Size		RB	16
Csi-ReportingBan			1111111
CSI-Report period		slot	10/9
aperiodicTriggerin	<u> </u>		Not configured
	Codebook Type		typel-SinglePanel
	Codebook Mode		1
Codebook	(CodebookConfig-		Not configured
configuration	N1,CodebookConfig-N2)		
	CodebookSubsetRestriction		010000
	RI Restriction		N/A
Physical channel	for CSI report		PUCCH
CQI/RI/PMI delay	(11450)	ms	9.5
Maximum number	of HARQ transmission		1
Measurement cha	nnel		As specified in Table A.4-2, TBS.2-
			4

6.2.2.2.2 CQI reporting under fading conditions

6.2.2.2.2.1 Minimum requirement for wideband CQI reporting

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

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

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

- a) A CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least α % of the time where α % is specified in Table 6.2.2.2.1-2;
- b) The ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be ≥ 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			40)
Subcarrier spacin	g	kHz	30	
Duplex Mode			TD	D
TDD UL-DL patte	rn		FR1.	30-1
SNR		dB	6 7	12 13
Propagation chan	nel		TDLA	30-5
Antenna configura			2×	2
Correlation config			ULA	nigh
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-CI	DM2
ZP CSI-RS	Density (ρ)		1	
configuration	First subcarrier index in the PRB		Row 5	5 (4)
Comgaration	used for CSI-RS (k ₀)		11000	,, (·/
	First OFDM symbol in the PRB used		9	
	for CSI-RS (I ₀)		,	
	CSI-RS	slot	10/	′1 l
	periodicity and offset			
	CSI-RS resource Type		Perio	
	Number of CSI-RS ports (X)		2	
	CDM Type		FD-CI	JM2
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	3
	for CSI-RS (I ₀)			
	NZP CSI-RS-timeConfig	slot	10/1	
	periodicity and offset CSI-IM resource Type		Perio	odio
	CSI-IM RE pattern		0	Juic
	CSI-IM Resource Mapping		0	
CSI-IM	(kcsi-im, lcsi-im)		(4,	9)
configuration	(NCSI-IM, ICSI-IM)		(4,	J)
	CSI-IM timeConfig	_		
	periodicity and offset	slot	10/	/1
ReportConfigType			Perio	odic
CQI-table	_		Tabl	
reportQuantity			cri-RI-PI	
	rChannelMeasurements		Not con	figured
	rInterferenceMeasurements		Not con	
cqi-FormatIndicat			Widel	
pmi-FormatIndica			Widek	oand
Sub-band Size		RB	16	
Csi-ReportingBan	id		1111	
CSI-Report period		slot	10/	
	periodicTriggeringOffset Not configure			
, , , , , ,	Codebook Type		typel-Sing	
	Codebook Mode		1	
Codebook	(CodebookConfig-		NIat a	figured
configuration	N1,CodebookConfig-N2)		Not con	iigurea
	CodebookSubsetRestriction		0000	001
	RI Restriction		N/A	
Physical channel	Physical channel for CSI report		PUC	CH
CQI/RI/PMI delay	·	ms	9.9	5
	r of HARQ transmission		1	
Measurement cha	ennel		As specified in Tal	ole A.4-2, TBS.2-
ivicasurement Cha			. 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

Parameter		Unit	Test 1	Test 2
Bandwidth		MHz	40	
Subcarrier spacing		kHz	30	
Duplex Mode	Duplex Mode		TDD	
TDD UL-DL patte	rn		FF	R1.30-1
SNR		dB	8 9	14 15
				I specified in Annex
Propagation chan	nel			=1, f_D = 5Hz, and
			Td=().1125µs
Antenna configura				2×2
Correlation config				r Annex B.1
Beamforming Mod				d in Annex B.4.1
	CSI-RS resource Type		Р	eriodic
	Number of CSI-RS ports (X)			4
	CDM Type		FL	D-CDM2
ZP CSI-RS	Density (ρ)			1
configuration	First subcarrier index in the PRB		Ro	w 5, (4)
	used for CSI-RS (k ₀) First OFDM symbol in the PRB used			
	for CSI-RS (I ₀)			9
	CSI-RS			
	periodicity and offset	slot		10/1
	CSI-RS resource Type		D	eriodic
	Number of CSI-RS ports (X)		<u> </u>	2
	CDM Type		FF	D-CDM2
	Density (ρ)		1.5	1
NZP CSI-RS for	First subcarrier index in the PRB			'
CSI acquisition	used for CSI-RS (k ₀)		Ro	ow 3,(6)
	First OFDM symbol in the PRB used			
	for CSI-RS (I ₀)		13	
	NZP CSI-RS-timeConfig	-1-4	10/4	
	periodicity and offset	slot		10/1
	CSI-IM resource Type		Р	eriodic
	CSI-IM RE pattern			0
CSI-IM	CSI-IM Resource Mapping			
configuration	(kcsi-im,lcsi-im)			(4, 9)
oomigaration				
	CSI-IM timeConfig	slot		10/1
D	periodicity and offset		Δ	:!:!! -
ReportConfigType	9			periodic
CQI-table				able 2
reportQuantity	rChannelMeasurements			I-PMI-CQI
	rInterferenceMeasurements			configured configured
cgi-FormatIndicate				ubband
pmi-FormatIndicat				ideband
Sub-band Size	ioi	RB	VV	16
csi-ReportingBan	4	ND ND	1.	111111
CSI-Report period		slot		configured
Aperiodic Report		3101	1401	8
	5.51 5.1051		1 in slots i wh	nere mod(i, 10) = 1,
CSI request				it is equal to 0
reportTriggerSize			54.151.11100	1
5 p 2 1 1 1 1 1 3 3 5 1 5 1 2 6			One State wi	th one Associated
				Configuration
CSI-AperiodicTrig	gerStateList		Associated Report Configuration contains pointers to NZP CSI-RS	
	and CSI-IM			
aperiodicTriggerin				configured
	Codebook Type		typel-S	SinglePanel
	Codebook Mode			1
Codebook	(CodebookConfig-		Not o	configured
configuration	N1,CodebookConfig-N2)			
	CodebookSubsetRestriction		0	00001
Dhueis start	RI Restriction		N/A	
Physical channel for CSI report			<u> </u>	USCH

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

Table 6.2.2.2.2-2: Minimum requirements

Parameters	Test 1	Test 2
α [%]	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			15	
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		Peri	odic
	CSI-IM RE pattern		1 611	
	CSI-IM Resource Mapping			,
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	
		slot		
	CSI-Report periodicity and offset slot 5/0 aperiodicTriggeringOffset Slot Not configu			
apendalerriggenin	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			PUC	
CQI/RI/PMI delay	or correport	ms	8	
	of HARQ transmission	1110	1	
Measurement cha			As specified in Ta	ble A.4-2, TBS.2-
		i		

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 ≥ γ, 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

Bandwidth		Parameter	Unit	Test 1	Test 2
Duplex Mode	Bandwidth		MHz	1	0
Duplex Mode			kHz	15	
Propagation channel			FDD)D
Antenna configuration	SNR		dB	3 4	9 10
Correlation configuration	Propagation chan	nel		TDLA	30-5
CSI-RS resource Type	Antenna configura	ation		2×	4
CSI-RS resource Type	Correlation configu	uration			
Number of CSI-RS ports (X)	Beamforming Mod	del		As specified in	n Annex B.4.1
CDM Type		CSI-RS resource Type		Peri	odic
Density (p)		Number of CSI-RS ports (X)		4	ļ
First subcarrier index in the PRB gow 5, (4)		CDM Type		FD-C	DM2
configuration First subcarrier index in the PRB used for CSI-RS (ko) Row 5, (4) First OFDM symbol in the PRB used for CSI-RS (lo) 9 CSI-RS persource Type Periodic NZP CSI-RS resource Type Periodic NZP CSI-RS for CSI-RS ports (X) 2 CDM Type FD-CDM2 Density (p) 1 First subcarrier index in the PRB used for CSI-RS (ko) Row 3,(6) First OFDM symbol in the PRB used for CSI-RS (ko) 13 NZP CSI-RS-timeConfig periodicity and offset slot CSI-IM resource Type Periodic CSI-IM Resource Mapping (kcsI-M, IcsI-M) (4, 9) CSI-IM Resource Mapping (kcsI-M, IcsI-M) (4, 9) CSI-IM Resource Mapping (coll-table Table 2 ReportConfigType Periodic CQI-table Table 2 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasurements Not configured timeRestrictionForInterrenceMeasurements Not configured timeRestrictionForInterrenceMeasurements Not configured CSI-ReportingBand 11111111 Codebook (Type	7D CSI_DS			1	
Used for CSI-RS (Rg)		First subcarrier index in the PRB		Pow	5 (4)
For CSI-RS (In) SION SIO	Comigaration			IXOW .	J, (4)
CSI-RS periodicity and offset periodic periodicity and offset periodicity and offset periodicity and offset periodic periodicity and offset periodicity and offset periodicity and offset periodic periodicity and offset periodic periodicity and offset periodic periodic periodicity and offset periodic periodicity and offset periodic periodicity and offset periodic					,
periodicity and offset Slot S/1 REPORTCONTIGITIPE CSI-IM timeConfig periodicity and offset Slot ReportConfigType CSI-IM timeConfig periodicity and offset ReportConfigType Periodic CSI-IM timeConfig periodicity and offset Slot ReportConfigType Periodic CSI-IM timeConfig periodicity Slot ReportConfigType Periodic CSI-IM timeConfig periodicity Slot ReportConfigType Periodic CSI-IM timeConfig Slot S/1 ReportConfigType Periodic ReportConfigType Periodic ReportConfigType ReportConfigType ReportConfigType ReportConfigType Codebook Slot S/5 Codebook Slot S/5 Codebook Codebook Slot S/5 Codebook Codebook Slot S/5 Codebook Codebook Slot S/5 Codebook Codebook Slot Slot S/5 Codebook Codebook Slot Slot S/5 Codebook Codebook Slot Sl					,
Defiolaticy and offset			slot	5/	′ 1
Number of CSI-RS ports (X) 2 CDM Type			0.01		
NZP CSI-RS for CSI acquisition FD-CDM2 Density (p)					
NZP CSI-RS for CSI acquisition				_	
First subcarrier index in the PRB used for CSI-RS (ko) First OFDM symbol in the PRB used for CSI-RS (ko) First OFDM symbol in the PRB used for CSI-RS (ko) First OFDM symbol in the PRB used for CSI-RS (ko) T3 T3 T3 T3 T3 T3 T3 T					
First subcarrier index in the PRB Seed for CSI-RS (kg)	NZP CSI-RS for			1	
Used tor CSI-RS (kg)				Row	3.(6)
for CSI-RS (Io) NZP CSI-RS-timeConfig periodicity and offset Slot 5/1		used for CSI-RS (k ₀)			0,(0)
NZP CSI-RS-timeConfig		First OFDM symbol in the PRB used		13	
Deriodicity and offset					
CSI-IM resource Type			slot	5/	1
CSI-IM CSI-IM Resource Mapping (KcSI-IM,IcSI-IM) CSI-IM Resource Mapping (KcSI-IM,IcSI-IM) CSI-IM timeConfig periodicity and offset Slot S/1				Desi	l' -
CSI-IM configuration CSI-IM timeConfig periodicity and offset ReportConfigType CQI-table reportQuantity timeRestrictionForChannelMeasurements timeRestrictionForInterferenceMeasurements cqi-FormatIndicator pmi-FormatIndicator pmi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-ReportingBand CSI-ReportingBand COI-Report periodicity and offset aperiodicTriggeringOffset Codebook Mode Codebook Configuration Codebook Configuration RI Restriction Physical channel for CSI report CQI/RI/PMI delay Measurement channel CSI-IM Resource Mapping (4, 9) (5/1 Periodic Not configured Not					
CSI-IM timeConfig periodicity and offset Slot S/1)
CSI-IM timeConfig periodicity and offset ReportConfigType				(4	0)
ReportConfigType Periodic CQI-table Table 2 reportQuantity Cri-RI-PMI-CQI timeRestrictionForChannelMeasurements Not configured timeRestrictionForInterferenceMeasurements Not configured timeRestrictionForInterferenceMeasurements Not configured cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report periodicity and offset slot 5/0 aperiodicTriggeringOffset Slot 5/0 aperiodicTriggeringOffset Not configured Codebook Type typel-SinglePanel Codebook (CodebookConfig- N1,CodebookConfig- N1,	configuration	(NCSI-IM,ICSI-IM)		(4,	3)
ReportConfigType		CSI-IM timeConfig		_	,,
ReportConfigType Periodic CQI-table Table 2 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasurements Not configured timeRestrictionForInterferenceMeasurements Not configured cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report periodicity and offset slot 5/0 aperiodicTriggeringOffset Not configured Codebook Type typel-SinglePanel Codebook Mode 1 Codebook Config-N1, CodebookConfig-N2) Not configured Not configured Not configured RI Restriction 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.4-2, TBS.2-			slot	5/	1
CQI-table Table 2 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasurements Not configured timeRestrictionForInterferenceMeasurements Not configured cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 8 csi-ReportingBand 11111111 CSI-Report periodicity and offset slot 5/0 aperiodicTriggeringOffset Not configured publication Codebook Type typel-SinglePanel Codebook Codebook Mode 1 Codebook Config-N1 Not configured N1, CodebookConfig-N2 Not configured N/A Physical channel for CSI report PUCCH CQI/RI/PMI delay ms 8 Maximum number of HARQ transmission As specified in Table A.4-2, TBS.2-	ReportConfigType			Peri	odic
timeRestrictionForChannelMeasurements timeRestrictionForInterferenceMeasurements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size Si-ReportingBand CSI-Report periodicity and offset aperiodicTriggeringOffset Codebook Configuration Codebook Configuration RI Restriction Physical channel for CSI report Mot configured As specified in Table A.4-2, TBS.2- Not configured Not c					
timeRestrictionForInterferenceMeasurements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size sub-band Size csi-ReportingBand CSI-Report periodicity and offset aperiodicTriggeringOffset Codebook Type Codebook Mode Codebook (CodebookConfig-N2) CodebookSubsetRestriction RI Restriction Physical channel for CSI report CQI/RI/PMI delay Measurement channel Mideband Wideband Wideband State Wideband State Wideband State Wideband State Wideband State Wideband Not configured 11111111 CSI-Report periodicity and offset slot 5/0 Not configured 1 Not configured As specified in Table A.4-2, TBS.2-	reportQuantity			cri-RI-P	MI-CQI
cqi-FormatIndicator 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 1 Codebook Config-N2) Not configured 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.4-2, TBS.2-	timeRestrictionFor	ChannelMeasurements		Not con	figured
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 1 Codebook Config-N2) Not configured 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.4-2, TBS.2-	timeRestrictionFor	InterferenceMeasurements		Not con	figured
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 1 Codebook Config-N2) Not configured 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 As specified in Table A.4-2, TBS.2-	cqi-FormatIndicato	or		Wide	band
csi-ReportingBand 1111111 CSI-Report periodicity and offset slot 5/0 aperiodicTriggeringOffset Not configured Codebook Type typel-SinglePanel Codebook Mode 1 Codebook Config-N2) Not configured 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 As specified in Table A.4-2, TBS.2-	pmi-FormatIndicat	or		Wide	band
CSI-Report periodicity and offset slot 5/0 aperiodicTriggeringOffset Not configured Codebook Type typel-SinglePanel Codebook Mode 1 Codebook Config- configuration Not configured N1,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.4-2, TBS.2-	Sub-band Size		RB	8	3
aperiodicTriggeringOffset Not configured Codebook Type typel-SinglePanel Codebook Mode 1 Codebook Config- configuration Not configured N1,CodebookConfig- N1,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.4-2, TBS.2-	csi-ReportingBand	d		1111	111
Codebook Type	CSI-Report period	licity and offset	slot	5/	0
Codebook Configuration Codebook Mode 1 Codebook Config-N1, Codebook Config-N2) Not configured Codebook SubsetRestriction 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.4-2, TBS.2-	aperiodicTriggerin	gOffset		Not con	figured
Codebook configuration (CodebookConfig-N1, CodebookConfig-N2) Not configured CodebookSubsetRestriction RI Restriction 000001 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.4-2, TBS.2-		Codebook Type		typel-Sin	glePanel
Configuration 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.4-2, TBS.2-		Codebook Mode		1	
N1,CodebookConlig-N2)	Codebook	(CodebookConfig-		Not con	figured
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.4-2, TBS.2-	configuration				•
Physical channel for CSI report CQI/RI/PMI delay Maximum number of HARQ transmission Measurement channel PUCCH ms 8 Maximum number of HARQ transmission 1 As specified in Table A.4-2, TBS.2-					
CQI/RI/PMI delay ms 8 Maximum number of HARQ transmission 1 Measurement channel As specified in Table A.4-2, TBS.2-					
Maximum number of HARQ transmission 1 Measurement channel As specified in Table A.4-2, TBS.2-		for CSI report			
Measurement channel As specified in Table A.4-2, TBS.2-			ms	8	3
weasurement channel	Maximum number	of HARQ transmission		·	
1	Measurement cha	nnel		As specified in Ta	ble A.4-2, TBS.2-
	Wodourement ona	111101		1	

Table 6.2.3.1.2.1-2: Minimum requirements

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

6.2.3.1.2.2 Minimum requirement for sub-band CQI reporting

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

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

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

- a) A sub-band differential CQI offset level of 0 shall be reported at least $\alpha\%$ of the time but less than $\beta\%$ of the time for each sub-band, where 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	1(Ö
Subcarrier spacing	g	kHz	15	5
Duplex Mode			FD)D
SNR		dB	5 6	11 12
Propagation chan			Two tap model sp B.2.4 with a=1, td=0.4	$f_D = 5$ Hz, and
Antenna configura	ation		2×	:4
Correlation config			As per Ar	
Beamforming Mod			As specified in	
	CSI-RS resource Type		Perio	
	Number of CSI-RS ports (X)		4	
	CDM Type Density (ρ)		FD-C	
ZP CSI-RS configuration	First subcarrier index in the PRB			
Corniguration	used for CSI-RS (k ₀) First OFDM symbol in the PRB used		Row	5, (4)
	for CSI-RS (I ₀)		9	
	CSI-RS periodicity and offset	slot	5/	
	CSI-RS resource Type		Perio	odic
	Number of CSI-RS ports (X)		2	
	CDM Type		FD-C	
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)		1:	3
	NZP CSI-RS-timeConfig periodicity and offset	slot	5/	1
	CSI-IM resource Type		Perio	odic
	CSI-IM RE pattern		0	
CSI-IM configuration	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(4,	9)
	CSI-IM timeConfig periodicity and offset	slot	5/	1
ReportConfigType)		Aperi	
CQI-table			Tabl	
reportQuantity			cri-RI-P	
	rChannelMeasurements		Not con	
cgi-FormatIndicate	rInterferenceMeasurements		Not con Subb	
pmi-FormatIndicat			Widel	
Sub-band Size	toi	RB	vvidei 8	
csi-ReportingBand	1	ND N	1111	
CSI-Report period		slot	Not con	
Aperiodic Report			5	
CSI request			1 in slots i, wher otherwise it i	
reportTriggerSize			1	
			One State with one Report Cor Associated Report	nfiguration
Joi Aperiodic Hg	CSI-AperiodicTriggerStateList		contains pointers	to NZP CSI-RS
aperiodicTriggerin	gOffset		Not con	
	Codebook Type		typel-Sin	glePanel
	Codebook Mode		1	
Codebook	(CodebookConfig-		Not con	figured
configuration	N1,CodebookConfig-N2)			
	CodebookSubsetRestriction RI Restriction		0000 N/	
Physical channel			PUS	
CQI/RI/PMI delay		ms	8	<u> </u>
Ostificial Ivii dolay				

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 COI-1) shall be less than or equal to 0.1.

Table 6.2.3.2.1.1-1: CQI reporting definition test

	Parameter	Unit	Test 1 Test 2
Bandwidth			40
Subcarrier spacing	g	kHz	30
Duplex Mode			TDD
TDD UL-DL patter	'n		FR1.30-1
SNR		dB	5 6 11 12
Propagation chan	nel		AWGN
Antenna configura	ation		2x4 with static channel specified in Annex B.1
Beamforming Mod			As specified in Annex B.4.1
	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (X)		4
	CDM Type		FD-CDM2
ZP CSI-RS	Density (ρ)		1
configuration	First subcarrier index in the PRB		Row 5, (4)
	used for CSI-RS (k ₀)		, ()
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		9
	CSI-RS	slot	10/1
	periodicity and offset	0.01	
	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (X)		2
	CDM Type		FD-CDM2
N7D 001 D0 (Density (ρ)		1
NZP CSI-RS for	5:		
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
CCLIM	CSI-IM Resource Mapping		
CSI-IM configuration	(ксы-ім,Ісы-ім)		(4, 9)
	CSI-IM timeConfig	alat	10/1
	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-ReportingBand		1111111
CSI-Report periodicity and offset aperiodicTriggeringOffset		slot	10/9
aperiodic i riggerin	<u> </u>		Not configured
	Codebook Type Codebook Mode		typel-SinglePanel
Codebook	(Codebook Config-		1
configuration	N1,CodebookConfig-N2)		Not configured
	CodebookSubsetRestriction		010000
	RI Restriction		N/A
Physical channel	for CSI report		PUCCH
CQI/RI/PMI delay	(11450)	ms	9.5
Maximum number	of HARQ transmission		1
Measurement cha	nnel		As specified in Table A.4-2, TBS.2-

6.2.3.2.2 CQI reporting under fading conditions

6.2.3.2.2.1 Minimum requirement for wideband CQI reporting

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

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

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

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

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

	Parameter	Unit	Test 1	Test 2
Bandwidth			40	
Subcarrier spacin	g	kHz	30	
Duplex Mode			TDI	
TDD UL-DL patte	rn		FR1.3	0-1
SNR		dB	3 4	9 10
Propagation chan			TDLA	
Antenna configura			2×4	
Correlation config			XP H	
Beamforming Mod			As specified in	
	CSI-RS resource Type Number of CSI-RS ports (X)		Perio 4	aic
	CDM Type		FD-CE	MO
	Density (p)		1	JIVIZ
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		Perio	dic
	Number of CSI-RS ports (X)		2	
	CDM Type		FD-C	DM2
NZP CSI-RS for	Density (ρ)		1	
CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k ₀)		Row 3	,(6)
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		13	
	NZP CSI-RS-timeConfig periodicity and offset	slot	10/	1
	CSI-IM resource Type		Perio	dic
	CSI-IM RE pattern		0	
CSI-IM configuration	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(4, 9	9)
	CSI-IM timeConfig periodicity and offset	slot	10/	1
ReportConfigType	9		Perio	dic
CQI-table			Table	
reportQuantity			cri-RI-PN	
	rChannelMeasurements		Not conf	
	rInterferenceMeasurements		Not conf	
cqi-FormatIndicat			Wideb	
pmi-FormatIndica	tor	רטט	Wideb	
Sub-band Size	A	RB	16 1111	
csi-ReportingBan		slot	11111	
	CSI-Report periodicity and offset aperiodicTriggeringOffset		Not conf	
apenduic i nggeni	Codebook Type		typel-Sing	
	Codebook Type Codebook Mode		1 typei-3iiig	ior unoi
Codebook	(CodebookConfig-			
configuration	N1,CodebookConfig-N2)		Not conf	igured
3	CodebookSubsetRestriction		0000	01
	RI Restriction		N/A	
Physical channel for CSI report			PUC	CH
	CQI/RI/PMI delay		9.5	; <u> </u>
Maximum number	Maximum number of HARQ transmission		1	
Measurement cha	annel		As specified in Tab	le A.4-2, TBS.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	Bandwidth		40
Subcarrier spacin	g	kHz	30
Duplex Mode			TDD
TDD UL-DL patte	rn		FR1.30-1
SNR		dB	5 6 11 12
Propagation chan	nnel		Two tap model specified in Annex B.2.4 with $a=1$, $f_D=5$ Hz, and $t_d=0.1125\mu s$
Antenna configura	ation		2×4
Correlation config			As per Annex B.1
Beamforming Mo			As specified in Annex B.4.1
	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (X)		4
	CDM Type		FD-CDM2
7D 001 D0	Density (ρ)		1
ZP CSI-RS configuration	First subcarrier index in the PRB used for CSI-RS (k ₀)		Row 5, (4)
	First OFDM symbol in the PRB used for CSI-RS (I ₀)		9
	CSI-RS periodicity and offset	slot	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			Subband
pmi-FormatIndica	tor		Wideband
Sub-band Size		RB	16
csi-ReportingBan			1111111
CSI-Report period		slot	Not configured
Aperiodic Report CSI request	Slot Offset		8 1 in slots i, where mod(i, 10) = 1,
reportTriggerSize	•		otherwise it is equal to 0
CSI-AperiodicTrig	ggerStateList		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)		Not configured
	CodebookSubsetRestriction		000001
	RI Restriction		N/A
Physical channel	for CSI report		PUSCH

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

Table 6.2.2.1.2.2-2: Minimum requirements

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

6.3 Reporting of Precoding Matrix Indicator (PMI)

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

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

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

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

6.3.1 1RX requirements

(Void)

6.3.2 2RX requirements

6.3.2.1 FDD

6.3.2.1.1 Single PMI with 4TX TypeI-SinglePanel Codebook

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

Table 6.3.2.1.1-1: Test parameters (single layer)

Pai	rameter	Unit	Test 1
Bandwidth	ameter	MHz	10
Subcarrier space	zina	kHz	15
Duplex Mode	g		FDD
Propagation cha	annel		TDLA30-5
Antenna configu			High XP 4 x 2
			(N1,N2) = (2,1)
Beamforming M			As specified in Annex B.4.1
	CSI-RS resource		Periodic
	Type Number of CSI-		
			4
	RS ports (X) CDM Type		FD-CDM2
	Density (ρ)		1 D-ODM2
	First subcarrier		•
ZP CSI-RS	index in the PRB		Daw 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	Olot	3/ 1
	CSI-RS resource		Aperiodic
	Туре		Aperiodic
	Number of CSI-		4
	RS ports (X)		
	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		(12)
	(l ₀) CSI-RS		
	periodicity and		Not configured
	offset		140t doringarda
	aperiodicTriggerin		0
	gOffset		0
	CSI-IM resource		Aperiodic
	Туре		•
	CSI-IM RE pattern		Pattern 0
CSI-IM	CSI-IM Resource		(4.0)
configuration	Mapping (kcsі-ім,lcsі-ім)		(4,9)
	CSI-IM timeConfig		
	periodicity and	slot	Not configured
	offset)
ReportConfigTy	rpe		Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasure			Not configured
ments timeRestrictionForInterferenceMeas			
urements			Not configured
cqi-FormatIndic	ator		Wideband
pmi-FormatIndio			Wideband
Sub-band Size		RB	8
csi-ReportingBa			1111111
CSI-Report peri	odicity and offset	slot	Not configured
Aperiodic Repo	rt Slot Offset		4

CSI request			1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
reportTriggerS	Size		1
	TriggerStateList		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 de		ms	6
Maximum num transmission	nber of HARQ		4
Measurement	channel		R.PDSCH.1-6.1 FDD
Precoding	figuration for random		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 pro			
Note 2: If the bas this	Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-3), this reported PMI cannot be applied at the gNB downlink before slot#(n+3).		k reporting instance at slot#n nk slot not later than slot#(n-3),
Note 3: Rar			

Table 6.3.2.1.1-2: Minimum requirement

Parameter	Test 1
γ	1.3

6.3.2.1.2 Single PMI with 8TX TypeI-SinglePanel Codebook

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

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

100

Bandwidth	Parameter		Unit	Test 1
Duplex Mode	Bandwidth			
Propagation channel		ring	kHz	
Antenna configuration				
Beamforming Mode	Propagation channel			
CSI-RS resource	Antenna configuration			
Type	Beamforming M	lodel		As specified in Annex B.4.1
Type				Doriodio
RS ports (X)				Periodic
CDM Type Density (p) 1				4
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 CSI-RS resource Type Number of CSI-RS ports (X) CDM Type Density (p) First subcarrier index in the PRB used for CSI-RS (o, k) CDM Type Density (p) First subcarrier index in the PRB used for CSI-RS (ko, k1) Expected for CSI-RS (ko, k1) CSI-RS ports (X) CDM Type Density (p) First subcarrier index in the PRB used for CSI-RS (ko, k1) First OFDM symbol in the PRB used for CSI-RS (ko, k1) CSI-RS periodicity and offset Experiodicity and offset CSI-IM resource Type CSI-IM Resource Mapping (kcsI-IMI, ICSI-IMI) CSI-IM Resource Mapping (kcsI-IMI, ICSI-IMI) CSI-IM timeConfig periodicity and offset ReportConfigType Aperiodic ReportConfigType Aperiodic ReportConfigType Aperiodic RestrictionForChannelMeasure ments TimeRestrictionForChannelMeasure ments TimeRestrictionForInterferenceMeas urements Videband Sub-band Size RB Row 5,(4) (9) (9) (9) (9) (9) (9) (9) (9) (9) (
Index in the PRB used for CSI-RS (ko)				1
Configuration Used for CSI-RS (ko)	ZP CSI-RS			
(ko)				Row 5,(4)
First OFDM symbol in the PRB used for CSI-RS (Io)	oormgaration			
Symbol in the PRB used for CSI-RS (lo)				
Used for CSI-RS (lo)				(0)
CSI-RS				(9)
Periodicity and offset		(l ₀)		
Offset		CSI-RS		
CSI-RS resource Type		periodicity and	slot	5/1
Type				
Type				Aperiodic
RS ports (X)				7 15 0110 0110
CDM Type				8
Density (p) 1				CDM4 (ED2, ED2)
NZP CSI-RS for CSI acquisition First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁) First OFDM symbol in the PRB used for CSI-RS (l ₀) CSI-RS (l ₀) CSI-RS Periodicity and offset Q Q Q Q Q Q Q Q Q				· .
NZP CSI-RS for CSI acquisition Index in the PRB used for CSI-RS (ko, k1)				1
for CSI acquisition Second State Second State				
CSI acquisition CSI First OFDM Symbol in the PRB used for CSI-RS (lo) CSI-RS periodicity and offset aperiodicTriggerin gOffset CSI-IM resource Type CSI-IM Resource Type CSI-IM Resource Mapping (kosI-IM, losI-IM) CSI-IM timeConfig periodicity and offset Table 1 reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements Cqi-FormatIndicator Report Offigured Cqi-Report periodicity and offset ReportConfigured Cqi-FormatIndicator Cqi-FormatIndicator Cqi-FormatIndicator Cqi-Report periodicity and offset ReportConfigured ReportConfigured Cqi-FormatIndicator Cqi-FormatIndicator Cqi-FormatIndicator Cqi-ReportIngBand CSI-Report periodicity and offset Slot Not configured Cqi-Report periodicity and offset Slot Cqi-Report periodicity and offset Slot Cqi-Report periodicity and offset				Row 8, (4,6)
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 O CSI-IM Resource Mapping (kcsi-im, lcsi-im) CSI-IM timeConfig periodicity and offset Stote when the cri-Ri-PMi-CQI timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband purce wish and size RB RB RS Si-ReportingBand 1111111 CSI-Report periodicity and offset slot Not configured Table 1 Table				
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 Aperiodic CQI-table Table 1 reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator SI-IM Resource Mapping (kcsI-IM.lcsI-IM) CSI-IM timeConfig periodicity and offset Aperiodic Not configured Not configured Not configured Not configured Wideband Wideband Sub-band Size RB RB RB RS Si-ReportingBand SI-IM Resource Aperiodic Ape	acquisition			
CSI-IM configuration CSI-IM resource Type CSI-IM Resource Mapping (KcSI-IM,IcSI-IM) CSI-IM timeConfig periodicity and offset ReportConfigType CQI-table ReportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements treportQuantity timeRestrictionForInterferenceMeas urements cqi-FormatIndicator SI-IM resource Mapping (4,9) (K-SI-IM,IcSI-IM) CSI-IM timeConfig periodicity and offset SI-IM timeConfig periodicity and offset Not configured Not configured Not configured Not configured Not configured Not configured RB RE REPORTIONION NOT CONFIGURED Not configured Not configured		symbol in the PRB		(5)
CSI-RS periodicity and offset aperiodicTriggerin gOffset CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping ((kcsI-IM,IcsI-IM) CSI-IM timeConfig periodicity and offset ReportConfigType CQI-table ReportQuantity TrapertQuantity TimeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Sub-band Size RB RB RS RB RS RB RS ReportConfigured O Aperiodic (4,9) (4,9) Not configured Aperiodic Cri-RI-PMI-CQI Table 1 Table 1 Tori-RI-PMI-CQI Not configured Not configured Wideband Wideband Sub-band Size RB RB RB RB RB RB RB RB RB RITTITITE Not configured Table 1 Rot configured Table 1 Rot configured Rot configured Table 1 Tori-RI-PMI-CQI TimeRestrictionForChannelMeasure Mot configured Tori-RI-PMI-CQI TimeRestrictionForInterferenceMeas Tori-RI-PMI-CQI Tori-RI-PMI-CQ		used for CSI-RS		(5)
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 csi-Report periodicity and offset ReportConfigType ReportConfigured ReportConfigType ReportConfi				
Offset aperiodicTriggerin gOffset CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (KcSI-IM,ICSI-IM) CSI-IM timeConfig periodicity and offset ReportConfigType CQI-table TeportQuantity TimeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas trements timeRestrictionForInterferenceMeas trements cqi-FormatIndicator Sub-band Size CSI-IM resource Mapping ((4,9) (4,9) Aperiodic Not configured Table 1 Table 1 Table 1 TreportQuantity TimeRestrictionForChannelMeasure ments Total Configured Not configured Wideband Wideband Sub-band Size RB 8 8 Si-ReportingBand T1111111 CSI-Report 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 SteeportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband Sub-band Size RB 8 csi-Report periodicity and offset slot Not configured CSI-IM timeConfig periodicity and slot offset Not configured Not configured Wideband Sub-band Size RB 8 csi-Report periodicity and offset slot Not configured			slot	Not configured
GSI-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-Report periodicity and offset CSI-IM resource Mapping (kcsi-im, lcsi-im) CSI-IM timeConfig periodicity and offset slot Not configured Not configured Videband Wideband Sub-band Size RB RB RB RB RB RI Aperiodic Not configured Videband Videb				
CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (k _{CSI-IM,IcSI-IM}) CSI-IM timeConfig periodicity and offset ReportConfigType CQI-table Table 1 reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-Report periodicity and offset CSI-IM RE pattern Pattern 0 Aperiodic Not configured Not configured Not configured Not configured Wideband Wideband Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report periodicity and offset				0
CSI-IM Resource Mapping (k _{CSI-IM} , l _{CSI-IM}) ReportConfigType Aperiodic CQI-table Table 1 reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband Sub-band Size csi-Report periodicity and offset Type CSI-IM Resputtern Pattern Pattern Pattern Pattern Pattern (4,9) (4,9) (4,9) (4,9) (4,9) Aperiodic Not configured Not configured Not configured Wideband Wideband Not configured				
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-Report periodicity and offset CSI-IM Resource Mapping (k4,9) (4,9) Aperiodic Not configured Not configured Not configured Wideband Wideband RB 8 1111111 CSI-Report periodicity and offset Slot Not configured				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 8 csi-Report periodicity and offset CSI-IM Resource Mapping (4,9) (4,9) (4,9) (4,9)				Pattern 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 Wideband Sub-band Size RB 8 csi-Report periodicity and offset slot Not configured Not configured 1111111 CSI-Report periodicity and offset slot Not configured	001114			i alioni e
Configuration CSI-IM timeConfig periodicity and offset Slot Not configured				(4,9)
Periodicity and offset Slot Not configured	configuration			
ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report periodicity and offset slot Not configured			-	
ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments Not configured timeRestrictionForInterferenceMeas urements Videband pmi-FormatIndicator Wideband Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report periodicity and offset slot Not configured		periodicity and	slot	Not configured
CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments Not configured timeRestrictionForInterferenceMeas urements Not configured cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB csi-ReportingBand 1111111 CSI-Report periodicity and offset slot Not configured				
reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report periodicity and offset slot Not configured				
timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-Report periodicity and offset Not configured Wideband Wideband 8 8 1111111 Not configured				
ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-Report periodicity and offset Not configured Wideband Wideband 8 8 1111111 Not configured				cri-RI-PMI-CQI
timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-Report periodicity and offset wot configured Wideband Wideband 8 8 1111111 Not configured				Not configured
urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-Report periodicity and offset Not configured Wideband 8 8 1111111 Not configured				-
cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report periodicity and offset slot Not configured				Not configured
pmi-FormatIndicatorWidebandSub-band SizeRB8csi-ReportingBand1111111CSI-Report periodicity and offsetslotNot configured				Wideband
Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report periodicity and offset slot Not configured				
csi-ReportingBand 11111111 CSI-Report periodicity and offset slot Not configured			RB	
CSI-Report periodicity and offset slot Not configured				-
	CSI-Report peri			

CSI request			1 in slots i, where $mod(i, 5) = 1$,
·			otherwise it is equal to 0
reportTriggerS	ze		1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
	Codebook Type		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 chann	el for CSI report		PUSCH
CQI/RI/PMI de		ms	8
Maximum number of HARQ			4
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
Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable i ₁ , i ₂ combination. Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-4),			
this reported PMI cannot be applied at the gNB downlink before slot#(n+4). Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.			

Table 6.3.2.1.2-2: Minimum requirement

Parameter	Test 1
γ	1.5

6.3.2.2 TDD

6.3.2.2.1 Single PMI with 4TX TypeI-SinglePanel Codebook

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

Table 6.3.2.2.1-1: Test parameters (single layer)

Parameter		Unit	Test 1
Bandwidth		MHz	40
	rier spacing	kHz	30
Duplex Mode			TDD
TDD DL-UL configuration			FR1.30-1 as specified in Annex A
Propaga	tion channel		TDLA30-5
Antenna	configuration		High XP 4 x 2
			(N1,N2) = (2,1)
Beamto	rming Model CSI-RS resource		As specified in Annex B.4.1
	Type		Periodic
	Number of CSI-		4
	RS ports (X)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
70 001 00	First subcarrier		
ZP CSI-RS	index in the PRB		Row 5,(4)
configuration	used for CSI-RS		, ,
	(k ₀) First OFDM		
	symbol in the PRB		
	used for CSI-RS		(9)
	(l ₀)		
	CSI-RS		
	periodicity and	slot	10/1
	offset		
	CSI-RS resource		Aperiodic
	Type		, .poou.c
	Number of CSI-		4
	RS ports (X)		FD-CDM2
	CDM Type Density (p)		1 1
	First subcarrier		I I
	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	alat	Not configured
	periodicity and offset	slot	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		(4,9)
Ü	(kcsi-im,lcsi-im) CSI-IM timeConfig		
	periodicity and	slot	Not configured
	offset	SIOL	Not configured
ReportConfigTy			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasure			Not configured
ments timeRestrictionForInterferenceMeas			. tot ooimgarea
timeRestrictionForInterferenceMeas urements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	16
csi-ReportingBa	and	, ,,,,	1111111
	odicity and offset	slot	Not configured
Col-Report periodicity and offset		J.J.	

Aperiodic Re	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)		(2,1)
configuration	(CodebookConfig- O1,CodebookCon fig-O2)		(4,1)
	CodebookSubset Restriction		11111111
	RI Restriction		0000001
Physical char	nnel 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 i1, i2 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.			
ba thi	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: Ra	Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.		

Table 6.3.2.2.1-2: Minimum requirement

Parameter	Test 1
γ	1.3

6.3.2.2.2 Single PMI with 8TX TypeI-SinglePanel Codebook

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

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

Par	rameter	Unit	Test 1
Parameter Bandwidth		MHz	40
Subcarrier spacing		kHz	30
Duplex Mode			TDD
TDD DL-UL configurations			FR1.30-1 as specified in Annex A
Propaga	ation channel		TDLA30-5
Antenna	configuration		High XP 8 x 2
Beamfo	rming Model		(N1,N2) = (4,1) As specified in Annex B.4.1
	CSI-RS resource		Periodic
	Туре		1 enouic
	Number of CSI- RS ports (X)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier		·
ZP CSI-RS	index in the PRB		Dow 5 (4)
configuration	used for CSI-RS		Row 5,(4)
	(k_0)		
	First OFDM		
	symbol in the PRB		(9)
	used for CSI-RS		()
	(l ₀) CSI-RS		
	periodicity and	slot	10/1
	offset	3101	10/1
	CSI-RS resource		Anaviadia
	Туре		Aperiodic
	Number of CSI-		8
	RS ports (X)		
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier 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		(5)
	(l ₀)		
	CSI-RS		
	periodicity and	slot	Not configured
	offset aperiodicTriggerin		
	gOffset		0
	CSI-IM resource		Anaviadia
	Туре		Aperiodic
	CSI-IM RE pattern		Pattern 0
CSI-IM	CSI-IM Resource		
configuration	Mapping		(4,9)
3	(kcsi-im,lcsi-im)		
	CSI-IM timeConfig	-1-4	Not configured
	periodicity and offset	slot	Not configured
ReportConfigTy			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForlChannelMeasur			
ements			Not configured
timeRestrictionForInterferenceMeas			Not configured
urements			Ţ.
cqi-FormatIndicator			Wideband
pmi-FormatIndicator Sub-band Size		RB	Wideband 16
csi-ReportingBa	and	KĎ	1111111
		slot	Not configured
CSI-Report periodicity and offset		3101	ivot configured

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Aperiodic Ren	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 char	nel for CSI report		PUSCH
CQI/RI/PMI d		ms	6.5
Maximum number of HARQ			4
transmission		-	D DDCCULG G G TDD
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.			
Note 2: If the base of this	Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-6), this reported PMI cannot be applied at the gNB downlink before slot#(n+6).		k reporting instance at slot#n k slot not later than slot#(n-6),
Note 3: Ra			

Table 6.3.2.2.2-2: Minimum requirement

Parameter	Test 1
γ	1.5

6.3.3 4RX requirements

6.3.3.1 FDD

6.3.3.1.1 Single PMI with 4TX TypeI-SinglePanel Codebook

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

Table 6.3.3.1.1-1: Test parameters (single layer)

Parameter		Unit MHz	Test 1
Bandwidth	Bandwidth		10
Subcarrier space	Subcarrier spacing		15
Duplex Mode			FDD
Propagation cha	annel		TDLA30-5
Antenna configu	ıration		High XP 4 x 4
			(N1,N2) = (2,1)
Beamforming M			As specified in Annex B.4.1
	CSI-RS resource		Periodic
	Туре		1 onodio
	Number of CSI-		4
	RS ports (X)		
	CDM Type		FD-CDM2
	Density (ρ)		1
70.001.00	First subcarrier		
ZP CSI-RS	index in the PRB		Row 5,(4)
configuration	used for CSI-RS		, , ,
	(k ₀)		
	First OFDM		
	symbol in the PRB used for CSI-RS		(9)
	(l ₀)		
	CSI-RS		
	periodicity and	slot	5/1
	offset	3101	3/1
	CSI-RS resource		
	Type		Aperiodic
	Number of CSI-		
	RS ports (X)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier		·
NIZD 001 D0	index in the PRB		- (5)
NZP CSI-RS	used for CSI-RS		Row 4, (0)
for CSI	(k ₀)		
acquisition	First OFDM		
	symbol in the PRB		(12)
	used for CSI-RS		(13)
	(l ₀)		
	CSI-RS		
	periodicity and	slot	Not configured
	offset		
	aperiodicTriggerin		0
	gOffset		-
	CSI-IM resource		Aperiodic
	Type		·
	CSI-IM RE pattern		Pattern 0
CSI-IM	CSI-IM Resource		(4.0)
configuration	Mapping		(4,9)
	(k _{CSI-IM} , l _{CSI-IM})		
	CSI-IM timeConfig periodicity and	slot	Not configured
	offset	SIOL	Not configured
ReportConfigTy	ReportConfigType		Aperiodic
CQI-table	μo		Table 1
	reportQuantity		cri-RI-PMI-CQI
timeRestrictionForChannelMeasure			
	ments		Not configured
	timeRestrictionForInterferenceMeas		
	urements		Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	8
csi-ReportingBand		,,,5	1111111
CSI-Report periodicity and offset		slot	Not configured
Aperiodic Repo		5.51	4
p 5.10 alo 1 topo		1	'

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 chann	nel for CSI report		PUSCH
CQI/RI/PMI de		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 i1, i2 combination, and with Wideband granularity
pred prob Note 2: If th bas	precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable i_1 , i_2 combination.		
slot#(n+3). 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 6.3.3.1.1-2: Minimum requirement

Parameter	Test 1
γ	1.3

6.3.3.1.2 Single PMI with 8TX TypeI-SinglePanel Codebook

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

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

Bandwidth	Parameter		Unit	Test 1
Duplex Mode	Bandwidth		MHz	10
Propagation channel				
Antenna configuration		annol		
Beamforming Model				
CSI-RS resource Type	Antenna configu	uration		
CSI-RS resource Type	Beamforming M	odel		
Type	J			
RS ports (X)		7.		Periodic
RS ports (X)				4
Density (p)				·
First subcarrier index in the PRB used for CSI-RS (ko)				FD-CDM2
Index in the PRB used for CSI-RS (ko) First OFDM symbol in the PRB used for CSI-RS (lo) CSI-RS (lo) CSI-RS periodicity and offset CSI-RS ports (X) CDM Type CDM4 (FD2, TD2) Density (p) Tirst subcarrier index in the PRB used for CSI-RS (ko, k.) First OFDM symbol in the PRB used for CSI-RS (ko, k.) First OFDM symbol in the PRB used for CSI-RS (ko, k.) First OFDM symbol in the PRB used for CSI-RS (lo) CSI-RS (l				1
Seed for CSI-RS Row 5,(4)	ZP CSI-RS			
(ko)				Row 5,(4)
Symbol in the PRB Used for CSI-RS (lo)	a com garantee			
Used for CSI-RS (lo)		First OFDM		
User In CSI-RS				(9)
CSI-RS				(6)
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, k1) First OFDM symbol in the PRB used for CSI-RS periodicity and offset aperiodicTriggerin gOffset CSI-IM CSI-IM RE pattern CSI-IM Resource Mapping (KCSI-IM REsource Mapping (KCSI-IM)) CSI-IM Resource Mapping (CSI-IM Resource Mapping (CSI-IM)) CSI-IM Resource Mapping (CSI-IM Tesource Type Aperiodic TeportConfigType Aperiodic ReportConfigType Aperiodic CQI-table Table 1 reportQuantity Cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cisi-ReportIngBand SIZE RB SESI-RS Aperiodic Type Aperiodic CSI-IM Tesource Type Aperiodic CSI-IM Tesource Table 1 Tori-RI-PMI-CQI Wideband Wideband Thill1111 Thill Till Till Till Till Till Till Till				
Offset			clot	5/1
CSI-RS resource Type			SIUL	3/1
Type				
RS ports (X)				Aperiodic
RS ports (X)				8
Density (p)				
NZP CSI-RS for CSI acquisition First subcarrier index in the PRB used for CSI-RS (ko, k1) 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 Mapping (cSI-IM) CSI-IM timeConfig periodicity and offset ReportConfigType Aperiodic CQI-table ReportConfigType Aperiodic CQI-table ReportConfigTope CQI-table ReportConfigTope CQI-table ReportConfigTope CQI-table ReportConfigTope Aperiodic CQI-table ReportConfigTope Aperiodic CQI-table Table 1 reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements urements videband pmi-FormatIndicator Wideband Sub-band Size RB Row 8, (4,6) Row 8, (4,6)				, , ,
NZP CSI-RS for CSI acquisition Index in the PRB used for CSI-RS (ko, k1)				1
for CSI acquisition Second State Second State				
CSI				Row 8, (4,6)
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 O CSI-IM Resource Mapping (kcsi-im, lcsi-im) CSI-IM timeConfig periodicity and offset Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband Sub-band Size RB 8 si-Reportperiodicity and offset SIot Not configured Sich RB				
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 TreportQuantity TreportQuantity TimeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Sub-band Size RB RB RB Rott Configured Not configured Not configured Wideband Sub-band Size RB RB RB RB RE SI-ReportingBand CSI-Report periodicity and offset Slot Not configured Not configured	acquisition			
CSI-IM configuration CSI-IM configuration CSI-IM resource Type CSI-IM Resource Mapping (kcsI-IM, lcsI-IM) CSI-IM timeConfig periodicity and offset ReportConfigType ReportQuantity TimeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator SI-IM resource Mapping (4,9) CSI-IM Resource Mapping (4,9) (4,9) (4,9) (4,9) CSI-IM timeConfig periodicity and offset Not configured Table 1 reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements CQi-FormatIndicator Wideband Sub-band Size RB 8 csi-ReportingBand Till1111 CSI-Report periodicity and offset Not configured				(5)
CSI-RS periodicity and offset aperiodicTriggerin gOffset CSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (kcsi-IM, lcsi-IM) CSI-IM timeConfig periodicity and offset ReportConfigType CQI-table reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Sub-band Size RB RB RB RS RB RB RS RB RB RS RB RS RB RB RS RI RO ROTIGITY ROTIGITY ROTIGITY RAPERIODIC				(-)
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 csi-Report periodicity and offset ReportConfigured ReportConfigured ReportConfigType Aperiodic Ci-RI-PMI-CQI Table 1 Table 1 Table 1 Tori-RI-PMI-CQI Wideband Wideband PMI-FormatIndicator Wideband Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report periodicity and offset				
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 TeportQuantity TeportQuantity TimeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Sub-band Size csi-Report periodicity and offset O Aperiodic (4,9) (4,9) (4,9) (4,9) (4,9) (A,9) (slot	Not configured
GSI-IM resource Type CSI-IM RE pattern CSI-IM Resource Mapping (kcsi-iM, lcsi-iM) CSI-IM timeConfig periodicity and offset ReportConfigType CQI-table Table 1 TeportQuantity TimeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Sub-band Size csi-Report periodicity and offset CSI-IM resource Mapping (kcsi-iM, lcsi-iM) CSI-IM timeConfig periodicity and slot offset Aperiodic Not configured Not configured Not configured Wideband Wideband Sub-band Size RB RB RB RB RB RB RB RB RI Not configured				
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 Table 1 TeportQuantity TreportQuantity TimeRestrictionForChannelMeasure ments TimeRestrictionForInterferenceMeas urements Cqi-FormatIndicator Sub-band Size CSI-IM Resource Mapping (kcsi-IM, lcsi-IM) CSI-IM timeConfig periodicity and slot Not configured Not configured Table 1 Table 1 Teriorical Not configured Not configured Not configured Wideband Wideband Wideband Sub-band Size RB 8 Csi-ReportingBand T1111111 CSI-Report periodicity and offset Slot Not configured				0
CSI-IM Resource Mapping (kcsI-IM, lcsI-IM) CSI-IM timeConfig periodicity and offset ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband Sub-band Size RB csi-Report periodicity and offset slot Not configured Type CSI-IM RE pattern Pattern O ReportConfigType (4,9) (4,9) (4,9) (4,9) (4,9) (Aperiodic Not configured Not configured Not configured Wideband Wideband Not configured RB 8 11111111 CSI-Report periodicity and offset slot Not configured				ŭ
CSI-IM RE pattern Pattern 0 CSI-IM Resource Mapping (kcsi-im,lcsi-im) CSI-IM timeConfig periodicity and offset ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband Sub-band Size RB 8 csi-Report periodicity and offset slot Not configured CSI-IM RE pattern Pattern 0 (4,9) (4,9) (4,9) (4,9) Not configured Not configured Not configured RB 8 1111111 CSI-Report periodicity and offset slot Not configured				Aperiodic
CSI-IM Resource Mapping (4,9) CSI-IM ImeConfig 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 8 csi-Report periodicity and offset slot Not configured (4,9) (4,9) (4,9) (4,9)				Pattern 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 8 csi-Report periodicity and offset slot Not configured Not configured Not configured Wideband 1111111 CSI-Report periodicity and offset slot Not configured	001.04			1 ditom 0
ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband pmi-FormatIndicator RB sub-band Size RB sci-Report periodicity and offset slot Not configured				(4,9)
Periodicity and offset Slot Not configured	Comiguration			
ReportConfigType				
ReportConfigType Aperiodic CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments Not configured timeRestrictionForInterferenceMeas urements Videband pmi-FormatIndicator Wideband Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report periodicity and offset slot Not configured			slot	Not configured
CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments Not configured timeRestrictionForInterferenceMeas urements Not configured cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB csi-ReportingBand 1111111 CSI-Report periodicity and offset slot Not configured	PoportConfigTv			Apariadia
reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report periodicity and offset slot Not configured		ρ e		
timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-Report periodicity and offset Not configured Not configured Not configured Not configured Not configured	reportQuantity			
timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-Report periodicity and offset timeRestrictionForInterferenceMeas Not configured Wideband Wideband 8 8 1111111 Not configured	timeRestrictionForChannelMeasure			
urements cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-Report periodicity and offset Not configured Wideband Wideband 1111111 RB 8 SB Not configured				Not configured
cqi-FormatIndicator pmi-FormatIndicator Sub-band Size csi-ReportingBand CSI-Report periodicity and offset Wideband 8 8 1111111 Not configured				Not configured
pmi-FormatIndicatorWidebandSub-band SizeRB8csi-ReportingBand1111111CSI-Report periodicity and offsetslotNot configured				
Sub-band Size RB 8 csi-ReportingBand 1111111 CSI-Report periodicity and offset slot Not configured				ł
csi-ReportingBand 1111111 CSI-Report periodicity and offset slot Not configured				
CSI-Report periodicity and offset slot Not configured				1111111
	CSI-Report peri	odicity and offset	slot	Not configured
	Aperiodic Repor	rt Slot Offset		

CSI request	CSI request 1 in slots i, where mod(i, 5) = 1 otherwise it is equal to 0			
reportTriggerSize			otherwise it is equal to 0	
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM	
	Codebook Type		typel-SinglePanel	
	Codebook Mode		1	
Codebook	(CodebookConfig- N1,CodebookConfig-N2)		(4,1)	
configuration	(CodebookConfig- O1,CodebookCon fig-O2)		(4,1)	
	CodebookSubset Restriction		0x FFFF	
	RI Restriction		0000010	
Physical chann	nel 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	
pred prob				
bas this	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).		nk slot not later than slot#(n-4),	
Note 3: Ran			direction shall be used as	

Table 6.3.3.1.2-2: Minimum requirement

Parameter	Test 1
γ	1.5

6.3.3.2 TDD

6.3.3.2.1 Single PMI with 4TX TypeI-SinglePanel Codebook

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

Table 6.3.3.2.1-1: Test parameters (single layer)

Par	rameter	Unit	Test 1
Bandwidth	Bandwidth		40
Subcarrier space	ing	kHz	30
Duplex Mode			TDD
TDD DL-UL con	TDD DL-UL configuration		FR1.30-1 as specified in Annex A
Propagation cha	annel		TDLA30-5
Antenna configu	uration		High XP 4 x 4 (N1,N2) = (2,1)
Beamforming M			As specified in Annex B.4.1
	CSI-RS resource		Periodic
	Туре		1 chedie
	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		Row 5,(4)
	(k_0)		
	First OFDM		
	symbol in the PRB		(9)
	used for CSI-RS		(3)
	(l ₀)		
	CSI-RS		10/1
	periodicity and	slot	10/1
	offset		
	CSI-RS resource		Aperiodic
	Type		·
	Number of CSI-		4
	RS ports (X) CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier		!
	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		(4.2)
	used for CSI-RS		(13)
	(I_0)		
	CSI-RS		
	periodicity and		Not configured
	offset		
	aperiodicTriggerin		0
	gOffset		
	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
	CSI-IM Resource		T ditom o
CSI-IM	Mapping		(4,9)
configuration	(ксынм,Ісынм)		(1,0)
	CSI-IM timeConfig		
	periodicity and	slot	Not configured
	offset		lgarea
ReportConfigTy			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasure ments			Not configured
	orInterferenceMeas		
	urements		Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	16
csi-ReportingBand			1111111
	odicity and offset	slot	Not configured
	•	-	

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)		(2,1)
configuration	(CodebookConfig- O1,CodebookCon fig-O2)		(4,1)
	CodebookSubset Restriction		11111111
RI Restriction			0000001
Physical char	nel 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
pre pre	precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable i ₁ , i ₂ combination.		
ba thi	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: Ra			

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)

Par	ameter	Unit	Test 1
Bandwidth		MHz	40
Subcarrier space	ing	kHz	30
Duplex Mode			TDD
TDD DL-UL con	figurations		FR1.30-1 as specified in Annex A
Propagation cha	annel		TDLA30-5
Antenna configu	ıration		High XP 8 x 4
Beamforming M			(N1,N2) = (4,1) As specified in Annex B.4.1
Bearmonning ivi	CSI-RS resource		Periodic
	Туре		renodic
	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		(9)
	used for CSI-RS		
	(l ₀) CSI-RS		
	periodicity and	slot	10/1
	offset	3101	10,1
	CSI-RS resource		Aperiodic
	Туре		Aperiodic
	Number of CSI-		8
	RS ports (X)		
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ) First subcarrier		1
	index in the PRB		
NZP CSI-RS	used for CSI-RS		Row 8, (4,6)
for CSI	(k ₀ , k ₁)		
acquisition	First OFDM		
	symbol in the PRB		(5)
	used for CSI-RS		(5)
	(I_0)		
	ČSI-RS		
	periodicity and	slot	Not configured
	offset aperiodicTriggerin		
	gOffset		0
	CSI-IM resource		Aperiodic
	Туре		· ·
	CSI-IM RE pattern		Pattern 0
CSI-IM	CSI-IM Resource		(4.0)
configuration	Mapping		(4,9)
	(kcsi-im,lcsi-im) CSI-IM timeConfig		
	periodicity and	slot	Not configured
	offset	3101	Not configured
ReportConfigTy			Aperiodic
CQI-table			Table 1
reportQuantity		_	cri-RI-PMI-CQI
timeRestrictionForChannnelMeasur			Not configured
ements timeRestrictionF	orInterferenceMeas		
urements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	16
csi-ReportingBa			1111111
CSI-Report perio	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)		(4,1)
configuration	fig-O2)		(4,1)
	CodebookSubset Restriction		0x FFFF
	RI Restriction		0000010
	nnel 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
propries	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.			at the gNB downlink before

Table 6.3.3.2.2-2: Minimum requirement

Parameter	Test 1
γ	1.5

6.4 Reporting of Rank Indicator (RI)

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

6.4.1 1RX requirements

(Void)

6.4.2 2RX requirements

6.4.2.1 FDD

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

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

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

Table 6.4.2.1-1: RI Test (FDD)

	Parameter	Unit	Test 1	Test 2	Test 3
Bandwidth		MHz	10	10	10
Subcarrier spa	acina	kHz	15	15	15
Duplex Mode	<u> </u>		FDD	FDD	FDD
SNR		dB	0	20	20
Propagation of	hannel		TDLA30-5	TDLA30-5	TDLA30-5
Antenna confi			ULA Low 2x2	ULA Low 2x2	ULA High 2x2
Doomforming	Madal		As defined in	As defined in	As defined in
Beamforming			Annex B.4.1	Annex B.4.1	Annex B.4.1
	CSI-RS resource Type		Periodic	Periodic	Periodic
	Number of CSI-RS ports (X)		4	4	4
	CDM Type		FD-CDM2	FD-CDM2	FD-CDM2
ZP CSI-RS	Density (ρ)		1	1	1
configuratio n	First subcarrier index in the PRB used for CSI-RS (k 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 periodicity and offset	slot	5/1	5/1	5/1
	CSI-RS resource Type		Periodic	Periodic	Periodic
	Number of CSI-RS ports (X)		2	2	2
NZP CSI-	CDM Type		FD-CDM2	FD-CDM2	FD-CDM2
RS for CSI	Density (ρ)		1	1	1
acquisition	First subcarrier index in the PRB used for CSI-RS (k ₀)		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	CSI-IM RE pattern		Pattern 0	Pattern 0	Pattern 0
configuratio	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(4,9)	(4,9)	(4,9)
11	CSI-IM timeConfig periodicity and offset	slot	5/1	5/1	5/1
ReportConfig			Periodic	Periodic	Periodic
CQI-table			Table 2	Table 2	Table 2
reportQuantity	/		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 configured	not configured
cqi-FormatInd			Wideband	Wideband	Wideband
pmi-FormatIn			Wideband	Wideband	Wideband
Sub-band Siz		RB	8	8	8
csi-Reportingl			1111111	1111111	1111111
CSI-Report pe	eriodicity and offset	slot	5/0	5/0	5/0
	Codebook Type		typel- SinglePanel	typel- SinglePanel	typel- SinglePanel
	Codebook Mode		1	1	1
Codebook	(CodebookConfig-N1,CodebookConfig-N2)		N/A	N/A	N/A
configuration	CodebookSubsetRestriction		010000 for	000011 for	000011 for
			fixed rank 2, 010011 for	fixed rank 1, 010011 for	fixed rank 1, 010011 for
			following rank	following rank	following rank
	RI Restriction	1	N/A	N/A	N/A
Physical chan	nel for CSI report	1	PUCCH	PUCCH	PUCCH
CQI/RI/PMI de		ms	8	8	8
Maximum nur	nber of HARQ transmission	1113	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: Measurements channels are specified in Table A.4-2. TBS.2-1 is used for Rank 1 case. TBS.2-2					

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	As defined in	As defined in
Beamlorning	Model		Annex B.4.1	Annex B.4.1	Annex B.4.1
	CSI-RS resource Type		Periodic	Periodic	Periodic
	Number of CSI-RS ports (X)		4	4	4
	CDM Type		FD-CDM2	FD-CDM2	FD-CDM2
ZP CSI-RS	Density (ρ)		1	1	1
configuratio	First subcarrier index in the		Row 5,(4)	Row 5,(4)	Row 5,(4)
n	PRB used for CSI-RS (k ₀)		NOW 5,(4)	NOW 5,(4)	NOW 5,(4)
	First OFDM symbol in the PRB		(9)	(9)	(9)
	used for CSI-RS (I ₀)		(9)	(9)	(9)
	CSI-RS	slot	10/1	10/1	10/1
	periodicity and offset	3101			
	CSI-RS resource Type		Periodic	Periodic	Periodic
	Number of CSI-RS ports (X)		2	2	2
	CDM Type		FD-CDM2	FD-CDM2	FD-CDM2
NZP CSI-	Density (ρ)		1	1	1
RS for CSI	First subcarrier index in the		Row 3 (6)	Row 3 (6)	Row 3 (6)
acquisition	PRB used for CSI-RS (k ₀)		110W 3 (0)	1(0W 3 (0)	110W 3 (0)
	First OFDM symbol in the PRB		(13)	(13)	(13)
	used for CSI-RS (I ₀)		(10)	(10)	(10)
	NZP CSI-RS-timeConfig	slot	10/1	10/1	10/1
	periodicity and offset	0.01			
	CSI-IM resource Type		Periodic	Periodic	Periodic
CSI-IM	CSI-IM RE pattern		Pattern 0	Pattern 0	Pattern 0
configuratio	CSI-IM Resource Mapping		(4,9)	(4,9)	(4,9)
n	(KCSI-IM, ICSI-IM)		()-/	(,-,	(,- ,
	CSI-IM timeConfig	slot	10/1	10/1	10/1
5 (0 (1	periodicity and offset				5
ReportConfig	туре		Periodic	Periodic	Periodic
CQI-table			Table 2	Table 2	Table 2
reportQuantity	/		cri-RI-PMI-CQI	cri-RI-PMI-	cri-RI-PMI-
				CQI	CQI
timeRestrictio	nForChannelMeasurements		not configured	not	not
				configured	configured
timeRestrictio	nForInterferenceMeasurements		not configured	not configured	not configured
cgi-FormatInd	licator		Wideband	Wideband	Wideband
pmi-Formating			Wideband	Wideband	Wideband
Sub-band Siz		RB	16	16	16
csi-Reporting		IVD	1111111	1111111	1111111
	eriodicity and offset	slot	10/9	10/9	10/9
OOI-IVEDOIT DE	Codebook Type	SIUL	typel-	typel-	typel-
	Codebook Type		SinglePanel	SinglePanel	SinglePanel
	Codebook Mode		1	1	1
	(CodebookConfig-				'
Codebook	N1,CodebookConfig-N2)		N/A	N/A	N/A
configuration	CodebookSubsetRestriction		010000 for	000011 for	000011 for
35			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 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
			Fixed RI = 2	Fixed RI = 1	Fixed RI = 1
RI Configurati	On		and follow RI	and follow RI	and follow RI
Note 1. Me	acuramanta abannala ara anasifia	ملطم تت ام		used for Dook 1	

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

Table 6.4.2.2-2: Minimum requirement (TDD)

	Test 1	Test 2	Test 3
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	- uramotor	MHz	10	10	10	10
Subcarrier spa	acina	kHz	15	15	15	15
Duplex Mode	9		FDD	FDD	FDD	FDD
SNR		dB	-2	16	16	22
Propagation c	hannel	-	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	iviodei		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 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		(0)	(0)	(0)	(0)
	used for CSI-RS (I ₀)		(9)	(9)	(9)	(9)
1	CSI-RS	-1-4	E /A	E /4	E /4	F /4
	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
NZP CSI-	CDM Type		FD-CDM2	FD-CDM2	FD-CDM2	FD-CDM2
RS for CSI	Density (ρ)		1	1	1	1
acquisition	First subcarrier index in the		Row 3 (6)	Row 3 (6)	Row 3 (6)	Row 4 (0)
aoquioition	PRB used for CSI-RS (k ₀)		110W 0 (0)	110W 0 (0)	110W 0 (0)	110W + (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	5/1	5/1	5/1	5/1
	CSI-IM resource Type		Periodic	Periodic	Periodic	Periodic
-	CSI-IM RE pattern		Pattern 0	Pattern 0	Pattern 0	Pattern 0
CSI-IM configuratio	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(4,9)	(4,9)	(4,9)	(4,9)
n	CSI-IM timeConfig	slot	5/1	5/1	5/1	5/1
D + O f 7	periodicity and offset		Davis dia		Dania dia	D - si - si -
ReportConfig ¹ CQI-table	уре		Periodic Table 2	Periodic Table 2	Periodic Table 2	Periodic Table 2
CQI-table			Table 2	cri-RI-PMI-	cri-RI-PMI-	cri-RI-PMI-
reportQuantity	1		cri-RI-PMI-CQI	CQI	CQI	CQI
timeRestriction	nForChannelMeasurements		not configured	not configured	not configured	not configured
timeRestriction	nForInterferenceMeasurements		not configured	not configured	not configured	not configured
cqi-FormatInd	icator		Wideband	Wideband	Wideband	Wideband
pmi-FormatIng			Wideband	Wideband	Wideband	Wideband
Sub-band Size		RB	8	8	8	8
csi-Reporting			1111111	1111111	1111111	1111111
CSI-Report pe	eriodicity and offset	slot	5/0	5/0	5/0	5/0
	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)					(-, · /
Codobasti	CodebookSubsetRestriction		010000 for	000011 for	000011 for	
Codebook configuration			fixed rank 2, 010011 for	fixed rank 1, 010011 for	fixed rank 1, 010011 for	11111111
	DID () (following rank	following rank	following rank	000000151
	RI Restriction					00000010 for
			N/A	N/A	N/A	fixed Rank 2
			IN/A	IN/A	IN/A	and 00001111 for
						follow RI
Physical chan	nel for CSI report		PUCCH	PUCCH	PUCCH	PUCCH
CQI/RI/PMI de		ms	8	8	8	8
	nber of HARQ transmission		1	1	1	1

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

Table 6.4.3.1-2: Minimum requirement (FDD)

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

6.4.3.2 TDD

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

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

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

Table 6.4.3.2-1: RI Test (TDD)

	Parameter	Unit	Toot 1	Toot 2	Toot 2	Toot 4
Bandwidth	Parameter	Unit MHz	Test 1 40	Test 2 40	Test 3 40	Test 4 40
	Subcarrier spacing		30	30	30	30
	Duplex Mode		TDD	TDD	TDD	TDD
TDD Slot Con	figuration		FR1.30-1	FR1.30-1	FR1.30-1	FR1.30-1
SNR	nguration	dB	-2	16	16	22
Propagation c	hannel	uD.	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)		1(0W 3,(4)	1(0W 3,(+)	1(0W 5,(+)	110W 3,(+)
	First OFDM symbol in the PRB		(9)	(9)	(9)	(9)
 	used for CSI-RS (I ₀)		(0)	(0)	(0)	(0)
	CSI-RS "	slot	10/1	10/1	10/1	10/1
	periodicity and offset					
-	CSI-RS resource Type		Periodic	Periodic	Periodic	Periodic
	Number of CSI-RS ports (X)		2 FD-CDM2	2 FD-CDM2	2 FD-CDM2	4 FD-CDM2
NZP CSI-	CDM Type Density (ρ)		1 FD-CDM2	1 FD-CDIM2	1 1	1
RS for CSI	First subcarrier index in the		I	I	I	I
acquisition	PRB used for CSI-RS (k ₀)		Row 3 (6)	Row 3 (6)	Row 3 (6)	Row 4 (0)
acquisition	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
001.104	CSI-IM RE pattern		Pattern 0	Pattern 0	Pattern 0	Pattern 0
CSI-IM	CSI-IM Resource Mapping					
configuratio n	(k _{CSI-IM} , l _{CSI-IM})		(4,9)	(4,9)	(4,9)	(4,9)
11	CSI-IM timeConfig	slot	10/1	10/1	10/1	10/1
	periodicity and offset	3101				
ReportConfig	Гуре		Periodic	Periodic	Periodic	Periodic
CQI-table			Table 2	Table 2	Table 2	Table 2
reportQuantity	,		cri-RI-PMI-CQI	cri-RI-PMI-	cri-RI-PMI-	cri-RI-PMI-
				CQI	CQI	CQI
timeRestriction	nForChannelMeasurements		not configured	not	not	not
				configured	configured	configured
timeRestriction	nForInterferenceMeasurements		not configured	not configured	not configured	not configured
cqi-FormatInd	icator		Wideband	Wideband	Wideband	Wideband
pmi-Formating			Wideband	Wideband	Wideband	Wideband
Sub-band Size		RB	16	16	16	16
csi-Reporting			1111111	1111111	1111111	1111111
	eriodicity and offset	slot	10/9	10/9	10/9	10/9
2211100000000	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)					(2,1)
	CodebookSubsetRestriction		010000 for	000011 for	000011 for	
Codebook			fixed rank 2,	fixed rank 1,	fixed rank 1,	11111111
configuration			010011 for	010011 for	010011 for	
	DI Destricti		following rank	following rank	following rank	000000101
	RI Restriction					00000010 for
			NI/A	NI/A	NI/A	fixed Rank 2
			N/A	N/A	N/A	and 00001111 for
						follow RI
Physical chan	nel for CSI report		PUCCH	PUCCH	PUCCH	PUCCH
CQI/RI/PMI de		ms	9.5	9.5	9.5	9.5
		1113	9.5	1	9.5	1
Maximum Hull	Maximum number of HARQ transmission		ı		ı	1

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

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	FR2	PDSCH	Clause 7.2.2.2.1 (Test 3-	
advanced receiver	TDD		1)	
Basic DL NR-NR CA operation (supportedBandCombinationList)	NR CA	SDR	Clause 7.5A.1	Up to 16 DL carriers Same numerology across carrier for data/control channel at a given time

7.1.1.4 Applicability of requirements for mandatory UE features with capability signalling

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

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

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

7.2 PDSCH demodulation requirements

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

Table 7.2-1: Common Test Parameters

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

	1		Stort DDD 0
	Frequency Occupation		Start PRB 0 Number of PRB =
	Frequency Occupation		ceil(BWP size/4)*4
	QCL info		TCI state #0
	First subcarrier index in the PRB used for CSI-		1CI state #0
	RS (k_0)		0
	First OFDM symbol in the PRB used for CSI-RS		12
	(10)		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
	, ,	51013	120 kHz SCS: 160
	CSI-RS offset		0
			Start PRB 0
	Frequency Occupation		Number of PRB =
			ceil(BWP size/4) *4
	QCL info		TCI state #1
	First subcarrier index in the PRB used for CSI-		4
	RS (k ₀)		
	First OFDM symbol in the PRB used for CSI-RS		12
	(10)		
	Number of CSI-RS ports (X)		4
ZP CSI-RS for CSI	CDM Type		FD-CDM2
acquisition	Density (ρ)		1
	CSI-RS periodicity	Slots	60 kHz SCS: 80
	CCL DC offeet		120 kHz SCS: 160
	CSI-RS offset		0 Start PRB 0
	Fraguency Occupation		
	Frequency Occupation		Number of PRB =
	First subcarrier index in the PRB used for CSI-		ceil(BWP size/4) *4 k ₀ =0 for CSI-RS
	RS		resource 1,2
	NO.		I ₀ = 8 for CSI-RS
			resource 1
	First OFDM symbol in the PRB used for CSI-RS		I ₀ = 9 for CSI-RS
			resource 2
	N 1 (00) D0 (00)		1 for CSI-RS resource
	Number of CSI-RS ports (X)		1,2
	ODM Town		'No CDM' for CSI-RS
	CDM Type		resource 1,2
CCL DC for boom	Donaity (a)		3 for CSI-RS resource
CSI-RS for beam refinement	Density (ρ)		1,2
remienieni			60 kHz SCS: 80 for CSI-
	CSI-RS periodicity	Slots	RS resource 1,2
	OSI-INO periodicity	01013	120 kHz SCS: 160 for
			CSI-RS resource 1,2
	CSI-RS offset	Slots	0 for CSI-RS resource
			1,2
	F		Start PRB 0
	Frequency Occupation		Number of PRB =
	Ponetition		ceil(BWP size/4)*4
	Repetition QCL info		ON TCI state #1
	QCL INIO		TCI state #1
			{1000} for Rank 1 tests
	Antonno porto indovos		{1000, 1001} for Rank 2
	Antenna ports indexes		tests
PDSCH DMRS			
configuration			
Johngaradon	Position of the first DMRS for PDSCH mapping		2
	type A		_
	Number of PDSCH DMRS CDM group(s) without		
	data		1
TCI state #0	SSB index		SSB #0
. Or state #6	COD IIIGOX		005 "0

	Type 1 QCL information	QCL Type	Type C
	IIIIOIIIIalioii	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
TOI State #1	Type 2 QCL information	CSI-RS resource	CSI-RS resource 1 from 'CSI-RS for tracking' configuration
		QCL Type	Type D
	Frequency den	sity (Kpt-Rs)	2
PTRS configuration	Time density (L	_PT-RS)	1
	Resource Elem	nent Offset	2
Maximum number of	code block group	s for ACK/NACK feedback	1
Maximum number of			4
HARQ ACK/NACK bu	undling		Multiplexed
Redundancy version	coding sequence		{0,2,3,1}
PDSCH & PDSCH DMRS Precoding configuration			Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i ₁ , i ₂ combination, andwith
Symbols for all unused REs			Wideband granularity 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 Anne B.4.1			
Note 1: LIE assum	oc that the TCL ct	tate for the DDSCH 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, 2-1, 2-2, 2-3, 2-4, 2-5, 2-6
under 2 receive antenna conditions and with different	
channel models, MCSs and number of MIMO layers	
Verify the PDSCH mapping Type A HARQ soft combining	1-2
performance under 2 receive antenna conditions.	
Verify the PDSCH mapping Type A performance	3-1
requirements for Enhanced Receiver Type 1 under 2	
receive antenna conditions.	

Table 7.2.2.2.1-2: Test Parameters

	Parameter	Unit	Value
Duplex mode			TDD
Active DL BWP index			1
CSI-RS for tracking	First OFDM symbol in the PRB used for CSI-RS (I_0)		For Test 1-1 and 1-2: 3 for CSI-RS resource 1 and 3 7 for CSI-RS resource 2 and 4
	CSI-RS offset	Slots	For Test 1-2: 82 for CSI-RS resource 1 and 2 83 for CSI-RS resource 3 and 4
PDCCH configuration	Number of PDCCH candidates and aggregation levels		1/AL4 for Test 2-3 1/AL8 for other tests
PDSCH configuration	Mapping type k0 Starting symbol (S) Length (L) PDSCH aggregation factor PRB bundling type PRB bundling size Resource allocation type		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, LRBS = 6
	RBG size VRB-to-PRB mapping type VRB-to-PRB mapping interleaver bundle size		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	ees		8 for Test 1-1, 1-3, 2-2, 2-4 10 for Test 2-1, 2-3, 2-5, 2-6, 3-1 16 for Test 1-2
The number of slots between information	een PDSCH and corresponding HARQ-ACK		As defined in Annex A.1.3

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

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

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

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

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

		Bandwidt		TDD	TDD !!!		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	

7.3 PDCCH demodulation requirements

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

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

Table 7.3-1: Common test Parameters

Carrier configuration		Parameter	Unit	Value
Common	Carrier	Offset between Point A and the		0
Carrier (Note 1)	configuration			
Configuration #1 Cyclic prefix Normal Common serving cell parameters SSB position in burst 1 SSB position in burst 1 1 SSB position in burst 1 1 SSB position in burst ms 20 SIOts for PDCCH monitoring Each slot Number of PDCCH candidates 1 Frequency domain resource allocation for CORESET Start from RB = 0 TCI state TCI state #1 TCI state TCI state #1 First subcarrier index in the PRB used for CSI-RS (k0) CSI-RS resource 2:		carrier (Note 1)		
Common serving cell parameters		Cyclic prefix		Normal
SSS position in burst SSS position in burst SSS position in burst SSS periodicity ms 20				
SSB periodicity				·
Slots for PDCCH monitoring Number of PDCCH candidates 1				
Number of PDCCH candidates	parameters		ms	
PDCCH				Each slot
Configuration Configuration Configuration Configuration Tile state Configuration Tile state T		Number of PDCCH candidates		1
TCl state #1 TCl state #1 First subcarrier index in the PRB used for CSI-RS (k0)				with contiguous RB
First subcarrier index in the PRB used for CSI-RS (k0)		TCI state		
Used for CSI-RS (k0)				
CSI-RS resource 1: 4				0
First OFDM symbol in the PRB used for CSI-RS (I0)				4
CSI-RS for tracking				8
Number of CSI-RS ports (X) 1				4
CDM Type				8
Density (p)	CSI-RS for	Number of CSI-RS ports (X)		1
CSI-RS periodicity	tracking	CDM Type		No CDM
CSI-RS offset				3
CSI-RS offset		CSI-RS periodicity	Slots	160
Repetition Slots				
Frequency Occupation Frequency Occupation Frequency Occupation QCL info First subcarrier index in the PRB used for CSI-RS (k0) Number of PRB = ceil(BWP size/4)*4 CSI-RS resource 1: 8 CSI-RS resource 2: 9 Number of CSI-RS (l0) Number of CSI-RS ports (X) CDM Type Density (p) Density (p) CSI-RS periodicity Slots Slots Slots Frequency Occupation Frequency Occupation Repetition QCL info PDCCH & PDCCH DMRS Precoding configuration Respect than 1		CSI-RS offset	Slots	
Start PRB 0 Number of PRB = ceil(BWP size/4)*4		COI NO Oliset	Cioto	
Frequency Occupation QCL info GCL info First subcarrier index in the PRB used for CSI-RS (k0) First OFDM symbol in the PRB used for CSI-RS (l0) Number of CSI-RS (l0) Number of CSI-RS ports (X) CDM Type Density (p) CSI-RS periodicity CSI-RS periodicity CSI-RS periodicity CSI-RS periodicity Slots CSI-RS resource 1: 8 CSI-RS resource 2: 9 No CDM No CDM 120 kHz SCS: 160 for CSI-RS resource 1,2 CSI-RS resource 1: 8 CSI-RS periodicity Slots Frequency Occupation Frequency Occupation CSI-RS periodicity Slots Slots TCI state #1 Single Panel Type I, Random per slot with equal probability of each applicable i1, i2 combination, and with REG bundling granularity for number of Tx larger than 1				
CCL info QCL info First subcarrier index in the PRB used for CSI-RS (k0) First OFDM symbol in the PRB used for CSI-RS (l0) Number of CSI-RS ports (X) CDM Type Density (p) CSI-RS periodicity CSI-RS periodicity CSI-RS periodicity CSI-RS offset CSI-RS offset CSI-RS offset Slots Frequency Occupation CSI-RS periodicity CSI-RS offset Repetition QCL info PDCCH & PDCCH DMRS Precoding configuration CCI info CSI-RS iceil(BWP size/4)*4 CSI-RS resource 1: 8 CSI-RS resource 2: 9 No CDM 120 kHz SCS: 160 for CSI-RS resource 1,2 Start PRB 0 Number of PRB = ceil(BWP size/4)*4 CSI-RS offset CSI-RS offset Slots TCI state #1 Single Panel Type I, Random per slot with equal probability of each applicable i1, i2 combination, and with REG bundling granularity for number of Tx larger than 1				
CCL info		Frequency Occupation		
First subcarrier index in the PRB used for CSI-RS (k0) First OFDM symbol in the PRB used for CSI-RS (l0) Number of CSI-RS (l0) Number of CSI-RS ports (X) CDM Type Density (p) CSI-RS periodicity CSI-RS periodicity CSI-RS periodicity Slots CSI-RS resource 2: 9 No CDM Density (p) 3 120 kHz SCS: 160 for CSI-RS resource 1,2 CSI-RS offset Slots CSI-RS resource 1,2 Start PRB 0 Number of PRB = ceil(BWP size/4) *4 Repetition QCL info PDCCH & PDCCH DMRS Precoding configuration First subcarrier index in the PRB CSI-RS resource 2: 9 No CDM 120 kHz SCS: 160 for CSI-RS resource 1,2 Start PRB 0 Number of PRB = ceil(BWP size/4) *4 Repetition ON TCI state #1 Single Panel Type I, Random per slot with equal probability of each applicable ii, i2 combination, and with REG bundling granularity for number of Tx larger than 1		OCL info		
used for CSI-RS (k0) First OFDM symbol in the PRB used for CSI-RS (l0) Number of CSI-RS ports (X) CDM Type Density (p) CSI-RS periodicity CSI-RS periodicity CSI-RS periodicity CSI-RS periodicity CSI-RS offset CSI-RS offset Slots Slots 120 kHz SCS: 160 for CSI-RS resource 1,2 CSI-RS offset Slots CSI-RS resource 1,2 Start PRB 0 Number of PRB = ceil(BWP size/4) *4 Repetition QCL info PDCCH & PDCCH DMRS Precoding configuration Value of PRS of				TCI state #0
First OFDM symbol in the PRB used for CSI-RS (I0) CSI-RS resource 1: 8 CSI-RS resource 2: 9				0
First OFDM symbol in the PRB used for CSI-RS (I0) Number of CSI-RS ports (X) CDM Type Density (p) Density (p) CSI-RS periodicity CSI-RS periodicity CSI-RS periodicity Slots 120 kHz SCS: 160 for CSI-RS resource 1,2 CSI-RS offset Slots Of for CSI-RS resource 1,2 Start PRB 0 Number of PRB = ceil(BWP size/4) *4 Repetition QCL info PDCCH & PDCCH DMRS Precoding configuration First OFDM symbol in the PRB Slots SI-RS resource 2: 9 No CDM 120 kHz SCS: 160 for CSI-RS resource 1,2 Start PRB 0 Number of PRB = ceil(BWP size/4) *4 Single Panel Type I, Random per slot with equal probability of each applicable i1, i2 combination, and with REG bundling granularity for number of Tx larger than 1		decarer cer ite (ite)		CSI-RS resource 1:
Used for CSI-RS (I0) CSI-RS resource 2: 9		First OFDM symbol in the PRB		
NZP CSI-RS for beam refinement NZP CSI-RS for beam refinement Density (ρ) 3 120 kHz SCS: 160 for CSI-RS resource 1,2 1,2 2 2 3 3 3 3 3 3 3				
NZP CSI-RS for beam refinement CSI-RS periodicity CSI-RS offset CSI-RS offset CSI-RS offset Slots Slots 120 kHz SCS: 160 for CSI-RS resource 1,2 CSI-RS offset Slots O for CSI-RS resource 1,2 Start PRB 0 Number of PRB = ceil(BWP size/4) *4 Repetition QCL info PDCCH & PDCCH DMRS Precoding configuration CDM Type No CDM Slots 120 kHz SCS: 160 for CSI-RS resource 1,2 Start PRB 0 Number of PRB = ceil(BWP size/4) *4 Repetition ON TCI state #1 Single Panel Type I, Random per slot with equal probability of each applicable i₁, i₂ combination, and with REG bundling granularity for number of Tx larger than 1				
NZP CSI-RS for beam refinement Density (p)		Number of CSI-RS ports (X)		1
beam refinement CSI-RS periodicity Slots Slots 120 kHz SCS: 160 for CSI-RS resource 1,2 CSI-RS offset Slots O for CSI-RS resource 1,2 Start PRB 0 Number of PRB = ceil(BWP size/4) *4 Repetition QCL info PDCCH & PDCCH DMRS Precoding configuration PDCCH & PDCCH DMRS Precoding configuration ON QCL info 120 kHz SCS: 160 for CSI-RS resource 1,2 Start PRB 0 Number of PRB = ceil(BWP size/4) *4 Single Panel Type I, Random per slot with equal probability of each applicable i1, i2 combination, and with REG bundling granularity for number of Tx larger than 1		CDM Type		No CDM
refinement CSI-RS periodicity Slots for CSI-RS resource 1,2 CSI-RS offset Slots 0 for CSI-RS resource 1,2 Start PRB 0 Number of PRB = ceil(BWP size/4) *4 Repetition ON TCI state #1 Single Panel Type I, Random per slot with equal probability of each applicable i1, i2 combination, and with REG bundling granularity for number of Tx larger than 1	NZP CSI-RS for	Density (ρ)		3
CSI-RS offset CSI-RS offset CSI-RS offset Slots Tesource 1,2 Start PRB 0 Number of PRB = ceil(BWP size/4) *4 Repetition QCL info TCI state #1 Single Panel Type I, Random per slot with equal probability of each applicable i1, i2 combination, and with REG bundling granularity for number of Tx larger than 1	beam			120 kHz SCS: 160
CSI-RS offset CSI-RS offset CSI-RS offset Slots O for CSI-RS resource 1,2 Start PRB 0 Number of PRB = ceil(BWP size/4) *4 Repetition ON TCI state #1 Single Panel Type I, Random per slot with equal probability of each applicable i1, i2 combination, and with REG bundling granularity for number of Tx larger than 1	refinement	CSI-RS periodicity	Slots	for CSI-RS resource
CSI-RS offset CSI-RS offset Slots resource 1,2				,
resource 1,2 Start PRB 0 Number of PRB = ceil(BWP size/4) *4 Repetition QCL info TCl state #1 Single Panel Type I, Random per slot with equal probability of each applicable i1, i2 combination, and with REG bundling granularity for number of Tx larger than 1		CSI-RS offset	Slots	
Frequency Occupation Number of PRB = ceil(BWP size/4) *4 Repetition QCL info TCl state #1 Single Panel Type I, Random per slot with equal probability of each applicable i1, i2 combination, and with REG bundling granularity for number of Tx larger than 1		COI-IXO Oliset	Oloto	
Ceil(BWP size/4) *4 Repetition				
Repetition QCL info TCI state #1 Single Panel Type I, Random per slot with equal probability of each applicable i1, i2 combination, and with REG bundling granularity for number of Tx larger than 1		Frequency Occupation		
PDCCH & PDCCH DMRS Precoding configuration QCL info TCl state #1 Single Panel Type I, Random per slot with equal probability of each applicable i ₁ , i ₂ combination, and with REG bundling granularity for number of Tx larger than 1				
PDCCH & PDCCH DMRS Precoding configuration Single Panel Type I, Random per slot with equal probability of each applicable i ₁ , i ₂ combination, and with REG bundling granularity for number of Tx larger than 1				
PDCCH & PDCCH DMRS Precoding configuration Random per slot with equal probability of each applicable i ₁ , i ₂ combination, and with REG bundling granularity for number of Tx larger than 1		QCL into		
PDCCH & PDCCH DMRS Precoding configuration with equal probability of each applicable i ₁ , i ₂ combination, and with REG bundling granularity for number of Tx larger than 1				
PDCCH & PDCCH DMRS Precoding configuration probability of each applicable i ₁ , i ₂ combination, and with REG bundling granularity for number of Tx larger than 1				
PDCCH & PDCCH DMRS Precoding configuration applicable i ₁ , i ₂ combination, and with REG bundling granularity for number of Tx larger than 1				
combination, and with REG bundling granularity for number of Tx larger than 1				
with REG bundling granularity for number of Tx larger than 1	PDCCH & PDCCH	H DMRS Precoding configuration		
granularity for number of Tx larger than 1				
number of Tx larger than 1				
than 1				
	TCI state #0	SSB index		SSB #0

	Type 1 QCL information	QCL Type	Type C		
	Type 2 QCL	SSB index	SSB #0		
	information	QCL Type	Type D		
	Type 1 QCL information	CSI-RS resource	CSI-RS resource 1 from 'CSI-RS for tracking' configuration		
TCI state #1		QCL Type	Type A		
TOT State #1	Type 2 QCL information	CSI-RS resource	CSI-RS resource 1 from 'CSI-RS for tracking' configuration		
		QCL Type	Type D		
Physical signals, of	channels mappi		As specified in Annex B.4.1		
Symbols for all un	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 slo	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.

1RX requirements 7.3.1

(Void)

2RX requirements 7.3.2

7.3.2.1 **FDD**

(Void)

7.3.2.2 **TDD**

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

Table 7.3.2.2-1: Test Parameters

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

7.3.2.2.1 1 Tx Antenna performances

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

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

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

7.3.2.2.2 2 Tx Antenna performances

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

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

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

7.4 PBCH demodulation requirements

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

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

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

7.4.1 1RX requirements

(Void)

7.4.2 2RX requirements

7.4.2.1 FDD

(Void)

7.4.2.2 TDD

Table 7.4.2.2-1: Test parameters for PBCH

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

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

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

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

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

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

7.5 Sustained downlink data rate provided by lower layers

7.5.1 FR2 single carrier requirements

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

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

7.5A Sustained downlink data rate provided by lower layers

7.5A.1 FR2 CA requirements

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

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

The test parameters are determined by the following procedure:

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

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

where

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

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

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

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

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

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

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

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

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

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

	Parameter	Unit	Value
PDSCH transmission	n scheme		Transmission scheme 1
PTRS epre-Ratio			0
Channel bandwidth		MHz	Channel bandwidth from selected CA bandwidth combination
	Physical Cell ID		0
Common serving	SSB position in burst		First SSB in Slot #0
cell parameters	SSB periodicity	ms	20
	First DMRS position for Type A PDSCH mapping		2
Cross carrier schedu			Not configured
Active DL BWP inde			1
Actual carrier configuration	Offset between Point A and the lowest usable subcarrier on this carrier (Note 3)	RBs	0
Comigaration	Subcarrier spacing	kHz	60 or 120
	RB Offset		0
DL BWP configuration #1	Number of contiguous PRB		Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-2 [7] for tested channel bandwidth and subcarrier spacing
	Subcarrier spacing	kHz	60 or 120
	Cyclic prefix		Normal
	Slots for PDCCH monitoring		Each slot
	Symbols with PDCCH		Symbols #0
	Number of PRBs in CORESET		Table 7.5A.1-2
	Number of PDCCH candidates and aggregation levels		1/8
PDCCH	CCE-to-REG mapping type		Non-interleaved
configuration	DCI format		1-1
Comigaration	TCI State		TCI state #1
	PDCCH &PDCCH DMRS Precoding configuration		Single Panel Type I, Random per slot with equal probability of precoder index 0 and 2, and with REG bundling granularity for number of Tx larger than 1
	Mapping type		Type A
	k0		0
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		wideband
PDSCH	Resource allocation type		Type 0
configuration	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
	Starting symbol (S)		1
	Length (L)		13
	DMRS Type		Type 1
	Number of additional DMRS		1 .
PDSCH DMRS	Length		1 (4000) (41 20
configuration	Antenna ports indexes		{1000} for 1 Layer CCs {1000, 1001} for 2 Layers CCs
	Number of PDSCH DMRS CDM group(s) without data		1
PTRS	Frequency density (K _{PT-RS})		2
configuration	Time density (L _{PT-RS})		1
	Subcarrier indexes in the PRB used for CSI-RS		$k_0 = 3$ for CSI-RS resource 1,2,3,4
	OFDM symbols in the PRB used for CSI-RS		I ₀ = 6 for CSI-RS resource 1 and 3 I ₀ = 10 for CSI-RS resource 2 and 4
CSI-RS for tracking	Number of CSI-RS ports (X)		1 for CSI-RS resource 1,2,3,4
	CDM Type		'No CDM' for CSI-RS resource
			1,2,3,4 3 for CSI-RS resource 1,2,3,4
	Density (ρ)		3 101 C31-K3 Tesoulce 1,2,3,4

CSI-RS periodicity Slots 1,2,3,4 120 kHz SCS: 160 for CSI-RS resource 1,2,3,4 60 kHz SCS: 40 for CSI-RS resource 1 and 2 41 for CSI-RS resource 3 and 4 120 kHz SCS: 40 for CSI-RS resource 3 and 4 120 kHz SCS: 80 for CSI-RS resource 3 an
120 kHz SCS: 160 for CSI-RS resource 1,2,3,4
CSI-RS offset
A0 for CSI-RS resource 1 and 2 41 for CSI-RS resource 3 and 4
CSI-RS offset
CSI-RS offset Slots 120 kHz SCS: 80 for CSI-RS resource 1 and 2 81 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
Ro for CSI-RS resource 1 and 2 81 for CSI-RS resource 3 and 4
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$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$
$NZP \ CSI-RS \ for \ CSI \ acquisition \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \$
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$NZP \ CSI-RS \ for \ CSI \ acquisition \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \$
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$\begin{tabular}{lll} NZP\ CSI-RS\ for CSI\ acquisition & & & & & & & & & & & & & & & & & & &$
$\begin{tabular}{ l l l l l l l l l l l l l l l l l l l$
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$
OFDM symbols in the PRB used for CSI-RS $I_0 = 12$
RS 10 = 12
1 1000000000000000000000000000000000000
ZP CSI-RS for CSI CDM Type 'FD-CDM2'
acquisition Density (ρ) 1
CSI-RS periodicity Slots 60 kHz SCS: 80
120 kHz SCS: 160
CSI-RS offset 0
Frequency Occupation Start PRB 0
Number of PRB = ceil(BWP size/4) ² First subcarrier index in the PRB used for Number of PRB = ceil(BWP size/4) ² First subcarrier index in the PRB used for Number of PRB = ceil(BWP size/4) ² First subcarrier index in the PRB used for Number of PRB = ceil(BWP size/4) ² First subcarrier index in the PRB used for Number of PRB = ceil(BWP size/4) ² First subcarrier index in the PRB used for Number of PRB = ceil(BWP size/4) ² First subcarrier index in the PRB used for Number of PRB = ceil(BWP size/4) ² First subcarrier index in the PRB used for Number of PRB = ceil(BWP size/4) ² First subcarrier index in the PRB used for Number of PRB = ceil(BWP size/4) ² First subcarrier index in the PRB used for Number of PRB = ceil(BWP size/4) ² First subcarrier index in the PRB used for Number of PRB
CSI-RS resource 1,2
First OFDM symbol in the PRB used for I ₀ = 8 for CSI-RS resource 1
CSI-RS I ₀ = 9 for CSI-RS resource 2
Number of CSI-RS ports (X) 1 for CSI-RS resource 1,2
CDM Type 'No CDM' for CSI-RS resource 1,2
Density (p) 3 for CSI-RS resource 1,2
CSI-RS for beam 60 kHz SCS: 80 for CSI-RS resource
refinement CSI-RS periodicity Slots 1,2
120 kHz SCS: 160 for CSI-RS resource 1,2
CSI-RS offset Slots 0 for CSI-RS resource 1,2
Start PRB 0
Frequency Occupation Number of PRB = ceil(BWP size/4) ³
Repetition ON
QCL info TCI state #1
Type 1 QCL SSB index SSB #0
TCI state #0 information QCL Type Type C
Type 2 QCL SSB index SSB #0
information QCL Type Type D
Type 1 QCL CSI-RS resource CSI-RS resource 1 from 'CSI-RS for tracking' configuration
information tracking configuration
TCI state #1 QCL Type Type A CSI-RS resource 1 from 'CSI-RS for
Type 2 QCL CSI-RS resource tracking configuration
information QCL Type Type D
Maximum number of code block groups for ACK/NACK
feedback

Number of HARQ	Processes	10 for FR2.60-1 and 8 for FR2.120-1
K1 value		Specific to each UL-DL pattern
Maximum numbe	r of HARQ transmission	4
HARQ ACK/NACI	K bundling	Multiplexed
Redundancy vers	ion coding sequence	{0,2,3,1}
TDD UL-DL patte	rn	60 kHz SCS: FR2.60-1 120 kHz SCS: FR2.120-1
PDSCH & PDSC	H DMRS Precoding configuration	Single Panel Type I, Precoder index 0 per slot with Wideband granularity for Rank 2
Symbols for all ur	nused REs	OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1
Propagation condition		Static propagation condition No external noise sources are applied
Antenna	1 layer CCs	1x2 or 1x4
configuration	2 layers CCs	2x2 or 2x4
Physical signals,	channels mapping and precoding	As specified in Annex B.4.1
	H is scheduled only on full DL slots not containing sumes that the TCI state for the PDSCH is identic.	

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

transmission.

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

channel bandwidth and subcarrier spacing.

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

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

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

Maximum number of PDSCH MIMO layers	Maximum modulation format	Scaling factor	MCS (Note 1)	
1 PD3CH WIIWO layers		1	27	
1	6	•		
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: 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 an MCS index Table 1 defined in					

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.

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

8.1.1.4 Applicability of requirements for mandatory UE features with capability signalling

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

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

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

8.1.2 Common test parameters

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

Table 8.1.2-1: Test parameters for CSI test cases

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

PDCCH & PDCCH DMRS Precoding configuration PDCCH & PDCCH DMRS PDCCH DMRS PDSCH Aggregation factor PDSCH PRB bundling size PRB bundlin		T		I
Mapping type				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
Mapping type	Cross carrier sch	nedulina		
PDSCH Configuration PDSCH Configuration PDSCH Configuration PRB bundling type Static PRB bundling type PRB				
Starting symbol (S)				
Length (L)				
PDSCH aggregation factor PRB bundling type Static				
PDSCH configuration PRB bundling type Static PRB bundling size 2 PRB concreallocation type Type 0 RBG size Config2 VRB-to-PRB mapping type Non-interleaved VRB-to-PRB mapping interleaver bundle size DMRS Type DMRS Type Type 1 Number of additional DMRS 1 DMRS ports indexes {10000 for Rank1 {1000,1001} for Rank2} Maximum number of OFDM symbols for DL front loaded DMRS 1 Number of PDSCH DMRS CDM group(s) without data 2 Frequency density (Ker.Rs) 2 Time density (Ler.Rs) 1 Resource Element Offset 2 First subcarrier index in the PRB used for CSI-RS (ko) 4 for CSI-RS resource 1,2,3,4 First OFDM symbol in the PRB used for CSI-RS (b) 8 for CSI-RS resource 2 and 4 Number of CSI-RS ports (X) 1 for CSI-RS resource 1,2,3,4 CSI-RS for tracking CSI-RS periodicity 3 for CSI-RS resource 1,2,3,4 CSI-RS periodicity 3 for CSI-RS resource 1,2,3,4 120 kHz SCS: 80 for CSI-RS resource 2 and 4 120 kHz SCS: 80 for CSI-RS resource 3 and 4 sta				•=
PRB bundling size	DDCCII			· ·
Resource allocation type				
RBG size Config2	configuration			_
VRB-to-PRB mapping type Non-interleaved VRB-to-PRB mapping interleaver bundle size DMRS Type Type 1				
VRB-to-PRB mapping interleaver bundle size		RBG size		
VRB-to-PRB mapping interleaver bundle size DMRS Type Type 1		VRB-to-PRB mapping type		Non-interleaved
DMRS Type				
DMRS Type Number of additional DMRS 1 (1000) for Rank1 (1000) for Rank1 (1000) for Rank2 (100				N/A
Number of additional DMRS				Type 1
DMRS ports indexes \$\ \text{\{1000\} for Rank1\} \\ \text{\{1000\} for Rank1\} \\ \text{\{1000\} for Rank2\} \end{\} \] Maximum number of OFDM symbols for DL front loaded DMRS Number of PDSCH DMRS CDM group(s) without data 2 PTRS				1
DMRS ports indexes \$\ \ \{1000,1001\} \{ \text{for Rank2}\} \\ DMRS ports indexes \$\ \ \{1000,1001\} \{ \text{for Rank2}\} \\ DMRS DMRS DMRS DMRS DMRS Number of PDSCH DMRS CDM group(s) without data 2 PTRS configuration Frequency density (\(\nabla_{PT-RS}\)) 2 Time density (\(\nabla_{PT-RS}\)) 2 Time density (\(\nabla_{PT-RS}\)) 1 Resource Element Offset 2 First subcarrier index in the PRB used for CSI-RS (\(\nabla_0\)) 4 for CSI-RS resource 1,2,3,4 First OFDM symbol in the PRB used for CSI-RS (\(\nabla_0\)) 4 for CSI-RS resource 1 and 3 8 for CSI-RS (\(\nabla_0\)) 8 for CSI-RS resource 1,2,3,4 Number of CSI-RS ports (\(\nabla_0\)) 1 for CSI-RS resource 1,2,3,4 CDM Type No CDM for CSI-RS resource 1,2,3,4 CDM Type 3 for CSI-RS resource 1,2,3,4 Density (\(\rho\)) 120kHz SCS: 160 for CSI-RS resource 1,2,3,4 120kHz SCS: 160 for CSI-RS resource 1,2,3,4 120kHz SCS: 80 for CSI-RS resource 1,2,3,4 120kH		Number of additional biving		(1000) for Pank1
PDSCH DMRS configuration Maximum number of OFDM symbols for DL front loaded DMRS 1 1 1 1 1 1 1 1 1		DMDC norte indexes		
Maximum number of OFDM symbols for DL front loaded DMRS 1 1 1 2 2 2 2 2 2 2	DD0011 DMD0	DIVIRS ports indexes		
Symbols for DL front loaded DMRS 1 2				Rank2
PTRS Frequency density (K _{PT-RS}) 2	configuration	symbols for DL front loaded		1
PTRS configuration				2
Time density (<i>L_{PT-RS}</i>)	DTDO	Frequency density (K _{PT-RS})		2
Resource Element Offset 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 (k_0) A 4 for CSI-RS resource 1,2,3,4 4 for CSI-RS resource 1 and 3 8 for CSI-RS resource 2 and 4 Number of CSI-RS ports (X) CDM Type CSI-RS for tracking CSI-RS periodicity CSI-RS periodicity CSI-RS periodicity CSI-RS offset CSI-RS offset CSI-RS offset Slot CSI-RS resource 1,2,3,4 120 kHz SCS: 160 for CSI-RS resource 1,2,3,4 120 kHz SCS: 80 for CSI-RS resource 1,2,3,4 120 kHz SCS: 80 for CSI-RS resource 1 and 2 81 for CSI-RS resource 1 and 2 81 for CSI-RS resource 3 and 4 Start PRB 0 Number of PRB = ceil(BWP size /4)*4 NZP CSI-RS for CSI RS for CSI RS Frequency Occupation NZP CSI-RS Frequency Occupation Frequency Occupation NZP CSI-RS for CSI RS Start PRB 0 Number of PRB = ceil(BWP size /4)*4				1
First subcarrier index in the PRB used for CSI-RS (k_0)	configuration			2
Used for CSI-RS (k ₀) resource 1,2,3,4 4 for CSI-RS resource 1 and 3 8 for CSI-RS resource 2 and 4				_
First OFDM symbol in the PRB used for CSI-RS (Io)				
First OFDM symbol in the PRB used for CSI-RS (<i>lo</i>)		used for CSI-ICS (A0)		4 for CSL DS
Used for CSI-RS (b) 8 for CSI-RS resource 2 and 4		First OFDM soush at its the DDD		
Number of CSI-RS ports (X) Tor CSI-RS resource 2 and 4		FIRST OFDINI SYMBOL IN THE PRB		
$ \text{CSI-RS for tracking} \\ \hline \text{CSI-RS offset} \\ \hline \\ \text{CSI-RS offset} \\ \hline \\ \text{CSI-RS for tracking} \\ \hline \\ \text{CSI-RS for tracking} \\ \hline \\ \text{CSI-RS periodicity} \\ \hline \\ \text{CSI-RS periodicity} \\ \hline \\ \text{CSI-RS periodicity} \\ \hline \\ \text{CSI-RS offset} \\ \hline \\ \text{SIot} \\ \hline \\ \text{CSI-RS resource} \\ \text{1.20 kHz SCS:} \\ \text{80 for CSI-RS resource} \\ \text{1.20 kHz SCS:} \\ \text{80 for CSI-RS resource 1 and 2} \\ \text{81 for CSI-RS resource 3 and 4} \\ \hline \\ \text{Start PRB 0} \\ \text{Number of PRB =} \\ \text{ceil(BWP size /4)*4} \\ \hline \\ \text{QCL info} \\ \hline \\ \hline \\ \text{NZP CSI-RS for CSI acquisition} \\ \hline \\ \text{Frequency Occupation} \\ \hline \\ \text{Frequency Occupation} \\ \hline \\ \text{Start PRB 0} \\ \text{Number of PRB =} \\ \text{ceil(BWP size/4)*4} \\ \hline \\ \text{CSI-RS offset} \\ \hline \\ \text{CSI-RS offset}$		used for CSI-RS (I ₀)		
Number of CSI-RS ports (X) resource 1,2,3,4				
CSI-RS for tracking CSI-RS for tracking CSI-RS periodicity CSI-RS periodicity CSI-RS periodicity CSI-RS periodicity Slot CSI-RS resource 1,2,3,4 120kHz SCS: 160 for CSI-RS resource 1,2,3,4 120 kHz SCS: 80 for CSI-RS resource 1,2,3,4 120 kHz SCS: 80 for CSI-RS resource 1,2,3,4 120 kHz SCS: 80 for CSI-RS resource 1 and 2 81 for CSI-RS resource 3 and 4 Start PRB 0 Number of PRB = ceil(BWP size /4)*4 QCL info NZP CSI-RS for CSI Requency Occupation NZP CSI-RS for CSI Requency Occupation Start PRB 0 Number of PRB = ceil(BWP size /4)*4 CSI-RS for CSI-RS for CSI-RS requency Occupation NZP CSI-RS for CSI-RS for CSI-RS requency Occupation		Number of CSI-RS ports (X)		
$ \text{CSI-RS for tracking} \\ \text{CSI-RS for tracking} \\ \text{CSI-RS periodicity} \\ \text{CSI-RS periodicity} \\ \text{Slot} \\ \text{Slot} \\ \text{Slot} \\ \text{CSI-RS resource 1,2,3,4} \\ \text{120kHz SCS: 160 for CSI-RS resource 1,2,3,4} \\ \text{120 kHz SCS: 80 for CSI-RS resource 1,2,3,4} \\ \text{120 kHz SCS: 80 for CSI-RS resource 1 and 2} \\ \text{81 for CSI-RS resource 3 and 4} \\ \text{Start PRB 0} \\ \text{Number of PRB = ceil(BWP size /4)*4} \\ \text{QCL info} \\ \text{NZP CSI-RS for CSI} \\ \text{for CSI} \\ \text{acquisition} \\ \text{Frequency Occupation} \\ \text{Frequency Occupation} \\ \text{Start PRB 0} \\ \text{Number of PRB = ceil(BWP size/4)*4} \\ \text{CSI-RS for CSI-RS for CSI} \\ \text{Requency Occupation} \\ \text{Start PRB 0} \\ \text{Number of PRB = ceil(BWP size/4)*4} \\ CSI-RS for $		Number of Col No ports (X)		resource 1,2,3,4
CSI-RS for tracking Density (ρ) $CSI-RS for tracking $ Density (ρ) $CSI-RS periodicity $ Slot Slot Slot Start PRB 0 Number of PRB = ceil(BWP size /4)*4 NZP CSI-RS periodicity Start PRB 0 Number of PRB = ceil(BWP size/4)*4 Number of PRB = ceil(BWP size/4)*4		CDM Typo		No CDM for CSI-RS
CSI-RS for tracking CSI-RS periodicity CSI-RS periodicity Slot CSI-RS resource 1,2,3,4 120 kHz SCS: 160 for CSI-RS resource 1,2,3,4 120 kHz SCS: 80 for CSI-RS resource 1 and 2 81 for CSI-RS resource 1 and 2 81 for CSI-RS resource 3 and 4 Start PRB 0 Number of PRB = ceil(BWP size /4)*4 QCL info NZP CSI-RS for CSI Requency Occupation NZP CSI-RS for CSI Requency Occupation Frequency Occupation Start PRB 0 Number of PRB = ceil(BWP size/4)*4		CDIVI Type		resource 1,2,3,4
CSI-RS for tracking CSI-RS periodicity Slot 120kHz SCS: 160 for CSI-RS resource 1,2,3,4 120 kHz SCS: 80 for CSI-RS resource 1,2,3,4 120 kHz SCS: 80 for CSI-RS resource 1 and 2 81 for CSI-RS resource 3 and 4 Start PRB 0 Number of PRB = ceil(BWP size /4)*4 QCL info CSI-RS requency Occupation Start PRB 0 Number of PRB = ceil(BWP size /4)*4		Donsity (a)		3 for CSI-RS
tracking CSI-RS periodicity Slot 120kHz SCS: 160 for CSI-RS resource 1,2,3,4 120 kHz SCS: 80 for CSI-RS 80 for CSI-RS 80 for CSI-RS resource 1 and 2 81 for CSI-RS resource 3 and 4 Start PRB 0 Number of PRB = ceil(BWP size /4)*4	CSI-RS for	Density (p)		resource 1,2,3,4
1,2,3,4 120 kHz SCS: 80 for CSI-RS 80 for CSI-RS 170 kHz SCS: 80 for CSI-RS 170 kHz Scyler 170 kHz	tracking	001.00		120kHz SCS: 160 for
120 kHz SCS: 80 for CSI-RS 80 for CSI-RS resource 1 and 2 81 for CSI-RS resource 3 and 4 Start PRB 0 Number of PRB = ceil(BWP size /4)*4		CSI-RS periodicity	slot	
CSI-RS offset Slot RS resource 1 and 2 81 for CSI-RS resource 3 and 4				
CSI-RS offset slot resource 1 and 2 81 for CSI-RS resource 3 and 4				
81 for CSI-RS resource 3 and 4		00,00 %		
resource 3 and 4		CSI-RS offset	slot	
ceil(BWP size /4)*4 QCL info TCI state #0 NZP CSI-RS for CSI acquisition Frequency Occupation Start PRB 0 Number of PRB = ceil(BWP size/4)*4				Start PRB 0
ceil(BWP size /4)*4 QCL info TCI state #0 NZP CSI-RS for CSI acquisition Frequency Occupation Start PRB 0 Number of PRB = ceil(BWP size/4)*4		Frequency Occupation		Number of PRB =
NZP CSI-RS for CSI acquisition Frequency Occupation TCI state #0 Start PRB 0 Number of PRB = ceil(BWP size/4)*4		, , ,		
NZP CSI-RS for CSI acquisition Frequency Occupation Start PRB 0 Number of PRB = ceil(BWP size/4)*4		QCL info		
for CSI acquisition Frequency Occupation Number of PRB = ceil(BWP size/4)*4				
for CSI ceil(BWP size/4)*4		Frequency Occupation		
		i requericy Occupation		
QUL INTO I CI State #1	acquisition	OCL into		
		QUL INIO		I CI State #1

Prequency Occupation	<u> </u>	T	I		
Frequency Occupation	ZP CSI-RS for	From Control O	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	P 14	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 (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 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.		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			
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) Redundancy version coding sequence CSI-RS resource 1 from 'CSI-RS for tracking' configuration Type D Multiplexed 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) = 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 Physical signals, channels mapping and precoding. CSI-RS resource 1 from 'CSI-RS for tracking' configuration Type D Number of HARQ recording.	TCI state #1		QCL Type		
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.			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		
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: K1 value (PDSCH-to-HARQ-timing-indicator)		information	001 =		
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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				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

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		FR2.120-2 Annex A.1.	
SNR _{BB}		dB	8 9 14 15	
Propagation of	channel			VGN
Antenna conf	iguration			tatic channel n Annex B.1
Beamforming	Model			ed in Annex .4.1
	CSI-RS resource Type		Pei	riodic
	Number of CSI-RS ports (X)			4
	CDM Type		FD-	CDM2
ZP CSI-RS	Density (ρ)			1
configuratio n	First subcarrier index in the PRB used for CSI-RS (k ₀ , k ₁)			8
	First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁)			13
	CSI-RS periodicity and offset	slot	8	3/1
	CSI-RS resource Type		Pei	riodic
	Number of CSI-RS ports (X)			2
	CDM Type		fd-C	CDM2
NZP CSI-	Density (ρ)			1
RS for CSI	First subcarrier index in the			
acquisition	PRB used for CSI-RS (k ₀ , k ₁)			6
acquiomen.	First OFDM symbol in the PRB used for CSI-RS (I ₀ , I ₁)			13
	NZP CSI-RS-timeConfig	slot	,	3/1
	periodicity and offset	3101		
	CSI-IM resource Type		Pei	riodic
CSI-IM	CSI-IM RE pattern			1
configuratio	CSI-IM Resource Mapping		(8.	, 13)
n	(KCSI-IM, ICSI-IM)		(0,	,
	CSI-IM timeConfig	slot	8	3/1
	periodicity and offset			
ReportConfig	Туре			riodic
CQI-table				ble 1
reportQuantity				PMI-CQI
	onForChannelMeasurements			nfigured
	nForInterferenceMeasurements			nfigured
cqi-FormatInd				eband
pmi-FormatIn			Wid	eband
Sub-band Siz		RB		8
csi-Reporting				11111
	eriodicity and offset	slot		3/3
aperiodicTrigg				nfigured
	Codebook Type		typel-Si	nglePanel
	Codebook Mode			1
Codebook	(CodebookConfig-	1	Not co	nfigured
configuration	N1,CodebookConfig-N2)	1		•
	CodebookSubsetRestriction			0000
<u></u>	RI Restriction			J/A
Physical char	nnel for CSI report	1		CCH
ļ., .	CQI/RI/PMI delay	ms	8.	375
Maximum nur	mber of HARQ transmission			1
Measurement	t channel			ed in Table TBS.1-2

8.2.2.2.2 CQI reporting under fading conditions

8.2.2.2.2.1 Minimum requirement for wideband CQI reporting

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

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

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

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

Table 8.2.2.2.1-1 Test parameters

	Parameter	Unit	Test 1 Test 2
Bandwidth	. aramoter	MHz	100
Subcarrier spa	acing	kHz	120
Duplex Mode	3		TDD
TDD Slot Con	figuration		FR2.120-2 Annex A.1.3
SNR _{BB}		dB	6 7 12 13
Propagation c	hannel		TDLA30-35
Antenna confi	guration		2×2 ULA High
Beamforming	Model		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
configuratio	First subcarrier index in the		8
n	PRB used for CSI-RS (k ₀ , k ₁)		8
	First OFDM symbol in the PRB		13
	used for CSI-RS (l ₀ , l ₁)		13
	CSI-RS	slot	8/1
	periodicity and offset	0.00	
	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (X)		2
	CDM Type		fd-CDM2
NZP CSI-	Density (ρ)		1
RS for CSI	First subcarrier index in the		6
acquisition	PRB used for CSI-RS (k ₀ , k ₁)		-
	First OFDM symbol in the PRB		13
	used for CSI-RS (I ₀ , I ₁)		
	NZP CSI-RS-timeConfig	slot	Not configured
	periodicity and offset		0
	aperiodicTriggeringOffset		•
	CSI-IM resource Type		Aperiodic
CSI-IM	CSI-IM RE pattern		l
configuratio	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(8, 13)
n	CSI-IM, ICSI-IM) CSI-IM timeConfig		
	periodicity and offset	slot	Not configured
ReportConfig			Aperiodic
CQI-table	.) 0		Table 1
reportQuantity	,		cri-RI-PMI-CQI
	nForChannelMeasurements		Not configured
	nForInterferenceMeasurements		Not configured
cqi-FormatInd			Wideband
pmi-FormatInd			Wideband
Sub-band Size	e	RB	8
csi-Reporting	Band		111111111
CSI-Report pe	eriodicity and offset	slot	Not configured
Aperiodic Rep	ort Slot Offset		6
			1 in slots i, where
CSI request			mod(i, 8) = 1,
Correquest			otherwise it is equal to
			0
reportTriggerS	Bize		1
			One State with one
CSI-AperiodicTriggerStateList			Associated Report
			Configuration
			Associated Report
			Configuration contains
			pointers to NZP CSI- RS and CSI-IM
	Codebook Type	1	typel-SinglePanel
Codebook	Codebook Type Codebook Mode		typer-onigier andi
configuration	(CodebookConfig-	1	I
Comiguration	N1,CodebookConfig-N2)		Not configured
	in 1,000c000k00iiig-inz)	<u> </u>	

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

Table 8.2.2.2.1-2 Minimum requirements

	Test 1	Test 2
α[%]	2	2
γ	1.05	1.05

8.3 Reporting of Precoding Matrix Indicator (PMI)

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

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

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

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

8.3.1 1RX requirements

(Void)

8.3.2 2RX requirements

8.3.2.1 FDD

(Void)

8.3.2.2 TDD

8.3.2.2.1 Single PMI with 2TX Typel-SinglePanel Codebook

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

Table 8.3.2.2.1-1: Test parameters (single layer)

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

cqi-FormatIndica	ator		Wideband	Wideband
pmi-FormatIndic	ator		Wideband	Wideband
Sub-band Size		RB	8	8
csi-ReportingBa	nd		111111111	111111111
CSI-Report perio	odicity and offset	slot	Not configured	Not configured
Aperiodic Repor	t Slot Offset		6	8
CSI request			1 in slots i, where mod(i, 8) = 1, otherwise it is equal to 0	1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
reportTriggerSiz	е		1	1
CSI-AperiodicTr			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM	One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
	Codebook Type		typel- SinglePanel	typel- SinglePanel
	Codebook Mode		1	1
Codebook configuration	(CodebookConfig- N1,CodebookConfi g-N2)		N/A	N/A
	CodebookSubsetR estriction		001111	001111
	RI Restriction		N/A	N/A
Physical channe	el for CSI report		PUSCH	PUSCH
CQI/RI/PMI delay		ms	1.375	1.75
Maximum number of HARQ transmission			4	4
Measurement ch	Measurement channel		R.PDSCH.5-8.1 TDD	R.PDSCH.5- 7.1 TDD
Note 1: For random precoder selection, the precoder shall be updated in each slot (0.125 ms granularity). Note 2: If the LIF reports in an available uplink reporting instance at slot#n based on				

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 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

Note 3:

(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	nfiguration		FR2.120-2	FR2.120-2	FR2.120-2
SNR		dB	0	16	16
Propagation of			TDLA30-35	TDLA30-35	TDLA30-35
Antenna conf	iguration		ULA Low 2x2	ULA Low 2x2	XP High 2x2
Beamforming	Model		As defined in	As defined in	As defined in
			Annex B.4.1	Annex B.4.1	Annex B.4.1
	CSI-RS resource Type		Periodic	Periodic 4	Periodic
	Number of CSI-RS ports (X) CDM Type		4 FD-CDM2	FD-CDM2	4 FD-CDM2
ZP CSI-RS	Density (ρ)		1 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				
	used for CSI-RS (lo, l1)		(13,-)	(13,-)	(13,-)
	CSI-RS		8/1	8/1	8/1
	periodicity and offset	slot		J. 1	J. 1
	CSI-RS resource Type		Aperiodic	Aperiodic	Aperiodic
	Number of CSI-RS ports (X)		2	2	2
	CDM Type		FD-CDM2	FD-CDM2	FD-CDM2
NZD CCI	Density (ρ)		1	1	1
NZP CSI- RS for CSI	First subcarrier index in the		Row 3 (6,-)	Row 3 (6,-)	Row 3 (6,-)
acquisition	PRB used for CSI-RS (k ₀ , k ₁)		KOW 3 (0,-)	KOW 3 (0,-)	KOW 3 (6,-)
acquisition	First OFDM symbol in the PRB		(13,-)	(13,-)	(13,-)
	used for CSI-RS (I ₀ , I ₁)				
	NZP CSI-RS-timeConfig	slot	Not configured	Not	Not
	periodicity and offset	0.01		configured	configured
	aperiodicTriggeringOffset		0	0	0
	CSI-IM resource Type		Aperiodic	Aperiodic	Aperiodic
CSI-IM	CSI-IM RE pattern		Pattern 1	Pattern 1	Pattern 1
configuratio	CSI-IM Resource Mapping		(8,13)	(8,13)	(8,13)
n	(kcsi-im,lcsi-im) CSI-IM timeConfig		Not configured	Not	Not
	periodicity and offset	slot	Not configured	configured	configured
ReportConfig			Aperiodic	Aperiodic	Aperiodic
CQI-table	1,400		Table 1	Table 1	Table 1
				cri-RI-PMI-	cri-RI-PMI-
reportQuantit	У		cri-RI-PMI-CQI	CQI	CQI
time o D o otri oti o	onForChannelMeasurements		not configurate	not	not
timeRestriction	onForChannelivieasurements		not configured	configured	configured
timePestrictic	onForInterferenceMeasurements		not configured	not	not
umenesmono	on contract the co		_	configured	configured
cqi-FormatIndicator			Wideband	Wideband	Wideband
pmi-FormatIndicator			Wideband	Wideband	Wideband
Sub-band Size		RB	8	8	8
csi-Reporting	Band		111111111	111111111	111111111
CSI-Report p	eriodicity and offset	slot	Not configured	Not configured	Not configured
Aperiodic Per	oort Slot Offset		6	6	6
Apenouic Re	JOIL GIOL GIISEL		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,
30.1044001			otherwise it is	otherwise it is	otherwise it is
			equal to 0	equal to 0	equal to 0
reportTrigger	Size		1	1	1
		_			

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 chan	nel for CSI report		PUSCH	PUSCH	PUSCH
CQI/RI/PMI de		ms	1.375	.375 1.375 1.375	
Maximum num	nber of HARQ transmission		1	1	1
RI Configuration			Fixed RI = 2 and follow RI	Fixed RI = 1 and follow RI	Fixed RI = 1 and follow RI
Note 1: Mes	euramente channale ara enacifia	d in Table	Δ /L1 TRS 1_1 ic	used for Rank 1	Casa 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
71	N/A	1.05	1.05
72	1.0	N/A	N/A

9 Demodulation performance requirements for interworking

9.1 General

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

9.1.1 Applicability of requirements

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

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

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

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

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

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

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

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

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

9.1.1.1 Applicability of requirements for optional UE features

Table 9.1.1.1-1: Void

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

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

9.1.1.2 Applicability of requirements for mandatory UE features with capability signalling

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

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

9.1.2 E-UTRA Cell setup

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

9.1.2.1 FDD

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

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

Parameter	Unit	Value
Cyclic prefix		Normal
Physical Cell ID		0
Number of PDCCH 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

Table 9.1.2.1-1: Common Test Parameters (FDD)

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

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

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

TDD 9.1.2.2

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

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

Table 9.1.2.2-1: Common Test Parameters (TDD)

Parameter	Unit	Value	
UL DL configuration		2 (Note1)	
Special subframe		7	
configuration		1	
Number of PDCCH	symbols	1	
symbols	391110013	'	
PHICH Ng (Note 3)		1	
PHICH duration		Normal	
Cyclic prefix		Normal	
Cell ID		0	
Maximum number of		4	
HARQ transmission		'	
Redundancy version		{0,0,1,2} for 64QAM	
coding sequence		· ·	
Propagation condition		Static propagation condition	
. 0		No external noise sources are applied	
Transmission mode		1	
Transmission time			
difference between E-	μs	0	
UTRA cell and NR	·		
cell(s)		All NR cells are in FR1: 1x2	
Antenna configuration		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 tra	nsmission of LTE fran	ne is delayed by 2 LTE subframes with	
respect to the start of transmission of NR frame when TDD-TDD EN-DC			
configuration is configured during the test.			
Note 2: As the link can	be provided over the	air, the UE Rx antenna configuration is not	
relevant for the test configuration and has no impact on the test implementation.			

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

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

9.2 PDSCH Demodulation

9.2A PDSCH demodulation for CA

9.2A.1 NR CA between FR1 and FR2

(Void)

9.2B PDSCH demodulation for DC

9.2B.1 EN-DC

9.2B.1.1 EN-DC within FR1

9.2B.1.1.1 PDSCH

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

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

9.2B.1.2.1 PDSCH

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

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

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

9.2B.2 NR DC between FR1 and FR2

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

9.3 PDCCH demodulation

9.3A PDCCH demodulation for CA

9.3A.1 NR CA between FR1 and FR2

(Void)

9.3B PDCCH demodulation for DC

9.3B.1 EN-DC

9.3B.1.1 EN-DC within FR1

9.3B.1.1.1 PDCCH

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

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

9.3B.1.2.1 PDCCH

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

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

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

9.3B.2 NR DC between FR1 and FR2

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

9.4 Void

9.4A SDR test for CA

9.4A.1 NR CA between FR1 and FR2

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

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

The test parameters are determined by the following procedure:

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

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

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

9.4B SDR test for DC

9.4B.1 EN-DC

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

9.4B.1.1 EN-DC within FR1

9.4B.1.1.1 SDR test

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

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

The test parameters are determined by the following procedure:

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

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

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

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

- For the configuration of DRB type of Split bearer, the TB success rate across CGs is defined as TB success rate = 100%*NDL_correct_rx/ (NDL_newtx + NDL_retx), where NDL_newtx is the number of newly transmitted DL transport blocks, NDL_retx is the number of retransmitted DL transport blocks, and NDL_correct_rx is the number of correctly received DL transport blocks. All the above numbers of transmitted, retransmitted or correctly received DL transport blocks are calculated as the sum of the numbers of DL transport blocks across all the CGs used for DC transmission or reception.
- For the configuration of DRB type of MCG or SCG bearer, the TB success rate across CGs is defined as TB success rate = 100%*NDL_correct_rx/ (NDL_newtx + NDL_retx), where NDL_newtx is the number of newly transmitted DL transport blocks, NDL_retx is the number of retransmitted DL transport blocks, and DL_correct_rx is the number of correctly received DL transport blocks. All the above numbers of transmitted, retransmitted or correctly received DL transport blocks are calculated as the sum of the numbers of DL transport blocks per CG used for DC.

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

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

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

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

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

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

9.4B.1.2 EN-DC including FR2 NR carrier

9.4B.1.2.1 SDR test

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

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

The test parameters are determined by the following procedure:

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

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

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

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

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

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

The test parameters are determined by the following procedure:

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

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

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

9.4B.2 NR DC between FR1 and FR2

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

9.4B.3 NE-DC

9.4B.3.1 NE-DC within FR1

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

10 CSI reporting requirements for interworking

10.1 General

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

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

10.1.1 Applicability of requirements

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

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

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

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

10.1.1.1 Applicability of requirements for optional UE features

Table 10.1.1.1-1: Void

10.1.1.2 Applicability of requirements for mandatory UE features with capability signalling

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

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

10.2 Reporting of Channel Quality Indicator (CQI)

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

(Void)

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

10.2B.1 EN-DC

10.2B.1.1 EN-DC within FR1

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

10.2B.1.2 EN-DC including FR2 NR carrier

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

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

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

10.2B.2 NR DC between FR1 and FR2

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

10.3 Reporting of Precoding Matrix Indicator (PMI)

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

(Void)

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

10.3B.1 EN-DC

10.3B.1.1 EN-DC within FR1

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

10.3B.1.2 EN-DC including NR FR2 carrier

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

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

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

10.3B.2 NR DC between FR1 and FR2

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

10.4 Reporting of Rank Indicator (RI)

10.4A Reporting of Rank Indicator (RI) for CA

10.4B Reporting of Rank Indicator (RI) for DC

10.4B.1 EN-DC

10.4B.1.1 EN-DC within FR1

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

10.4B.1.2 EN-DC including NR FR2 carrier

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

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

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

10.4B.2 NR DC between FR1 and FR2

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

Annex A (normative): Measurement channels

A.1 General

A.1.1 Throughput definition

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

A.1.2 TDD UL-DL configurations for FR1

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

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

	Parameter	Unit	UL-DL pattern
	Parameter	Unit	FR1.15-1
TDD Slot Configura	ation pattern (Note 1)		DDDSU
Special Slot Config	juration (Note 2)		10D+2G+2U
referenceSubcarrierSpacing			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

Parameter		1	UL-DL pattern					
Param	neter	Unit	FR1.30-1	FR1.30-2	FR1.30-3	FR1.30-4	FR1.30-5	FR1.30-6
TDD Slot Configuration pattern	(Note 1)		7DS2U	DDDSU	DDDSUDDSUU	DDDSUUDDDD	DSUU	DS₁S₂U
Special Slot Configuration (Note	e 2)		6D+4G+4U	10D+2G+2U	10D+2G+2U	6D+4G+4U	12D+2G	S1: 10D+2G+2U S2: 12D+2G+0U
referenceSubcarrierSpacing		kHz	30	30	30	30	30	30
pattern1								
	dl-UL- TransmissionPeriodicity	ms	5	2.5	2.5	3	2	1
	nrofDownlinkSlots		7	3	3	3	1	1
	nrofDownlinkSymbols		6	10	10	6	12	10
	nrofUplinkSlot		2	1	1	2	2	0
_	nrofUplinkSymbols		4	2	2	4	0	2
pattern2	dl-UL- TransmissionPeriodicity	ms	N/A	N/A	2.5	2	N/A	1
	nrofDownlinkSlots		N/A	N/A	2	4	N/A	0
	nrofDownlinkSymbols		N/A	N/A	10	0	N/A	12
	nrofUplinkSlot		N/A	N/A	2	0	N/A	1
	nrofÚplinkSymbols		N/A	N/A	2	0	N/A	0
The number of slots between P HARQ-ACK information (Note 3			8 if mod(i,10) = 0 7 if mod(i,10) = 1 6 if mod(i,10) = 2 5 if mod(i,10) = 3 5 if mod(i,10) = 4 4 if mod(i,10) = 5 3 if mod(i,10) = 6 2 if mod(i,10) = 7	4 if mod(i,5) = 0 3 if mod(i,5) = 1 2 if mod(i,5) = 2 6 if mod(i,5) = 3	4 if mod(i,10) = 0 $3 if mod(i,10) = 1$ $2 if mod(i,10) = 2$ $5 if mod(i,10) = 3$ $3 if mod(i,10) = 5$ $3 if mod(i,10) = 6$ $2 if mod(i,10) = 7$	5 if mod(i,10) = 0 4 if mod(i,10) = 1 3 if mod(i,10) = 2 2 if mod(i,10) = 6 7 if mod(i,10) = 7 6 if mod(i,10) = 8 5 if mod(i,10) = 9	3 if mod(i,4) = 0 2 if mod(i,4) = 1	3 if mod(i,4) = 0 2 if mod(i,4) = 1 3 if mod(i,4) = 2

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

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

Parame	eter	Unit	UL-DL pattern			
		Oilit	FR1.30-1A			
TDD Slot Configuration pattern (N			7DS2U			
Special Slot Configuration (Note:	2)		6D+4G+4U			
referenceSubcarrierSpacing		kHz	N/A			
pattern1 (Note 4)						
	dl-UL- TransmissionPeriodicity	ms	N/A			
	nrofDownlinkSlots		N/A			
	nrofDownlinkSymbols		N/A			
	nrofUplinkSlot		N/A			
	nrofUplinkSymbols		N/A			
PDCCH DCI Configuration	DCI Format		1-1 for slot			
			indices with			
			mod(i,10) =			
			0,1,2,3,4,5,6,7			
	Scheduled Grant		Symbol 2-13 for			
			slot indices with			
			mod(i,10) =			
			0,1,2,3,4,5,6 and			
			Symbol 2-5 for			
			slot indices with			
T			mod(i,10) = 7			
The number of slots between PD	SCH and corresponding		8 if $mod(i,10) = 0$			
HARQ-ACK information (Note 3)			7 if $mod(i,10) = 1$			
(PDSCH-to-HARQ-timing-indicate	or)		6 if $mod(i,10) = 2$			
			5 if $mod(i,10) = 3$			
			5 if mod(i,10) = 4 4 if mod(i,10) = 5			
			3 if $mod(i, 10) = 6$			
			2 if $mod(i, 10) = 0$			
Note 1: D denotes a slot with all DL symbols; S denotes a slot with a mix of DL, UL and						
guard symbols; U denotes a slot with all UL symbols. The field is for information.						
Note 2: D, G and U denote DL, guard and UL symbols, respectively. The field is for						
information.	, , ,	,				
Note 3: i is the slot index per fr	rame; $i = \{0,, 19\}$					
Note 4: Do not configure tdd-L	/L-DL-ConfigurationCommon ເ	using RF	RC configuration			

A.1.3 TDD UL-DL configurations for FR2

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

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

	Parameter	Unit	UL-DL pattern
_	rarameter	Offic	FR2.60-1
TDD Slot Configuration pa	ttern (Note 1)		DDSU
Special Slot Configuration	(Note 2)		11D+3G+0U
referenceSubcarrierSpacii	ng	kHz	60
pattern1	dl-UL-	ms	1
	TransmissionPeriodicity		ı
	nrofDownlinkSlots		2
	nrofDownlinkSymbols		11
	nrofUplinkSlot		1
	nrofUplinkSymbols		0
The number of slots between	The number of slots between PDSCH and corresponding		3 if $mod(i,4) = 0$
HARQ-ACK information (N	HARQ-ACK information (Note 3)		2 if $mod(i,4) = 1$
			5 if $mod(i,4) = 2$

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

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

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

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

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

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

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

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

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

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

	Parameter		Unit	UL-DL pattern			
	Falalik	eter	Ullit	FR2.120-1A			
TDD Slot	Configuration pattern (N	Note 1)		DDDSU			
	lot Configuration (Note 2			10D+2G+2U			
reference	SubcarrierSpacing		kHz	N/A			
pattern1 ((Note 4)	dl-UL-	ms	N/A			
		TransmissionPeriodicity		IV/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			
		SCH and corresponding		4 if $mod(i,5) = 0$			
HARQ-AC	CK information(Note 3)			3 if $mod(i,5) = 1$			
				2 if $mod(i,5) = 2$			
				6 if $mod(i,5) = 3$			
Note 1:		all DL symbols; S denotes a slo					
		denotes a slot with all UL syml	oois. Ir	ne tield is for			
Note O	information.		ا المرائدة	The field in few			
Note 2:	Note 2: D, G and U denote DL, guard and UL symbols, respectively. The field is for information.						
Note 3:		rama: i = (0 70)					
	i is the slot index per fr		icina D	PC configuration			
Note 4:	Do not configure taa-0	IL-DL-ConfigurationCommon ւ	ising R	KC configuration.			

A.2 Void

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

A.3 DL reference measurement channels

A.3.1 General

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

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

A.3.2 Reference measurement channels for PDSCH performance requirements

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

A.3.2.1 FDD

A.3.2.1.1 Reference measurement channels for SCS 15 kHz FR1

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

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

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

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

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

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

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

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

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

Parameter	Unit		Value
Deference 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 frames	Mbps	42.841	

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

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

Parameter	Unit		Value
Deference 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	
Reference channel		R.PDSCH.1-	R.PDSCH.1-		
Reference channel		6.1 FDD	6.2 FDD		
Channel bandwidth	MHz	10	10		
Subcarrier spacing	kHz	15	15		
Number of allocated resource blocks	PRBs	52	52		
Number of consecutive PDSCH		12	12		
symbols		12	12		
Allocated slots per 2 frames	Slots	15	15		
MCS table		64QAM	64QAM		
MCS index		13	13		
Modulation		16QAM	16QAM		
Target Coding Rate		0.48	0.48		
Number of MIMO layer		1	2		
Number of DMRS REs (Note 3)		24	24		
Overhead for TBS determination		0	0		
Information Bit Payload per Slot					
For Slot i = 0	Bits	N/A	N/A		
For CSI Slots i, if mod (i,5) =1,		NI/A	NI/A		
i={0,,19}		N/A	N/A		
For Non CSI-RS Slot i, if mod (i,5)	Bits	12040	24072		
={0,2,3,4}, i={1,19}	סונס	12040	24072		
Transport block CRC per Slot					
For Slot i = 0	Bits	N/A	N/A		
For CSI Slots i, if mod (i,5) =1,		N/A	N/A		
i={0,,19}		IN/A	IN/A		
For Non CSI-RS Slot i, if mod (i,5)	Bits	24	24		
={0,2,3,4}, i={1,19}	Dita	24	24		
Number of Code Blocks per Slot					
For Slot i = 0	CBs	N/A	N/A		
For CSI Slots i, if mod (i,5) =1,		N/A	N/A		
i={0,,19}		14/73	14/71		
For Non CSI-RS Slot i, if mod (i,5)	CBs	2	3		
={0,2,3,4}, i={1,,19}	020	_	Ŭ		
Binary Channel Bits Per Slot					
For Slot i = 0	Bits	N/A	N/A		
For CSI Slots i, if mod (i,5) =1,		N/A	N/A		
i={0,,19}		•			
For Slots i = 10	Bits	23712	47424		
For Non CSI-RS Slot i, if mod (i,5)	Bits	24960	49920		
={0,2,3,4}, i={1,9,11,,19}			.5525		
Max. Throughput averaged over 2	Mbps	9.030	18.054		
Note 1: SS/DBCH block is transmitt					

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

Note 2:

Slot i is slot index per 2 frames

Number of DMRS REs includes the overhead of the DM-RS CDM groups without data Note 3:

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

Parameter	Unit			Value	
Reference channel		R.PDSCH.1-	R.PDSCH.1-		
		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
Reference channel		R.PDSCH.1-	
Reference channel		8.1 FDD	
Channel bandwidth	MHz	10	
Subcarrier spacing	kHz	15	
Number of allocated resource blocks	PRBs	52	
Number of consecutive PDSCH		12	
symbols			
Allocated slots per 2 frames	Slots	19	
MCS table		64QAM	
MCS index		13	
Modulation		16QAM	
Target Coding Rate		0.48	
Number of MIMO layers		1	
Number of DMRS REs		18	
Overhead for TBS determination		0	
Information Bit Payload per Slot			
For Slot i = 0	Bits	N/A	
For Slots i = 1,, 19	Bits	12552	
Transport block CRC per Slot			
For Slot i = 0	Bits	N/A	
For Slots i = 1,, 19	Bits	24	
Number of Code Blocks per Slot			
For Slot i = 0	CBs	N/A	
For Slots i = 1,, 19	CBs	2	
Binary Channel Bits Per Slot			
For Slot i = 0	Bits	N/A	
For Slots i = 1,2,11,12	Bits	24960	
For Slots i = 3,, 10, 13,, 19	Bits	26208	
Max. Throughput averaged over 2	Mbps	11.924	
frames Note 1: SS/PRCH block is transmitted.	المالية الما	#0ith a mi a ali ai	t. 00

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

A.3.2.1.2 Reference measurement channels for SCS 30 kHz FR1

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

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

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

A.3.2.1.3 Reference measurement channels for SCS 60 kHz FR1

A.3.2.1.4 Reference measurement channels for E-UTRA

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

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

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

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

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

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

A.3.2.2 TDD

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

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

Parameter	Unit			Value	
Reference channel		R.PDSCH.2-	R.PDSCH.2-	R.PDSCH.2-	
		1.1 TDD	1.2 TDD	1.3 TDD	
Channel bandwidth	MHz	40	40	40	
Subcarrier spacing	kHz	30	30	30	
Allocated resource blocks	PRBs	106	6	106	
Number of consecutive PDSCH					
symbols					
For Slots 0 and Slot i, if mod(i, 10) =		N/A	N/A	N/A	
$\{8,9\}$ for i from $\{0,,39\}$ For Slot i, if mod(i, 10) = 7 for i from					
$\{0,,39\}$		4	4	N/A	
For Slot i, if mod(i, 10) =					
{0,1,2,3,4,5,6} for i from {1,,39}		12	12	7	
Allocated slots per 2 frames		31	31	27	
MCS table		64QAM	64QAM	64QAM	
MCS index		4	4	4	
Modulation		QPSK	QPSK	QPSK	
Target Coding Rate		0.30	0.30	0.30	
Number of MIMO layers		1	1	1	
Number of DMRS REs		•			
For Slots 0 and Slot i, if mod(i, 10) =					
{8,9} for i from {0,,39}		N/A	N/A	N/A	
For Slot i, if $mod(i, 10) = 7$ for i from		_		21/2	
{0,,39}		6	6	N/A	
For Slot i, if mod(i, 10) =		40	40	40	
{0,1,2,3,4,5,6} for i from {1,,39}		18	12	12	
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/A	
{8,9} for i from {0,,39}	Bits	N/A	N/A	N/A	
For Slot i, if mod(i, 10) = 7 for i from	D:4-	2004	4.44	NI/A	
{0,,39}	Bits	2664	144	N/A	
For Slot i, if mod(i, 10) =	Bits	8064	480	4608	
{0,1,2,3,4,5,6} for i from {1,,39}	DIIS	0004	400	4000	
Transport block CRC per Slot					
For Slots 0 and Slot i, if mod(i, 10) =	Bits	N/A	N/A	N/A	
{8,9} for i from {0,,39}	Dito	IN/A	IN//A	IN//A	
For Slot i, if $mod(i, 10) = 7$ for i from	Bits	16	16	N/A	
{0,,39}	Dito			14/7 (
For Slot i, if mod(i, 10) =	Bits	24	16	24	
{0,1,2,3,4,5,6} for i from {1,,39}	Dito		.0		
Number of Code Blocks per Slot					
For Slots 0 and Slot i, if mod(i, 10) =	CBs	N/A	N/A	N/A	
{8,9} for i from {0,,39}					
For Slot i, if $mod(i, 10) = 7$ for i from	CBs	1	1	N/A	
{0,,39}				-	
For Slot i, if mod(i, 10) =	CBs	1	1	1	
{0,1,2,3,4,5,6} for i from {1,,39}	-				
Binary Channel Bits Per Slot	1		1	+	
For Slots 0 and Slot i, if $mod(i, 10) =$	Bits	N/A	N/A	N/A	
$\{8,9\}$ for i from $\{0,,39\}$ For Slots i = 20, 21	Bits	25440	1510	13992	
For Slots I = 20, 21 For Slot i, if mod(i, 10) = 7 for i from	DIIS	20440	1512		
For Slot I, If $mod(I, 10) = 7$ for I from $\{0,, 39\}$	Bits	8904	504	N/A	
For Slot i, if mod(i, 10) =					+
{0,1,2,3,4,5,6} for i from	Bits	26712	1584	15264	
{1,,19,22,,39}	DIIS	20/12	1504	10204	
Max. Throughput averaged over 2			1		
frames	Mbps	11.419	0.677	6.221	
Note 1: SS/PBCH block is transmitte	d in slot #0) with periodicity	/ 20 ms	<u> </u>	L
Note 2: Slot i is slot index per 2 frame		portodioit	, _00		

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

Parameter	Unit			Value	
Reference channel		R.PDSCH.2-	R.PDSCH.2-	R.PDSCH.2-	R.PDSCH.2-
		2.1 TDD	2.2 TDD	2.3 TDD	2.4 TDD
Channel bandwidth	MHz	40	40	40	40
Subcarrier spacing	kHz	30	30	30	30
Allocated resource blocks	PRBs	106	106	106	106
Number of consecutive PDSCH					
symbols For Slots 0 and Slot i, if mod(i, 10) =					
$\{8,9\}$ for i from $\{0,,39\}$		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
For Slot i, if mod(i, 10) =					
{0,1,2,3,4,5,6} for i from {1,,39}		12	12	12	12
Allocated slots per 2 frames		31	31	31	31
MCS table		64QAM	64QAM	64QAM	64QAM
MCS index		13	13	13	13
Modulation		16QAM	16QAM	16QAM	16QAM
Target Coding Rate		0.48	0.48	0.48	0.48
Number of MIMO layers		1	2	3	4
Number of DMRS REs					
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}		1471	1471	14/71	14/71
For Slot i, if $mod(i, 10) = 7$ for i from		6	6	12	12
{0,,39}					
For Slot i, if mod(i, 10) =		12	12	24	24
{0,1,2,3,4,5,6} for i from {1,,39} Overhead for TBS determination		0	0	0	0
Information Bit Payload per Slot		U	U	0	U
For Slots 0 and Slot i, if mod(i, 10) =					
{8,9} for i from {0,,39}	Bits	N/A	N/A	N/A	N/A
For Slot i, if $mod(i, 10) = 7$ for i from					
{0,,39}	Bits	8456	16896	22032	29192
For Slot i, if mod(i, 10) =	Bits	20022	F2200	70770	00070
{0,1,2,3,4,5,6} for i from {1,,39}	DIIS	26632	53288	73776	98376
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}	Dito	14/7 (14/73	14// (14/71
For Slot i, if $mod(i, 10) = 7$ for i from	Bits	24	24	24	24
{0,,39}					
For Slot i, if mod(i, 10) =	Bits	24	24	24	24
{0,1,2,3,4,5,6}for i from {1,,39}					
Number of Code Blocks per Slot For Slots 0 and Slot i, if mod(i, 10) =					
{8,9} for i from {0,,39}	CBs	N/A	N/A	N/A	N/A
For Slot i, if $mod(i, 10) = 7$ for i from					
{0,,39}	CBs	2	3	3	4
For Slot i, if mod(i, 10) =	OD-	4	7		40
{0,1,2,3,4,5,6} for i from {1,,39}	CBs	4	7	9	12
Binary Channel Bits Per Slot					
For Slots 0 and Slot i, if mod(i, 10) =	Bits	N/A	N/A	N/A	N/A
{8,9} for i from {0,,39}					
For Slots i = 20, 21	Bits	53424	106848	144008	193344
For Slot i, if $mod(i, 10) = 7$ for i from	Bits	17808	35616	45792	61056
{0,,39}				13.32	
For Slot i, if mod(i, 10) =	D:+-	<i>EE</i> 000	111000	150040	202520
{0,1,2,3,4,5,6} for i from	Bits	55968	111936	152640	203520
{1,,19,22,,39} Max. Throughput averaged over 2					
frames	Mbps	37.644	75.318	104.004	138.646
Note 1: SS/PBCH block is transmitte	ed in slot	#0 with periodic	city 20 ms	1	<u> </u>
Note 2: Slot i is slot index per 2 fram		" o with periodit	ony 20 1113		
Siot i io diot illuox poi z Ilali					

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

Parameter	Unit		Value	
Reference channel		R.PDSCH.2- 3.1 TDD		
Channel bandwidth	MHz	40		
Subcarrier spacing	kHz	30		
Allocated resource blocks	PRBs	106		
Number of consecutive PDSCH				
symbols For 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 $\{0,,39\}$		4		
For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,6\}$ for i from $\{1,,39\}$		12		
Allocated slots per 2 frames		31		
MCS table		64QAM		
MCS index		19		
Modulation		64QAM		
Target Coding Rate		0.51		
Number of MIMO layers		2		
Number of DMRS REs				
For 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	27144		
For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,6\}$ for i from $\{1,,39\}$	Bits	83976		
Transport block CRC per Slot				
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}	Bits	N/A		
For Slot i, if $mod(i, 10) = 7$ for i from $\{0,,39\}$	Bits	24		
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6}for i from {1,,39}	Bits	24		
Number of Code Blocks per Slot				
For Slots 0 and Slot i, if mod(i, 10) =	CBs	N/A		
$\{8,9\}$ for i from $\{0,,39\}$ For Slot i, if mod(i, 10) = 7 for i from	CBs	4		
$\{0,,39\}$ For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,6\}$	CBs	10		
for i from {1,,39}	CD9	10		
Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 10) =	Bits	N/A		
{8,9} for i from {0,,39}				
For Slots i = 20, 21 For Slot i, if mod(i, 10) = 7 for i from	Bits Bits	160272 53424		
$\{0,,39\}$ For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,6\}$	Bits	167904		
for i from {1,,19,22,,39} Max. Throughput averaged over 2				
frames Note 1: SS/PBCH block is transmitted i	Mbps	118.796) me	
Note 1: SS/PBCH block is transmitted in Note 2: Slot i is slot index per 2 frames	11 SIUL #U V	vitir periodicity 20) III2	

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

Parameter	Unit		Va	lue		
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) =		N/A				
{8,9} for i from {0,,39}		IN/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 Number of MIMO layers		0.82				
Number of DMRS REs		1				
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		N/A				
{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	Mbps	130.308				
frames Note 1: SS/PBCH block is transmitted i) me			
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms Note 2: Slot i is slot index per 2 frames						

Table A.3.2.2.5: 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	Bits	17808				
$\{0,,39\}$ 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 slot #0 with periodicity 20 ms Note 2: Slot i is slot index per 2 frames						

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

Parameter	Unit		V	alue		
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		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, 10) =						
{4,8,9} for i from {0,,39} For Slot i, if mod(i, 10) = {3,7} for i from		N/A				
{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 i from $\{1,,39\}$	Bits	24				
Number of Code Blocks per Slot						
For Slot 0 and Slot i, if mod(i, 10) = {4,8,9} for i from {0,,39}	CBs	N/A				
For Slot i, if $mod(i, 10) = \{3,7\}$ for i from $\{0,,39\}$	CBs	1				
For Slot i, if mod(i, 10) = $\{0,1,2,5,6\}$ for i from $\{1,,39\}$	CBs	2				
Binary Channel Bits Per Slot						
For Slot 0 and Slot i, if mod(i, 10) = {4,8,9} for i from {0,,39}	Bits	N/A				
For Slot i = 20, 21	Bits	26712				
For Slot i, if mod(i, 10) = $\{3,7\}$ for i from $\{0,,39\}$	Bits	17808				
For Slot i, if $mod(i, 10) = \{0,1,2,5,6\}$ for i from $\{1,,19,22,,39\}$	Bits	27984				
Max. Throughput averaged over 2	Mbps	10.184				
frames Note 1: SS/PBCH block is transmitted i	•) me			
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms Note 2: Slot i is slot index per 2 frames						

Table A.3.2.2.7: 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-			
	NAL I—	7.1 TDD			
Channel bandwidth Subcarrier spacing	MHz kHz	40 30			
Allocated resource blocks	PRBs	106			
Number of consecutive PDSCH	11120	100			
symbols			1		
For Slots 0 and Slot i, if mod(i, 10) =		N/A			
{8,9} for i from {0,,39}		IN/A			
For Slot i, if mod(i, 10) = 7 for i from		4			
{0,,39}					
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$		12			
for i from {1,,39} Allocated slots per 2 frames		31			
MCS table		64QAM			
MCS table 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, 10) =		N/A			
{8,9} for i from {0,,39}		IN/A			
For Slot i, if $mod(i, 10) = 7$ for i from		6			
{0,,39}					
For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,6\}$		12	1		
for i from {1,,39} Overhead for TBS determination		0			
Information Bit Payload per Slot		0			
For Slots 0 and Slot i, if mod(i, 10) =					
{8,9} for i from {0,,39}	Bits	N/A			
For Slot i, if $mod(i, 10) = 7$ for i from	D:4-	40000			
{0,,39}	Bits	16896			
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$	Bits	53288			
for i from {1,,39}	Dito	33200			
Transport block CRC per Slot					
For Slots 0 and Slot i, if mod(i, 10) =	Bits	N/A			
{8,9} for i from $\{0,,39\}$ For Slot i, if mod(i, 10) = 7 for i from					
{0,,39}	Bits	24			
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$					
for i from {1,,39}	Bits	24			
Number of Code Blocks per Slot					
For Slots 0 and Slot i, if mod(i, 10) =	CBs	N/A			
{8,9} for i from {0,,39}	ODS	19/73			
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 i from $\{1,,39\}$	CBs	7	1		
Binary Channel Bits Per Slot					
For Slots 0 and Slot i, if mod(i, 10) =					
{8,9} for i from {0,,39}	Bits	N/A			
For Slot i, if $mod(i, 10) = \{0,5\}$ for i from	D:+-	400450			
{1,,19,22,,39}	Bits	103456			
For Slots i = 20	Bits	98368			
For Slots i = 21	Bits	106848			
For Slot i, if $mod(i, 10) = 7$ for i from	Bits	35616			
{0,,39}					
For Slot i, if $mod(i, 10) = \{1,2,3,4,6\}$ for i from $\{1, 10, 22, 30\}$	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) ms	1	1
Note 2: Slot i is slot index per 2 frames	5.51 // 0	50561616, 20	· ··· ·		
THORE Z. GIOLITIS SIDE HIDEX PET Z HATTIES					

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

Parameter	Unit			Value
Defenses showed		R.PDSCH.2-	R.PDSCH.2-	
Reference channel		8.1 TDD	8.2 TDD	
Channel bandwidth	MHz	40	40	
Subcarrier spacing	kHz	30	30	
Allocated resource blocks	PRBs	106	106	
Number of consecutive PDSCH		40	40	
symbols		12	12	
Allocated slots per 2 frames		23	23	
MCS table		64QAM	64QAM	
MCS index		13	13	
Modulation		16QAM	16QAM	
Target Coding Rate		0.48	0.48	
Number of MIMO layers		1	2	
Number of DMRS REs (Note 3)		24	24	
Overhead for TBS determination		0	0	
Information Bit Payload per Slot				
For Slots 0 and Slot i, if mod(i, 10) =	D:4-	NI/A	NI/A	
{7,8,9} for i from {0,,39}	Bits	N/A	N/A	
For CSI-RS Slot i, if mod(i,10) =1 for i	D:4-	NI/A	NI/A	
from {0,,39}	Bits	N/A	N/A	
For Slot i = 20	Bits	24576	49176	
For Slot i, if $mod(i, 10) = \{0,2,3,4,5,6\}$	Dito	24576	40476	
for i from {1,,19,22,,39}	Bits	24576	49176	
Transport block CRC per Slot				
For Slots 0 and Slot i, if mod(i, 10) =	Bits	N/A	N/A	
{7,8,9} for i from {0,,39}	DIIS	IN/A	IN/A	
For CSI-RS Slot i, if mod(i,10) =1 for i	Bits	N/A	N/A	
from {0,,39}		IN/A	IN/A	
For Slot i = 20	Bits	24	24	
For Slot i, if $mod(i, 10) = \{0,2,3,4,5,6\}$	Bits	24	24	
for i from {1,,19,22,,39}	DIIS	24	24	
Number of Code Blocks per Slot				
For Slots 0 and Slot i, if mod(i, 10) =	CBs	N/A	N/A	
{7,8,9} for i from {0,,39}	CD3	IN/A	IN/A	
For CSI-RS Slot i, if mod(i,10) =1 for i	CBs	N/A	N/A	
from {0,,39}		IN//A		
For Slot i = 20	CBs	3	6	
For Slot i, if $mod(i, 10) = \{0,2,3,4,5,6\}$	CBs	3	6	
for i from {1,,19,22,,39}	ODS	J	Ů	
Binary Channel Bits Per Slot				
For Slots 0 and Slot i, if mod(i, 10) =	Bits	N/A	N/A	
{7,8,9} for i from {0,,39}	טונט	1 1/7	14/7	
For CSI-RS Slot i, if mod(i,10) =1 for i	Bits	N/A	N/A	
from {0,,39}				
For Slot i = 20	Bits	48336	96672	
For Slot i, if $mod(i, 10) = \{0,2,3,4,5,6\}$	Bits	50880	101760	
for i from {1,,19,22,,39}	510	00000	101700	
Max. Throughput averaged over 2	Mbps	28.2624	56.5524	
Note 1: SS/PBCH block is transmitted	-			

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		V	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	vith periodicity 20) ms			
Note 2: Slot i is slot index per 2 frames						

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

Parameter	Unit		Value				
Reference channel		R.PDSCH.2-					
Channel bandwidth	MHz	10.1 TDD 40		-			
Subcarrier spacing	kHz	30	+				
Allocated resource blocks	PRBs	106					
Number of consecutive PDSCH	FINDS	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 $\{0,,39\}$		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					
Modulation		16QAM					
Target Coding Rate		0.48					
Number of MIMO layers		1					
Number of DMRS REs		ı					
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 $mod(i, 10) = \{0,1,2,3,4,5,6\}$		18					
for i from {1,,39}							
Overhead for TBS determination		0					
Information Bit Payload per Slot							
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}	Bits	N/A					
For Slot i, if $mod(i, 10) = 7$ for i from $\{0,,39\}$	Bits	8456					
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ for i from $\{1,,39\}$	Bits	25608					
Transport block CRC per Slot							
For Slots 0 and Slot i, if mod(i, 10) =	D:4-	NI/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					
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ for i from $\{1,,39\}$	Bits	24					
Number of Code Blocks per Slot							
For Slots 0 and Slot i, if mod(i, 10) =	CBs	N/A					
$\{8,9\}$ for i from $\{0,,39\}$ For Slot i, if mod(i, 10) = 7 for i from							
{0,,39}	CBs	2					
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,6\}$ for i from $\{1,,39\}$	CBs	4					
Binary Channel Bits Per Slot							
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}	Bits	N/A					
For Slots i = 1,2,21,22	Bits	52176 (Note 3)					
For Slot i, if $mod(i, 10) = 7$ for i from	Bits	17808					
$\{0,,39\}$ For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,6\}$ for i from $\{3,,20,23,,39\}$	Bits	53424					
Max. Throughput averaged over 2	Mbps	36.262					
frames	•						
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms							

Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms
Note 2: Slot i is slot index per 2 frames
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}		14/71		
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 $mod(i, 4) = \{2,3\}$		N/A		
for i 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		18		
{0,,39} Overhead for TBS determination		0		
Information Bit Payload per Slot		U		
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	Bits	24		
{0,,39} 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 $mod(i, 4) = \{2,3\}$	D:±-	N1/A		
for i from {0,,39}	Bits	N/A		
For Slot i = 20	Bits	25440		
For Slot i = 21	Bits	20352		
For Slot i, if $mod(i, 4) = 0$ for i from $\{1,,19,22,,39\}$	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	n slot #0 v	vith periodicity 20) ms	
Note 2: Slot i is slot index per 2 frames		· •		

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

Parameter	Unit		Value	
Reference channel	<u> </u>	R.PDSCH.2-		
	N 47 1	12.1 TDD		
Channel bandwidth	MHz kHz	40 30		
Subcarrier spacing Allocated resource blocks	PRBs	106		
Number of consecutive PDSCH	LIVDS	100		
symbols				
For Slot 0 and Slot i, if mod(i, 4) = 3 for i		N/A		
from {0,,39}		IN/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				
{0,,39}		8		
For Slot i, if $mod(i, 4) = 2$ for i from		10		
{0,,39}				
Allocated slots per 2 frames		31		
MCS table		64QAM		
MCS index Modulation		4 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) = 3 for i		N/A		
from {0,,39}		IN/A		
For Slot i, if $mod(i, 4) = 0$ for i from		18		
$\{1,,39\}$ 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		4.0		
{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				
{1,,39}	Bits	8064		
For Slot i, if mod(i, 4) = 1 for i from	Bits	4002		
{0,,39}	DIIS	4992		
For Slot i, if $mod(i, 4) = 2$ for i from	Bits	6528		
{0,,39}				
Transport block CRC per Slot For Slot 0 and Slot i, if mod(i, 4) = 3 for				
i from {0,,39}	Bits	N/A		
For Slot i, if $mod(i, 4) = 0$ for i from	Bits	24		
{1,,39}	DIIS	24		
For Slot i, if $mod(i, 4) = 1$ for i from	Bits	24		
$\{0,,39\}$ For Slot i, if mod(i, 4) = 2 for i from				
For Slot 1, if $mod(1, 4) = 2$ for 1 from $\{0,, 39\}$	Bits	24		
Number of Code Blocks per Slot				
For Slot 0 and Slot i, if $mod(i, 4) = 3$ for	CD-	NI/A		
i from {0,,39}	CBs	N/A		
For Slot i, if $mod(i, 4) = 0$ for i from	CBs	1		
{1,,39}		<u> </u>		
For Slot i, if $mod(i, 4) = 1$ for i 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}				
For Slot i = 20	Bits Bits	25440 15264		
For Slot $i = 21$ For Slot i, if mod(i, 4) = 0 for i from		15264		
{1,,19,22,,39}	Bits	26712		
1			ı.	 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 in slot #0 with periodicity 20 ms Note 2: Slot i is slot index per 2 frames						

- A.3.2.2.3 Reference measurement channels for SCS 60 kHz FR1
- A.3.2.2.4 Reference measurement channels for SCS 60 kHz FR2

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

Parameter	Unit		Value
Deference showed		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			
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 $\{1,, 79\}$		10	
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	-		
		N/A	
i from $\{0,,79\}$ For Slot i, if mod(i, 4) = 2 for i from	-		
		12	
{1,, 79}			
For Slot i, if $mod(i, 4) = \{0,1\}$ for i from		12	
{1,,79}		0	
Overhead for TBS determination		6	
Information Bit Payload 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	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}	D.KO	1071	
For Slot i, if $mod(i, 4) = 2$ for i from $\{1,, 79\}$	Bits	24	
For Slot i, if $mod(i, 4) = \{0,1\}$ for i from	Bits	24	
{1,,79}	DIIS	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 $\{1,, 79\}$	CBs	4	
For Slot i, if mod(i, 4) = $\{0,1\}$ for i from $\{1,,79\}$	CBs	5	
Binary Channel Bits Per Slot			
For Slots 0 and Slot i, if $mod(i, 4) = 3$			
for i from $\{0,,79\}$	Bits	N/A	
For Slot i = 40, 41	Bits	69960	
For Slot i, if mod(i, 4) = 2 for i from			
{4,, 79}	Bits	54912	
For Slot i, if $mod(i, 4) = \{0,1\}$ for i from $\{1,,39,42,,79\}$	Bits	73128	
Max. Throughput averaged over 2 frames	Mbps	93.499	
Note 1: SS/PBCH block is transmitted	in slot #0 v	vith periodicity 2	0 ms
Note 2: Slot i is slot index per 2 frames			

Note 2: Slot i is slot index per 2 frames

A.3.2.2.5 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	
Reference channel		R.PDSCH.5-		
Reference charmer		1.1 TDD		
Channel bandwidth	MHz	100		
Subcarrier spacing	kHz	120		
Allocated resource blocks	PRBs	66		
Number of consecutive PDSCH				
symbols				
For Slots 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,159\}$		N/A		
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 159\}$		9		
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,159\}$		13		
Allocated slots per 2 frames		127		
MCS table		64QAM		
MCS index		4		
Modulation		QPSK		
Target Coding Rate		0.30		
Number of MIMO layers		1		
Number of DMRS REs				
For Slots 0 and Slot i, if mod(i, 5) = 4 for		N1/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		10		
from {1,,159}		12		
Overhead for TBS determination		6		
Information Bit Payload per Slot				
For Slots 0 and Slot i, if mod(i, 5) = 4	Bits	N/A		
for i from {0,,159}	DIIS	IN/A		
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 159\}$	Bits	3624		
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,159\}$	Bits	5504		
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	16		
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i	Bits	24		
from {1,,159} Number of Code Blocks per Slot				
For Slots 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,159\}$	CBs	N/A		
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 159\}$	CBs	1		
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,159\}$	CBs	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		
For Slots i = 80, 81	Bits	17490		
For Slot i, if $mod(i, 5) = 3$ for i from $\{0, \dots, 159\}$	Bits	12210		
For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i from $\{1,,79,82,,159\}$	Bits	18282		
	1			
Max. Throughput averaged over 2	Mbps	31.942		

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	
		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 $mod(i, 5) = 4$		N/A	N/A	N/A	
for i from {0,,159}					
For Slot i, if $mod(i, 5) = 3$ for i from		9	9	9	
{0,, 159}		_	_	_	
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i		13	13	13	
from {1,,159} Allocated slots per 2 frames		127	127	127	
MCS table		64QAM	64QAM	64QAM	
MCS lable MCS index		13	13	13	
Modulation		16QAM	16QAM	16QAM	
Target Coding Rate		0.48		0.48	
Number of MIMO layers		1	0.48 2	2	
Number of DMRS REs		, , , , , , , , , , , , , , , , , , ,		2	
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				-	
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	D::	44070	00500	45000	
{0,, 159}	Bits	11272	22536	45096	
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i	Dita	47404	0.404.0	00070	
from {1,,159}	Bits	17424	34816	69672	
Transport block CRC per Slot					
For Slots 0 and Slot i, if $mod(i, 5) = 4$	Bits	N/A	N/A	N/A	
for i from {0,,159}	Dito	IN//A	19/73	IN//A	
For Slot i, if $mod(i, 5) = 3$ for i from	Bits	24	24	24	
{0,, 159}	Dito	24	2-7	2-7	
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i	Bits	24	24	24	
from {1,,159}		- '			
Number of Code Blocks per Slot					
For Slots 0 and Slot i, if $mod(i, 5) = 4$	CBs	N/A	N/A	N/A	
for i from {0,,159}		·	•	·	
For Slot i, if $mod(i, 5) = 3$ for i from	CBs	2	3	6	
{0,, 159}					
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i	CBs	3	5	9	
from {1,,159}					
Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 5) = 4					
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	1_				
from {1,,79,84,,159}	Bits	36564	73128	146256	
Max. Throughput averaged over 2	1	165 ===	061.15	405.55	
Max. Illioudiput averaged over /	Mbps	100.799	201.434	403.096	
frames	Minha	100.700	201.101	100.000	
	•			100.000	

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

Parameter	Unit		Va	lue		
Reference channel		R.PDSCH.5- 3.1 TDD				
Channel bandwidth	MHz	100				
Subcarrier spacing	kHz	120				
Allocated resource blocks	PRBs	66				
Number of consecutive PDSCH symbols						
For Slots 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,159\}$		N/A				
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 159\}$		9				
For Slot i, if mod(i, 5) = $\{0,1,2\}$ for i from $\{1,,159\}$		13				
Allocated slots per 2 frames		127				
MCS table		64QAM				
MCS index		18				
Modulation		64QAM				
Target Coding Rate		0.46				
Number of MIMO layers Number of DMRS REs		1				
For Slots 0 and Slot i, if $mod(i, 5) = 4$ for						
i from {0,,159} For Slot i, if mod(i, 5) = 3 for i from		N/A				
{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		N1/A				
For Slots 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,159\}$	Bits	N/A				
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 159\}$	Bits	16136				
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,159\}$	Bits	25104				
Transport block CRC per Slot						
For Slots 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,159\}$	Bits	N/A				
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 159\}$	Bits	24				
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,159\}$	Bits	24				
Number of Code Blocks per Slot						
For Slots 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,159\}$	CBs	N/A				
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 159\}$	CBs	2				
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,159\}$	CBs	3				
Binary Channel Bits Per Slot						
For Slots 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,159\}$	Bits	N/A				
For Slots i = 80, 81	Bits	52470				
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 159\}$	Bits	36630				
For Slot i, if $mod(i, 5) = \{0,1,2\}$ for i from $\{1,,79,82,,159\}$	Bits	54846				
Max. Throughput averaged over 2 frames	Mbps	145.062				
	-	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.3.2.2.5-4: PDSCH Reference Channel for TDD UL-DL pattern FR2.120-2 (QPSK)

Parameter	Unit		Value		
Reference channel		R.PDSCH.5- 4.1 TDD			
Channel bandwidth	MHz	100			_
Subcarrier spacing	kHz	120			
Allocated resource blocks	PRBs	6			
Number of consecutive PDSCH					
symbols					
For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$		N/A			
for i from {0,,159} For Slot i, if mod(i, 4) = 2 for i from {1,, 159}		10			
For Slot i, if $mod(i, 4) = \{0, 1\}$ for i from $\{1,, 159\}$		13			
Allocated slots per 2 frames		119			
MCS table		64QAM			
MCS index		4			
Modulation		QPSK			
Target Coding Rate		0.30			
Number of MIMO layers		2			
Number of DMRS REs					
For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$		N/A			
For Slot i, if $mod(i, 4) = 2$ for i from $\{1,, 159\}$		12			
For Slot i, if $mod(i, 4) = \{0, 1\}$ for i from $\{1,, 159\}$		12			
Overhead for TBS determination		6			
Information Bit Payload per Slot					
For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$	Bits	N/A			
For Slot i, if mod(i, 4) = 2 for i from {1,, 159}	Bits	736			
For Slot i, if mod(i, 4) = $\{0,1\}$ for i from $\{1,,159\}$	Bits	1032			
Transport block CRC per Slot					-
For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$	Bits	N/A			
For Slot i, if mod(i, 4) = 2 for i from {1,, 159}	Bits	16			
For Slot i, if mod(i, 4) = $\{0,1\}$ for i from $\{1,,159\}$	Bits	16			
Number of Code Blocks per Slot					_
For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$	CBs	N/A			
For Slot i, if mod(i, 4) = 2 for i from {1,, 159}	CBs	1			
For Slot i, if mod(i, 4) = $\{0,1\}$ for i from $\{1,,159\}$	CBs	1			
Binary Channel Bits Per Slot					\dashv
For Slots 0 and Slot i, if $mod(i, 4) = 3$	Bits	N/A			
for i from {0,,159} For Slot i = 80, 81	Bits	3180			
For Slot i, if $mod(i, 4) = 2$ for i from					\dashv
{4,, 159}	Bits	2496			
For Slot i, if $mod(i, 4) = \{0,1\}$ for i from $\{1,,79,82,,159\}$	Bits	3324			
Max. Throughput averaged over 2 frames	Mbps	5.548			
Note 1: SS/PBCH block is transmitted in Note 2: Slot i is slot index per 2 frames		vith periodicity 20) ms	<u> </u>	

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

Parameter	Unit			Value	
Reference channel		R.PDSCH.5-	R.PDSCH.5-		
		5.1 TDD	5.2 TDD		
Channel bandwidth	MHz	100	50		
Subcarrier spacing	kHz	120	120		
Allocated resource blocks Number of consecutive PDSCH	PRBs	66	32		
symbols					
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 $\{1,, 159\}$		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				†	
For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$	Bits	N/A	N/A		
For Slot i = 80, 81	Bits	69960	33920	†	
For Slot i, if $mod(i, 4) = 2$ for i from	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	e	
Reference channel		R.PDSCH.5- 6.1 TDD			
Channel bandwidth	MHz	100			
Subcarrier spacing	kHz	120			
Allocated resource blocks	PRBs	66			
Number of consecutive PDSCH symbols					
For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$		N/A			
For Slot i, if $mod(i, 4) = 2$ for i from $\{1,, 159\}$		10			
For Slot i, if $mod(i, 4) = \{0,1\}$ for i from $\{1,,159\}$		13			
Allocated slots per 2 frames		119			
MCS table		64QAM			
MCS index		17			
Modulation Date		64QAM			
Target Coding Rate		0.43			
Number of MIMO layers Number of DMRS REs		2			
For Slots 0 and Slot i, if $mod(i, 4) = 3$ for					
i from {0,,159} For Slot i, if mod(i, 4) = 2 for i from		N/A			
{1,, 159}		12			
For Slot i, if mod(i, 4) = $\{0,1\}$ for i from $\{1,,159\}$		12			
Overhead for TBS determination		6			
Information Bit Payload per Slot For Slots 0 and Slot i, if mod(i, 4) = 3 for i from {0,,159}	Bits	N/A			
For Slot i, if mod(i, 4) = 2 for i from $\{1,, 159\}$	Bits	34816			
For Slot i, if $mod(i, 4) = \{0,1\}$ for i from $\{1,,159\}$	Bits	47112			
Transport block CRC per Slot					
For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$	Bits	N/A			
For Slot i, if $mod(i, 4) = 2$ for i from $\{1,, 159\}$	Bits	24			
For Slot i, if $mod(i, 4) = \{0,1\}$ for i from $\{1,,159\}$	Bits	24			
Number of Code Blocks per Slot					
For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$	CBs	N/A			
For Slot i, if $mod(i, 4) = 2$ for i from $\{1,, 159\}$	CBs	5			
For Slot i, if $mod(i, 4) = \{0,1\}$ for i from $\{1,,159\}$	CBs	6			
Binary Channel Bits Per Slot					
For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$	Bits	N/A			
For Slot i = 80, 81	Bits	114940			
For Slot i, if $mod(i, 4) = 2$ for i from $\{4,, 159\}$	Bits	82368			
For Slot i, if $mod(i, 4) = \{0,1\}$ for i from $\{1,,79,82,,159\}$	Bits	109692			
Max. Throughput averaged over 2 frames	Mbps	255.724			
Note 1: SS/PBCH block is transmitted it Note 2: Slot i is slot index per 2 frames		with periodicity 20	ms	1	

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

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

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

Note 2:

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

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

Parameter	Unit		Value
Reference channel		R.PDSCH.5-	
Reference channel		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	<u> </u>	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) =	Bits	N/A	
{2,3} for i from {0,,159}	Dito	IN/A	
For CSI-RS Slot i, if mod(i,8) =1 for i	Bits	N/A	
from {0,,159}			
For Slot i = 80	Bits	14344	
For Slot i, if $mod(i, 8) = \{0,4,5\}$ for i	Bits	14344	
from {1,,79,82,,159}		11011	
Transport block CRC per Slot	<u> </u>		
For Slots 0 and Slot i, if mod(i, 4) =	Bits	N/A	
{2,3} for i from {0,,159}		14// (
For CSI-RS Slot i, if mod(i,8) =1 for i	Bits	N/A	
from {0,,159}			
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	OD-	NI/A	
from {0,,159}	CBs	N/A	
For Slot i = 80	CBs	2	
For Slot i, if $mod(i, 8) = \{0,4,5\}$ for i		İ	
from {1,,79,82,,159}	CBs	2	
Binary Channel Bits Per Slot			
For Slots 0 and Slot i, if mod(i, 4) =	D:+-	NI/A	
{2,3} for i from {0,,159}	Bits	N/A	
For CSI-RS Slot i, if mod(i,8) =1 for i	D:to	NI/A	
from {0,,159}	Bits	N/A	
For Slot i = 80	Bits	28776	
For Slot i, if $mod(i, 8) = \{0,4,5\}$ for i	Dito	30360	
from {1,,79,82,,159}	Bits	30360	
Max. Throughput averaged over 2	Mhna	12 21 10	
frames	Mbps	42.3148	
Note 1: SS/PBCH block is transmitted in	a 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

Note 3: Number of DMRS REs includes the overhead of the DM-RS CDM groups without data

A.3.2.2.6 Reference measurement channels for E-UTRA

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

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

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

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

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

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

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

Parameter	Unit		Valu	e	
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		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)

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

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

A.3.3.1.2 Reference measurement channels for SCS 30 kHz FR1

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

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

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

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

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

Parameter	Unit		Val	ue	
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	

CSI reference measurement channels A.4

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

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

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

TBS Scheme	e			TBS.1-1	TBS.1-2				
MCS table						640	QAM		•
Number of a	llocated PDS	CH resource	blocks	66	66				
Number of c	onsecutive Pl	DSCH symbo	ls	12	12				
Number of F	DSCH MIMO	layers		1	2				
Number of D	MRS REs (N	ote 1)		24	24				
Overhead fo	r TBS determ	ination		6	6				
Available RE	-s			7590	7590				
CQI index	Spectral	MCS	Modulatio		Infor	mation Bit	Payload p	er Slot	
	efficiency	index	n						
0	OOR	OOR	OOR	N/A	N/A				
1	0.2344	0	QPSK	1800	3624				
2	0.2344	0		1800	3624				
3	0.3770	2		2856	5640				
4	0.6016	4	QFSK	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	6400M	29192	58384				
13	4.5234	24	64QAM	33816	67584				
14	5.1152	26		38936	77896				
15	5.5547	28		42016	83976				
Note 1: N	umber of DMI	RS REs inclu	des the overhe	ead of the D	M-RS CDI	M groups v	vithout dat	a	

PDSCH is not scheduled on slots containing CSI-RS or slots which are not full DL Note 2: PDSCH is not scheduled on slots containing PBCH, i.e. slot#0 per 20ms periodicity Note 3:

Spectral efficiency is based on MCS Table defined in Table 5.1.3.1-1 of TS 38.214 [12] Note 4:

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

TBS Schem	е			TBS.2-1	TBS.2-2	TBS.2-3	TBS.2-4	TBS.2-5	TBS.2-6
MCS table						2560	QAM		
Number of a	allocated PDS	CH resource	blocks	52	52	106	106	8	16
Number of o	Number of consecutive PDSCH symbols			12	12	12	12	12	12
Number of F	PDSCH MIMO	layers		1	2	1	2	1	1
Number of [Number of DMRS REs (Note 1)			24	24	24	24	24	24
Overhead for	or TBS determ	ination		0	0	0	0	0	0
Available RI	Available RE-s for PDSCH			6240	6240	12720	12720	960	1920
CQI index	Spectral	MCS	Modulatio		Infor	mation Bit F	Payload per	r Slot	
	efficiency	index	n						
0	OOR	OOR	OOR	N/A	N/A	N/A	N/A	N/A	N/A
1	0.2344	0		1480	2976	2976	5896	224	456
2	0.3770	1	QPSK	2408	4744	4744	9480	368	736
3	0.8770	3		5504	11016	11016	22536	848	1736
4	1.4766	5		9224	18432	18960	37896	1416	2856
5	1.9141	7	16QAM	12040	24072	24576	49176	1864	3752
6	2.4063	9		15112	30216	30728	61480	2408	4608
7	2.7305	11		16896	33816	34816	69672	2600	5248
8	3.3223	13		20496	40976	42016	83976	3240	6400
9	3.9023	15	64QAM	24576	49176	49176	98376	3752	7424
10	4.5234	17		28168	56368	57376	114776	4352	8712
11	5.1152	19	1	31752	63528	65576	131176	4864	9736
12	5.5547	21		34816	69672	69672	139376	5248	10760
13	6.2266	23	2560 414	38936	77896	79896	159880	6016	12040
14	6.9141	25	256QAM	43032	86040	88064	176208	6656	13320
15	7.4063	27		46104	92200	94248	188576	7040	14088
Note 1: N	lumber of DMI	RS REs inclu	des the overh	ead of the D	M-RS CDI	√l groups w	ithout data		
Note 2: P	Ÿ ·								

Note 2: PDSCH is not scheduled on slots containing CSI-RS or slots which are not full DL

Note 3: PDSCH is not scheduled on slots containing PBCH, i.e. slot#0 per 20ms periodicity

Note 4: Spectral efficiency is based on MCS Table defined in Table 5.1.3.1-2 of TS 38.214 [12]

Table A.4-3: 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	allocated PDS	CH resource	blocks	52	52	106	106		
Number of consecutive PDSCH symbols			12	12	12	12			
Number of F	PDSCH MIMO	layers		3	4	3	4		
Number of [OMRS REs (N	ote 1)		24	24	24	24		
Overhead for	r TBS determ	ination		0	0	0	0		
Available RI	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	7.4063	27		139376	184424	278776	376896		
Note 1: N									
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: S									

A.5 OFDMA Channel Noise Generator (OCNG)

A.5.1 OCNG Patterns for FDD

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

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

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

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

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

A.5.2 OCNG Patterns for TDD

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

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

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

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

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

Annex B (normative): Propagation conditions

B.1 Static propagation condition

B.1.1 UE Receiver with 2Rx

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

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

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

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

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

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

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

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

B.1.2 UE Receiver with 4Rx

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

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

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

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

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

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

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

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

B.2 Multi-path fading propagation conditions

The multipath propagation conditions consist of several parts:

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

B.2.1 Delay profiles

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

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

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

B.2.1.1 Delay profiles for FR1

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

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

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

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

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

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

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

B.2.2 Combinations of channel model parameters

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

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

Table B.2.2-1: Channel model parameters for FR1

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

Table B.2.2-2: Channel model parameters for FR2

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

B.2.3 MIMO Channel Correlation Matrices

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

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

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

B.2.3.1.1 Definition of MIMO Correlation Matrices

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

Table B.2.3.1.1-1: gNB correlation matrix

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

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

Table B.2.3.1.1-2: UE correlation matrix

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

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

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

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

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

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

The 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 & 0.8882 & 1.0000 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9541 & 0.9430 & 0.9105 & 0.8894 & 0.8999 & 0.8894 & 0.8599 & 0.8581 & 0.9882 & 1.0000 & 0.9882 & 0.9430 & 0.9767 & 0.9882 & 0.8587 & 0.9105 & 0.9430 & 0.9541 & 0.8099 & 0.8587 & 0.8894 & 0.8999 & 0.8894 & 0.8999 & 0.9541 & 0.9882 & 1.0000 & 0.8894 & 0.9430 & 0.9767 & 0.9430 & 0.9541 & 0.8099 & 0.8587 & 0.8894 & 0.8999 & 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 & 0.9541 & 0.9430 & 0.9105 & 0.8587 & 0.9882 & 0.9767 & 0.9430 & 0.9541 & 0.9430 & 0.9541 & 0.9430 & 0.9541 & 0.9430 & 0.9541 & 0.9430 & 0.9541 & 0.9430 & 0.9541 & 0.9430 & 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9541 & 0.9430 & 0.9541 & 0.9430 & 0.9105 & 0.8587 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9430 & 0.9541 & 0.9430 & 0.9105 & 0.9430 & 0.9541 & 0.9430 & 0.9105 & 0.9430 & 0.9541 & 0.9430 & 0.9105 & 0.9430 & 0.9541 & 0.9430 & 0.9105 & 0.9430 & 0.9767 & 0.9430 & 0.8894 & 1.0000 & 0.9882 & 0.9541 & 0.8999 & 0.8882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9882 & 0.9767 & 0.9882 & 0.9767 & 0.9430 & 0.9882$	587 894 999 587 105 430 541 894 430 767 882 999 541									

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

1x2 case	N/A
2x1	N/A
case	
2x2 case	$R_{medium} = \begin{pmatrix} 1 & 0.9 & 0.3 & 0.27 \\ 0.9 & 1 & 0.27 & 0.3 \\ 0.3 & 0.27 & 1 & 0.9 \\ 0.27 & 0.3 & 0.9 & 1 \end{pmatrix}$
2x4 case	$R_{medium} = \begin{pmatrix} 1.0000 & 0.9882 & 0.9541 & 0.8999 & 0.3000 & 0.2965 & 0.2862 & 0.2700 \\ 0.9882 & 1.0000 & 0.9882 & 0.9541 & 0.2965 & 0.3000 & 0.2965 & 0.2862 \\ 0.9541 & 0.9882 & 1.0000 & 0.9882 & 0.2862 & 0.2965 & 0.3000 & 0.2965 \\ 0.8999 & 0.9541 & 0.9882 & 1.0000 & 0.2700 & 0.2862 & 0.2965 & 0.3000 \\ 0.3000 & 0.2965 & 0.2862 & 0.2700 & 1.0000 & 0.9882 & 0.9541 & 0.8999 \\ 0.2965 & 0.3000 & 0.2965 & 0.2862 & 0.9882 & 1.0000 & 0.9882 & 0.9541 \\ 0.2862 & 0.2965 & 0.3000 & 0.2965 & 0.9541 & 0.9882 & 1.0000 & 0.9882 \\ 0.2700 & 0.2862 & 0.2965 & 0.3000 & 0.8999 & 0.9541 & 0.9882 & 1.0000 \end{pmatrix}$
4x2 case	$R_{medium} = \left(\begin{array}{cccccccccccccccccccccccccccccccccccc$
4x4 case	1.0000

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

1x4 case						R _{mediu}		1 0.9000 0.6561 0.3874	0.9000 1 0.9000 0.6561	0.90) 1	0.0 0.9	3874 5561 0000 1					
2x4 case			R_{med}	$_{iumA}=$	(1.0000 0.9000 0.6561 0.3874 0.3000 0.2700 0.1968 0.1162	1.00 0.90 4 0.65 0 0.27 0 0.30 0 0.27	00 0 000 1 661 0 700 0 000 0	.9000 .0000 .9000 .1968 .2700	0.3874 0.6561 0.9000 1.0000 0.1162 0.1968 0.2700 0.3000	0.116 1.000 0.900 0.656	0 0.3 68 0.2 62 0.1 00 0.9 00 1.0	000 700 968 9000 9000	0.1968 0.2700 0.3000 0.2700 0.6561 0.9000 1.0000 0.9000	0.1162 0.1968 0.2700 0.3000 0.3874 0.656 0.9000 1.0000	3 0 1 1 1		
4x4 case	$R_{medium A} =$	0.9000 0.6561 0.3874 0.8748 0.7873 0.5739 0.3389 0.5856 0.5270 0.3842 0.2269 0.3000 0.2700 0.1968	1.0000 0.9000 0.6561 0.7873 0.8748 0.7873 0.5270 0.5856 0.5270 0.3842 0.2700 0.3000 0.2700	0.9000 1.0000 0.9000 0.5739 0.7873 0.8748 0.7873 0.3842 0.5270 0.5856 0.5270 0.1968 0.2700 0.3000	0.6561 0.9000 1.0000 0.3389 0.5739 0.7873 0.8748 0.2269 0.3842 0.5270 0.5856 0.1162 0.1968 0.2700	0.7873 0.5739 0.3389 1.0000 0.9000 0.6561 0.3874 0.7873 0.5739 0.3389 0.5856 0.5270 0.3842	0.8748 0.7873 0.5739 0.9000 1.0000 0.9000 0.6561 0.7873 0.5739 0.5270 0.5856 0.5270	0.7873 0.8748 0.7873 0.6561 0.9000 1.0000 0.9000 3 0.5739 3 0.7873 3 0.8748 9 0.7873 0 0.3842 5 0.5270 0 0.5856	0.5739 0.7873 0.8748 0.3874 0.6561 0.9000 1.0000 0.3389 0.5739 0.7873 0.8748 0.2269 0.3842 0.5270	0.5270 0.3842 0.2269 0.8748 0.7873 0.5739 0.3389 1.0000 0.9000 0.6561 0.3874 0.8748 0.7873	0.5856 0.5270 0.3842 0.7873 0.8748 0.7873 0.5739 0.9000 1.0000 0.9000 0.6561 0.7873 0.8748 0.7873	0.5270 0.5856 0.5270 0.5739 0.7873 0.8748 0.7873 0.6561 0.9000 0.9000 0.5739 0.7873 0.8748	2 0.2269 0.3842 0.5270 0.5856 0.3389 0.5739 0.8748 0.3874 0.6561 0.9000 0 0.3389 3 0.5739 3 0.7873 3 0.8748	0.2700 0.1968 0.1162 0.5856 0.5270 0.3842 0.2269 0.8748 0.7873 0.5739 0.3389 1.0000 0.9000 0.6561	0.3000 0.2700 0.1968 0.5270 0.5856 0.5270 0.3842 0.7873 0.8748 0.7873 0.5739 0.9000 1.0000 0.9000	0.2700 0.3000 0.2700 0.3842 0.5270 0.5856 0.5270 0.5739 0.7873 0.8748 0.7873 0.6561 0.9000 1.0000	0.1968 0.2700 0.3000 0.2269 0.3842 0.5270 0.5856 0.3389 0.5739 0.7873 0.8748 0.3874 0.6561 0.9000

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

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

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

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

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

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

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

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

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

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

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

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

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

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

where

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

$$R_{gNB} = R_{gNB_Dim,1} \otimes R_{gNB_Dim,2}$$

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where

- - R_{gNB_Dim1} 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,

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

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

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

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

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

$$R_{gNB} = R_{gNB_Dim1}$$

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 α_1 applies when more than one pair of cross-polarized antenna elements in first dimension at gNB side.								
Note 2:		olies when more than one pair of cross-polarized nts in second dimension at gNB side.							
Note 3:	Value of β applies elements at UE sid	es when more than one pair of cross-polarized antenna side.							

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

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

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

Where the value "a" is a scaling factor such that the smallest value is used to obtain a positive semi-definite result. For the 8(4,1,2)x2 high spatial correlation case, a=0.00010.

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

				Γ 1	.0000	0.0000	0.90	000 (0.0000	-0.30	000 (0.0000	-0.27	700 0	0.0000		
						1.0000	0.00).9000	0.00		0.3000	0.00		0.2700		
						0.0000	1.00		0.0000	-0.27		0.0000	-0.30		0.0000		
4(2,1,2)x2 case			$R_{high} =$:		0.9000	0.00		0000.1	0.00		0.2700	0.00		0.3000		
Case				- 0	.3000	0.0000			0.0000	1.00		0.0000	0.90		0.0000		
						0.3000			0.2700	0.00		.0000	0.00		0.9000		
				-0	.2700	0.0000	- 0.3	000 (0.0000	0.90	00 0	.0000	1.00	00 0	0.0000		
					0.0000	0.2700	0.0	0000	0.3000	0.00	00 0	.9000	0.00	000 1	.0000		
				1	.0000	0.9000	0.0	000	0.0000	-0.30	000 -	0.2700	0.000	0.0	0000		
				0	.9000	1.0000	0.0	000	0.0000	-0.27	700 -0	0.3000	0.000	0.0	0000		
				0	.0000	0.0000	0 1.0	000	0.9000	0.00	000 0	.0000	0.300	0 0.2	700		
2(1,1,2)x4			D	0	.0000	0.0000	0.9	000	1.0000	0.00	000 0	.0000	0.270	0 0.3	000		
case			R_{high}	= -(0.3000	-0.270	0.0	000	0.0000	1.00	000 0	.9000	0.000	0.0	000		
				-(0.2700	-0.300	0.0	000	0.0000	0.90	000 1	.0000	0.000	0.0	000		
				0	.0000	0.0000	0.3	000	0.2700	0.00	000 0	.0000	1.000	0 0.9	000		
				0	.0000	0.0000		700	0.3000			.0000	0.900	0 1.0	000		
		1.0000	0.9000	0.0000	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	0.9000	0.0000	0.0000	0.9000 0.8100	0.8100 0.9000	0.0000	0.0000	0.3000 0.2700	0.2700 0.3000	0.0000	0.0000	0.2700 0.2430	0.2430 0.2700
		0.9000		0.0000		1.0000	0.0000	0.0000	0.0000	-0.2700	-0.2430	0.2700	0.0000	-0.3000	-0.2700	0.2430	0.0000
		0.8100	0.9000	0.0000	0.0000	0.9000	1.0000	0.0000	0.0000	-0.2430	-0.2700	0.0000	0.0000	-0.2700	-0.3000	0.0000	0.0000
4(0.4.0) 4		0.0000		0.9000		0.0000	0.0000	1.0000	0.9000	0.0000	0.0000	0.2700	0.2430	0.0000	0.0000	0.3000	0.2700
4(2,1,2)x4 case	$R_{ m high}$ $=$	0.0000		0.8100		0.0000 -0.2700	0.0000 -0.2430	0.9000	1.0000 0.0000	0.0000 1.0000	0.0000	0.2430 0.0000	0.2700 0.0000	0.0000	0.0000 0.8100	0.2700 0.0000	0.3000
Case		-0.2700		0.0000		-0.2430	-0.2700	0.0000	0.0000	0.9000	1.0000	0.0000	0.0000	0.8100	0.9000	0.0000	0.0000
		0.0000	0.0000	0.3000	0.2700	0.0000	0.0000	0.2700	0.2430	0.0000	0.0000	1.0000	0.9000	0.0000	0.0000	0.9000	0.8100
		0.0000		0.2700		0.0000	0.0000	0.2430	0.2700	0.0000	0.0000	0.9000	1.0000	0.0000	0.0000	0.8100	0.9000
		-0.2700 -0.2430		0.0000		-0.3000 -0.2700	-0.2700 -0.3000	0.0000	0.0000	0.9000 0.8100	0.8100 0.9000	0.0000	0.0000	1.0000 0.9000	0.9000 1.0000	0.0000	0.0000
		0.0000		0.2700		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				0.0000		0.0000	-0.2862		-0.2700	0.0000
		0.0000			00 0.988						0.3000		0.2965	0.0000		0.0000	
		0.9883				0 0.9883											
		0.0000				0.0000											
		0.9542				0 1.0000 3 0.0000											
		0.8999				0.0883											
8(4,1,2)x2		0.0000				2 0.0000											
case		-0.3000				0 -0.2862											
		0.0000	0.3000	0.00	00 0.296	5 0.0000	0.2862	0.0000	0.2700	0.0000	1.0000	0.0000	0.9883	0.0000	0.9542	0.0000	0.8999
		-0.2965	5 0.0000	-0.30	00.000	0 -0.2965	0.0000	-0.2862	0.0000	0.9883	0.0000	1.0000	0.0000	0.9883	0.0000	0.9542	0.0000
		0.0000	0.2965	0.00	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 -0.3000							0.0000			0.9883	
		0.0000				5 0.0000								0.0000		0.0000	
						0 -0.2965											
		0.0000	0.2700	0.00	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

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

B.2.3.2.3 Beam steering approach

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

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

And the steering matrix is further expressed as following:

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

where

- H is the $Nr \times Nt$ channel matrix per subcarrier.
- $D_{\theta_{k,1},\theta_{k,2}}$ is the steering matrix,
- $D_{\theta_{i,1}}(N_1)$ is the steering matrix in first dimension with same polarization,
- $D_{\theta_{0,2}}(N_2)$ is the steering matrix in second dimension with same polarization,
- N_1 is the number of antenna elements in first dimension with same polarization,
- N_2 is the number of antenna elements in second dimension with same polarization,
- For antenna array with only one direction, number of antenna element in second direction N_2 equals 1.

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

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

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

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

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

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

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

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

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

- $\theta_{k,i}$ controls the phase variation in first dimension and second dimension respectively, and the phase for k-th subframe is denoted by $\theta_{k,i} = \theta_{0,i} + \Delta \theta \cdot k$, where $\theta_{0,i}$ is the random start value with the uniform distribution, i.e., $\theta_{0,i} \in [0,2\pi]$, $\Delta \theta$ is the step of phase variation, which is defined in Table B.2.3B.4-1, and k is the linear increment of $2^{-\mu}$ for every slot throughout the simulation, the index i=1,2 stands for first dimension and second dimension respectively.
- w is the precoding matrix for Nt transmission antennas,
- y is the received signal, x is the transmitted signal, and n is AWGN.
- μ corresponds to subcarrier spacing configuration, $\Delta f = 2^{\mu} \cdot 15 [\text{kHz}]$

For the 1D cross-polarized antenna array at gNB, the corresponding random channel matrix H can be calculated by letting N_2 =1, i.e.,

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

Table B.2.3B.4-1: The step of phase variation

Variation Step	Value (rad/ms)
$\Delta \theta$	1.2566×10 ⁻³

B.2.4 Two-tap propagation conditions for CQI tests

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

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

in continuous time (t, τ) representation, with \mathcal{T}_d the delay, a constant value of a and f_D the Doppler frequency. The same $h(t,\tau)$ is used to describe the fading channel between every pair of Tx and Rx.

B.3 High Speed Train Scenario

B.3.1 Single Tap Channel Profile

The high speed train condition for the test of the baseband performance is a non fading propagation channel with one tap. Doppler shift is given by

$$f_s(t) = f_d \cos \theta(t) \tag{B.3.1.1}$$

where $f_s(t)$ is the Doppler shift and f_d is the maximum Doppler frequency. The cosine of angle $\theta(t)$ is given by

$$\cos\theta(t) = \frac{D_s/2 - vt}{\sqrt{D_{\min}^2 + (D_s/2 - vt)^2}}, \ 0 \le t \le D_s/v$$
(B.3.1.2)

$$\cos \theta(t) = \frac{-1.5D_s + vt}{\sqrt{D_{\min}^2 + (-1.5D_s + vt)^2}}, \ D_s/v < t \le 2D_s/v$$
(B.3.1.3)

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

where $D_s/2$ is the initial distance of the train from gNB, and D_{\min} is gNB Railway track distance, both in meters; v is the velocity of the train in m/s, t is time in seconds.

Doppler shift and cosine angle are given by equation B.3.1.1 and B.3.1.2-B.3.1.4 respectively, where the required input parameters listed in Table B.3.1-1 and the resulting Doppler shift shown in Figure B.3.1-1 are applied for all frequency bands.

Table B.3.1-1: High speed train scenario

- Note 1: Parameters for HST conditions in Table B.3.1-1 including f_d and Doppler shift trajectories presented on figure B.3.1-1 for 750 Hz for 15 kHz SCS and figure B.3.1-2 for 1000 Hz for 30 kHz SCS are applied for performance verification in all frequency bands.
- Note 2: The propagation conditions used for the performance requirements under high speed train condition are indicated as a combination of "HST" and Doppler shift f_d , i.e. HST-<Doppler shift>, where '<Doppler shift>' indicates the maximum Doppler shift (Hz) .

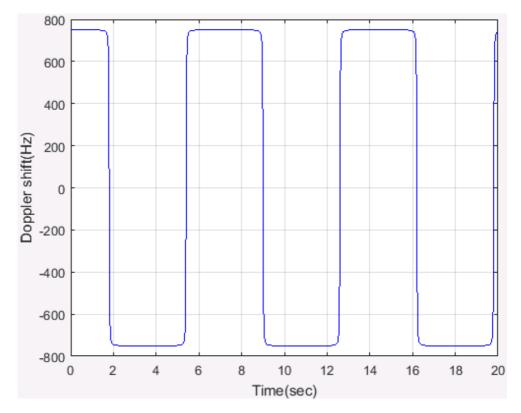


Figure B.3.1-1: Doppler shift trajectory ($f_{\scriptscriptstyle d}$ = 750 Hz)

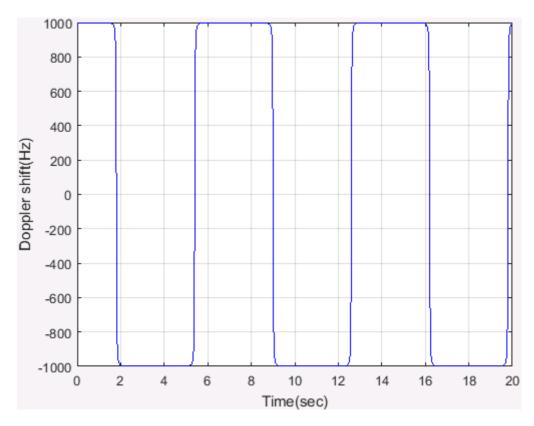


Figure B.3.1-2: Doppler shift trajectory ($f_{\it d}$ = 1000 Hz)

For 1x2 antenna configuration, the same $h(t,\tau)$ is used to describe the channel between every pair of Tx and Rx. For 1x4 antenna configuration, the same $h(t,\tau)$ is used to describe the channel between every pair of Tx and Rx. Static channel matrix will be used as defined in Annex B.1.

B.4 Physical signals, channels mapping and precoding

B.4.1 General

Unless otherwise stated, the transmission on antenna port(s) $p = p_0, p_0 + 1, \dots, p_0 + N_p - 1$ is defined by using a precoder matrix W(i) of size $N_{ANT} \times N_p$, where N_{ANT} is the number of physical transmit antenna elements configured per test, N_p is the number of ports for a reference signal or physical channel configured per test, and p_0 is the first port for that reference signal or physical channel as defined in clauses 7.3 and 7.4 in TS 38.211 [9]. This precoder takes as an input a block of signals for antenna port(s) $p = p_0, p_0 + 1, \dots, p_0 + N_p - 1, y^{(p)}(i) =$

 $\begin{bmatrix} y^{(p_0)}(i) \ y^{(p_0+1)}(i) \ \dots \ y^{(p_0+N_p-1)}(i) \end{bmatrix}^T, \ i=0,1,\dots,M_{\text{symb}}^{\text{ap}}-1, \ \text{with} \ M_{\text{symb}}^{\text{ap}} \ \text{being the number of modulation}$ symbols per antenna port including the reference signal symbols, and generates a block of signals $y_{bf}^{(q)}(i)=\begin{bmatrix} y_{bf}^{(0)}(i) \ y_{bf}^{(1)}(i) \ \dots \ y_{bf}^{(N_{ANT}-1)}(i) \end{bmatrix}^T$ the elements of which are to be mapped onto the frequency-time index pair (k,l) as per the test configuration but transmitted on different physical antenna elements:

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

For Clause 6 and 8, the transmission of PDCCH and PDCCH DMRS on antenna port $p = p_0$ is defined by using a precoder matrix W(i) of size 2x1. This precoder takes as an input a block of signals for antenna port(s) $p = p_0$,

$$y^{(p)}(i) = y^{(p_0)}(i)$$
 and generates a block of signals $y_{bf}^{(q)}(i) = \left[y_{bf}^{(0)}(i) \ y_{bf}^{\left(\frac{N_{ANT}}{2}\right)}(i)\right]^T$ the elements of which are to be

mapped onto the frequency-time index pair (k, l) as per the test configuration but transmitted on different physical antenna elements:

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

The precoder matrix W(i) is specific to the test case configuration. W(i) is defined in Clause 5.2.2.2 of TS 38.214 [12].

The transimison on PT-RS antenna port is associated (using same precoder) with the lowest indexed DM-RS antenna port among the DM-RS antenna ports assigned for the PDSCH.

The physical antenna elements are identified by indices $j = 0,1,...,N_{ANT}-1$, where N_{ANT} is the number of physical antenna elements configured per test.

Modulation symbols $y^{(p)}(i)$ with $p \in \{4000\}$ (i.e. PSS, SSS, PBCH and DM-RS for PBCH) are directly mapped to first physical antenna element.

Modulation symbols $a_{k,l}$ for CSI-RS resources which configured for tracking with one port are directly mapped to first physical antenna element.

Modulation symbols $a_{k,l}$ for CSI-RS resources which configured for beam refinement with one port are directly mapped to first physical antenna element.

Modulation symbols $a_{k,l}^{(p)}$ for NZP CSI-RS which configured for CSI acquisition with

 $p \in \{p_0, p_0 + 1, ..., p_0 + N_{CSI} - 1\}$ are mapped to the physical antenna index $j = p - p_0$ where N_{CSI} is the number of NZP CSI-RS ports configured per test.

Annex C (normative): Downlink physical channels

C.1 General

This annex specifies the downlink physical channels that are needed for setting a connection and channels that are needed during a connection.

C.2 Setup (Conducted)

Table C.2-1 describes the downlink Physical Channels that are required for connection set up.

Table C.2-1: Downlink Physical Channels required for connection set-up

Physical Channel
PBCH
SSS
PSS
PDCCH
PDSCH
PBCH DMRS
PDCCH DMRS
PDSCH DMRS
CSI-RS

C.3 Connection (Conducted)

The following clauses, describes the downlink Physical Channels that are transmitted during a connection i.e., when measurements are done.

C.3.1 Measurement of Performance requirements

Table C.3.1-1 is applicable for measurements in which uniform RS-to-EPRE boosting for all downlink physical channels, unless otherwise stated.

Table C.3.1-1: Downlink Physical Channels transmitted during a connection (FDD and TDD)

Parameter	Unit	Value (Note 2)					
SSS transmit power	W	Test specific					
EPRE ratio of PSS to SSS	dB	0					
EPRE ratio of PBCH to SSS	dB	0					
EPRE ratio of PBCH to PBCH DMRS	dB	0					
EPRE ratio of PDCCH to SSS	dB	0					
EPRE ratio of PDCCH to PDCCH DMRS	dB	0					
EPRE ratio of PDSCH to SSS	dB	0					
EPRE ratio of PDSCH to PDSCH DMRS	dB	Test specific (Note 1)					
EPRE ratio of NZP CSI-RS to SSS	dB	-10*log10(L) (Note 3)					
EPRE ratio of PDSCH OCNG to SSS	dB	0					
EPRE ratio of PDCCH OCNG to SSS	dB	0					
EPRE ratio of LTE CRS to NR SSS	dB	0 (Note 4)					
Note 1: Value is derived from Table 4.1-1 in TS 38.214 [12] based on "Number of DM-RS CDM							
groups without data" and "DMRS Type" parameters specified for each test							
Note 2: The value is the energy of per RE for a single antenna port before pre-coding.							
Note 2: X [1.2.4.0] in the CDM group aims of NZD CCL DC appoiling for each test							

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

Note 4: It is only applicable to LTE-NR coexistence tests.

C.4 Setup (Radiated)

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

Table C.4-1: Downlink Physical Channels required for connection set-up

Physical Channel
PBCH
SSS
PSS
PDCCH
PDSCH
PBCH DMRS
PDCCH DMRS
PDSCH DMRS
CSI-RS
PTRS

C.5 Connection (Radiated)

The following clauses, describes the downlink Physical Channels that are transmitted during a connection i.e., when measurements are done.

C.5.1 Measurement of Receiver Characteristics

Table C.5.1-1 is applicable for measurements in which uniform RS-to-EPRE boosting for all downlink physical channels, unless otherwise stated.

Table C.5.1-1: Downlink Physical Channels transmitted during a connection (TDD)

Parameter	Unit	Value (Note 2)
SSS transmit power	W	Test specific
EPRE ratio of PSS to SSS	dB	0
EPRE ratio of PBCH to SSS	dB	0
EPRE ratio of PBCH to PBCH DMRS	dB	0
EPRE ratio of PDCCH to SSS	dB	0
EPRE ratio of PDCCH to PDCCH DMRS	dB	0
EPRE ratio of PDSCH to SSS	dB	0
EPRE ratio of PDSCH to PDSCH DMRS	dB	Test specific (Note 1)
EPRE ratio of NZP CSI-RS to SSS	dB	-10*log10(L) (Note 3)
EPRE ratio of PTRS to PDSCH	dB	Test specific (Note 4)
EPRE ratio of PDSCH OCNG to SSS	dB	0
EPRE ratio of PDCCH OCNG to SSS	dB	0
Note 1: Value is derived from Table 4.1	-1 in TS	38.214 [12] based on "Number of DM-RS CDM

Note 1: Value is derived from Table 4.1-1 in TS 38.214 [12] based on "Number of DM-RS CDM groups without data" and "DMRS Type" parameters specified for each test

Note 2: The value is the energy of per RE for a single antenna port before pre-coding. Note 3: $L \in \{1,2,4,8\}$ is the CDM group size of NZP CSI-RS specified for each test.

Note 4: Value is derived from Table 4.1-2 in TS 38.214 [12] based on "The number of PDSCH layers" and "epre-Ratio" parameters specified for each test.

Annex D (informative): Void

Annex E (normative): Environmental conditions

E.1 General

This annex specifies the environmental requirements of the UE. Within these limits the requirements of the present documents shall be fulfilled.

E.2 Environmental (Conducted)

The requirements in this clause apply to all types of UE(s).

E.2.1 Temperature

The UE shall fulfil all the requirements in the temperature range defined in Table E.2.1-1.

Table E.2.1-1: Temperature conditions

+15°C to +35°C	For normal conditions (with relative humidity of 25 % to 75 %)
----------------	--

Outside this temperature range the UE, if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in clause 6.2 of TS 38.101-1 [6] for extreme operation.

E.2.2 Voltage

The UE shall fulfil all the requirements in the voltage range defined in Table E.2.2-1.

Table E.2.2-1: Voltage conditions

Power source	Normal conditions voltage
AC mains	nominal
Regulated lead acid battery	1,1 * nominal
Non regulated batteries:	
Leclanché	Nominal
Lithium	1,1 * Nominal
Mercury/nickel & cadmium	Nominal

Outside this voltage range the UE if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in TS 38.101-1[6, Clause 6.2] for extreme operation. In particular, the UE shall inhibit all RF transmissions when the power supply voltage is below the manufacturer declared shutdown voltage.

E.2.3 Vibration

The UE shall fulfil all the requirements when vibrated at the following frequency/amplitudes.

Table E.2.3-1: Vibration conditions

Frequency	ASD (Acceleration Spectral Density) random vibration
5 Hz to 20 Hz	$0.96 \text{ m}^2/\text{s}^3$
20 Hz to 500 Hz	0,96 m ² /s ³ at 20 Hz, thereafter –3 dB/Octave

Outside the specified frequency range the UE, if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in TS 38.101-1[6] for extreme operation.

E.3 Environmental (Radiated)

The requirements in this clause apply to all types of UE(s).

E.3.1 Temperature

All requirements for UEs operating in FR2 are defined over the air and can only be tested in an OTA chamber.

The UE shall fulfil all the requirements in the temperature range defined in Table E.3.1-1.

Table E.3.1-1: Temperature conditions

+ 25 °C ± 10 °C	For normal (room temperature) conditions with relative
	humidity of 25% to 75%

Outside this temperature range the UE, if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in clause 6.2 of TS 38.101-2 [7] for extreme operation.

E.3.2 Voltage

< Editor's note: This requirement is incomplete. The following aspects are either missing or not yet determined:

Methodology to control the voltage in a case which a power cable is not connected to DUT is FFS since it is not agreed whether we can connect the power cable to DUT at the OTA measurement situation yet.

>

The UE shall fulfil all the requirements in the voltage range defined in Table E.3.2-1.

Table E.3.2-1: Voltage conditions

Power source	Normal conditions voltage
AC mains	nominal
Regulated lead acid battery	1,1 * nominal
Non regulated batteries:	
Leclanché	Nominal
Lithium	1,1 * Nominal
Mercury/nickel & cadmium	Nominal

Outside this voltage range the UE if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in clause 6.2 of TS 38.101-2 [7] for extreme operation. In particular, the UE shall inhibit all RF transmissions when the power supply voltage is below the manufacturer declared shutdown voltage.

E.3.3 Void

Annex G (informative): Void
Annex H (informative): Void
Annex I (informative): Void
Annex J (informative): Void
Annex K (informative): Void

Annex L (informative): Change history

Date	Meeting	tDoc	CR	Rev	Cat	Change history Subject/Comment	New
Date	Meeting	iboc	JOIN .	IXCV	Oat	oubject comment	version
2018-07	RAN4 AH18-07	R4- 1809554				Draft skeleton	0.0.1
2018-08	RAN4#88	R4- 1811357				Skeleton update	0.0.2
2018-10	RAN4#88	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	
2018-11	RAN4#89	R4-				conditions" Approved Text Proposal in RAN4#89:	0.2.0
2010-11	KAN4#09	1816559				R4-1814053, "TP on performance specification 38.101-4 Chapter 4	0.2.0
						general part"	
						R4-1814487, "TP for TS38.101-4 section 2 (Reference)"	
						R4-1814488, "TP for TS38.101-4 section 3 (Definitions, symbols and labbreviations)"	
						R4-1814579, "TP to TS 38.101-4: Annex A Measurement channels -	
						PDSCH"	
						R4-1814580, "TP to TS 38.101-4: Annex A Measurement channels - DL Control"	
						R4-1814581, "TP to TS 38.101-4: Annex A Measurement channels –	
						CSI" R4-1816395, "FR2 demod: Noc, Band groups and Ref point - TP for	
						TS 38.101-4"	
						R4-1816692, "TP to TS 38.101-4: Requirements applicability"	
						R4-1816693, "TP for performance requirements for interworking (9)" R4-1816694, "TP to TS 38.101-4: FR1 PDSCH demodulation	
						requirements (5.2)"	
						R4-1816695, "Draft TP on FR2 PDSCH Demodulation Performance	
						Requirements" R4-1816697, "TP for updating FR1 PDCCH requirements in TS	
						38.101-4 section 5.3"	
						R4-1816699, "TP to TS 38.101-4: 5.4 FR1 PBCH demodulation	
						requirements" R4-1816700, "TP to TS 38.101-4: 7.4 FR2 PBCH demodulation	
						requirements"	
						R4-1816701, "TP of introduction of FR1 CQI requirement (6.2)"	
						R4-1816702, "TP to TS 38.101-4: FR2 CQI requirements (8.2)" R4-1816703, "Draft TP on FR1 Rank Indication Reporting	
						Performance Requirements"	
				1		R4-1816704, "Draft TP on FR2 Rank Indication Reporting	
						Performance Requirements" R4-1816705, "TP for TS 38.101-4 FR1 PMI test requirement"	
				1		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" R4-1816714, "TP for propagation conditions in TS 38.104-4(Annex	
						B)"	
2018-12	RAN#82	RP-182408		1		V1.0.0 is submitted to RAN for 1-step approval	1.0.0
2018-12	RAN#82	RP-182704	1	1	i	V1.0.1 with editorial changes	1.0.1

2019-03	RAN#83	RP-190403	0001	В	CR on UE demodulation and CSI requirements for 38.101-4	15.1.0
					This CR comboines all the endorsed draft CRs as list below:	
					General sections R4-1902427, Draft CR on NR UE demodulation requirements	
					applicability (Intel Corporation)	
					R4-1902576, Draft CR on General Applicability of Requirements	
					(Qualcomm Incorporated)	
					R4-1902412, Editorial cleanup of FR2 Radiated Requirements	
					General section (ANRITSU) PDSCH	
					R4-1902414, Draft CR on FR1 normal PDSCH demodulation	
					requirements (Intel Corporation)	
					R4-1902415, Draft CR on FR2 PDSCH Requirements (Qualcomm	
					Incorporated)	
					R4-1902411, Draft CR on FR1 SDR requirements (Intel Corporation) PDCCH	
					R4-1902416 Draft CR for updating FR1 PDCCH performance	
					requirements in TS38.101-4Huawei, HiSilicon	
					R4-1902423 Draft CR for updating FR2 PDCCH performance	
					requirements in TS38.101-4 section 7.3 CATT PBCH	
					R4-1902420, Draft CR on 2Rx PBCH demodulation requirement for	
					FR1 (CMCC)	
					R4-1902421, Draft CR on 4Rx PBCH demodulation requirements for	
					FR1 (CMCC)	
					R4-1902422, Draft CR on 2Rx PBCH demodulation requirement for FR2 (CMCC)	
					CSI	
					R4-1902418, Draft CR on FR2 CSI Reporting Tests (Qualcomm	
					Incorporated)	
					R4-1902419, Draft CR on FR1 CSI Reporting Tests (Qualcomm Incorporated)	
					R4-1900105, Draft CR on NR CSI reporting (Intel Corporation)	
					R4-1902058, Draft CR for update of FR1 CQI reporting test (Huawei,	
					HiSilicon)	
					R4-1902059, Draft CR for update of FR2 CQI reporting test (Intel) R4-1902426, Draft CR for PMI test cases: 6.2, 8.2, A.3.2.2.2,	
					A.3.2.2.5 (Samsung)	
					R4-1902425, Draft CR for FR1 and FR2 RI test cases (Qualcomm)	
					Annex	
					R4-1900369, Draft CR on PDSCH FRC (Intel Corporation) R4-1900370, Draft CR on PDCCH FRC (Intel Corporation)	
					R4-190370, Draft CR off PDCCH FRC (Intel Colporation) 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:	
					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#91 endorsed draft CRs from RAN4#90bis RA-1902885, Draft CR on DL power allocation for TS 38.101-4 R4-1903387, Draft CR for adding applicable rules on CSI test cases: 6, 8, 10 R4-1904750, draftCR on RMC for demod requirement for 38.101-4 R4-1904751, Clarification on step 5 and step 6 for delay profiles calculation in B.2.1 R4-1904751, Clarification on step 5 and step 6 for delay profiles calculation in B.2.1 R4-1904756, Draft CR on FR1 normal PDSCH demodulation requirements R4-1904757, Draft CR on FR1 normal PDSCH demodulation Performance Tests R4-1904758, Draft CR on EN-DC SDR requirements R4-1904759, Addition of alternative TDD configuration for UE demodulation requirements R4-1904756, Draft CR on FR2 PDCCH demodulation requirements R4-1904766, draftCR: Updates to FR1 PDCCH demodulation requirements R4-1904767, Draft CR for Beamforming model: Annex B.4.1 R4-1904767, Draft CR for modification on CSI test cases: 6, 8, 10 R4-1904776, Draft CR on FR1 SDR requirements R4-1904777, Draft CR on FR1 SDR requirements R4-1904777, Draft CR on FR1 SDR requirements R4-1904777, Draft CR on FR3 SDR Requirements R4-1904777, Draft CR on FR3 SDR Requirements R4-1904779, Draft CR on FR3 SDR Requirements R4-1904779, Draft CR on FR3 SDR Requirements R4-1904779, Draft CR to TS38.101-4: Correction to FR1 CSI test cases R4-1904790, Draft CR to TS38.101-4 on SNR, Es and Noc setup endorsed draft CRs from RAN4#91 R4-190690, Draft CR to no PBCH requirements R4-190690, Editorial corrections for 38.101-4 PBCH tables R4-1907293, Draft CR to TS38.101-4 for FR2 SDR test cases R4-1907393, Draft CR to No can de Setup R4-1907293, Draft CR to TS38.101-4 for FR2 SDR test cases R4-1907294, Draft CR no Noc and Es setup R4-1907293, Draft CR to TS38.101-4 for FR2 SDR test cases R4-1907294, Draft CR no Noc and Es setup R4-1907295, draftCR: updates to FRC for demodulation performance	2.0
R4-1902885, Draft CR on DL power allocation for TS 38.101-4 R4-190337, Draft CR for adding applicable rules on CSI test cases: 6, 8, 10 R4-1903471, Draft CR on PBCH requirements R4-1904750, draftCR on RMC for demod requirement for 38.101-4 R4-1904751, Clarification on step 5 and step 6 for delay profiles calculation in B.2.1 R4-1904756, Draft CR on FR1 normal PDSCH demodulation requirements R4-1904757, Draft CR on FR2 PDSCH Demodulation Performance Tests R4-1904758, Draft CR on EN-DC SDR requirements R4-1904759, Addition of alternative TDD configuration for UE demodulation requirements R4-1904756, Draft CR on FR2 PDCCH demodulation requirements R4-1904766, Draft CR on FR2 PDCCH demodulation requirements R4-1904766, Draft CR on FR2 PDCCH demodulation requirements R4-1904767, Draft CR for Beamforming model: Annex B.4.1 R4-1904767, Draft CR for Beamforming model: Annex B.4.1 R4-1904776, Draft CR on FR1 SDR requirements R4-1904776, Draft CR on FR2 SDR Requirements R4-1904777, Draft CR on FR2 SDR Requirements R4-1904777, Draft CR on FR2 SDR Requirements R4-1904779, Draft CR on PDSCH DL RMC R4-1904779, Draft CR to TS38.101-4: Correction to FR1 CSI test cases R4-1904790, Draft CR to TS38.101-4: Correction to FR2 CSI test cases R4-1904780, Draft CR to TS38.101-4: On SNR, Es and Noc setup endorsed draft CRs from RAN4#91 R4-1904794, Draft CR on PBCH requirements R4-1904794, Draft CR to TS 38.101-4 on SNR, Es and Noc setup endorsed draft CRs from RAN4#91 R4-1906069, Draft CR to TS38.101-4 for FR2 SDR test cases R4-1907194, Draft CR on Noc and Es setup R4-1907294, draft CR: Introduce single-tap HST channel model in TS 38.101-4 R4-1907295, draftCR: Introduce single-tap HST channel model in TS 38.101-4 R4-1907296, draftCR: Introduce single-tap HST channel model in TS 38.101-4 R4-1907295, draftCR: updates to FR2 PDSCH test parameters R4-1907296, draftCR: updates to FRC for demodulation	
R4-1903387, Draft CR for adding applicable rules on CSI test cases: 6, 8, 10 R4-1903471, Draft CR on PBCH requirements R4-1904750, draftCR on RMC for demod requirement for 38.101-4 R4-1904751, Clarification on step 5 and step 6 for delay profiles calculation in B.2.1 R4-1904756, Draft CR on FR1 normal PDSCH demodulation requirements R4-1904757, Draft CR on FR2 PDSCH Demodulation Performance Tests R4-1904758, Draft CR on EN-DC SDR requirements R4-1904758, Draft CR on EN-DC SDR requirements R4-1904758, Draft CR on FR2 PDCCH demodulation requirements R4-1904765, Draft CR on FR2 PDCCH demodulation requirements R4-1904766, draftCR: Updates to FR1 PDCCH demodulation requirements R4-1904767, Draft CR for Beamforming model: Annex B.4.1 R4-1904768, Draft CR for modification on CSI test cases: 6, 8, 10 R4-1904776, Draft CR on FR2 SDR requirements R4-1904776, Draft CR on FR2 SDR Requirements R4-1904776, Draft CR on FR2 SDR Requirements R4-1904777, Draft CR on FR2 SDR Requirements R4-1904778, Draft CR on FR2 SDR Requirements R4-1904778, Draft CR on FDSCH DL RMC R4-1904778, Draft CR to TS38.101-4: Correction to FR1 CSI test cases R4-1904780, Draft CR to TS38.101-4: Correction to FR2 CSI test cases R4-1904796, Draft CR to TS38.101-4: Correction to FR2 CSI test cases R4-1904796, Draft CR to TS38.101-4 on splicable SNR level for FR2 R4-1904796, Draft CR to TS 38.101-4 on SNR, Es and Noc setup endorsed draft CRs from RAN4#91 R4-1906069, Draft CR to TS 38.101-4 for FR2 SDR test cases R4-1907294, Draft CR to TS 38.101-4 for FR2 SDR test cases R4-1907294, Draft CR to TS 38.101-4 for FR2 SDR test cases R4-1907294, Draft CR to TS 38.101-4 for FR2 SDR test cases R4-1907294, draft CR: Introduce single-tap HST channel model in TS 38.101-4 R4-1907296, draftCR: updates to FRC for demodulation performance	
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2020-06	RAN#88	RP-200985	0039		F	CR to Aperiodic Report Slot Offset for CQI report	15.6.0

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2020-06	RAN#88	RP-200985	0049	1	F	Update of DL physical channels definitions	15.6.0
2020-06	RAN#88	RP-200985	0051	1	F	CR: clarification on EPRE ratio definition	15.6.0
2020-06	RAN#88	RP-200985	0046	1	F	CR to TS 38.101-4: MIMO correlation matrices definition (R15)	15.6.0
2020-09	RAN#89	RP-201512	0060		F	CR to 2Rx PDSCH mapping type B	15.7.0
2020-09	RAN#89	RP-201512	0077	1	F	CR on Corrections in 38.101-4	15.7.0
2020-09	RAN#89	RP-201512	0058	1	F	CR to ZP-CSI-RS configuration	15.7.0
2020-12	RAN#90	RP-202489	0079		F	Update of Noc for NR operating bands in FR2	15.8.0
2020-12	RAN#90	RP-202489	0081		F	Correction to FR1 Aperiodic CSI Reporting	15.8.0
2020-12	RAN#90	RP-202489	0083		F	Correction to FR2 PMI Aperiodic CSI Reporting	15.8.0
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2021-03	RAN#91	RP-210116	0157	1	F	Correction of CQI test parameters and FRC for UE demodulation test	15.9.0
2021-03	RAN#91	RP-210116	0161	1	F	CR on FRC for NR RI requirements (Rel-15)	15.9.0
2021-03	RAN#91	RP-210116	0167	1	F	CR on corrections for LTE-NR Co-existence tests and OCNG pattern	15.9.0
2021-03	RAN#91	RP-210116	0169	1	F	CR to 38.101-4 on update to CSI reporting test parameters for Aperiodic reporting (R15)	15.9.0
2021-06	RAN#92e	RP-211083	0177	1	F	CR to the definition of explicitly HARQ feedback timing in DCI format 1_0 for PDCCH demodulation tests	15.10.0
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2021-06	RAN#92e	RP-211100	0228	1	F	CR on SDR requirements for DL 256QAM for FR2 (Rel-15)	15.10.0
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2021-09	RAN#93e	RP-211922	0270		F	Big CR for TS 38.101-4 Maintenance (Rel-15, CAT F)	15.11.0

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