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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

Siret N° 348 623 562 00017 - NAF 742 C Association à but non lucratif enregistrée à la Sous-Préfecture de Grasse (06) N° 7803/88

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# Foreword

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# 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.
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- 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".
- [8] 3GPP TS 38.101-3: "NR; User Equipment (UE) radio transmission and reception; Part 3: Range 1 and Range 2 Interworking operation with other radios".
- [9] 3GPP TS 38.211: "NR; Physical channels and modulation".
- [10] 3GPP TS 38.212: "NR; Multiplexing and channel coding".
- [11] 3GPP TS 38.213: "NR; Physical layer procedures for control".
- [12] 3GPP TS 38.214: "NR; Physical layer procedures for data".
- [13] 3GPP TS 37.340: "Evolved Universal Terrestrial Radio Access (E-UTRA) and NR; Multi-connectivity", Stage 2.
- [14] 3GPP TS 38.306: "NR; User Equipment (UE) radio access capabilities".

# 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 TS 37.340 [13, Section 4.1.2].

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

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

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

# 3.2 Symbols

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

 $\mu$  Subcarrier spacing configuration as defined in TS 38.211 [9, Section 4.2]

 $N_{oc}$  The power spectral density of a white noise source with average power per RE normalized to the subcarrier spacing as defined in Section 4.4.3 for conducted requirements and Section 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 and 8.1].

## 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 interwork minimum requirement specified in this specification shall be met in all applicable scenarios for NR interworking operation.

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

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

# 4.3 Specification suffix information

Unless stated otherwise the following suffixes are used for indicating at 2<sup>nd</sup> level subclause, 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 subclause (suffix A, B, C) in clauses 5, 6, 7, 8, 9, 10.

## 4.4 Conducted requirements

## 4.4.1 Conducted requirement reference point

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

#### 4.4.2 SNR definition

UE demodulation and CSI requirements define the SNR as:

$$SNR = \frac{\sum_{j=1}^{N_{RX}} \hat{E}_{s}^{(j)}}{\sum_{i=1}^{N_{RX}} N_{oc}^{(j)}}$$

 $N_{RX}$  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.

E<sub>s</sub> denotes the averaged received energy per resource element (EPRE) of the wanted signal. 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 each requirement.

 $N_{oc}$  denotes the power spectral density of a white noise source, with average power per RE normalized to the subcarrier spacing.

#### 4.4.3 Noc

Unless otherwise stated, the spectral density of Noc is [-142dBm/Hz].

### 4.5 Radiated requirements

#### 4.5.1 Radiated requirement reference point

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

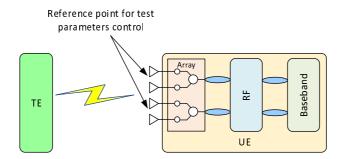


Figure 4.5.1-1: Reference point for radiated Demodulation and CSI requirements

Radiated performance requirements are specified at the Reference point, with signal-to-noise ratio (SNR)  $SNR_{RP} = SNR_{BB} + \Delta_{BB}$ 

where SNR<sub>BB</sub> is the baseband SNR level specified by the Minimum performance requirement in clause 7, 8, 9 and 10, and  $\Delta_{BB}$  is specified in clause 4.5.3.2. The noise spectral density for Noc is specified in Table 4.5.3.2-1.

#### 4.5.2 SNR definition

UE demodulation and CSI requirements define the SNR as:

$$SNR_{\langle signal \rangle} = \frac{\sum_{j=1}^{NRX} \hat{E}_{\langle signal \rangle}^{(j)}}{\sum_{i=1}^{NRX} N_{oc}^{(j)}}$$

 $N_{RX}$  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.

 $\hat{E}_{\langle signal \rangle}$  denotes the averaged received energy per resource element (EPRE) of the wanted signal. 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 each requirement.

 $N_{oc}$  denotes the power spectral density of a white noise source, with average power per RE normalized to the subcarrier spacing.

#### 4.5.3 Noc

#### 4.5.3.1 Introduction

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

#### 4.5.3.2 Noc for NR operating bands in FR2

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

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

Operating band	UE Power class			
	1	2	3	4
n257	-166.8	-163.8	-157.6	-166.3
n258	-166.8	-163.8	-157.6	-166.3
n260	-163.8		-155.0	-164.3
n261	-166.8	-163.8	-157.6	-166.3
Note 1: Noc levels are specified in dBm/Hz				

The handling of Carrier Aggregation is FFS, and the handling of multi-band relaxation is FFS.

#### 4.5.3.3 Derivation of Noc values for NR operating bands in FR2

The Noc values in Table 4.5.3.2-1 are based on Refsens for the Operating band and on the UE Power class, and taking a baseline of UE Power class 3 in Band n260.

Spectral density of Noc = Refsens<sub>PC3</sub>,  $_{n260,\ 50MHz}$  - $10Log_{10}(SCS_{Refsens}\ x\ PRB_{Refsens}\ x\ 12) - SNR_{Refsens} + \Delta_{thermal}$  where:

Refsens<sub>PC3, n260, 50MHz</sub> is the Refsens value in dBm specified for Power Class 3 in Band n260 for 50MHz Channel bandwidth in TS 38.101-2 [7, Table 7.3.2.3-1].

SCS<sub>Refsens</sub> is a subcarrier spacing associated with N<sub>RB</sub> for 50MHz in TS 38.101-2 [7, Table 5.3.2-1], chosen as 120 kHz.

PRB<sub>Refsens</sub> is N<sub>RB</sub> associated with subcarrier spacing 120 kHz for 50MHz in TS 38.101-2 [7, Table 5.3.2-1] and is 32.

12 is the number of subcarriers in a PRB

SNR<sub>Refsens</sub> is the SNR used for simulation of Refsens, and is -1dB

 $\Delta_{thermal}$  is the amount of dB that the wanted noise is set above UE thermal noise, giving a rise in total noise of  $\Delta_{BB}$ .  $\Delta_{thermal}$  is chosen as 6dB, giving a rise in total noise of 1dB.

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

The following methodology to define the Noc level for power class X (PC\_X) and operating band Y (Band\_Y) is used for the single carrier case:

 $Noc(PC\_X, Band\_Y) = -155 \ dBm/Hz + Refsens_{PC\_X, Band\_Y, 50MHz} - Refsens_{PC3, n260, 50MHz} + \Sigma MB_{PC} + Refsens_{PC3, n260, 50MHz} + Refsens_{PC3, n260, 5$ 

where Refsens and  $\Sigma MB_P$  values are specified in TS 38.101-2 [7].

### 4.5.4 Angle of arrival

Unless otherwise stated, the downlink signal and noise are aligned to arrive in the UE Rx beam peak direction as defined in TS 38.101-2 [7].

# 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].

The minimum performance requirements in Clause 5 are mandatary for UE supporting NR operation, except test cases listed in Clause 5.1.1.3.

#### 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 7.4 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.

Supported RX antenna ports	Test type	Test list
UE supports only	PDSCH	All tests in Clause 5.2.2
2RX	PDCCH	All tests in Clause 5.3.2
	PBCH	All tests in Clause 5.4.2
UE supports only	PDSCH	All tests in Clause 5.2.3
4RX or both 2RX	PDCCH	All tests in Clause 5.3.3
and 4RX	PBCH	All tests in Clause 5.4.3

Table 5.1.1.2-1: Requirements applicability

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

For UE which supports optional UE capabilities the additional performance requirements from Table 5.1.1.3-1 should be applied.

Table 5.1.1.3-1: Requirements applicability for optional UE capabilities

UE feature/capability	Test	type	Test list	Applicability notes
[Enhanced Type X receiver]	FR1 FDD	PDSCH	5.2.2.1.1 Minimum requirements for PDSCH Mapping Type A (Test 3-1)	
			5.2.3.1.1 Minimum requirements for PDSCH Mapping Type A (Test 5-1)	
	FR1 TDD	PDSCH	5.2.2.2.1 Minimum requirements for PDSCH Mapping Type A (Test 3-1)	
			5.2.3.2.1 Minimum requirements for PDSCH Mapping Type A (Test 5-1)	
[Support alternative additional DMRS position for co-existence with LTE CRS]	FR1 FDD	PDSCH	5.2.2.1.4 Minimum requirements for PDSCH Mapping Type A and LTE- NR coexistence (Test 1-2)	
			5.2.3.1.4 Minimum requirements for PDSCH Mapping Type A and LTE- NR coexistence (Test 1-2)	

# 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
EPRE ratio of PTRS	to PDSCH	dB	N/A
DL BWP configuration #1	Cyclic prefix		Normal
comigaration #1	Physical Cell ID		0
	SSB position in burst		First SSB in Slot #0
Common serving	SSB periodicity	ms	20
cell parameters	First DMRS position for Type A PDSCH		
	mapping		2
	Slots for PDCCH monitoring		Each slot
	Symbols with PDCCH	Symbols	0, 1
PDCCH	Number of PDCCH candidates and		1/[AL8]
configuration	aggregation levels		
	DCI format		1_1
	TCI state		TCI state #1
Cross carrier schedu			Not configured
	First subcarrier index in the PRB used for CSI-RS		k <sub>0</sub> =0 for CSI-RS resource 1,2,3,4
	First OFDM symbol in the PRB used for CSI-RS		$l_0$ = 6 for CSI-RS resource 1 and 3 $l_0$ = 10 for CSI-RS resource 2 and 4
	Number of CSI-RS ports (X)		1 for CSI-RS resource 1,2,3,4
	CDM Type		'No CDM' for CSI-RS resource 1,2,3,4
	Density (ρ)		3 for CSI-RS resource 1,2,3,4
			15 kHz SCS: 20 for CSI-RS resource
	CSI-RS periodicity	Slots	1,2,3,4
CSI-RS for tracking	Col 110 pollodioity		30 kHz SCS: 40 for CSI-RS resource
COI-ING for tracking			1,2,3,4 15 kHz SCS:
			10 for CSI-RS resource 1 and 2
			11 for CSI-RS resource 3 and 4
	CSI-RS offset	Slots	
			30 kHz SCS:
			20 for CSI-RS resource 1 and 2
			21 for CSI-RS resource 3 and 4
	Frequency Occupation		Start PRB 0
	QCL info		Number of PRB = BWP size TCI state #0
	First subcarrier index in the PRB used for		TOI State #0
	CSI-RS		$k_0 = 0$
	First OFDM symbol in the PRB used for		1 40
	CSI-RS		$l_0 = 12$
	Number of CSI-RS ports (X)		Same as number of transmit antenna
NZP CSI-RS for	CDM Type		'FD-CDM2'
CSI acquisition	Density (ρ)		1
oor acquicition	CSI-RS periodicity	Slots	15 kHz SCS: 20
	CSI-RS offset	Slots	30 kHz SCS: 40 0
		01013	Start PRB 0
	Frequency Occupation		Number of PRB = BWP size
	QCL info		TCI state #1
	First subcarrier index in the PRB used for CSI-RS		k <sub>0</sub> = 4
	First OFDM symbol in the PRB used for		l <sub>0</sub> = 12
	CSI-RS		•
7D 001 D0 ( 00)	Number of CSI-RS ports (X)		4 (ED ODMO)
ZP CSI-RS for CSI	CDM Type		'FD-CDM2'
acquisition	Density (ρ)		15 kHz SCS: 20
	CSI-RS periodicity	Slots	30 kHz SCS: 40
	CSI-RS offset	Slots	0
	Frequency Occupation		Start PRB 0 Number of PRB = BWP size
			{1000} for Rank 1 tests
		1	
PDSCH DMRS			{1000, 1001} for Rank 2 tests
PDSCH DMRS configuration	Antenna ports indexes		{1000, 1001} for Rank 2 tests {1000-1002} for Rank 3 tests

	Number of PDSCH DMRS CDM group(s)		1 for Rank 1 and Rank 2 tests	
	without data		2 for Rank 3 and Rank 4 tests	
	Type 1 QCL	SSB index	SSB #0	
TCI atata #0	information	QCL Type	Type C	
TCI state #0	Type 2 QCL	SSB index	N/A	
	information	QCL Type	N/A	
	Type 1 QCL	CSI-RS resource	CSI-RS resource 1 from 'CSI-RS for tracking' configuration	
TCI state #1	information	QCL Type	Type A	
	Type 2 QCL	CSI-RS resource	N/A	
	information	QCL Type	N/A	
PTRS configuration			PTRS is not configured	
Maximum number of	f code block grou	os for ACK/NACK feedback	1	
Maximum number of	f HARQ transmiss	sion	4	
HARQ ACK/NACK b	undling		Multiplexed	
Redundancy version coding sequence			{0,2,3,1}	
Precoding configuration		SP Type I, Random per slot with PRB bundling granularity		
Symbols for all unused REs			OCNG Annex A.5	
Note 1: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH transmission.				

# 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, 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 enhanced	3-1
performance requirement Type X under 2 receive	
antenna conditions and with 2 MIMO layers.	

Table 5.2.2.1.1-2: Test parameters

Parameter		Unit	Value
Channel bandwidth		MHz	20 for Test 2-3
Charinei bandwidin		IVITIZ	10 for other tests
Duplex mode			FDD
Active DL BWP index			1
	First PRB		0
DL BWP	Number of contiguous PRB	PRBs	51 for Test 2-3 52 for other tests
configuration #1	Subcarrier spacing	kHz	30 for Test 2-3 15 for other tests
PDCCH configuration	Number of PRBs in CORESET	PRBs	48
	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		4 for Test 1-1 2 for other tests
	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
PDSCH DMRS configuration	Number of additional DMRS		2 for Test 1-1 1 for other tests
<b>3</b>	Length		Single symbol
Number of HARQ Processes			8 for Tests 1-4, [2-1] 4 for other tests
K1 value (PDSCH-to-HARQ-	timing-indicator)		2

Table 5.2.2.1.1-3: Minimum performance for Rank 1

- Modulation			Correlation matrix	Reference value		
Test num.	Reference channel	format and code rate	Propagation condition	and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-1.1 FDD	QPSK, 0.30	TDLB100-400	2x2, ULA Low	70	[-0.8]
1-2	R.PDSCH.1-1.2 FDD	QPSK, 0.30	TDLC300-100	2x2, ULA Low	70	[0.3]
1-3	R.PDSCH.1-4.1 FDD	256QAM, 0.82	TDLA30-10	2x2, ULA Low	70	[24.6]
1-4	R.PDSCH.1-2.1 FDD	16QAM, 0.48	TDLC300-100	2x2, ULA Low	30	[1.2]

Table 5.2.2.1.1-4: Minimum performance for Rank 2

Test – Modulation Propa		Duonomation	Correlation matrix	Reference value			
	num.	Reference channel	format and code rate Propagation		and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
	2-1	R.PDSCH.1-3.1 FDD	64QAM, 0.51	TDLA30-10	2x2, ULA Low	70	TBD
	2-2	R.PDSCH.2-1.1 FDD	64QAM, 0.51	TDLA30-10	2x2, ULA Low	70	[19.7]

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

Too		Modulation	Dropogotion	Correlation matrix Reference		ue
Tes	Reference channel	format and code rate	Propagation condition	and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
3-1	R.PDSCH.1-2.2 FDD	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 punder 2 receive antenna conditions and CSI- overlapped with PDSCH	

Table 5.2.2.1.2-2: Test parameters

	Parameter	Unit	Value
Channel bandwidth		MHz	10
Duplex mode			FDD
Active DL BWP index	(		1
DI DWD	First PRB		0
DL BWP	Number of contiguous PRB	PRBs	52
configuration #1	Subcarrier spacing	kHz	15
PDCCH configuration	Number of PRBs in CORESET	PRBs	48
	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		12
PDSCH	PDSCH aggregation factor		1
. = 00	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
PDSCH DMRS	Number of additional DMRS		1
configuration	Length		1
NZP CSI-RS for	OFDM symbols in the PRB used for CSI-RS		I <sub>0</sub> = 13
CSI acquisition	CSI-RS periodicity		5
ZP CSI-RS for CSI	Subcarrier index in the PRB used for CSI-RS		(k <sub>0</sub> , k <sub>1</sub> , k <sub>2</sub> , k <sub>3</sub> )=(2, 4, 6, 8)
acquisition	Number of CSI-RS ports (X)		8
	CSI-RS periodicity		5
Number of HARQ Pr			4
K1 value (PDSCH-to-HARQ-tii	ming-indicator)		2

Table 5.2.2.1.2-3: Minimum performance for Rank 2

Test		Modulation	Proposition	Correlation matrix	Reference val	ue
num.	Reference channel	format and code rate	Propagation condition	and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-5.1 FDD	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
Channel bandwidth		MHz	10
Duplex mode			FDD
Active DL BWP inde	x		1
DL BWP	First PRB		0
configuration #1	Number of contiguous PRB	PRBs	52
configuration #1	Subcarrier spacing	kHz	15
PDCCH configuration	Number of PRBs in CORESET	PRBs	48
<u> </u>	Mapping type		Type B
	k0		0
	Starting symbol (S)		5
	Length (L)		7
PDSCH	PDSCH aggregation factor		1
configuration	PRB bundling type		Static
Comiguration	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
PDSCH DMRS	Number of additional DMRS		1
configuration	Length	1	1
Number of HARQ Processes			4
K1 value			2
(PDSCH-to-HARQ-ti	ming-indicator)		

Table 5.2.2.1.3-3: Minimum performance for Rank 1

Tool		Modulation	Duonovetion	Correlation matrix	Reference val	ue
Test num.	Reference channel	format and code rate	Propagation condition	and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-1.4 FDD	QPSK, 0.30	TDLA30-10	2x2, ULA Low	70	[-0.9]

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

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

The test purposes are specified in Table 5.2.2.1.4-1.

Table 5.2.2.1.4-1: Tests purpose

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

Table 5.2.2.1.4-2: Test parameters

	Parameter	Unit	Value
Channel bandwidth		MHz	10
Duplex mode			FDD
Active DL BWP inde	X		1
DI DWD	First PRB		0
DL BWP	Number of contiguous PRB	PRBs	52
configuration #1	Subcarrier spacing	kHz	15
PDCCH configuration	Number of PRBs in CORESET	PRBs	48
	Mapping type		Type A
	k0		0
	Starting symbol (S)		3
	Length (L)		9 for Test 1-1 11 for Test 1-2
PDSCH	PDSCH aggregation factor		1
configuration	PRB bundling type		Static
	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
DD00H DMD0	DMRS Type		Type 1
PDSCH DMRS	Number of additional DMRS		1
configuration	Length		1
000 (	LTE carrier centre subcarrier location		Same as NR carrier centre subcarrier location
CRS for rate matching	LTE carrier BW	MHz	10
	Number of antenna ports		4
	v-shift		0
Number of HARQ P	Number of HARQ Processes		4
K1 value (PDSCH-to-HARQ-t	iming-indicator)		2

Table 5.2.2.1.4-3: Minimum performance for Rank 1

Toot	Reference Modulation Propagation		Correlation	Reference value		
Test num.	channel	format and code rate	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-1.4 FDD	QPSK, 0.30	TDLA30-10	4x2, ULA Low	70	[-1.0]
1-2	R.PDSCH.1-1.5 FDD	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 5.2.2.1-1: Tests purpose

Purpose	Test index
Verify the PDSCH mapping Type A normal performance	1-1, 1-2, 1-3, 1-5, 1-6, 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 enhanced	3-1
performance requirement Type X under 2 receive	
antenna conditions and with 2 MIMO layers.	

Table 5.2.2.1-2: Test parameters

Parameter			Value
Channel bandwidth		MHz	20 for Test 2-3
Charinei bandwidin		IVITZ	40 for other tests
Duplex mode			TDD
Active DL BWP inde	ex		1
	First PRB		0
DL BWP configuration #1	Number of contiguous PRB	PRBs	51 for Test 2-3 106 for other tests
· ·	Subcarrier spacing	kHz	30
PDCCH configuration Number of PRBs in CORESET		PRBs	48 for Test 2-3 102 for other tests
	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 2 for other tests
	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
PDSCH DMRS configuration	Number of additional DMRS		2 for Test 1-1 1 for other tests
	Length		1
Number of HARQ Processes			16 for Test 1-4, [2-1] 8 for other tests
K1 value (PDSCH-to-HARQ-	timing-indicator)		Specific to each UL-DL pattern

Table 5.2.2.2.1-3: Minimum performance for Rank 1

		<b>M</b> 1 1 4			Correlation	Reference value	
Test num.	Reference channel	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	QPSK, 0.30	FR1.30-1	TDLB100-400	2x2, ULA Low	70	[-1.1]
1-2	R.PDSCH.2- 1.2 TDD	QPSK, 0.30	FR1.30-1	TDLC300-100	2x2, ULA Low	70	[0.3]
1-3	R.PDSCH.2- 4.1 TDD	256QAM, 0.82	FR1.30-1	TDLA30-10	2x2, ULA Low	70	[25.3]
1-4	R.PDSCH.2- 2.1 TDD	16QAM, 0.48	FR1.30-1	TDLC300-100	2x2, ULA Low	30	[1.6]
1-5	R.PDSCH.2- 5.1 TDD	QPSK, 0.3	FR1.30-2	TDLA30-10	2x2, ULA Low	70	[-0.8]
1-6	R.PDSCH.2- 6.1 TDD	QPSK, 0.30	FR1.30-3	TDLA30-10	2x2, ULA Low	70	[-0.9]

Table 5.2.2.2.1-4: Minimum performance for Rank 2

					Correlation	Reference value	
Test num.	Reference channel	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	64QAM, 0.51	FR1.30-1	TDLA30-10	2x2, ULA Low	70	TBD
2-2	R.PDSCH.2- 3.2 TDD	64QAM, 0.51	FR1.30-1	TDLA30-10	2x2, ULA Low	70	[19.8]

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

		Modulation			Correlation	Reference v	alue /
Test num.	Reference channel	tormat and	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)	
3-1	R.PDSCH.2- 2.2 TDD	16QAM, 0.48	FR1.30-1	TDLA30-10	2x2, ULA Medium	70	[18.1]

# 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	1-1
under 2 receive antenna conditions and CSI-RS	
overlapped with PDSCH	

Table 5.2.2.2-2: Test parameters

Parameter			Value
Channel bandwidth		MHz	40
Duplex mode			TDD
Active DL BWP index	X		1
DL BWP	First PRB		0
	Number of contiguous PRB	PRBs	106
configuration #1	Subcarrier spacing	kHz	30
PDCCH configuration	Number of PRBs in CORESET	PRBs	102
_	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		Specific to each Reference channel
PDSCH	PDSCH aggregation factor		1
configuration	PRB bundling type		Static
Configuration	PRB bundling size		2
	Resource allocation type		Type 0
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
DD0011 D14D0	DMRS Type		Type 1
PDSCH DMRS	Number of additional DMRS		1
configuration	Length		1
NZP CSI-RS for	OFDM symbols in the PRB used for CSI-RS		I <sub>0</sub> = 13
CSI acquisition	CSI-RS periodicity		5
ZP CSI-RS for CSI	Subcarrier index in the PRB used for CSI-RS		(k <sub>0</sub> , k <sub>1</sub> , k <sub>2</sub> , k <sub>3</sub> )=(2, 4, 6, 8)
acquisition	Number of CSI-RS ports (X)		8
	CSI-RS periodicity		5
Number of HARQ Processes			8
K1 value (PDSCH-to-HARQ-tin	ming-indicator)		Specific to each UL-DL pattern

Table 5.2.2.2-3: Minimum performance for Rank 2

		Ma dulation			Correlation	Reference value	
Tes		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	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
Channel bandwidth		MHz	40
Duplex mode			TDD
Active DL BWP index	X		1
DL BWP	First PRB		0
configuration #1	Number of contiguous PRB	PRBs	106
Corniguration #1	Subcarrier spacing	kHz	30
PDCCH configuration	Number of PRBs in CORESET	PRBs	102
	Mapping type		Type B
	k0		0
	Starting symbol (S)		5
	Length (L)		7
PDSCH	PDSCH aggregation factor		1
configuration	PRB bundling type		Static
Comiguration	PRB bundling size		2
	Resource allocation type		Type 0
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle		N/A
	size		IN/A
PDSCH DMRS	DMRS Type		Type 1
configuration	Number of additional DMRS		1
	Length		1
Number of HARQ Pr	ocesses		4
K1 value (PDSCH-to-HARQ-tii	ming-indicator)		Specific to each UL-DL pattern

Table 5.2.2.3-3: Minimum performance for Rank 1

Toot	Poforonoo	Modulation	TDD UL-	Propagation	Correlation matrix and	Reference val	ue
Test num.	Reference channel	format and code rate	DL pattern	Propagation condition	antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH,2- 1.3 TDD	QPSK, 0.30	FR1.30-1	TDLA30-10	2x2, ULA Low	70	[-0.9]

# 5.2.3 4RX requirements

#### 5.2.3.1 FDD

#### 5.2.3.1.1 Minimum requirements for PDSCH Mapping Type A

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

The test purposes are specified in Table 5.2.3.1.1-1.

Table 5.2.3.1.1-1: Tests purpose

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

Table 5.2.3.1.1-2: Test parameters

	Parameter	Unit	Value
Chanal handuidth		MHz	20 for Test 2-2
Channel bandwidth		IVIHZ	10 for other tests
Duplex mode			FDD
Active DL BWP inde	eX		1
	First PRB		0
DL BWP	Number of contiguous PRB	PRBs	51 for Test 2-2
configuration #1	Number of configuous FKB	FKD2	52 for other tests
corniguration #1	Subcarrier spacing	kHz	30 for Test 2-2
	Subcarrier spacing	KI IZ	15 for other tests
PDCCH	Number of PRBs in CORESET	PRBs	51 for Test 2-2
configuration	Number of FRES III CORECET	1 IVD3	52 for other tests
	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		12
	PDSCH aggregation factor		1
PDSCH	PRB bundling type		Static
configuration			4 for Test 1-1
comigaration	PRB bundling size		WB for Test 3-1
			2 for other tests
	Resource allocation type		Type 0
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle		N/A
	size		<u> </u>
	DMRS Type		Type 1
PDSCH DMRS	Number of additional DMRS		2 for Test 1-1
configuration	Transcr of additional Divino		1 for other tests
	Length		1
Number of HARQ Processes			8 for Test 1-4, [2-1]
			4 for other tests
K1 value			2
(PDSCH-to-HARQ-t	iming-indicator)		-

Table 5.2.3.1.1-3: Minimum performance for Rank 1

T1	Modulation Brancastian		Correlation matrix	Reference value		
Test num.	Reference channel	format and code rate	Propagation condition	and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-1.1 FDD	QPSK, 0.30	TDLB100-400	2x4, ULA Low	70	[-3.5]
1-2	R.PDSCH.1-1.2 FDD	QPSK, 0.30	TDLC300-100	2x4, ULA Low	70	[-2.8]
1-3	R.PDSCH.1-4.1 FDD	256QAM, 0.82	TDLA30-10	2x4, ULA Low	70	[21.0]
1-4	R.PDSCH.1-2.1 FDD	16QAM, 0.48	TDLC300-100	2x4, ULA Low	30	[-1.3]

Table 5.2.3.1.1-4: Minimum performance for Rank 2

Toot		Modulation   Correlation matrix		Reference val	ue	
Test num.	Reference channel	format and code rate	Propagation condition	and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
2-1	R.PDSCH.1-3.1 FDD	64QAM, 0.51	TDLA30-10	2x4, ULA Low	70	[TBD]
2-2	R.PDSCH.2-1.1 FDD	64QAM, 0.51	TDLA30-10	2x4, ULA Low	70	[13.7]

#### Table 5.2.3.1.1-5: Minimum performance for Rank 3

Test		Modifiation		Modulation	Correlation matrix and	Reference v	alue
num.	Reference channel	format and code rate	Propagation condition	antenna configuration	Fraction of maximum throughput (%)	SNR (dB)	
3-1	R.PDSCH.1-2.3 FDD	16QAM, 0.48	TDLA30-10	4x4, ULA Low	70	[10.9]	

#### Table 5.2.3.1.1-6: Minimum performance for Rank 4

Toot		Modulation	Dranagation	Correlation matrix	Reference val	ue
Test num.	Reference channel	format and code rate	Propagation condition	and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
4-1	R.PDSCH.1-2.4 FDD	16QAM, 0.48	TDLA30-10	4x4, ULA Low	70	[15.5]

#### Table 5.2.3.1.1-7: Minimum performance for Rank 3 and Enhanced Type X Receiver

Toot		Modulation		Correlation	Reference v	alue
Test num.	Reference channel	format and code rate	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
5-1	R.PDSCH.1-2.3 FDD	16QAM, 0.48	TDLA30-10	4x4, ULA Medium A	70	[22.1]

# 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	1-1
overlapped with PDSCH	

Table 5.2.3.1.2-2: Test parameters

	Parameter	Unit	Value
Channel bandwidth		MHz	10
Duplex mode			FDD
Active DL BWP index	X		1
DL BWP	First PRB		0
	Number of contiguous PRB	PRBs	52
configuration #1	Subcarrier spacing	kHz	15
PDCCH configuration	Number of PRBs in CORESET	PRBs	48
	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		12
PDSCH	PDSCH aggregation factor		1
configuration	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
DD00H DMD0	DMRS Type		Type 1
PDSCH DMRS	Number of additional DMRS		1
configuration	Length		1
NZP CSI-RS for	OFDM symbols in the PRB used for CSI-RS		I <sub>0</sub> = 13
CSI acquisition	CSI-RS periodicity		5
ZP CSI-RS for CSI	Subcarrier index in the PRB used for CSI-RS		(k <sub>0</sub> , k <sub>1</sub> , k <sub>2</sub> , k <sub>3</sub> )=(2, 4, 6, 8)
acquisition	Number of CSI-RS ports (X)		8
•	CSI-RS periodicity		5
Number of HARQ Pr			4
K1 value (PDSCH-to-HARQ-ti	ming-indicator)		2

Table 5.2.3.1.2-3: Minimum performance for Rank 2

	•		Modulation	Correlation matrix		Reference val	ue
	est um.	Reference channel	format and code rate	Propagation condition	and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1	I-1	R.PDSCH.1-5.1 FDD	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
Channel bandwidth		MHz	10
Duplex mode			FDD
Active DL BWP index	(		1
DL BWP	First PRB		0
configuration #1	Number of contiguous PRB	PRBs	52
corniguration #1	Subcarrier spacing	kHz	15
PDCCH configuration	Number of PRBs in CORESET	PRBs	48
	Mapping type		Type B
	k0		0
	Starting symbol (S)		5
	Length (L)		7
PDSCH	PDSCH aggregation factor		1
configuration	PRB bundling type		Static
Corniguration	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
PDSCH DMRS	Number of additional DMRS		1
configuration	Length		1
Number of HARQ Processes			4
K1 value (PDSCH-to-HARQ-tin			2

Table 5.2.3.1.3-3: Minimum performance for Rank 1

Toot		Modulation	Dranagation	Correlation matrix	Reference value	
Test num.	Reference channel	format and code rate	Propagation condition	and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-1.4 FDD	QPSK, 0.30	TDLA30-10	4x4, ULA Low	70	[-3.8]

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

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

The test purposes are specified in Table 5.2.3.1.4-1.

Table 5.2.3.1.4-1: Tests purpose

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

Table 5.2.3.1.4-2: Test parameters

	Parameter	Unit	Value
Channel bandwidth		MHz	10
Duplex mode			FDD
Active DL BWP inde	X		1
DL BWP	First PRB		0
configuration #1	Number of contiguous PRB	PRBs	52
Corniguration #1	Subcarrier spacing	kHz	15
PDCCH configuration	Number of PRBs in CORESET	PRBs	48
	Mapping type		0
	k0		52
	Starting symbol (S)		15
	Length (L)		48
	PDSCH aggregation factor		Type A
PDSCH	PRB bundling type		0
configuration	PRB bundling size		3
	Resource allocation type		9 for Test 1-1
	Resource anocation type		11 for Test 1-2
	VRB-to-PRB mapping type		1
	VRB-to-PRB mapping interleaver bundle size		Static
PDSCH DMRS	DMRS Type		2
	Number of additional DMRS		Type 0
configuration	Length		Non-interleaved
0001	LTE carrier centre subcarrier location		Same as NR carrier centre subcarrier location
CRS for rate	LTE carrier BW	MHz	10
matching	Number of antenna ports		4
	v-shift		0
Number of HARQ Pr	rocesses		4
K1 value (PDSCH-to-HARQ-timing-indicator)			2

Table 5.2.3.1.4-3: Minimum performance for Rank 1

Test		Modulation	Dranagation	Correlation matrix	Reference va	lue
num.	Reference channel	format and code rate	Propagation condition	and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-1.4 FDD	QPSK, 0.30	TDLA30-10	4x4, ULA Low	70	[-4.0]
1-2	R.PDSCH.1-1.5 FDD	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 under4 receive antenna conditions and with different	1-1, 1-2, 1-3, 1-5, 1-6, 2-1, 2-2, 3-1, 4-1
channel models, MCSs and number of MIMO layers	
Verify the PDSCH mapping Type A HARQ soft combining	1-4
performance under 4 receive antenna conditions.	
Verify the PDSCH mapping Type A enhanced	5-1
performance requirement Type X under 4 receive	
antenna conditions and with 3 MIMO layers.	

Table 5.2.3.2.1-2: Test parameters

	Parameter	Unit	Value
Channel bandwidth			20 for Test 2-2
Charinei bandwidth		MHz	40 for other tests
Duplex mode			TDD
Active DL BWP ind	ex		1
	First PRB		0
DL BWP	Number of contiguous PRB	PRBs	51 for Test 2-2
configuration #1	Number of contiguous FNB	LIVDS	106 for other tests
	Subcarrier spacing	kHz	30
PDCCH	Number of PRBs in CORESET	PRBs	48 for Test 2-2
configuration	Number of FRBS III CORESET	LVD2	102 for other tests
	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	DDP hundling size		4 for Test 1-1
	PRB bundling size		2 for other tests
	Resource allocation type		Type 0
	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		2 for Tests 1-1
configuration	Number of additional DIVIRS		1 for other tests
	Length		1
Number of HARQ Processes			16 for Test 1-4, [2-1]
INUITIDE OF FIARQ F	10000000		8 for other tests
K1 value			Specific to each UL-DL pattern
(PDSCH-to-HARQ-	timing-indicator)		opeonic to each of-pr pattern

Table 5.2.3.2.1-3: Minimum performance for Rank 1

		Modulation format and code rate			Correlation	Reference value	
Test num.			TDD UL-DL pattern	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.2- 1.1 TDD	QPSK, 0.30	FR1.30-1	TDLB100-400	2x4, ULA Low	70	[-4.1]
1-2	R.PDSCH.2- 1.2 TDD	QPSK, 0.30	FR1.30-1	TDLC300-100	2x4, ULA Low	70	[-2.6]
1-3	R.PDSCH.2- 4.1 TDD	256QAM, 0.82	FR1.30-1	TDLA30-10	2x4, ULA Low	70	[21.6]
1-4	R.PDSCH.2- 2.1 TDD	16QAM, 0.48	FR1.30-1	TDLC300-100	2x4, ULA Low	30	[-1.0]
1-5	[R.PDSCH.2- 5.1 TDD]	QPSK, 0.3	FR1.30-2	TDLA30-10	2x4, ULA Low	70	[-3.6]
1-6	[R.PDSCH.2- 6.1 TDD]	QPSK, 0.30	FR1.30-3	TDLA30-10	2x4, ULA Low	70	[-3.8]

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

		Ma delation			Correlation	Reference value	
Test num.	Reference channel	format and	_	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
2-1	R.PDSCH.2- 3.1 TDD	64QAM, 0.51	FR1.30-1	TDLA30-10	2x4, ULA Low	70	TBD
2-2	R.PDSCH.2- 3.2 TDD	64QAM, 0.51	FR1.30-1	TDLA30-10	2x4, ULA Low	70	[13.7]

#### Table 5.2.3.2.1-5: Minimum performance for Rank 3

		Madulation			Correlation	Reference v	alue
Test num.	Reference channel	Modulation format and code rate	TDD UL-DL pattern	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
3-1	R.PDSCH.2- 2.3 TDD	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

					Correlation	Reference value	
Test num.	Reference channel	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	16QAM, 0.48	FR1.30-1	TDLA30-10	4x4, ULA Low	70	[15.7]

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

		Madulatian			Correlation	Reference v	alue
Test num.	Reference channel	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	16QAM, 0.48	FR1.30-1	TDLA30-10	4x4, ULA Medium A	70	[22.9]

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

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

The test purposes are specified in Table 5.2.3.2.2-1.

Table 5.2.3.2.2-1: Tests purpose

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

Table 5.2.3.2.2-2: Test parameters

Parameter		Unit	Value
Channel bandwidth		MHz	40
Duplex mode			TDD
Active DL BWP index			1
DL BWP configuration #1	First PRB		0
	Number of contiguous PRB	PRBs	106
	Subcarrier spacing	kHz	30
PDCCH configuration	Number of PRBs in CORESET	PRBs	102
PDSCH configuration	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		12
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS configuration	DMRS Type		Type 1
	Number of additional DMRS		1
	Length		1
NZP CSI-RS for CSI acquisition	OFDM symbols in the PRB used for CSI-RS		l <sub>0</sub> = 13
	CSI-RS periodicity		5
ZP CSI-RS for CSI acquisition	Subcarrier index in the PRB used for CSI-RS		$(k_0, k_1, k_2, k_3)=(2, 4, 6, 8)$
	Number of CSI-RS ports (X)		8
	CSI-RS periodicity		5
Number of HARQ Processes			8
K1 value (PDSCH-to-HARQ-timing-indicator)			Specific to each UL-DL pattern

Table 5.2.3.2.2-3: Minimum performance for Rank 2

		Madulatian			Correlation	Reference va	alue
Test num.	Reference channel	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	16QAM, 0.48	FR1.30-1	TDLC300-100	4x4, 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	1-1
antenna conditions	

Table 5.2.3.2.3-2: Test parameters

	Parameter	Unit	Value
Channel bandwidth		MHz	40
Duplex mode			TDD
Active DL BWP index	X		1
DL BWP	First PRB		0
configuration #1	Number of contiguous PRB	PRBs	106
corniguration #1	Subcarrier spacing	kHz	30
PDCCH configuration	Number of PRBs in CORESET	PRBs	102
	Mapping type		Type B
	k0		0
	Starting symbol (S)		5
	Length (L)		7
PDSCH	PDSCH aggregation factor		1
configuration	PRB bundling type		Static
Corniguration	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
DD00H DMD0	DMRS Type		Type 1
PDSCH DMRS	Number of additional DMRS		1
configuration	Length		1
Number of HARQ Pr	ocesses		8
K1 value (PDSCH-to-HARQ-tii	ming-indicator)		Specific to each UL-DL pattern

Table 5.2.3.2.3-3: Minimum performance for Rank 1

Toot	Deference	Modulation	TDD UL-DL	Dranagation	Correlation	Reference value	
Test num.	Reference channel	format and code rate	pattern	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH,2- 1.3 TDD	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
DL BWP configuration #1	Cyclic prefix			Normal
Common	Physical Cel	I ID		0
serving cell	SSB position			1
parameters	SSB periodic		ms	20
PDCCH		CCH monitoring		Each slot
configuration		DCCH candidates		1
comigaration	TCI state			TCI state #1
	used for CSI	ier index in the PRB -RS ( $k_0$ )		0
		symbol in the PRB		CSI-RS resource 1: 4 CSI-RS resource 2: 8
	used for CSI	-RS ( <i>lo</i> )		CSI-RS resource 3: 4 CSI-RS resource 4:
	Number of C	SI-RS ports (X)		8 1
	CDM Type	ου-ινο μυπο (Δ)		No CDM
	Density (ρ)			3
CSI-RS for	CSI-RS perio	odicity	Slots	15 kHz SCS: 20 30 kHz SCS: 40
tracking	CSI-RS offse	et	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 C	Occupation		Start PRB 0 Number of PRB = BWP size
	QCL info			TCI state #0
	Type 1	SSB index		SSB #0
TCI state #0	QCL information	QCL Type		Type C
l or orang mo	Type 2	SSB index		SSB #0
	QCL 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
	Type 2 QCL information	CSI-RS resource		CSI-RS resource 1 from 'CSI-RS for tracking' configuration
		QCL Type		Type D
Precoding configu	ıration		SP Type I, Random per slot with REG bundling granularity for number of Tx larger than 1	
			<u> </u>	OCNG in Annex A.5

## 5.3.1 1RX requirements

(Void)

## 5.3.2 2RX requirements

### 5.3.2.1 FDD

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

Table 5.3.2.1-1: Test Parameters

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

### 5.3.2.1.1 1 Tx Antenna performances

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

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

			CORES				Antenna	Reference	e value
Test numbe r	Bandw idth	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 MHz	24	2	2	R.PDCCH. 1-2.1 FDD	TDLA30-10	1x2 Low	1	[8.0]
2	10 MHz	24	2	2	R.PDCCH. 1-2.3 FDD	TDLC300- 100	1x2 Low	1	[8.0]
3	10 MHz	48	2	4	R.PDCCH. 1-2.4 FDD	TDLA30-10	1x2 Low	1	[5.5]
4	10 MHz	48	1	4	R.PDCCH. 1-1.1 FDD	TDLA30-10	1x2 Low	1	[4.3]
5	10MHz	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	e value
Test numbe r	Bandw idth	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 MHz	24	2	4	R.PDCCH.	TDLC300-	2x2 Low	1	TBD
					1-2.2 FDD	100			
2	10 MHz	48	2	8	R.PDCCH.	TDLC300-	2x2 Low	1	[-1.5]
					1-2.5 FDD	100			
3	10 MHz	48	1	8	R.PDCCH.	TDLA30-10	2x2 Low	1	[-0.3]
					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		interleaved			
Interleaver size		3			
REG bundle size		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	e value
Test numbe r	Bandw idth	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 MHz	102	1	2	R.PDCCH. 2-1.1 TDD	TDLA30-10	1x2 Low	1	[6.7]
2	40 MHz	102	1	4	R.PDCCH. 2-1.2 TDD	TDLC300- 100	1x2 Low	1	[2.7]
3	40 MHz	48	2	16	R.PDCCH. 2-2.1 TDD	TDLC300- 100	1x2 Low	1	[-4.4]

### 5.3.2.2.2 2 Tx Antenna performances

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

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

			CORES				Antenna	Reference	value
Test numbe r	Bandw idth	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 MHz	[90]	1	8	R.PDCCH. 2-1.3 TDD	TDLC300- 100	2x2 Low	1	[-1.5]

# 5.3.3 4RX requirements

### 5.3.3.1 FDD

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

Table 5.3.3.1-1: Test Parameters

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

### 5.3.3.1.1 1 Tx Antenna performances

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

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

			CORES				Antenna	Reference	e value
Test numbe r	Bandw idth	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 MHz	24	2	2	R.PDCCH.	TDLA30-10	1x4 Low	1	[2.3]
					1-2.1 FDD				
2	10 MHz	24	2	2	R.PDCCH.	TDLC300-	1x4 Low	1	[2.5]
					1-2.3 FDD	100			
3	10 MHz	48	2	4	R.PDCCH.	TDLA30-10	1x4 Low	1	[0.0]
					1-2.4 FDD				
4	10 MHz	48	1	4	R.PDCCH.	TDLA30-10	1x4 Low	1	[-0.7]
					1-1.1 FDD				- <del>-</del>

### 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	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 MHz	24	2	4	R.PDCCH.	TDLC300-	2x4 Low	1	TBD
					1-2.2 FDD	100			
2	10 MHz	48	2	8	R.PDCCH.	TDLC300-	2x4 Low	1	[-4.8]
					1-2.5 FDD	100			
3	10 MHz	48	1	4	R.PDCCH.	TDLA30-10	2x4 Low	1	TBD
					1-1.3 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		interleaved		
Interleaver size		3		
REG bundle size	G bundle size 2 6		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	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 MHz	102	1	2	R.PDCCH. 2-1.1 TDD	TDLA30-10	1x4 Low	1	TBD
2	40 MHz	102	1	4	R.PDCCH. 2-1.2 TDD	TDLC300- 100	1x4 Low	1	TBD
3	40 MHz	48	2	16	R.PDCCH. 2-2.1 TDD	TDLA30-10	1x4 Medium A	1	[-4.1]

### 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	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 MHz	90	1	8	TBD	TDLC300- 100	2x4 Low	1	[-4.6]

# 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 TS 38.213 [11, Section 4.1]		

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	Bandwidth	Reference	e Propagation Antenna configuration and		Reference value		
number		channel	condition	correlation matrix	Pm- bch (%)	SNR (dB)	
1	10 MHz	R.PBCH.1	TDLC300-100	1 x 2 Low	1	[-6.4]	

Table 5.4.2.1-3 Minimum performance PBCH in case SS/PBCH block index is known

Test	Bandwidth	Reference	Propagation Antenna configuration and		Reference value		
number		channel	condition	correlation matrix	Pm- bch (%)	SNR (dB)	
1	10 MHz	R.PBCH.1	TDLC300-100	1 x 2 Low	1	[-8.5]	

### 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 TS 38.213 [11, Section 4.1]					
Note 2: as specified in TS 38.213 [11, Section 11.1]					

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	est Bandwidth Reference		Propagation	Antenna configuration and	Reference value		
number		channel	condition	correlation matrix	Pm- bch (%)	SNR (dB)	
1	40 MHz	R.PBCH.2	TDLA30-10	1 x 2 Low	1	[-5]	

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

Test	Bandwidth	Reference	Propagation	Antenna configuration and	Reference	ce value
number		channel	condition	correlation matrix	Pm- bch (%)	SNR (dB)
1	40 MHz	R.PBCH.2	TDLA30-10	1 x 2 Low	1	[-6.4]

## 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 4.1 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	Bandwidth	Reference	Propagation	Antenna configuration and	Reference	ce value
number		channel	condition	correlation matrix	Pm- bch (%)	SNR (dB)
1	10 MHz	R.PBCH.1	TDLC300-100	1 x 4 Low	1	[-9.1]

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

Test	Bandwidth	Reference	Propagation	Antenna configuration and	Reference	ce value
number		channel	condition	correlation matrix	Pm- bch (%)	SNR (dB)
1	10 MHz	R.PBCH.1	TDLC300-100	1 x 4 Low	1	TBD

### 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	Bandwidth	Reference	Propagation	Antenna configuration and	Reference	ce value
number		channel	condition	correlation matrix	Pm- bch (%)	SNR (dB)
1	40 MHz	R.PBCH.2	TDLA30-10	1 x 4 Low	1	[-8.5]

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

Test	Bandwidth	Reference	Propagation	ion Antenna configuration and		ce value
number		channel	condition	correlation matrix	Pm-	SNR
					bch	(dB)
					(%)	
1	40 MHz	R.PBCH.2	TDLA30-10	1 x 4 Low	1	[-9.9]

# 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:

Sustained rate minimum duration

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

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

The TB success rate is defined as 100%\*NDL\_correct\_rx/ (NDL\_newtx + NDL\_retx), where NDL\_newtx is the number of newly transmitted DL transport blocks, NDL\_retx is the number of retransmitted DL transport blocks, and NDL\_correct\_rx is the number of correctly received DL transport blocks. The TB success rate shall be sustained during at least TBD ms.

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		Jiii	Transmission scheme 1
EPRE ratio of PTRS		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	ms	20
	First DMRS position for Type A PDSCH mapping		2
Cross carrier schedu			Not configured
Active DL BWP index			1
	First PRB		0
DL BWP configuration #1	Number of contiguous PRB		Maximum transmission bandwidth configuration as specified in TS 38.101-1 [6, Section 5.3.2] 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
PDCCH	Number of PRBs in CORESET		Table 5.5A-4
configuration	Number of PDCCH candidates and aggregation levels		1/[AL 8]
	DCI format		1_1
	TCI State		TCI state #1
	Mapping type		Type A
	k0		0
	PDSCH aggregation factor		1
PDSCH	PRB bundling type		Static WB
configuration	PRB bundling size		
	Resource allocation type VRB-to-PRB mapping type		Type 0 Non-interleaved
	VRB-to-PRB mapping interleaver bundle		
	size		N/A
	DMRS Type		Type 1
	Number of additional DMRS		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)		1 for 1 layer and 2 layers CCs
PTRS configuration	without data		2 for 4 Layers CCs PTRS is not configured
. The configuration	Subcarrier indexes in the PRB used for		
	CSI-RS		$k_0 = 3$ for CSI-RS resource 1,2,3,4
	OFDM symbols in the PRB used for CSI-RS		$l_0$ = 6 for CSI-RS resource 1 and 3 $l_0$ = 10 for CSI-RS resource 2 and 4
	Number of CSI-RS ports (X)	1	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
	, M.		15 kHz SCS: 20 for CSI-RS resource
CSI-RS for tracking	CSI-RS periodicity	Slots	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
		2.5.0	30 kHz SCS: 20 for CSI-RS resource 1 and 2 21 for CSI-RS resource 3 and 4
	Frequency Occupation		Start PRB 0 Number of PRB = BWP size

	QCL info		TCI state #0
		dexes in the PRB used for	k <sub>0</sub> = 4
		ols in the PRB used for CSI-	l <sub>0</sub> = 12
		SI-RS ports (X)	Same as number of transmit antenna
	CDM Type	Stree ports (x)	'FD-CDM2'
NZP CSI-RS for	Density (ρ)		1
CSI acquisition	CSI-RS perio	dicity	15 kHz SCS: 20 30 kHz SCS: 40
	CSI-RS offse	t I	0
	Frequency O		Start PRB 0 Number of PRB = BWP size
	QCL info		TCI state #1
	Subcarrier ind CSI-RS	dexes in the PRB used for	k <sub>0</sub> = 0
	RS	ols in the PRB used for CSI-	l <sub>0</sub> = 12
		SI-RS ports (X)	4
ZP CSI-RS for CSI	CDM Type		'FD-CDM2'
acquisition	Density (ρ)		1
	CSI-RS perio	dicity	15 kHz SCS: 20 30 kHz SCS: 40
	CSI-RS offset	t	0
	Frequency O	ccupation	Start PRB 0 Number of PRB = BWP size
	Type 1 QCL	SSB index	SSB #0
TCI state #0	information	QCL Type	Type C
TOI State #0	Type 2 QCL	SSB index	N/A
	information	QCL Type	N/A
	Type 1 QCL information	CSI-RS resource	CSI-RS resource 1 from 'CSI-RS for tracking' configuration
TCI state #1		QCL Type	Type A
TCI state #1	Type 2 QCL	CSI-RS resource	N/A
Tot state #0	information Type 1 QCL information	SSB index	SSB #0
Maximum number of		ups for ACK/NACK feedback	1
Maximum number of			4
HARQ ACK/NACK b			Multiplexed
Redundancy version		ce	{0,2,3,1}
Precoding configuration			SP Type I, Random per slot with PRB bundling granularity
Symbols for all unused Res		OCNG Annex A.5	
Propagation condition			Static propagation condition  No external noise sources are applied
Antonno	1 layer CCs		[1x2 or 1x4]
Antenna	2 layers CCs		[2x2 or 2x4]
configuration	4 layers CCs	[4x4]	
Note 1: UE assum	nes that the TCI	state for the PDSCH is identical to t	the TCI state applied for the PDCCH
transmissi			

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

Parameter			Value
Duplex mode			FDD
PDSCH Starting symbol (S)			1
configuration	Length (L)		13
Number of HARQ Processes			TBD
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 P	rocesses		TBD
K1 value			Specific to each UL-DL pattern
TDD III DI nottorn			15 kHz SCS: FR1.15-1
TDD UL-DL pattern			30 kHz SCS: FR1.30-1
Note 1: PDSCH is s	cheduled only on full DL slots		

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

SCS (kHz)	5MHz	10MHz	15MHz	20 MHz	25 MHz	30 MHz	40 MHz	50MHz	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

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

Maximum number of PDSCH MIMO layers	Maximum modulation format	Scaling factor	MCS
1	8	1	[26]
1	8	0.8	[21]
1	8	0.75	[20]
1	8	0.4	[11]
1	6	1	[27]
1	6	0.8	[23]
1	6	0.75	[22]
1	6	0.4	[14]
1	4	1	[16]
1	4	0.8	[16]
1	4	0.75	[16]
1	4	0.4	[10]
1	2	1	[9]
1	2	0.8	[9]
1	2	0.75	[9]
1	2	0.4	[4]
2	8	1	[26]
2	8	0.8	[21]
2	8	0.75	[20]
2	8	0.4	[11]
2	6	1	[27]
2	6	0.8	[23]
2	6	0.75	[22]
2	6	0.4	[14]
2	4	1	[16]
2	4	0.8	[16]
2	4	0.75	[16]
2	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]

# 6 CSI reporting requirements (Conducted requirements)

# 6.1 General

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

# 6.1.1 Applicability of requirements

# 6.1.2 Common test parameters

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

Table 6.1.2-1: Test parameters for CSI test cases

	Parameter	Unit	Value
PDSCH transmis	sion scheme		Transmission scheme 1
EPRE ratio of PT	RS to PDSCH	dB	33.10.110
Active DL BWP in	ndex		1
Cyclic prefix	T		Normal
Common	Physical Cell ID		0
serving cell	SSB position in burst		First SSB in Slot #0
parameters	SSB periodicity Slots for PDCCH monitoring	ms	20 Each slot
	Symbols with PDCCH		0,1
PDCCH	Number of PDCCH candidates		,
configuration	and aggregation levels		1/[8]
J	DCI format		1_1
	TCI state		TCI state #1
Cross carrier sch			Not configured
	Mapping type		Type A
	k0		0
	Starting symbol (S)		2 12
	Length (L) PDSCH aggregation factor		12
PDSCH	PRB bundling type		Static
configuration	PRB bundling size		2
	Resource allocation type		0
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver		N/A
	bundle size		· · · · · · · · · · · · · · · · · · ·
	DMRS Type		Type 1
	Number of additional DMRS		Cincello avendo d DM
	Length		Single-symbol DM- RS
PDSCH DMRS			{1000} for Rank1 {1000,1001} for Rank2
configuration	DMRS ports indexes		{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 (KpT-Rs)		N/A
configuration	Time density (L <sub>PT-RS</sub> )		N/A
	First subcarrier index in the PRB used for CSI-RS ( $k_0$ )		[0]
	First OFDM symbol in the PRB used for CSI-RS ( <i>l</i> <sub>0</sub> )		[4]
	Number of CSI-RS ports (X)		1
	CDM Type		No CDM
	Density (ρ)		3
	CSI-RS periodicity	slot	15 kHz SCS: 20 30 kHz SCS: 40
			15 kHz SCS: 10 for CSI-RS
CSI-RS for tracking			resource 1 and 2 11 for CSI-RS
3			resource 3 and 4
	CSI-RS offset	slot	
			30 kHz SCS:
			20 for CSI-RS resource 1 and 2
			21 for CSI-RS
			resource 3 and 4
			Start PRB 0
	Frequency Occupation		Number of PRB =
	OCL info		BWP size
	QCL info	<u> </u>	TCI state #0

CSI acquisition         BWP size           QCL info         TCI state #1           ZP CSI-RS for CSI acquisition         Frequency Occupation         Start PRB 0 Number of PRB BWP size           Type 1 QCL information         SSB index         SSB #0           TCI state #0         Type 2 QCL information         Type C           Type 2 QCL information         SSB index         N/A           QCL Type         N/A           CSI-RS resource				
QCL info		Frequency Oc	ccupation	Number of PRB =
TCI state #1   Frequency Occupation   Number of PRB : BWP size	o o : a o qui o : ii o :	QCL info		
TCI state #0   Information   QCL Type   Type C				Number of PRB =
TCI state #0   QCL Type   Type C		Type 1 QCL	SSB index	SSB #0
TCI state #1  Type 2 QCL information  QCL Type  CSI-RS resource  CSI-RS resource from 'CSI-RS for tracking' configuration  QCL Type  Type 2 QCL information  QCL Type  Type 3 QCL Type  CSI-RS resource Type 4 Type 2 QCL information  CSI-RS resource N/A	TOI state #0	information	QCL Type	Type C
TCI state #1  Type 1 QCL information  TCI state #1  CSI-RS resource  CSI-RS resource  from 'CSI-RS for tracking' configuration  QCL Type  Type 2 QCL information  CSI-RS resource  from 'CSI-RS for tracking' configuration  CSI-RS resource  N/A	TCI state #0		SSB index	N/A
TCI state #1  Type 1 QCL information  CSI-RS resource  from 'CSI-RS for tracking' configuration  QCL Type  Type 2 QCL information  CSI-RS resource  N/A		information	QCL Type	N/A
Type 2 QCL CSI-RS resource N/A	TCI ototo #4	information  Type 2 QCL	CSI-RS resource	
information	TCI state #1			Type A
information QCL Type N/A			CSI-RS resource	N/A
			QCL Type	N/A
Number of HARQ Processes 4 For FDD	Number of HARO	Processes		4 For FDD
8 for IDD				
HARQ ACK/NACK bundling Multiplexed				
Redundancy version coding sequence {0,2,3,1}	Redundancy vers	ion coding sequ	uence	
K1 value 2 for FDD	K1 value			
(PDSCH-to-HARQ-timing-indicator)  Defined in Anne: A.1.2 for TDD	111 12114			
Symbols for unused Res  OCNG as specified A.5	Symbols for unused Res			OCNG as specified in A.5
Note 1: PDSCH is not scheduled on slots containing CSI-RS or slots which are not function DL.  Note 2: UE assumes that the TCI state for the PDSCH is identical to the TCI state				

# 6.2 Reporting of Channel Quality Indicator (CQI)

applied for the PDCCH transmission.

< Editor's note: The requirements were introduced based on current results from companies; these requirements can be revised based on more results from companies.>

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

# 6.2.1 1RX requirements

(Void)

# 6.2.2 2RX requirements

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

### 6.2.2.1 FDD

### 6.2.2.1.1 CQI reporting definition under AWGN conditions

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

### 6.2.2.1.1.1 Minimum requirement for periodic CQI reporting

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

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

Table 6.2.2.1.1.1-1: CQI reporting definition test

	Parameter			Test 1 Test 2			
Bandwidth			MHz		10		
Duplex Mode					FD	D	
DL BWP configura	ation	First PRB			0		
#1	allon	Number of contiguous PRB			52		
		Subcarrier spacing	kHz		1		
SNR			dB	[8]	[9]	[14] [15]	
Propagation chan	nel				AW		
Antenna configura	ation				Anne		
Beamforming Mod	del			As s	TB		
		RS resource Type			Perio	odic	
		per of CSI-RS ports (X)			4		
		Туре			FD-C		
ZP CSI-RS		ity (ρ)			1		
configuration	I	subcarrier index in the PRB			Row	5.4	
	used	for CSI-RS (k <sub>0</sub> )					
	for C	OFDM symbol in the PRB used SI-RS (I <sub>0</sub> )			9	)	
	CSI-F	RS dicity and offset	slot		5/	1	
		RS resource Type			Perio	odic	
		per of CSI-RS ports (X)			2		
		Туре			FD-C	DM2	
		ity (ρ)			1		
NZP CSI-RS for CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )				Row 3	3,(6,-)	
·	First	OFDM symbol in the PRB used SI-RS (I <sub>0</sub> )			13		
	NZP	CSI-RS-timeConfig dicity and offset	slot	5/1			
		M RE pattern			0	<u> </u>	
CSI-IM		M Resource Mapping		(4, 9)		•	
configuration		м,lcsi-iм)				9)	
		M timeConfig dicity and offset	slot	5/1		1	
ReportConfigType					Perio	odic	
CQI-table					Tabl		
reportQuantity					cri-RI-P		
timeRestrictionFo	rChann	elMeasurements			Not con	figured	
timeRestrictionFo	rInterfe	renceMeasurements			Not con	figured	
cqi-FormatIndicate	or				Widel		
pmi-FormatIndicat	tor				Widel		
Sub-band Size			RB		N/	A	
CSI-Report period	dicity ar	nd offset	slot		5/		
aperiodicTriggerin	<u> </u>				Not con		
		ebook Type			typel-Sing	glePanel	
Codebook		ebook Mode			1		
configuration		debookConfig- CodebookConfig-N2)			Not con	figured	
		ebookSubsetRestriction			[0100	000]	
RI Restriction					[N/		
Physical channel					[PUC	CH]	
		RI/PMI delay	ms		8		
Maximum number	of HAI	RQ transmission			1	<del></del>	
Measurement cha	innel			As spe	cified in Tal	ble A.4-1, 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 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 6.2.2.1.2.1-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

- a) A CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least  $\alpha$ % of the time where  $\alpha$ % is specified in Table 6.2.2.1.2.1-2;
- b) The ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be ≥ 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

	Parameter	Unit	Test 1 Test 2		
Bandwidth		MHz	10		
Duplex Mode			FDD		
DL BWP configura	First PRB		0		
#1	Number of configuous PRB		52		
	Subcarrier spacing	kHz	15		
SNR		dB	[6] [7] [12]	[13]	
Propagation chan			TDLA30-5		
Antenna configura			2×2		
Correlation config	uration		ULA high		
Beamforming Mod	del		As specified in Section [An	nex	
	CSI-RS resource Type		TBD] Periodic		
	Number of CSI-RS ports (X)		4		
	CDM Type		FD-CDM2		
ZP CSI-RS	Density (p)		1 D-0DIVIZ		
configuration	First subcarrier index in the PRB		·		
oormgaration	used for CSI-RS (k <sub>0</sub> )		Row 5,4		
	First OFDM symbol in the PRB used		_		
	for CSI-RS (I <sub>0</sub> )		9		
	CSI-RS	-1-4	F/4		
	periodicity and offset	slot	5/1		
	CSI-RS resource Type		Periodic		
	Number of CSI-RS ports (X)		2		
	CDM Type		FD-CDM2		
	Density (ρ)		1		
NZP CSI-RS for	First subcarrier index in the PRB		Row 3,(6,-)		
CSI acquisition	used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		110W 3,(0, )		
	First OFDM symbol in the PRB used		13		
	for CSI-RS (I <sub>0</sub> )				
	NZP CSI-RS-timeConfig periodicity and offset	slot	5/1		
	CSI-IM RE pattern		0		
CSI-IM	CSI-IM Resource Mapping		Ü		
configuration	(Kcsi-im, Icsi-im)		(4, 9)		
	(Noor Impoor Imp		( ', ')		
	CSI-IM timeConfig	olot	F./A		
	periodicity and offset	slot	5/1		
ReportConfigType	)		Periodic		
CQI-table			Table 2		
reportQuantity			cri-RI-PMI-CQI		
	rChannelMeasurements		Not configured		
	rInterferenceMeasurements		Not configured		
cqi-FormatIndicate			Wideband		
pmi-FormatIndica	tor		Wideband		
Sub-band Size		RB	[8]		
Csi-ReportingBan			[111111]		
CSI-Report period		slot	5/1		
aperiodicTriggerin			Not configured		
Codebook	Codebook Type Codebook Mode		typel-SinglePanel 1		
configuration	(Codebook Config-		1		
Comiguration	N1,CodebookConfig-N2)		Not configured		
	CodebookSubsetRestriction		000001		
	RI Restriction		[N/A]		
Physical channel			[PUCCH]		
. Hyoroan orianii lor	CQI/RI/PMI delay	ms	8		
Maximum number	of HARQ transmission		1		
			As specified in Table A.4-1, T	BS.2-	
Measurement cha	nnei		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.

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

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

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	)
Duplex Mode				FDD	
DI DIVID configura	-4:	First PRB		0	
DL BWP configura	ation	Number of contiguous PRB		52	<u>)</u>
#1		Subcarrier spacing	kHz	15	5
SNR			dB	TBD TBD	TBD TBD
Propagation chan	nel			[Two tap model sp B.2.4 with a=1,	$f_D = 5$ Hz, and
Antenna configura	tion			т <sub>d</sub> =0.4	
Correlation config				As per Ar	
				As specified in S	
Beamforming Mod				TBI	D]
	CSI-I	RS resource Type		Perio	
		ber of CSI-RS ports (X)		4	
70.001.00		Type		FD-CI	JM2
ZP CSI-RS		ity (p)		1	
configuration	used	subcarrier index in the PRB for CSI-RS (k <sub>0</sub> )		Row	5,4
	for C	OFDM symbol in the PRB used SI-RS (I <sub>0</sub> )		9	
	CSI-I perio	RS dicity and offset	slot	5/	1
	CSI-I	RS resource Type		Perio	odic
	Num	ber of CSI-RS ports (X)		2	
	CDM Type			FD-CDM2	
	Dens	sity (ρ)		1	
NZP CSI-RS for CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )			Row 3	,(6,-)
·	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> )			13	
		CSI-RS-timeConfig dicity and offset	slot	5/	1
		M RE pattern		0	
CSI-IM configuration		M Resource Mapping ıм,lcsı-ıм)		(4,	9)
		M timeConfig dicity and offset	slot	5/1	
ReportConfigType	)			Perio	
CQI-table				Tabl	e 2
reportQuantity			<u></u>	cri-RI-PI	
timeRestrictionFo			<u></u>	Not conf	
timeRestrictionFo	rInterfe	renceMeasurements	<u></u>	Not conf	
cqi-FormatIndicate	or			Subb	and
pmi-FormatIndicat	tor			Widek	oand
Sub-band Size			RB	8	
CSI-Report period			slot	5/	1
aperiodicTriggerin	aperiodicTriggeringOffset			Not conf	figured
	Cod	lebook Type		typel-Sing	glePanel
Codebook	Cod	lebook Mode		1	
configuration	(Co	debookConfig- CodebookConfig-N2)		Not conf	figured
	CodebookSubsetRestriction			0000	001
	RI Restriction			[N//	
Physical channel				TB	
. Hydrodi dilatilidi		RI/PMI delay	ms	8	
Maximum number			1110	1	
Measurement cha		TQ TAHOHIOOH		TB	D
Mododiomont ond	1.0				

Table 6.2.2.1.2.2-2: Minimum requirements

Parameters	Test 1	Test 2
α [%]	TBD	TBD
β [%]	TBD	TBD
γ	TBD	TBD

### 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 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.

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

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

Table 6.2.2.2.1.1-1: CQI reporting definition test

	Parameter			Test 1 Test 2			st 2
Bandwidth			Unit MHz		4(	)	
Duplex Mode				TDD			
TDD UL-DL patter	rn				FR1.	30-1	
DL BWP configura	ation	First PRB		0			
#1	allon	Number of contiguous PRB		106			
		Subcarrier spacing	kHz		30		T
SNR			dB	[8]	[9]	[14]	[15]
Propagation chan	nel			0.0 ''	AW		.6. 1.
Antenna configura	ation				h static cha Anne	x B.1	
Beamforming Mod	del			As sp	pecified in S TB	D] -	Annex
		RS resource Type			Perio		
		per of CSI-RS ports (X)			4		
		Туре			FD-C		
ZP CSI-RS		ity (ρ)			1		
configuration	used	subcarrier index in the PRB for CSI-RS (k <sub>0</sub> )			Row	5,4	
		OFDM symbol in the PRB used SI-RS (I <sub>0</sub> )			9	)	
	CSI-F		slot		10.	/1	
		RS resource Type			Perio	odic	
		per of CSI-RS ports (X)			2		
		Type		FD-CDM2			
		ity (ρ)			1		
NZP CSI-RS for	First	subcarrier index in the PRB			Dow 2	) (G )	
CSI acquisition	used	for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )			Row 3	5,(6,-)	
	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> )				13	3	
	NZP	CSI-RS-timeConfig dicity and offset	slot		10	/1	
		M RE pattern		0		)	
CSI-IM	CSI-I	M Resource Mapping		(4, 9)			
configuration	-	м,Ісзінм)					
	CSI-I perio	M timeConfig dicity and offset	slot	10/1			
ReportConfigType				Periodic			
CQI-table				Table 2			
reportQuantity					cri-RI-P		
timeRestrictionFo					Not con		
		renceMeasurements			Not con		
cqi-FormatIndicate					Widel		
pmi-FormatIndica	tor				Widel		
Sub-band Size			RB		N/		
CSI-Report period			slot		10/1		
aperiodicTriggerin					Not con		
Cadabasts		ebook Type			typel-Sing		
Codebook configuration		ebook Mode debookConfig-			1		
Corniguration		CodebookConfig-N2)			Not con	figured	
		ebookSubsetRestriction			[0100	000]	
	RIR	Restriction			[N/	A]	
Physical channel	for CSI	report			[PUC	CH]	
CQI/RI/PMI delay			ms		[9.	5]	
Maximum number	of HAI	RQ transmission			1		
Measurement cha	innel			As spec	cified in Tal 4		, TBS.2-

### 6.2.2.2.2 Wideband 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.

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

- a) A CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least  $\alpha$ % of the time where  $\alpha$ % is specified in Table 6.2.2.2.1-2;
- b) The ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be ≥ 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

	Pa	arameter	Unit	Test 1	Test 2	
Bandwidth			MHz	40		
Duplex Mode				TDD		
TDD UL-DL patter	'n			FR1.30-1		
DL BWP configura	ation	First PRB		0		
#1	ation	Number of contiguous PRB		106		
		Subcarrier spacing	kHz	30		
SNR			dB	6 7 1	2 13	
Propagation chann				[TDLA30-5	]	
Antenna configura				2×2		
Correlation configu	uration			ULA high		
Beamforming Mod	lel			As specified in Section TBD]	on [Annex	
	CSI-F	RS resource Type		Periodic		
		per of CSI-RS ports (X)		4		
		Туре		FD-CDM2		
ZP CSI-RS		ity (ρ)		1		
configuration		subcarrier index in the PRB for CSI-RS (k <sub>0</sub> )		Row 5,4		
	First	OFDM symbol in the PRB used SI-RS (I <sub>0</sub> )		9		
CSI-RS periodicity and offset			slot	10/1		
	CSI-RS resource Type			Periodic		
		per of CSI-RS ports (X)		2		
		Type		FD-CDM2		
	Density (ρ)			1		
NZP CSI-RS for CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )			Row 3,(6,-)	)	
·	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> )			13		
	NZP CSI-RS-timeConfig periodicity and offset		slot	10/1		
		M RE pattern		0		
CSI-IM configuration		M Resource Mapping м,lcsi-ім)		(4, 9)		
		M timeConfig dicity and offset	slot	10/1		
ReportConfigType		alony and oneot		Periodic		
CQI-table				Table 2		
reportQuantity				cri-RI-PMI-C	QI	
timeRestrictionFor	Chann	elMeasurements		Not configure		
		renceMeasurements		Not configure		
cqi-FormatIndicato	or			Wideband		
pmi-FormatIndicat	or			Wideband		
Sub-band Size			RB	[16]		
Csi-ReportingBand				[111111]		
CSI-Report period	icity ar	nd offset	slot	10/1		
aperiodicTriggerin	gOffse	t	·	Not configure		
		ebook Type		typel-SinglePa	anel	
Codebook		ebook Mode		1		
configuration		debookConfig- CodebookConfig-N2)		Not configure	ed	
	Cod	ebookSubsetRestriction		000001		
		estriction	·	[N/A]		
Physical channel f	or CSI	report		[PUCCH]		
		RI/PMI delay	ms	[9.5]		
Maximum number	of HAI	RQ transmission	·	1		
Measurement cha	nnel			As specified in Table A	4-1, TBS.2-	

Table 6.2.2.2.1-2: Minimum requirements

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

### 6.2.2.2.2.2 Minimum requirement for sub-band CQI reporting

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

The accuracy of sub-band channel CQI reporting under the frequency-selective fading conditions is determined by a double-sided percentile of the reported differential CQI offset level 0 per sub-band, and the relative increase of the throughput obtained when transmitting the transport format indicated by the corresponding reported sub-band CQI on a randomly selected sub-band among the sub-bands with the highest reported differential CQI offset level compared to the throughput when transmitting a fixed transport format according to the wideband CQI median on a randomly selected sub-band among all the sub-bands.

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

- a) A sub-band differential CQI offset level of 0 shall be reported at least  $\alpha\%$  of the time but less than  $\beta\%$  of the time for each sub-band, where  $\alpha$  and  $\beta$  are specified in Table 6.2.2.2.2-2;
- b) The ratio of the throughput obtained when transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level and that obtained when transmitting the transport format indicated by the reported wideband CQI median on a randomly selected sub-band among all the sub-bands shall be  $\geq \gamma$ , where  $\gamma$  is specified in Table 6.2.2.2.2.2;
- c) When transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level, the average BLER for the indicated transport format shall be greater than or equal to TBD.

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

	Pa	arameter	Unit	Tes	t 1	Test 2
Bandwidth			MHz		4(	
Duplex Mode					TD	
TDD UL-DL patter	n				FR1.	30-1
DL BWP configura	tion	First PRB			C	1
#1	illori	Number of contiguous PRB			10	6
		Subcarrier spacing	kHz		30	)
SNR			dB	TBD	TBD	TBD TBD
Propagation chann				[Two tap model specified in Anno B.2.4 with a=1, f <sub>D</sub> = 5Hz, and t <sub>d</sub> =0.1125µs]		
Antenna configura	tion				TB	D
Correlation configu	ıration				As per Ar	
Beamforming Mod	Beamforming Model			As spe	cified in S TB	Section [Annex D]
	CSI-F	RS resource Type			Perio	odic
	Numb	per of CSI-RS ports (X)			4	•
		Type			FD-C	DM2
ZP CSI-RS		ity (ρ)			1	
configuration	First	subcarrier index in the PRB for CSI-RS (k <sub>0</sub> )			Row	5,4
	for C	OFDM symbol in the PRB used SI-RS (I <sub>0</sub> )			9	1
	CSI-F perio	RS dicity and offset	slot		10	/1
		RS resource Type			Perio	odic
	Number of CSI-RS ports (X) CDM Type			2		
					FD-C	DM2
	Density (ρ)				1	
NZP CSI-RS for CSI acquisition	used	subcarrier index in the PRB for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )			Row 3	3,(6,-)
	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> )				13	3
	NZP CSI-RS-timeConfig periodicity and offset		slot		10	/1
		M RE pattern			0	
CSI-IM configuration	CSI-IM Resource Mapping (kcsi-im,lcsi-im)  CSI-IM timeConfig periodicity and offset				(4,	9)
			slot		10	/1
ReportConfigType					Perio	
CQI-table					Tab	e 2
reportQuantity					cri-RI-P	
timeRestrictionFor					Not con	
		renceMeasurements			Not con	
cqi-FormatIndicato					Subb	
pmi-FormatIndicate	or				Widel	oand
Sub-band Size			RB		10	
CSI-Report period			slot		10	
aperiodicTriggeringOffset					Not con	
		ebook Type		1	ypel-Sin	glePanel
Codebook configuration	(Cod	ebook Mode debookConfig-			Not con	figured
		CodebookConfig-N2)				
		ebookSubsetRestriction			0000	
<b>D</b>		estriction			[N/	
Physical channel for					TB	
		RI/PMI delay	ms		[9.	
Maximum number		RQ transmission			1	
Measurement char	nnel			<u> </u>	TB	ט

Table 6.2.2.2.2-2: Minimum requirements

Parameters	Test 1	Test 2
α <b>[%]</b>	TBD	TBD
β [%]	TBD	TBD
γ	TBD	TBD

## 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 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.

### 6.2.3.1.1.1 Minimum requirement for period CQI reporting

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

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

Table 6.2.2.1.1.1-1: CQI reporting definition test

	Parameter			Test 1 Test 2			
Bandwidth			MHz		10		
Duplex Mode					FD	D	
DL BWP configura	ation	First PRB			0		
#1	allon	Number of contiguous PRB			52		
		Subcarrier spacing	kHz		1		
SNR			dB	[5]	[6]	[11] [12]	
Propagation chan	nel				AW		
Antenna configura	ation				Anne		
Beamforming Mod	del			As s	pecified in S TB	Section [Annex D]	
	CSI-I	RS resource Type			Perio	odic	
		per of CSI-RS ports (X)			4		
		Туре			FD-C	DM2	
ZP CSI-RS		ity (ρ)			1		
configuration		subcarrier index in the PRB			Row	5.4	
	used	for CSI-RS (k <sub>0</sub> )			11011		
	for C	OFDM symbol in the PRB used SI-RS (I <sub>0</sub> )			9		
	CSI-I	RS dicity and offset	slot		5/	1	
		RS resource Type			Perio	odic	
		per of CSI-RS ports (X)			2		
		Type			FD-C		
		ity (ρ)			150		
NZP CSI-RS for CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )				Row 3		
	First	OFDM symbol in the PRB used SI-RS (I <sub>0</sub> )			13	3	
	NZP	CSI-RS-timeConfig dicity and offset	slot		5/1		
		M RE pattern			0		
CSI-IM		M Resource Mapping		(4, 9)		,	
configuration		м,lcsi-iм)				9)	
		M timeConfig dicity and offset	slot	5/1		1	
ReportConfigType					Perio	odic	
CQI-table					Tabl		
reportQuantity					cri-RI-P		
timeRestrictionFo	rChanr	elMeasurements			Not con	figured	
timeRestrictionFo	rInterfe	renceMeasurements			Not con	figured	
cqi-FormatIndicate					Widel		
pmi-FormatIndica	tor				Widel		
Sub-band Size			RB		N/		
CSI-Report period	dicity ar	nd offset	slot		5/		
aperiodicTriggerin					Not con		
		ebook Type			typel-Sing	glePanel	
Codebook		ebook Mode			1		
configuration		debookConfig- CodebookConfig-N2)			Not con	figured	
		ebookSubsetRestriction			[0100	000]	
RI Restriction				[N/			
Physical channel	Physical channel for CSI report				[PUC	CH]	
	CQI/RI/PMI delay				8		
Maximum number	r of HA	RQ transmission			1		
Measurement cha	annel			As spe	cified in Tal 2	ble A.4-1, TBS.2-	

### 6.2.3.1.2 Wideband 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.

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

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

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

Parameter			Unit	Test 1 Test 2		st 2	
Bandwidth			MHz		10		
Duplex Mode				FDD			
DL DWD configuration First PRB				0			
DL BWP configuration  Number of contiguous P				52			
#1 Subcarrier spacing		kHz	15				
SNR		dB	[3]	[4]	[9]	[10]	
Propagation channel					TDLA		
Antenna configuration				2×4			
Correlation configuration				XP High			
Beamforming Model				As specified in Section [Annex TBD]			
	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 <sub>0</sub> )			10W 0,4			
	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> )				9		
	CSI-RS		-1-4	5/4			
	periodicity and offset		slot	5/1			
	CSI-RS resource Type			Periodic			
NZP CSI-RS for CSI acquisition	Number of CSI-RS ports (X)			2			
	CDM Type			FD-CDM2			
	Density (p)				1		
	First subcarrier index in the PRB					(0.)	
	used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )				Row 3	5,(6,-)	
	First OFDM symbol in the PRB used				4,4		
	for CSI-RS (I <sub>0</sub> )				13	3	
	NZP CSI-RS-timeConfig periodicity and offset		slot	5/1			
	CSI-IM RE pattern				0		
CSI-IM	CSI-IM Resource Mapping						
configuration	(kcsi-im,lcsi-im)				(4,	9)	
	CSI-IM timeConfig periodicity and offset		slot	5/1			
ReportConfigType					Perio	ndic	
CQI-table					Tabl		
reportQuantity					cri-RI-PI		
timeRestrictionForChannelMeasurements					Not con		
timeRestrictionForInterferenceMeasurements				1	Not con		
cgi-FormatIndicator					Widel		
pmi-FormatIndicator				1	Widel		
Sub-band Size			RB	1	8]		
csi-ReportingBand			1,10		[1111		
CSI-Report periodicity and offset			slot	1	5/		
aperiodicTriggeringOffset			3101	1	Not con		
aperiodic rriggeriii	Codebook Type			+	typel-Sing		
Codebook	Codebook Type Codebook Mode			1	1 typei-oii	J. O. W. W.	
configuration		debookConfig-		1			
3	N1,CodebookConfig-N2)				Not con	figured	
	CodebookSubsetRestriction				0000	001	
	RI Restriction			1	[N/		
Physical channel for CSI report					[PUC		
CQI/RI/PMI delay			mc				
Maximum number of HARQ transmission			ms	1	0		
iviaxiiiiuiii iiuiiibei	от пА	IVA II ALISHII ISSIULI		Ac ana	ified in Tal	hlo /\ 4 4	TDC 2
Measurement channel				va sher	illed in Tai		, 100.2-

Table 6.2.3.1.2.1-2: Minimum requirements

Parameters	Test 1	Test 2
<i>α</i> [%]	[5]	[5]
γ	[1.05]	[1.05]

#### 6.2.3.1.2.2 Minimum requirement for sub-band CQI reporting

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

The accuracy of sub-band channel CQI reporting under the frequency-selective fading conditions is determined by a double-sided percentile of the reported differential CQI offset level 0 per sub-band, and the relative increase of the throughput obtained when transmitting the transport format indicated by the corresponding reported sub-band CQI on a randomly selected sub-band among the sub-bands with the highest reported differential CQI offset level compared to the throughput when transmitting a fixed transport format according to the wideband CQI median on a randomly selected sub-band among all the sub-bands.

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

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

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			Test 1	Test 2
Bandwidth			MHz	10	
Duplex Mode				FDD	
DL BWP configura	ation	First PRB		0	
#1	ation	Number of contiguous PRB		52	
		Subcarrier spacing	kHz	15	
SNR			dB	TBD TBD	TBD TBD
Propagation chan	nel			[Two tap model sp B.2.4 with a=1, τ <sub>d</sub> =0.4	$f_D = 5$ Hz, and
Antenna configura				TB	D
Correlation configu	uration			As per Ar	
Beamforming Mod				As specified in S	D]
	CSI-F	RS resource Type		Perio	odic
		per of CSI-RS ports (X)		4	
	CDM			FD-CI	DM2
ZP CSI-RS		ity (ρ)		1	
configuration	used	subcarrier index in the PRB for CSI-RS (k <sub>0</sub> )		Row	5,4
	for CS	OFDM symbol in the PRB used SI-RS (I <sub>0</sub> )		9	
		dicity and offset	slot	5/	
		RS resource Type		Perio	
		per of CSI-RS ports (X)		2	
	CDM Type			FD-CDM2	
	Density (ρ)			1	
NZP CSI-RS for CSI acquisition	used	subcarrier index in the PRB for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 3	,(6,-)
	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> )			13	3
	perio	CSI-RS-timeConfig dicity and offset	slot	5/1	
		M RE pattern		0	
CSI-IM configuration	(kcsı-ı	M Resource Mapping м,Ісsнм)		(4,	9)
		M timeConfig dicity and offset	slot	5/	1
ReportConfigType	)			Perio	
CQI-table				Tabl	
reportQuantity				cri-RI-PI	
timeRestrictionFor				Not con	
		renceMeasurements		Not con	
cqi-FormatIndicato				Subb	
pmi-FormatIndicat	or			Widek	
Sub-band Size			RB	8	
	CSI-Report periodicity and offset		slot	5/	
aperiodicTriggeringOffset			Not con		
		ebook Type		typel-Sing	
Codebook configuration	(Cod	ebook Mode debookConfig-		Not con	
		CodebookConfig-N2) ebookSubsetRestriction			
	_			0000	
Dhygiaal shannal f		estriction		[N/	
Physical channel f			m.c	TB	
Maximove		RI/PMI delay	ms	8	
Maximum number		KU Transmission		1	
ivieasurement cha	Measurement channel			ТВ	ט

Table 6.2.3.1.2.2-2: Minimum requirements

Parameters	Test 1	Test 2
a [%]	TBD	TBD
β [%]	TBD	TBD
γ	TBD	TBD

## 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.

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

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

Table 6.2.3.2.1.1-1: CQI reporting definition test

	Pa	arameter	Unit	Те	st 1	Test 2	
Bandwidth			MHz		40		
Duplex Mode				TDD			
TDD UL-DL patter	rn			FR1.30-1			
DL BWP configura	ation	First PRB			0		
#1	allon	Number of contiguous PRB			106		
		Subcarrier spacing	kHz		30		
SNR			dB	[5]	[6]	[11] [1:	2]
Propagation chan	nel			0.4 1	AW	-	
Antenna configura	ation				Anne		
Beamforming Mod	del			As sp	TB		X
		RS resource Type			Perio		
		per of CSI-RS ports (X)			4		
		Туре			FD-C		
ZP CSI-RS		ity (ρ)			1		
configuration	used	subcarrier index in the PRB for CSI-RS (k <sub>0</sub> )			Row	5,4	
		OFDM symbol in the PRB used SI-RS (I <sub>0</sub> )			9	)	
	CSI-F	RS dicity and offset	slot		10.	/1	
		RS resource Type			Perio	odic	
		per of CSI-RS ports (X)			2	)	
		Туре			FD-C	DM2	
		ity (ρ)		1			
NZP CSI-RS for		subcarrier index in the PRB			Row 3	3 (6 -)	
CSI acquisition		for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		11000 0,(0, )		J,(U,-)	
	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> )				13	3	
		CSI-RS-timeConfig dicity and offset	slot		10	/1	
		M RE pattern			0	)	
CSI-IM configuration		M Resource Mapping м,Ісзым)		(4, 9)		9)	
		M timeConfig dicity and offset	slot	10/1			
ReportConfigType				Periodic			
CQI-table					Tabl		
reportQuantity					cri-RI-P	MI-CQI	
timeRestrictionFo					Not con		
		renceMeasurements			Not con		
cqi-FormatIndicate					Widel		
pmi-FormatIndica	tor				Widel		
Sub-band Size			RB		N/		
CSI-Report period			slot		10.		
aperiodicTriggerin	aperiodicTriggeringOffset				Not con		
Cadabasts		ebook Type			typel-Sing		
Codebook configuration		ebook Mode debookConfig-		1	1		
Corniguration	N1,0	CodebookConfig-N2)			Not con		
		ebookSubsetRestriction			[0100		
<u> </u>	RI Restriction				[N/		
Physical channel			ms		[PUC		
Manda	CQI/RI/PMI delay				[9.	5]	
Maximum number	ot HAI	KQ transmission		Λ	1	hla A 4.4 TDO	
Measurement channel			As spec	cified in Tal	ble A.4-1, TBS	>.∠-	

## 6.2.3.2.2 Wideband 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.

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

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

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

	Parameter			Test 1 Test 2	
Bandwidth			MHz	40	
Duplex Mode				TDD	
TDD UL-DL patter	rn			FR1.30-1	
DL BWP configura	ation	First PRB		0	
#1		Number of contiguous PRB	Lal III	106	
	Subcarrier spacing		kHz	-	30 
SNR			dB	[3] [4]	[9] [10]
Propagation chan				[TDL/	A30-5]
Antenna configura					×4
Correlation config	uration				High
Beamforming Mod	del				Section [Annex BD]
	CSI-I	RS resource Type			iodic
		ber of CSI-RS ports (X)			4
		Type		FD-0	CDM2
ZP CSI-RS		ity (ρ)			1
configuration	used	subcarrier index in the PRB for CSI-RS (k <sub>0</sub> )		Rov	v 5,4
		OFDM symbol in the PRB used SI-RS (I <sub>0</sub> )			9
	CSI-I	RS dicity and offset	slot	10	D/1
	CSI-I	RS resource Type		Per	iodic
		ber of CSI-RS ports (X)		· ·	2
		Туре		FD-CDM2	
N7D 001 D0 (	Density (ρ)				1
NZP CSI-RS for CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )			Row	3,(6,-)
	First OFDM symbol in the PRB used for CSI-RS ( $I_0$ )			1	3
		CSI-RS-timeConfig dicity and offset	slot	10/1	
	CSI-I	M RE pattern			0
CSI-IM configuration	CSI-IM Resource Mapping (kcsi-im,lcsi-im)			(4	, 9)
		M timeConfig dicity and offset	slot	10/1	
ReportConfigType	Э				iodic
CQI-table					ole 2
reportQuantity	-Ch	a IN de a course acrete			PMI-CQI
timeRestrictionFo		renceMeasurements			nfigured nfigured
cqi-FormatIndicate		rencemeasurements			eband
pmi-FormatIndicat					eband
Sub-band Size			RB		6]
csi-ReportingBand	d				1111]
CSI-Report period		nd offset	slot		0/1
aperiodicTriggerin					nfigured
		ebook Type		typel-Sir	nglePanel
Codebook		lebook Mode			1
configuration	N1,0	debookConfig- CodebookConfig-N2)		Not co	nfigured
		ebookSubsetRestriction			0001
DI : : :		Restriction			/A]
Physical channel				•	CCH]
Maximum number		RI/PMI delay	ms	[9	1.5]
		NG II alioliiiooluli		As specified in To	able A.4-1, TBS.2-
Measurement channel					3

Table 6.2.3.2.2.1-2: Minimum requirements

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

#### 6.2.3.2.2.2 Minimum requirement for sub-band CQI reporting

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

The accuracy of sub-band channel CQI reporting under the frequency-selective fading conditions is determined by a double-sided percentile of the reported differential CQI offset level 0 per sub-band, and the relative increase of the throughput obtained when transmitting the transport format indicated by the corresponding reported sub-band CQI on a randomly selected sub-band among the sub-bands with the highest reported differential CQI offset level compared to the throughput when transmitting a fixed transport format according to the wideband CQI median on a randomly selected sub-band among all the sub-bands.

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

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

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			Test 1	Test 2
Bandwidth			MHz	40	
Duplex Mode				TDD	
TDD UL-DL patter	n			FR1.30-1	
DL BWP configura	tion	First PRB		0	
#1	illori	Number of contiguous PRB		10	
	Subcarrier spacing		kHz	30	
SNR			dB	TBD TBD	TBD TBD
Propagation chann	nel			[Two tap model s <sub>1</sub> B.2.4 with <i>a</i> =1, τ <sub>d</sub> =0.11	$f_D = 5Hz$ , and
Antenna configura	tion			TB	
Correlation configu				As per Ar	nnex B.1
Beamforming Mod	el			As specified in	Section [Annex
		OC recourse Type		TB Perio	
		RS resource Type per of CSI-RS ports (X)		Peno 4	
	CDM	, , ,		FD-C	
ZP CSI-RS	Dens			1 1	
configuration		subcarrier index in the PRB		-	
oormgaraorr		for CSI-RS (k <sub>0</sub> )		Row	5,4
		OFDM symbol in the PRB used SI-RS (I <sub>0</sub> )		9	
	CSI-F	RS dicity and offset	slot	10	/1
		RS resource Type		Perio	odic
	Numb	per of CSI-RS ports (X)		2	
	CDM Type			FD-CDM2	
	Density (ρ)			1	
NZP CSI-RS for CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )			Row 3	3,(6,-)
	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> )			1:	3
	NZP	CSI-RS-timeConfig dicity and offset	slot	10/1	
		M RE pattern		C	
CSI-IM configuration		M Resource Mapping м,Ісsни)		(4,	9)
		M timeConfig dicity and offset	slot	10/1	
ReportConfigType				Perio	odic
CQI-table				Tab	
reportQuantity				cri-RI-P	
timeRestrictionFor	Chann	elMeasurements		Not con	
timeRestrictionFor	<u>Interfe</u>	renceMeasurements		Not con	figured
cqi-FormatIndicato	r			Subb	
pmi-FormatIndicat	or			Widel	
Sub-band Size			RB	10	
CSI-Report periodicity and offset		slot	10		
aperiodicTriggeringOffset			Not con		
		ebook Type		typel-Sin	
Codebook		ebook Mode		1	
configuration		debookConfig- CodebookConfig-N2)		Not con	figured
		ebookSubsetRestriction		0000	001
	RI Restriction			[N/	
Physical channel f	or CSI	report		TB	
•	CQI/F	RI/PMI delay	ms	[9.	5]
Maximum number	of HAF	RQ transmission		1	
Measurement char	nnel			TB	D

Table 6.2.2.1.2.2-2: Minimum requirements

Parameters	Test 1	Test 2
a [%]	TBD	TBD
β [%]	TBD	TBD
γ	TBD	TBD

# 6.3 Reporting of Precoding Matrix Indicator (PMI)

< Editor's note: The requirements were introduced based on current results from companies; these requirements can be revised based on more results from companies. >

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

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

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

## 6.3.1 1RX requirements

(Void)

## 6.3.2 2RX requirements

#### 6.3.2.1 FDD

#### 6.3.2.1.1 Single PMI with 4TX 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)

Bandwidth	Pai	rameter	Unit	Test 1
DL BWP   Number of configuration   Subcarrier   Spacing   Spa	Bandwidth		MHz	10
DL BWP configuration	Duplex Mode			FDD
Contiguous PRB				0
#1 Subcarrier spacing Propagation channel  Antenna configuration  Beamforming Model  CSI-RS resource Type Number of CSI-RS posts (X) CDM Type Density (p) CSI-RS (k(k, k)) CSI-RS (k(k, k)) CSI-RS resource Type Number of CSI-RS (x) CSI-RS resource Type Number of CSI-RS (k(k, k)) CSI-RS resource Type Density (p) Tirst of DM Symbol in the PRB used for CSI-RS (k(k, k)) CSI-RS (k(k, k)				52
Spacing	_			-
Propagation channel	#1		kHz	15
Antenna configuration	Propagation cha			TDI A30-5
Beamforming Model				
CSI-RS resource	Antenna configu	uration		
Type	Beamforming M	lodel		TBD
Number of CSI- RS ports (X)				Aperiodic
RS ports (X)				, ipoliodio
CDM Type				4
Density (p)				FD-CDM2
First subcarrier index in the PRB used for CSI-RS (ko, k1)				
Index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )   First OFDM symbol in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )	ZP CSI-RS			·
symbol in the PRB used for CSI-RS (lo, lr) CSI-RS interval and offset Type Number of CSI-RS (RS ports (X)) NZP CSI-RS for CSI acquisition  NZP CSI-RS (ko, kr)  NZP CSI-RS (ko, kr)  NZP CSI-RS (ko, kr)  NZP CSI-RS for CSI acquisition  NZP CSI-RS (ko, kr)  First of DM symbol in the PRB used for CSI-RS (ko, kr)  CSI-IM RE pattern CSI-IM RE pattern CSI-IM Resource Mapping (KCSI-IM, IcSI-IM)  CSI-IM Resource Mapping (CSI-IM timeConfig interval and offset Table 1  ReportConfigType  Aperiodic  CQI-table  Table 1  reportQuantity  timeRestrictionForChannelMeasure ments  timeRestrictionForChannelMeasure ments  used for CSI-RS (lo, lr)  CSI-IM Resource Mapping (KCSI-IM, IcSI-IM)  CSI-IM timeConfig interval and offset  ReportConfigType  Aperiodic  CQI-table  Table 1  reportQuantity  timeRestrictionForChannelMeasure ments  urements  Not configured  timeRestrictionForInterferenceMeas  urements  RB [8]  csi-ReportingBand  CGodebook Type  Lodebook Type  (A,9)	configuration	index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 5, (4,-)
Interval and offset		symbol in the PRB used for CSI-RS		(9,-)
Type			slot	5/1
Number of CSI-RS ports (X)				Aperiodic
NZP CSI-RS for CSI acquisition		Number of CSI-		4
Density (p)   1   1				FD-CDM2
for CSI acquisition    Index in the PRB used for CSI-RS (ko, k1)				
First OFDM symbol in the PRB used for CSI-RS (lo, l1)  CSI-RS interval and offset	for CSI	index in the PRB used for CSI-RS		Row 4, (0,-)
interval and offset  CSI-IM RE pattern  CSI-IM Resource Mapping (kcsi-im,lcsi-im)  CSI-IM timeConfig interval and offset  ReportConfigType  CQI-table reportQuantity timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator pmi-FormatIndicator sub-band Size csi-Report interval and offset  CSI-IM timeConfig interval and offset slot slot slot slot slot slot slot slo		First OFDM symbol in the PRB used for CSI-RS		(13,-)
CSI-IM Resource Mapping (k <sub>CSI-IM</sub> , l <sub>CSI-IM</sub> )  CSI-IM timeConfig interval and offset Slot 5/1  ReportConfigType Aperiodic  CQI-table Table 1  reportQuantity cri-RI-PMI-CQI  timeRestrictionForChannelMeasure ments Not configured  timeRestrictionForInterferenceMeas urements Not configured  cqi-FormatIndicator Wideband  pmi-FormatIndicator Wideband  Sub-band Size RB [8]  csi-Report interval and offset slot 5/1  aperiodicTriggeringOffset Ocdebook Type typeI-SinglePanel				5/1
CSI-IM configuration  CSI-IM timeConfig interval and offset  ReportConfigType  CQI-table  reportQuantity  timeRestrictionForChannelMeasure ments  timeRestrictionForInterferenceMeas urements  cqi-FormatIndicator  Sub-band Size  csi-Report interval and offset  Rapping (kcsi-im, lcsi-im)  Slot  5/1  Aperiodic  Table 1  Table 1  Taring Table 1  Not configured  Not configured  Wideband  Wideband  Wideband  Sub-band Size  RB  [8]  csi-ReportingBand  CSI-Report interval and offset  aperiodicTriggeringOffset  Codebook Type  (4,9)				Patten 0
Interval and offset   Siot   Siot   Siot   ReportConfigType   Aperiodic		Mapping		(4,9)
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 [111111] CSI-Report interval and offset slot aperiodicTriggeringOffset  Codebook Type typeI-SinglePanel			slot	5/1
CQI-table Table 1 reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments timeRestrictionForInterferenceMeas urements cqi-FormatIndicator Wideband pmi-FormatIndicator Wideband Sub-band Size RB [8] csi-Report interval and offset slot aperiodicTriggeringOffset  Codebook Type  Table 1  rable 1  reportQuantity cri-RI-PMI-CQI  Not configured  Wideband Wideband  FRB [8]  [1111111] CSI-Report interval and offset slot 5/1  aperiodicTriggeringOffset  Codebook Type typel-SinglePanel				Aperiodic
timeRestrictionForChannelMeasure ments  timeRestrictionForInterferenceMeas urements  cqi-FormatIndicator pmi-FormatIndicator Sub-band Size Csi-Report interval and offset aperiodicTriggeringOffset  Codebook Type  Not configured  Wideband Wideband  Figure Wideband Wideband  Sub-band Size Figure Size Figure Not configured  Videband Figure Size				Table 1
ments  timeRestrictionForInterferenceMeas urements  cqi-FormatIndicator pmi-FormatIndicator Sub-band Size Csi-ReportingBand CSI-Report interval and offset aperiodicTriggeringOffset  Mot configured Wideband Wideband Wideband Sub-band Size RB SSI SSI SSI STITTINIA SID STIT STITTINIA SID STITTINIA				cri-RI-PMI-CQI
urements  cqi-FormatIndicator  pmi-FormatIndicator  Sub-band Size  Csi-ReportingBand  CSI-Report interval and offset  aperiodicTriggeringOffset  Codebook Type  Not configured  Wideband  Figure  Wideband  Figure  Sideband  Sub-band Size  RB  [8]  [1111111]  Figure  Codebook Type  Sideband  Figure  Wideband  Sideband  Sideband  Figure  Wideband  Sideband  Sideband  Figure  Codeband  Sideband  Si	ments			Not configured
pmi-FormatIndicator         Wideband           Sub-band Size         RB         [8]           csi-ReportingBand         [1111111]           CSI-Report interval and offset         slot         5/1           aperiodicTriggeringOffset         0           Codebook Type         typel-SinglePanel		ForInterferenceMeas		Not configured
Sub-band Size RB [8]  csi-ReportingBand [111111]  CSI-Report interval and offset slot 5/1  aperiodicTriggeringOffset 0  Codebook Type typel-SinglePanel				
csi-ReportingBand [111111]  CSI-Report interval and offset slot 5/1 aperiodicTriggeringOffset 0  Codebook Type typeI-SinglePanel		cator		
CSI-Report interval and offset slot 5/1 aperiodicTriggeringOffset 0 Codebook Type typeI-SinglePanel			RB	
aperiodicTriggeringOffset 0 Codebook Type typeI-SinglePanel			-1-4	
Codebook Type typel-SinglePanel			SIOT	
	apenodic mgge			
		Codebook Mode		_

Codebook configuration	,		(2,1)			
	CodebookSubset Restriction		11111111			
	RI Restriction		0000001			
Physical chan	nel for CSI report		PUSCH			
CQI/RI/PMI de	CQI/RI/PMI delay		6			
Maximum number of HARQ transmission			4			
Measurement	channel	R.PDSCH.1-6.1 FDD				
slot	e 1: For random precoder selection, the precoder shall be updated in each slot (1 ms granularity).					
bas this	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 eNB downlink before slot#[(n+3)].					
	Randomization of the principle beam direction shall be used as specified in TBD.					

Table 6.3.2.1.1-2: Minimum requirement

Parameter	Test 1
γ	[1.3]

## 6.3.2.1.2 Single PMI with 8TX TypeI-SinglePanel Codebook

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

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

Pai	rameter	Unit	Test 1
Bandwidth		MHz	10
Duplex Mode			FDD
	First PRB		0
DL BWP	Number of		52
configuration #1	contiguous PRB Subcarrier		
#1	spacing	kHz	15
Propagation cha			TDLA30-5
			High XP 8 x 2
Antenna configu	uration		(N1,N2) = (4,1)
Beamforming M			TBD
	CSI-RS resource		Aperiodic
	Type Number of CSI-		ļ. i i i i
	RS ports (X)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
ZP CSI-RS	First subcarrier		
configuration	index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (lo, l1)		(9,-)
	CSI-RS interval and offset	slot	5/1
	CSI-RS resource Type		Aperiodic
	Number of CSI- RS ports (X)		8
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
NZP CSI-RS for CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 8, (4,6)
	First OFDM symbol in the PRB used for CSI-RS (lo, l <sub>1</sub> )		(5,-)
	CSI-RS interval and offset	slot	5/1
	CSI-IM RE pattern		Patten 0
001.114	CSI-IM Resource Mapping		(4,9)
CSI-IM configuration	(Kcsi-im, lcsi-im)		( ) - )
	CSI-IM timeConfig interval and offset	slot	5/1
ReportConfigTy	rpe		Aperiodic
CQI-table			Table 1 cri-RI-PMI-CQI
reportQuantity timeRestrictionF	timeRestrictionForChannelMeasure		
ments			Not configured
timeRestrictionForInterferenceMeas urements			Not configured
cqi-FormatIndic	ator		Wideband
pmi-FormatIndic			Wideband
Sub-band Size		RB	[8]
csi-ReportingBa			[111111]
CSI-Report inte	rval and offset	slot	5/1
aperiodicTrigge			0
	Codebook Type		typel-SinglePanel
	Codebook Mode		1

Codebook configuration	(CodebookConfig- N1,CodebookConfig-N2)		(4,1)
	CodebookSubset Restriction		0x FFFF
	RI Restriction		0000010
Physical chann	el for CSI report		PUSCH
CQI/RI/PMI de	ay	ms	8
Maximum number of HARQ			4
transmission			·
Measurement channel			R.PDSCH.1-6.2
Note 1: For random precoder selection, the precoder shall be updated in each slot (1 ms granularity).			
base this	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 eNB downlink before slot#[(n+4)].		
	Randomization of the principle beam direction shall be used as specified in TBD.		

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
Duplex Mode			TDD
TDD DL-UL con	figuration		FR1.30-1 as specified in Annex A
	First PRB		0
DL BWP	Number of		106
configuration	contiguous PRB		106
#1	Subcarrier spacing	kHz	30
Propagation cha			TDLA30-5
Antenna configu	uration		High XP 4 x 2
Beamforming M			(N1,N2) = (2,1) TBD
	CSI-RS resource		1
	Туре		Aperiodic
	Number of CSI-		4
	RS ports (X)		ED ODMO
	CDM Type		FD-CDM2
ZP CSI-RS	Density (ρ) First subcarrier		1
configuration	index in the PRB		
Comiguration	used for CSI-RS		Row 5, (4,-)
	(k <sub>0</sub> , k <sub>1</sub> )		
	First OFDM		
	symbol in the PRB		(0.)
	used for CSI-RS		(9,-)
	$(I_0, I_1)$		
	CSI-RS	slot	10/1
	interval and offset	3101	10/1
	CSI-RS resource		Aperiodic
	Type		Aponodio
	Number of CSI-		4
	RS ports (X) CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier		'
NZP CSI-RS	index in the PRB		D 4 (0.)
for CSI	used for CSI-RS		Row 4, (0,-)
acquisition	$(k_0, k_1)$		
	First OFDM		
	symbol in the PRB		(13,-)
	used for CSI-RS		(13, )
	(l <sub>0</sub> , l <sub>1</sub> )		
	CSI-RS	slot	10/1
	interval and offset CSI-IM RE pattern		Patten 0
	CSI-IM Resource		ratteno
	Mapping		
CSI-IM	(kcsi-im,lcsi-im)		(4,9)
configuration	( cross mily see mily		
	CSI-IM timeConfig	-1-4	40/4
	interval and offset	slot	10/1
	ReportConfigType		Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasure ments			Not configured
timeRestrictionForInterferenceMeas			Not configured
urements			
cqi-FormatIndicator			Wideband Wideband
pmi-FormatIndicator Sub-band Size		RB	(16)
csi-ReportingBand		ויט	[111111]
CSI-Report interval and offset		slot	10/1
aperiodicTriggeringOffset		5,51	0
Codebook Type			typel-SinglePanel
L			,,,

	Codebook Mode		1
Codebook configuration	(CodebookConfig- N1,CodebookConf		(2,1)
oormgaraorr	ig-N2)		(2,1)
	CodebookSubset Restriction		1111111
	RI Restriction		0000001
Physical chan			PUSCH
Physical channel for CSI report  CQI/RI/PMI delay		ms	5.5
Maximum number of HARQ		1110	0.0
transmission			4
Measurement channel			R.PDSCH.2-8.1 TDD
Note 1: For random precoder select		ction, the p	recoder shall be updated in each
	(0.5 ms granularity).		
Note 2: If the UE reports in an available uplink reporting instance at slot #n			
based on PMI estimation at a downlink slot not later than slot#[(n-4)],			
	this reported PMI cannot be applied at the eNB downlink before		
	ot#[(n+4)].		
Note 3: Randomization of the principle beam direction shall be used as			direction shall be used as
spe	specified in TBD.		

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 TBD, the minimum requirements are specified in Table 6.3.2.2.2-2.

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

Parameter		Unit	Test 1
Bandwidth		MHz	40
Duplex Mode			TDD
TDD DL-UL con	figurations		FR1.30-1 as specified in Annex A
	First PRB		0
DL BWP	Number of		106
configuration	contiguous PRB		100
#1	Subcarrier spacing	kHz	30
Propagation cha	annel		TDLA30-5
Antenna configu	uration		High XP 8 x 2 (N1,N2) = (4,1)
Beamforming M	lodel		TBD
	CSI-RS resource		Aperiodic
	Type		Aperiodic
	Number of CSI- RS ports (X)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
ZP CSI-RS	First subcarrier		
configuration	index in the PRB		Row 5, (4,-)
	used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		
	First OFDM		
	symbol in the PRB		(9,-)
	used for CSI-RS		(3,-)
	(l <sub>0</sub> , l <sub>1</sub> ) CSI-RS		
	interval and offset	slot	10/1
	CSI-RS resource		Aperiodic
	Туре		Apenduic
	Number of CSI- RS ports (X)		8
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
NZP CSI-RS	First subcarrier		
for CSI	index in the PRB used for CSI-RS		Row 8, (4,6)
acquisition	(k <sub>0</sub> , k <sub>1</sub> )		
	First OFDM		
	symbol in the PRB		(5,-)
	used for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		( , ,
	CSI-RS	1.4	40/4
	interval and offset	slot	10/1
	CSI-IM RE pattern		Patten 0
	CSI-IM Resource Mapping		
CSI-IM	(kcsi-im,lcsi-im)		(4,9)
configuration	(*************************************		
	CSI-IM timeConfig	slot	10/1
interval and offset ReportConfigType			
	CQI-table		Aperiodic Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForlChannelMeasur ements			Not configured
timeRestrictionForInterferenceMeas			Not configured
urements			-
cqi-FormatIndicator			Wideband Wideband
pmi-FormatIndicator Sub-band Size		RB	vvideband [16]
csi-ReportingBand		ואט	[111111]
CSI-Report interval and offset		slot	10/1
	aperiodicTriggeringOffset		0
Codebook Type			typel-SinglePanel

	Codebook Mode		1
Codebook	(CodebookConfig-		(4.4)
configuration	N1,CodebookConf		(4,1)
	ig-N2)		
	CodebookSubset		0x FFFF
	Restriction		OXIIII
	RI Restriction		0000010
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	6.5
Maximum number of HARQ			4
transmission			4
Measurement channel			R.PDSCH.2-8.2 TDD
Note 1: For random precoder select		ction, the p	recoder shall be updated in each
slot	slot (0.5 ms granularity).		
Note 2: If the	UE reports in an avai	ilable uplinl	k reporting instance at slot#n
base	based on PMI estimation at a downlink slot not later than slot#[(n-6)],		
this	this reported PMI cannot be applied at the eNB downlink before		
	slot#[(n+6)].		
	3: Randomization of the principle beam direction shall be used as		

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

specified in TBD.

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

Table 6.3.3.1.1-1: Test parameters (single layer)

Bandwidth	Parameter		Unit	Test 1
DL BWP   Number of configuration   Subcarrier   Spacing   Spacing   Subcarrier   Spacing   Spa	Bandwidth		MHz	10
DL BWP configuration	Duplex Mode			FDD
Contiguous PRB				0
#1 Subcarrier spacing				52
Spacing	_			-
Propagation channel	#1		kHz	15
Antenna configuration	Propagation cha			TDI A30-5
Beamforming Model				
CSI-RS resource	Antenna configu	uration		
Type	Beamforming M	lodel		TBD
Number of CSI- RS ports (X)				Aperiodic
RS ports (X)				7,70000
CDM Type				4
Density (p)				FD-CDM2
First subcarrier index in the PRB used for CSI-RS (ko, k1)				
Used for CSI-RS   (Ro, k1 )   First OFDM   Symbol in the PRB   Used for CSI-RS   (Io, I1)   CSI-RS   interval and offset   Slot   Sports (X)   CDM Type   Density (p)   Tirst subcarrier index in the PRB used for CSI-RS (Ro, k1 )   First OFDM   Symbol in the PRB used for CSI-RS (Ro, k1 )   First OFDM   Symbol in the PRB used for CSI-RS (Io, I1)   CSI-RS   (Io, I1)   CSI-RS   (Io, I1)   CSI-IM RE pattern   Patten 0   CSI-IM Resource   Mapping (RosI-IM, IcSI-IM)   (Io, I1)   CSI-IM Iterval and offset   Ionguration   CSI-IM timeConfig interval and offset   Slot   Table 1   TerportQuantity   TimeRestrictionForChannelMeasure ments   Not configured   Table 1   TerportQuantity   TimeRestrictionForInterferenceMeas urements   Rosi   Responsible	ZP CSI-RS			
symbol in the PRB used for CSI-RS (lo, lr)  CSI-RS interval and offset Type  Number of CSI-RS (RS ports (X))  NZP CSI-RS for CSI acquisition  NZP CSI-RS (lo, lr)  NZP CSI-RS for CSI acquisition  NZP CSI-RS (lo, lr)  First Subcarrier index in the PRB used for CSI-RS (lo, lr)  CSI-RS interval and offset Slot S/1  CSI-IM RE pattern  CSI-IM Resource Mapping (KCSI-IM, ICSI-IM)  CSI-IM Resource Mapping (KCSI-IM, ICSI-IM)  CSI-IM Resource Mapping (CSI-IM timeConfig interval and offset Table 1  ReportConfigType Aperiodic CQI-table Table 1  reportQuantity cri-RI-PMI-CQI timeRestrictionForChannelMeasure ments  timeRestrictionForChannelMeasure ments  urements  Videband Size RB [8]  csi-ReportingBand [1111111]  CSI-Report interval and offset Slot S/1  RB [8]  csi-ReportingBand [1111111]  CGI-ReportingeringOffset O O Codebook Type Vypel-SinglePanel	configuration	used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 5, (4,-)
Interval and offset		symbol in the PRB used for CSI-RS		(9,-)
Type			slot	5/1
NZP CSI-RS ports (X)  CDM Type  Density (p)  First subcarrier index in the PRB used for CSI-RS (ko, k1)  First OFDM symbol in the PRB used for CSI-RS (lo, l1)  CSI-RS interval and offset  CSI-IM RE pattern  CSI-IM Resource Mapping (KCSI-IM, ICSI-IM)  CSI-IM timeConfig interval and offset  ReportConfigType  CSI-IM timeConfig interval and offset  ReportQuantity  timeRestrictionForChannelMeasure ments  timeRestrictionForInterferenceMeas urements  cqi-FormatIndicator  guide and offset  RB 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8				Aperiodic
NZP CSI-RS for CSI acquisition		Number of CSI-		4
Density (p)				FD-CDM2
for CSI acquisition    Index in the PRB used for CSI-RS (ko, k1)				1
First OFDM symbol in the PRB used for CSI-RS (lo, l1)  CSI-RS interval and offset sinterval and offset cSI-IM RE pattern  CSI-IM Resource Mapping (kcsI-IM, lcsI-IM)  CSI-IM timeConfig interval and offset slot slot sinterval and offset slot sinterval sinter	for CSI	index in the PRB used for CSI-RS		Row 4, (0,-)
interval and offset Slot S/1  CSI-IM RE pattern Patten 0  CSI-IM Resource Mapping (kcsi-im,lcsi-im)  CSI-IM timeConfig interval and offset Slot S/1  ReportConfigType Aperiodic  CQI-table Table 1  reportQuantity cri-RI-PMI-CQI  timeRestrictionForChannelMeasure ments  timeRestrictionForInterferenceMeas urements  cqi-FormatIndicator Wideband  pmi-FormatIndicator Wideband  Sub-band Size RB [8]  csi-Report interval and offset slot 5/1  aperiodicTriggeringOffset Ocodebook Type typel-SinglePanel		First OFDM symbol in the PRB used for CSI-RS		(13,-)
CSI-IM Resource Mapping (kcsi-im, lcsi-im)  CSI-IM timeConfig interval and offset Slot 5/1  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-Report interval and offset slot 5/1  aperiodicTriggeringOffset Ocodebook Type typel-SinglePanel			slot	5/1
CSI-IM configuration  CSI-IM timeConfig interval and offset  ReportConfigType  CQI-table  reportQuantity  timeRestrictionForChannelMeasure ments  timeRestrictionForInterferenceMeas urements  cqi-FormatIndicator  Sub-band Size  csi-Report interval and offset  Rapping (kcsi-im, lcsi-im)  Slot  5/1  Aperiodic  Table 1  Table 1  Taring Table 1  Not configured  Not configured  Wideband  Wideband  Wideband  Sub-band Size  RB  [8]  csi-ReportingBand  CSI-Report interval and offset  aperiodicTriggeringOffset  Codebook Type  (4,9)		CSI-IM RE pattern		Patten 0
Interval and offset   Siot   Siot   Siot   ReportConfigType   Aperiodic		Mapping		(4,9)
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 [111111] CSI-Report interval and offset slot aperiodicTriggeringOffset  Codebook Type typeI-SinglePanel	-		slot	5/1
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 [111111] CSI-Report interval and offset slot aperiodicTriggeringOffset Codebook Type typel-SinglePanel				Aperiodic
timeRestrictionForChannelMeasure ments  timeRestrictionForInterferenceMeas urements  cqi-FormatIndicator pmi-FormatIndicator Sub-band Size Csi-Report interval and offset aperiodicTriggeringOffset  Codebook Type  Not configured  Wideband Wideband  Figure Wideband Wideband  Sub-band Size Figure Size Figure Not configured  Videband Figure Size				Table 1
ments  timeRestrictionForInterferenceMeas urements  cqi-FormatIndicator pmi-FormatIndicator Sub-band Size Csi-ReportingBand CSI-Report interval and offset aperiodicTriggeringOffset  Mot configured Wideband Wideband Wideband Sub-band Size RB SSI SSI SSI STITTINIA SID STIT STITTINIA SID STITTINIA				cri-RI-PMI-CQI
urements  cqi-FormatIndicator  pmi-FormatIndicator  Sub-band Size  Csi-ReportingBand  CSI-Report interval and offset  aperiodicTriggeringOffset  Codebook Type  Not configured  Wideband  Figure  Wideband  Figure  Sideband  Sub-band Size  RB  [8]  [1111111]  Figure  Codebook Type  Sideband  Figure  Wideband  Sideband  Sideband  Figure  Wideband  Sideband  Sideband  Figure  Codeband  Sideband  Si	ments			Not configured
pmi-FormatIndicator         Wideband           Sub-band Size         RB         [8]           csi-ReportingBand         [1111111]           CSI-Report interval and offset         slot         5/1           aperiodicTriggeringOffset         0           Codebook Type         typel-SinglePanel				Not configured
Sub-band Size RB [8]  csi-ReportingBand [111111]  CSI-Report interval and offset slot 5/1  aperiodicTriggeringOffset 0  Codebook Type typel-SinglePanel				
csi-ReportingBand [111111]  CSI-Report interval and offset slot 5/1 aperiodicTriggeringOffset 0  Codebook Type typeI-SinglePanel				
CSI-Report interval and offset slot 5/1 aperiodicTriggeringOffset 0 Codebook Type typeI-SinglePanel			RB	
aperiodicTriggeringOffset 0 Codebook Type typeI-SinglePanel			-1-4	
Codebook Type typel-SinglePanel			SIOT	
	apenouic mgge			
		Codebook Mode		_

Codebook configuration	(CodebookConfig- N1,CodebookConf ig-N2)		(2,1)
	CodebookSubset Restriction		11111111
	RI Restriction		0000001
Physical chan	nel for CSI report		PUSCH
CQI/RI/PMI delay		ms	6
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.1-6.1 FDD
Note 2: If the base this	Note 1: For random precoder selection, the precoder shall be updated in each slot (1 ms granularity).  Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#[(n-3)], this reported PMI cannot be applied at the eNB downlink before slot#[(n+3)].		
	Randomization of the principle beam direction shall be used as specified in TBD.		

Table 6.3.3.1.1-2: Minimum requirement

Parameter	Test 1
γ	[1.3]

## 6.3.3.1.2 Single PMI with 8TX TypeI-SinglePanel Codebook

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

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

Parameter		Unit	Test 1
Bandwidth		MHz	10
Duplex Mode			FDD
	First PRB		0
DL BWP configuration	Number of contiguous PRB		52
#1	Subcarrier	kHz	15
Propagation cha	spacing		TDLA30-5
-			High XP 8 x 4
Antenna configu	uration		(N1,N2) = (4,1)
Beamforming M			TBD
	CSI-RS resource Type		Aperiodic
	Number of CSI- RS ports (X)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
ZP CSI-RS configuration	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (lo, l1)		(9,-)
	CSI-RS interval and offset	slot	5/1
	CSI-RS resource Type		Aperiodic
	Number of CSI- RS ports (X)		8
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
NZP CSI-RS for CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 8, (4,6)
	First OFDM symbol in the PRB used for CSI-RS (lo, l1)		(5,-)
	CSI-RS interval and offset	slot	5/1
	CSI-IM RE pattern		Patten 0
CSI-IM configuration	CSI-IM Resource Mapping (k <sub>CSI-IM</sub> , l <sub>CSI-IM</sub> )		(4,9)
	CSI-IM timeConfig interval and offset	slot	5/1
ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasure ments			Not configured
timeRestrictionForInterferenceMeas urements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	[8]
csi-ReportingBand			[111111]
CSI-Report interval and offset		slot	5/1
aperiodicTrigge			0 typol SinglePanel
	Codebook Type Codebook Mode		typel-SinglePanel 1
	SOUCHOUR MIDGE		l

Codebook configurati	,		(4,1)	
	CodebookSubset Restriction		0x FFFF	
	RI Restriction		0000010	
Physical cl	nannel for CSI report		PUSCH	
CQI/RI/PM	ll delay	ms	8	
Maximum transmission	number of HARQ on		4	
Measurem	ent channel		R.PDSCH.1-6.2 FDD	
	<ul> <li>For random precoder selection, the precoder shall be updated in each slot (1 ms granularity).</li> </ul>			
	e 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 eNB downlink before slot#[(n+4)].			

Slot#[(n+4)].

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

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 TBD, the minimum requirements are specified in Table 6.3.3.2.1-2.

Table 6.3.3.2.1-1: Test parameters (single layer)

Parameter		Unit	Test 1
Bandwidth		MHz	40
Duplex Mode			TDD
TDD DL-UL configuration			FR1.30-1 as specified in Annex A
	First PRB		0
DL BWP	Number of		106
configuration	contiguous PRB		108
#1 	Subcarrier spacing	kHz	30
Propagation cha			TDLA30-5
Antenna configu	uration		High XP 4 x 4
Beamforming M			(N1,N2) = (2,1) TBD
Dearmorning W	CSI-RS resource		1
	Туре		Aperiodic
	Number of CSI-		4
	RS ports (X)		FD-CDM2
	CDM Type Density (p)		1 1
ZP CSI-RS	First subcarrier		·
configuration	index in the PRB		Row 5, (4,-)
	used for CSI-RS		Now 5, (4,-)
	(k <sub>0</sub> , k <sub>1</sub> ) First OFDM		
	symbol in the PRB		
	used for CSI-RS		(9,-)
	$(I_0, I_1)$		
	CSI-RS	slot	10/1
	interval and offset CSI-RS resource		
	Type		Aperiodic
	Number of CSI-		4
	RS ports (X)		4
	CDM Type		FD-CDM2
	Density (ρ) First subcarrier		1
NZP CSI-RS	index in the PRB		
for CSI	used for CSI-RS		Row 4, (0,-)
acquisition	(k <sub>0</sub> , k <sub>1</sub> )		
	First OFDM		
	symbol in the PRB used for CSI-RS		(13,-)
	$(I_0, I_1)$		
	CSI-RS		10/1
	interval and offset		
	CSI-IM RE pattern		Patten 0
	CSI-IM Resource Mapping		
CSI-IM	(kcsi-im,lcsi-im)		(4,9)
configuration	(		
	CSI-IM timeConfig	slot	10/1
Dan aut Cauffer Tu	interval and offset	0.01	
ReportConfigType CQI-table			Aperiodic Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasure			Not configured
ments timeRestrictionForInterferenceMeas			_
urements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndio	cator	DD	Wideband
Sub-band Size csi-ReportingBa	and	RB	[16] [1111111]
CSI-Report inte		slot	10/1
aperiodicTrigge	ringOffset		0
	Codebook Type		typel-SinglePanel

	Codebook Mode		1			
Codebook	(CodebookConfig-		(2.4)			
Configuration	onfiguration N1,CodebookConf ig-N2)		(2,1)			
	CodebookSubset Restriction		11111111			
	RI Restriction		0000001			
Physical chann	el for CSI report		PUSCH			
CQI/RI/PMI del	ay	ms	5.5			
Maximum num	per of HARQ		4			
transmission			4			
Measurement of	channel		R.PDSCH.2-8.1 TDD			
		ction, the p	recoder shall be updated in each			
	(0.5 ms granularity).					
	Note 2: If the UE reports in an available uplink reporting instance at slot#n					
base	ed on PMI estimation a	ıt a downlin	k slot not later than slot#[(n-4)],			
this	this reported PMI cannot be applied at the eNB downlink before					
slot#	slot#[(n+4)].					
Note 3: Randomization of the principle beam direction shall be used as specified in TBD.						

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 TBD, the minimum requirements are specified in Table 6.3.3.2.2-2.

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

Parameter		Unit	Test 1
Bandwidth		MHz	40
Duplex Mode			TDD
TDD DL-UL configurations			FR1.30-1 as specified in Annex A
	First PRB		0
DL BWP	Number of		106
configuration	contiguous PRB		100
#1	Subcarrier spacing	kHz	30
Propagation cha	annel		TDLA30-5
Antenna configu	uration		High XP 8 x 4 (N1,N2) = (4,1)
Beamforming M	lodel		TBD
	CSI-RS resource		Aperiodic
	Type		Apenduic
	Number of CSI- RS ports (X)		4
	CDM Type		FD-CDM2
	Density (p)		1
ZP CSI-RS	First subcarrier		
configuration	index in the PRB		Row 5, (4,-)
	used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		
	First OFDM		
	symbol in the PRB		(0.)
	used for CSI-RS		(9,-)
	(l <sub>0</sub> , l <sub>1</sub> )		
	CSI-RS interval and offset	slot	10/1
	CSI-RS resource		
	Туре		Aperiodic
	Number of CSI-		8
	RS ports (X)		CDM4 (FD2, TD2)
	CDM Type Density (p)		1
NZP CSI-RS	First subcarrier		·
for CSI	index in the PRB		Row 8, (4,6)
acquisition	used for CSI-RS		1.6.1.6, (1,6)
	(k <sub>0</sub> , k <sub>1</sub> ) First OFDM		
	symbol in the PRB		(5.)
	used for CSI-RS		(5,-)
	(l <sub>0</sub> , l <sub>1</sub> )		
	CSI-RS interval and offset	slot	10/1
	CSI-IM RE pattern		Patten 0
	CSI-IM Resource		21112
CCLIM	Mapping		(4,9)
CSI-IM configuration	(ксы-ім,Ісы-ім)		(1,0)
Comigaration	CSI-IM timeConfig		
	interval and offset	slot	10/1
	ReportConfigType		Aperiodic
CQI-table			Table 1
reportQuantity timeRestrictionForChannnelMeasur			cri-RI-PMI-CQI
ements			Not configured
timeRestrictionForInterferenceMeas			Not configured
urements			-
	cqi-FormatIndicator pmi-FormatIndicator		Wideband Wideband
Sub-band Size	Jaioi	RB	[16]
csi-ReportingBa			[111111]
CSI-Report inte	rval and offset	slot	10/1
aperiodicTrigge			0
	Codebook Type		typel-SinglePanel

	Codebook Mode		1			
Codebook	(					
configuration	N1,CodebookConf		(4,1)			
	ig-N2)					
	CodebookSubset		0x FFFF			
	Restriction		OX FFFF			
	RI Restriction		0000010			
Physical chann	el for CSI report		PUSCH			
CQI/RI/PMI del	ay	ms	6.5			
Maximum num	per of HARQ		4			
transmission			4			
Measurement of	channel		R.PDSCH.2-8.2 TDD			
Note 1: For i	andom precoder selec	ction, the p	recoder shall be updated in each			
slot	(0.5 ms granularity).					
			k reporting instance at slot#n			
base	ed on PMI estimation a	ıt a downlin	k slot not later than slot#[(n-6)],			
this	t the eNB downlink before					
slot#	slot#[(n+6)].					
Note 3: Randomization of the principle beam direction shall be used a						
spec	specified in TBD.					

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)

	F	Parameter	Unit	Test 1	Test 2	Test 3
Bandwidth			MHz	10	10	10
Duplex Mode			FDD	FDD	FDD	
		First PRB		0	0	0
DL BWP Number of contiguous configuration #1 PRB			52	52	52	
		Subcarrier spacing	kHz	15	15	15
SNR		<u> </u>	dB	[0]	[20]	[20]
Propagation of	chann	iel		TDLA30-5	TDLA30-5	TDLA30-5
Antenna conf	igurat	tion		ULA Low 2x2	ULA Low 2x2	ULA High 2x2
Beamforming	Mod	el		As defined in Annex B.4.1	As defined in Annex B.4.1	As defined in Annex B.4.1
	CSI	-RS resource Type		Periodic	Periodic	Periodic
	Nur	nber of CSI-RS ports (X)		4	4	4
ZP CSI-RS	CDI	М Туре		FD-CDM2	FD-CDM2	FD-CDM2
configuratio	Der	nsity (ρ)		1	1	1
n		t subcarrier index in the		Row 5, (4,-)	Pow 5 (4 )	Row 5, (4,-)
''		B used for CSI-RS $(k_0, k_1)$		ROW 5, (4,-)	Row 5, (4,-)	ROW 5, (4,-)
		t OFDM symbol in the PRB		(9,-)	(9,-)	(9,-)
	use	d for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		(3,-)	(3,-)	(3,-)
		-RS	slot	5/1	5/1	5/1
		odicity and offset	3101			
		-RS resource Type		Periodic	Periodic	Periodic
		nber of CSI-RS ports (X)		2	2	2
		M Type		FD-CDM2	FD-CDM2	FD-CDM2
NZP CSI-		nsity (ρ)		1	1	1
RS for CSI acquisition		t subcarrier index in the 3 used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 3 (6,-)	Row 3 (6,-)	Row 3 (6,-)
acquisition		t OFDM symbol in the PRB				
	LICO	d for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		(13,-)	(13,-)	(13,-)
	NIZE	CSI-RS-timeConfig				
		odicity and offset	slot	5/1	5/1	5/1
		-IM RE pattern		Pattern 0	Pattern 0	Pattern 0
CSI-IM		-IM Resource Mapping				
configuratio n		si-im,lcsi-im)		(4,9)	(4,9)	(4,9)
		-IM timeConfig odicity and offset	slot	5/1	5/1	5/1
ReportConfig		odicity and onset		Periodic	Periodic	Periodic
CQI-table	туро			Table 2	Table 2	Table 2
					cri-RI-PMI-	cri-RI-PMI-
reportQuantity	y			cri-RI-PMI-CQI	CQI	CQI
timo Doctrictio	n E o r	ChannelMeasurements		not configured	not	not
umertesuicuo	ill Oi	Charmenveasurements		not configured	configured	configured
timeRestriction	nForl	InterferenceMeasurements		not configured	not	not
					configured	configured
cqi-FormatInd				Wideband	Wideband	Wideband
pmi-FormatIn		or		Wideband	Wideband	Wideband
Sub-band Siz			RB	[8]	[8]	[8]
csi-Reporting				[1111111]	[1111111]	[1111111]
CSI-Report p		city and offset	slot	5/1	5/1	5/1
0-4	Co	debook Type		typel-	typel-	typel-
Codebook	<u></u>	alaba a la Marala		SinglePanel	SinglePanel	SinglePanel
configuration		debook Mode		1	1	1
	Ň1	odebookConfig- ,CodebookConfig-N2)		N/A	N/A	N/A
	Co	debookSubsetRestriction		[010000 for	[000011 for	[000011 for
				fixed rank 2,	fixed rank 1,	fixed rank 1,
				010011 for	010011 for	010011 for
				following rank]	following	following
		B		_	rank]	rank]
RI Restriction			N/A	N/A	N/A	
Physical char	Physical channel for CSI report			PUCCH	PUCCH	PUCCH
CQI/RI/PMI d			ms	8	8	8
Maximum nur	Maximum number of HARQ transmission			1	1	1

DI Configuration	Fixed RI = 2	Fixed RI = 1	Fixed RI = 1
RI Configuration	and follow RI	and follow RI	and follow RI

Table 6.4.2.1-2: Minimum requirement (FDD)

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

## 6.4.2.2 TDD

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

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

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

Table 6.4.2.2-1: RI Test (TDD)

	P	Parameter	Unit	Test 1	Test 2	Test 3
Bandwidth			MHz	40	40	40
Duplex Mode				TDD	TDD	TDD
TDD Slot Cor	figura	ation		FR1.30-1	FR1.30-1	FR1.30-1
	g	First PRB		0	0	0
DL BWP configuration	#1	Number of contiguous PRB		106	106	106
_		Subcarrier spacing	kHz	30	30	30
SNR			dB	[0]	[20]	[20]
Propagation of				TDLA30-5	TDLA30-5	TDLA30-5
Antenna conf	igurat	ion		ULA Low 2x2	ULA Low 2x2	ULA High 2x2
Beamforming	Mode	el		As defined in Annex B.4.1	As defined in Annex B.4.1	As defined in Annex B.4.1
		-RS resource Type		Periodic	Periodic	Periodic
		nber of CSI-RS ports (X)		4	4	4
ZP CSI-RS		И Туре		FD-CDM2	FD-CDM2	FD-CDM2
configuratio		ısity (ρ)		1	1	1
n	PRE	t subcarrier index in the B used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 5, (4,-)	Row 5, (4,-)	Row 5, (4,-)
	use	t OFDM symbol in the PRB d for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		(9,-)	(9,-)	(9,-)
		-RS odicity and offset	slot	10/1	10/1	10/1
		-RS resource Type		Periodic	Periodic	Periodic
	Nun	nber of CSI-RS ports (X)		2	2	2
	CDI	И Туре		FD-CDM2	FD-CDM2	FD-CDM2
NZP CSI-		ısity (ρ)		1	1	1
RS for CSI acquisition		t subcarrier index in the B used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 3 (6,-)	Row 3 (6,-)	Row 3 (6,-)
		t OFDM symbol in the PRB d for CSI-RS (l <sub>0</sub> , l <sub>1</sub> )		(13,-)	(13,-)	(13,-)
	NZF	CSI-RS-timeConfig odicity and offset	slot	10/1	10/1	10/1
		-IM RE pattern		Pattern 0	Pattern 0	Pattern 0
CSI-IM configuration		-IM Resource Mapping ынм,Ісзым)		(4,9)	(4,9)	(4,9)
		-IM timeConfig odicity and offset	slot	10/1	10/1	10/1
ReportConfig		calcity and oncor		Periodic	Periodic	Periodic
CQI-table	. , po			Table 2	Table 2	Table 2
reportQuantity	y			cri-RI-PMI-CQI	cri-RI-PMI- CQI	cri-RI-PMI- CQI
timePestrictio	nFor(	ChannelMeasurements		not configured	not	not
unier (estrictio	010	J. Idi II Gilvicasul Cilicilis		not configured	configured	configured
		nterferenceMeasurements		not configured	not configured	not configured
cqi-FormatInd				Wideband	Wideband	Wideband
pmi-FormatIn		or		Wideband	Wideband	Wideband
Sub-band Siz			RB	[16]	[16]	[16]
csi-Reporting				[1111111]	[1111111]	[1111111]
CSI-Report pe		city and offset	slot	10/1	10/1	10/1
Codebook		debook Type		typel- SinglePanel	typel- SinglePanel	typel- SinglePanel
configuration	(Co	debook Mode odebookConfig- ,CodebookConfig-N2)		1 N/A	1 N/A	1 N/A
		debookSubsetRestriction		[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]
	DI	Restriction		N/A	N/A	N/A
Physical char				PUCCH	PUCCH	PUCCH
CQI/RI/PMI d		7. 001 10poit	ms	9.5	9.5	9.5
		of HARQ transmission	0	1	1	1
				1		

DI Configuration	Fixed RI = 2	Fixed RI = 1	Fixed RI = 1
RI Configuration	and follow RI	and follow RI	and follow RI

Table 6.4.2.2-2: Minimum requirement (TDD)

	Test 1	Test 2	Test 3
<i>γ</i> 1	N/A	[1.05]	[0.9]
72	[1.0]	N/A	N/A

### 6.4.3 4RX requirements

#### 6.4.3.1 FDD

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

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

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

Table 6.4.3.1-1: RI Test (FDD)

	Parameter	Unit	Test 1	Test 2	Test 3	Test 4
Bandwidth	· ·	MHz	10	10	10	10
Duplex Mode			FDD	FDD	FDD	FDD
•	First PRB		0	0	0	0
DL BWP	Number of contiguous		50	50	50	
configuration			52	52	52	52
	Subcarrier spacing	kHz	15	15	15	15
SNR	·	dB	TBD	[16]	[16]	TBD
Propagation of	hannel		TDLA30-5	TDLA30-5	TDLA30-5	TDLA30-5
Antenna confi	guration		ULA Low 2x4	ULA Low 2x4	ULA High 2x4	ULA Low 4x4
De a meta masim m	Madal		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
7D CCL DC	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		Daw 5 (4 )	Daw 5 (4 )	Daw 5 (4 )	Daw 5 (4 )
n	PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 5, (4,-)	Row 5, (4,-)	Row 5, (4,-)	Row 5, (4,-)
	First OFDM symbol in the PRB		(0.)	(0.)	(0.)	(0.)
	used for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		(9,-)	(9,-)	(9,-)	(9,-)
	CSI-RS	olo4	5/1	5/1	5/1	5/1
	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
	CDM Type		FD-CDM2	FD-CDM2	FD-CDM2	FD-CDM2
NZP CSI-	Density (ρ)		1	1	1	1
RS for CSI	First subcarrier index in the		Day: 2 (C.)	Day: 2 (C )	Day 2 (C.)	Day 4 (0 )
acquisition	PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 3 (6,-)	Row 3 (6,-)	Row 3 (6,-)	Row 4 (0,-)
	First OFDM symbol in the PRB		(42.)	(42.)	(42.)	(42.)
	used for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		(13,-)	(13,-)	(13,-)	(13,-)
	NZP CSI-RS-timeConfig	-1-4	E /A	F/4	F /A	F /4
	periodicity and offset	slot	5/1	5/1	5/1	5/1
	CSI-IM RE pattern		Pattern 0	Pattern 0	Pattern 0	Pattern 0
CSI-IM	CSI-IM Resource Mapping					
configuratio	(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
	periodicity and offset	3101				
ReportConfig	Гуре		Periodic	Periodic	Periodic	Periodic
CQI-table			Table 2	Table 2	Table 2	Table 2
reportQuantity	1		cri-RI-PMI-CQI	cri-RI-PMI-	cri-RI-PMI-	cri-RI-PMI-
roportadantity	<u> </u>		OII I I I I I I OQI	CQI	CQI	CQI
timeRestriction	nForChannelMeasurements		not configured	not	not	not
timertestrictio	in ordinalinelivieasurements		not comigared	configured	configured	configured
timeRestriction	nForInterferenceMeasurements		not configured	not	not	not
			<u> </u>	configured	configured	configured
cqi-FormatInd			Wideband	Wideband	Wideband	Wideband
pmi-FormatIn			Wideband	Wideband	Wideband	Wideband
Sub-band Siz		RB	[8]	[8]	[8]	[8]
csi-Reportingl			[1111111]	[1111111]	[1111111]	[1111111]
CSI-Report pe	eriodicity and offset	slot	5/1	5/1	5/1	5/1
	Codebook Type		typel-	typel-	typel-	typel-
Codebook			SinglePanel	SinglePanel	SinglePanel	SinglePanel
configuration	Codebook Mode		1	1	1	1
	(CodebookConfig-		N/A	N/A	N/A	(2,1)
	N1,CodebookConfig-N2)		1,47.			(=, · )
	CodebookSubsetRestriction		[010000 for	[000011 for	[000011 for	
			fixed rank 2,	fixed rank 1,	fixed rank 1,	44444
			010011 for	010011 for	010011 for	11111111
			following rank]	following	following	
	DI De etriet			rank]	rank]	000000101
	RI Restriction					00000010 for
			N1/A	N1/A	N1/A	fixed Rank 2
			N/A	N/A	N/A	and 00001111 for
		l	i		1	follow RI

Physical channel for CSI report		PUCCH	PUCCH	PUCCH	PUCCH
CQI/RI/PMI delay	ms	8	8	8	8
Maximum number of HARQ transmission		1	1	1	1
RI Configuration		Fixed RI = 2 and follow RI	Fixed RI = 1 and follow RI	Fixed RI = 1 and follow RI	Fixed RI = 2 and follow RI

Table 6.4.3.1-2: Minimum requirement (FDD)

	Test 1	Test 2	Test 3	Test 4
71	N/A	[1.05]	[0.9]	N/A
72	TBD	N/A	N/A	TBD

#### 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 TBD, the minimum requirements are specified in Table 6.4.3.2-2.

Table 6.4.3.2-1: RI Test (TDD)

	Parameter	Unit	Test 1	Test 2	Test 3	Test 4
Bandwidth			40	40	40	40
Duplex Mode			TDD	TDD	TDD	TDD
TDD Slot Con			FR1.30-1	FR1.30-1	FR1.30-1	FR1.30-1
	First PRB		0	0	0	0
	DL BWP Number of contiguous configuration #1 PRB		106	106	106	106
	Subcarrier spacing	kHz	30	30	30	30
SNR		dB	TBD	[16]	[16]	TBD
Propagation of			TDLA30-5	TDLA30-5	TDLA30-5	TDLA30-5
Antenna confi	guration		ULA Low 2x4 As defined in	ULA Low 2x4 As defined in	ULA High 2x4 As defined in	ULA Low 4x4 As defined in
Beamforming			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 FD-CDM2	4 FD CDM2	4 FD CDM2	4 FD CDM2
ZP CSI-RS	CDM Type		FD-CDIVIZ	FD-CDM2	FD-CDM2	FD-CDM2
configuratio	Density (p) First subcarrier index in the		1	1	1	1
n	PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 5, (4,-)	Row 5, (4,-)	Row 5, (4,-)	Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (l <sub>0</sub> , l <sub>1</sub> )		(9,-)	(9,-)	(9,-)	(9,-)
	CSI-RS periodicity and offset	slot	10/1	10/1	10/1	10/1
	CSI-RS resource Type		Periodic	Periodic	Periodic	Periodic
	Number of CSI-RS ports (X)		2	2	2	2
	CDM Type		FD-CDM2	FD-CDM2	FD-CDM2	FD-CDM2
NZP CSI-	Density (ρ)		1	1	1	1
RS for CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 3 (6,-)	Row 3 (6,-)	Row 3 (6,-)	Row 4 (0,-)
	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		(13,-)	(13,-)	(13,-)	(13,-)
	NZP CSI-RS-timeConfig periodicity and offset	slot	10/1	10/1	10/1	10/1
	CSI-IM RE pattern		Pattern 0	Pattern 0	Pattern 0	Pattern 0
CSI-IM configuratio n	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(4,9)	(4,9)	(4,9)	(4,9)
	CSI-IM timeConfig periodicity and offset	slot	10/1	10/1	10/1	10/1
ReportConfig			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-
reporteduantity			CH-IXI-I WII-OQI	CQI	CQI	CQI
timeRestrictio	nForChannelMeasurements		not configured	not configured	not configured	not configured
	nForInterferenceMeasurements		not configured	not configured	not configured	not configured
cqi-FormatInd			Wideband	Wideband	Wideband	Wideband
pmi-FormatIng			Wideband	Wideband	Wideband	Wideband
Sub-band Size		RB	[16]	[16]	[16]	[16]
csi-ReportingBand			[1111111]	[1111111]	[1111111]	[1111111]
CSI-Report pe	eriodicity and offset	slot	10/1	10/1	10/1	10/1
Codebook	Codebook Type		typel-	typel-	typel-	typel-
configuration	Codebook Mode		SinglePanel	SinglePanel	SinglePanel	SinglePanel
Johngaration	(CodebookConfig- N1,CodebookConfig-N2)		N/A	N/A	N/A	(2,1)
	CodebookSubsetRestriction		1	[000011 for	[000011 for	
	CodebookSubsetkestiliction		[010000 for	fixed rank 1,	fixed rank 1,	
			fixed rank 2,	010011 for	010011 for	11111111
			010011 for	following	following	
			following rank]	rank]	rank]	

RI Restriction		N/A	N/A	N/A	00000010 for fixed Rank 2 and 00001111 for follow RI
Physical channel for CSI report		PUCCH	PUCCH	PUCCH	PUCCH
CQI/RI/PMI delay	ms	9.5	9.5	9.5	9.5
Maximum number of HARQ transmission		1	1	1	1
RI Configuration		Fixed RI = 2 and follow RI	Fixed RI = 1 and follow RI	Fixed RI = 1 and follow RI	Fixed RI = 2 and follow RI

Table 6.4.3.2-2: Minimum requirement (TDD)

	Test 1	Test 2	Test 3	Test 4
71	N/A	[1.05]	[0.9]	N/A
72	TBD	N/A	N/A	TBD

# 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.

#### 7.1.1.2 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 Test type		Test list		
antenna ports				
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 capabilities

For UE which supports optional UE capabilities the additional performance requirements from Table 7.1.1.3-1 should be applied.

Table 7.1.1.3-1: Requirements applicability for optional UE capabilities

UE feature/capability	Test type		Test list	Applicability notes
[Enhanced Type X receiver]	FR2 TDD	PDSCH	7.2.2.2.1 Minimum requirements for PDSCH Mapping Type-A (Test 3- 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** 

PDSCH transmission scheme		Parameter	Unit	Value
EPRE ratio of PTRS to PDSCH	PDSCH transmissi	on scheme		
Configuration #1   Cyclic prieffx   Septimization   Provisional Cell ID   0   0   0   0   0   0   0   0   0		S to PDSCH	dB	
Common serving cell parameters		Cyclic prefix		Normal
SSB periodicity	<b>J</b>			
Cell parameters			me	·
Sicts for PDCCH monitoring   Each slot	cell parameters		1113	
Symbols with PDCCH				_
Number of PDCCH candidates and aggregation levels				
Cross carrier scheduling				
Cross carrier scheduling	configuration	aggregation levels		
First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> )				_
First subcarrier index in the PRB used for CSI-RS resource 1: 6 CSI-RS resource 2: 10 CSI-RS resource 2: 10 CSI-RS resource 2: 10 CSI-RS resource 2: 10 CSI-RS resource 4: 10 Number of CSI-RS ports (X)	Cross carrier sched			
CSI-RS (hb)   CSI-RS resource 2: 10   CSI-RS resource 3: 6   CSI-RS periodicity   Slots   Slo		First subcarrier index in the PRB used		_
CSI-RS for tracking				CSI-RS resource 2: 10 CSI-RS resource 3: 6
Density (p)				•
CSI-RS periodicity	CSI-RS for			
CSI-RS offset			Slots	
Frequency Occupation		CSI-RS offset	Slots	resource 1 and 2 81 for CSI-RS
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		Frequency Occupation		Start PRB 0 Number of PRB =
First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> )   12				
NZP CSI-RS for CSI acquisition $(p)$		for CSI-RS (k <sub>0</sub> )		0
NZP CSI-RS for CSI acquisition		CSI-RS (I <sub>0</sub> )		
Density (ρ)				_
CSI-RS periodicity         Slots         160           CSI-RS offset         0         Start PRB 0           Frequency Occupation         Number of PRB = BWP size           QCL info         TCI state #1           First subcarrier index in the PRB used for CSI-RS (k₀)         4           First OFDM symbol in the PRB used for CSI-RS (k₀)         12           XP CSI-RS for CSI-RS for CSI-RS ports (X)         4           ZP CSI-RS for CSI-RS for CSI-RS periodicity         5           Density (ρ)         1           CSI-RS periodicity         Slots           CSI-RS periodicity         Slots           CSI-RS periodicity         Slots           Start PRB 0         Number of PRB = BWP size           First subcarrier index in the PRB used for CSI-RS         Resource 1,2           First OFDM symbol in the PRB used for CSI-RS         Io = 8 for CSI-RS resource 1           CSI-RS for beam refinement         Number of CSI-RS ports (X)         1 for CSI-RS resource 2           CDM Type         "No CDM' for CSI-RS resource 1,2           Density (ρ)         3 for CSI-RS resource				
CSI-RS offset	CSI acquisition	CSI-RS periodicity	Slots	
Frequency Occupation   Number of PRB = BWP size		CSI-RS offset		0
First subcarrier index in the PRB used for CSI-RS ( $k_0$ )  First OFDM symbol in the PRB used for CSI-RS ( $l_0$ )  Number of CSI-RS ports ( $X$ )  CDM Type  First Speriodicity  CSI-RS periodicity  CSI-RS offset  Firequency Occupation  CSI-RS for CSI-RS  First subcarrier index in the PRB used for CSI-RS  First OFDM symbol in the PRB used for CSI-		Frequency Occupation		Number of PRB =
First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> )   12				TCI state #1
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		for CSI-RS (k <sub>0</sub> )		4
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		CSI-RS (I <sub>0</sub> )		
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	7P CSI-RS for			·
CSI-RS periodicity				
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	00. 0040.0		Slots	·
Frequency Occupation  Number of PRB = BWP size  First subcarrier index in the PRB used for CSI-RS  First OFDM symbol in the PRB used for CSI-RS  CSI-RS for beam refinement  CSI-RS ports (X)  CDM Type  Frequency Occupation  Number of PRB = BWP size $k_0=0$ for CSI-RS  resource 1,2 $l_0=8$ for CSI-RS  resource 2  1 for CSI-RS resource 2  'No CDM' for CSI-RS  resource 1,2  2 for CSI-RS resource 1,2  3 for CSI-RS resource		CSI-RS offset		
		Frequency Occupation		Number of PRB = BWP size
CSI-RS for beam refinement First OFDM symbol in the PRB used for CSI-RS resource 1 $l_0 = 9$ for CSI-RS resource 2  Number of CSI-RS ports (X) 1 for CSI-RS resource 1,2  CDM Type resource 1,2  Density (a) 3 for CSI-RS resource				resource 1,2
Number of CSI-RS ports (X)	CSI DS for boom			resource 1 $I_0 = 9$ for CSI-RS
CDM Type 'No CDM' for CSI-RS resource 1,2  Density (a) 3 for CSI-RS resource		Number of CSI-RS ports (X)		1 for CSI-RS resource
Density (a) 3 for CSI-RS resource		CDM Type		'No CDM' for CSI-RS
		Density (ρ)		3 for CSI-RS resource

				120 kHz SCS: 160 for
	CSI-RS perio	odicity	Slots	CSI-RS resource 1,2
	CSI-RS offse	et	Slots	0 for CSI-RS resource 1,2
PDSCH DMRS configuration	Antenna por			{1000} for Rank 1 tests {1000, 1001} for Rank 2 tests
	Number of P group(s) with	DSCH DMRS CDM nout data		1
	Type 1	SSB index		SSB #0
TOL -1-1- #0	QCL information	QCL Type		Type C
TCI state #0	Type 2	SSB index		SSB #0
	QCL information	QCL Type		Type D
	Type 1 QCL information	CSI-RS resource		CSI-RS resource 1 from 'CSI-RS for tracking' configuration
TOI		QCL Type		Type A
TCI state #1	Type 2 QCL information	CSI-RS resource		CSI-RS resource 1 from 'CSI-RS for tracking' configuration
		QCL Type		Type D
PTRS		ensity (K <sub>PT-RS</sub> )		2
configuration	Time density	(L <sub>PT-RS</sub> )		1
Maximum number feedback	of code block (	groups for ACK/NACK		1
Maximum number	of HARQ trans	smission		4
HARQ ACK/NACK	bundling			Multiplexed
Redundancy version		ience		{0,2,3,1}
Precoding configur			SP Type I, Random per slot with PRB bundling granularity	
Symbols for all unu	sed Res			OCNG in Annex A.5
Note 1: UE as	sumes that t	he TCI state for the PDSC	CH is identi	
applie	d for the PD0	CCH transmission.		

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	[1-2]
combining performance under 2 receive antenna	
conditions.	
Verify the PDSCH mapping Type A enhanced	[3-1]
performance requirement Type X under 2 receive	
antenna conditions and with 2 MIMO layers.	

Table 7.2.2.2.1-2: Test Parameters

	Parameter	Unit	Value
Duplex mode			TDD
Active DL BWP index			1
	First PRB		0
			Maximum
			transmission
			bandwidth
DI DWD configuration			configuration as
DL BWP configuration #1	Number of contiguous PRB		specified in
#1	Number of configuous PRB		subclause 5.3.2 of
			TS 38.101-2 [7] for
			tested channel
			bandwidth and
			subcarrier spacing
PDCCH configuration	Number of PRBs in CORESET	PRBs	As defined in Table
1 Deer configuration		1 1/03	7.2-2
	Mapping type		Type A
	kO		0
	Starting symbol (S)		1
	Length (L)		As defined in Annex
	• , ,		A.1.3
	PDSCH aggregation factor		1
PDSCH configuration	PRB bundling type		Static
	PRB bundling size		WB for 1-1,
			2 for other tests
	Resource allocation type		Type 1
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping		N/A
	interleaver bundle size		
	DMRS Type		Type 1
	Number of additional DMRS		1
PDSCH DMRS	Length		Single-symbol DM- RS
configuration			{1000} for Rank1
Configuration	Antenna ports indexes		{1000,1001} for
			Rank2
	Number of PDSCH DMRS CDM group(s) without data		1
			8 for Test 1-1, 1-3,
			2-4
Number of HARQ Proc	2022		10 for Test 2-1, 2-3,
I MUMBEL OF FIANG FIOO	53353		2-5, 2-6, 3-1
			16 for Test 1-2
			TBD for Test 2-2
K1 value			As defined in Annex
(PDSCH-to-HARQ-timin	ng-indicator)		A.1.3

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

			Madulatian	TDD III		Correlation	Reference value		
Test num.	Reference channel	Bandwidth/Subcarrier spacing	Modulation and code rate	TDD UL- DL pattern	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR <sub>BB</sub> (dB)	
1-1	R.PDSCH. 5-1.1_TDD	100MHz/120kHz	QPSK, 0.30	FR2.120- 1	TDLC60-300	2x2 ULA Low	70	[-0.4]	
1-2	R.PDSCH. 5-2.1_TDD	100MHz/120kHz	16QAM, 0.48	FR2.120- 1	TDLA30-300	2x2 ULA Low	30	[1.7]	
1-3	R.PDSCH. 5-3.1_TDD	100MHz/120kHz	64QAM, 0.45	FR2.120- 1	TDLA30-300	2x2 XPL Med- A	70	[12.4]	

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

						Correlation	Reference	value
Test num.	Reference channel	Bandwidth/Subcarrier spacing	Modulation and code rate	TDD UL- DL pattern	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR <sub>BB</sub> (dB)
2-1	R.PDSCH. 5- 4.1_TDD	100MHz/120kHz	QPSK, 0.30	FR2.120- 2	TDLA30-75	2x2 ULA Low	70	[4.1]
2-2	R.PDSCH. 5- 2.2_TDD	100MHz/120kHz	16QAM, 0.48	FR2.120- 1	TDLA30-300	2x2 ULA Low	70	[TBD]
2-3	R.PDSCH. 5- 5.2_TDD	50MHz/120kHz	16QAM,0.48	FR2.120- 2	TDLA30-75	2x2 ULA Low	70	[14.0]
2-4	R.PDSCH. 5- 2.3_TDD	200MHz/120kHz	16QAM, 0.48	FR2.120- 1	TDLA30-300	2x2 ULA Low	70	[14.2]
2-5	R.PDSCH. 4- 1.1_TDD	50MHz/60kHz	16QAM, 0.48	FR2.60-1	TDLA30-75	2x2 ULA Low	70	[14.3]
2-6	R.PDSCH. 5- 6.1_TDD	100MHz/120kHz	64QAM, 0.43	FR2.120- 2	TBD	2x2 ULA Low	70	[18.6]

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

						Correlation	Reference	value
Test num.	Reference channel	Bandwidth/Subcarrier spacing	Modulation and code rate	TDD UL- DL pattern	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR <sub>BB</sub> (dB)
3-1	R.PDSCH. 5- 5.1_TDD	100MHz/120kHz	16QAM, 0.48	FR2.120- 2	TDLA30-75	2x2 ULA Med	70	[19.4]

### 7.3 PDCCH demodulation requirements

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

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

**Table 7.3-1: Common test Parameters** 

	Parameter		Unit	Value
DL BWP configuration #1	Cyclic prefix			Normal
Common	Physical Cell I	D		0
serving cell	SSB position i	n burst		1
parameters	SSB periodicit		ms	20
PDCCH		CH monitoring		Each slot
configuration		CCH candidates		1
Corniguration	TCI state			TCI state #1
	First subcarrie used for CSI-F	er index in the PRB RS (k0)		0
				CSI-RS resource 1: 4 CSI-RS resource 2:
	First OFDM sy used for CSI-F	mbol in the PRB		8 CSI-RS resource 3:
		,		4 CSI-RS resource 4: 8
CSI-RS for	Number of CS	SI-RS norts (X)		1
tracking	CDM Type	i ito porto (x)		No CDM
liacking	Density (ρ)			3
	CSI-RS period	dicity	Slots	160
	CSI-RS offset		Slots	80 for CSI-RS resource 1 and 2 81 for CSI-RS resource 3 and 4
	Frequency Oc	cupation		Start PRB 0 Number of PRB = BWP size
	QCL info			TCI state #0
Precoding config	guration			SP Type I, Random per slot with REG bundling granularity for number of Tx larger than 1
	Type 1 QCL	SSB index		SSB #0
TCI state #0	information	QCL Type		Type C
	Type 2 QCL	SSB index		SSB #0
	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
	Type 2 QCL information CSI-RS resource			CSI-RS resource 1 from 'CSI-RS for tracking' configuration
		QCL Type		Type D
Symbols for all u	nused REs			OCNG in Annex A.5

## 7.3.1 1RX requirements

(Void)

#### 7.3.2 2RX requirements

#### 7.3.2.1 FDD

(Void)

#### 7.3.2.2 TDD

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

Table 7.3.2.2-1: Test Parameters

Parameter	Unit	1 Tx Antenna	2 Tx Antenna	
TDD UL-DL pattern		FR2.1:	20-1	
CCE to REG mapping type		Interlea	aved	
REG bundle size		2 for test 1-1	2	
REG buridle size		6 for test 1-2		
Interleguer eize		3 for test 1-1	2	
Interleaver size		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		CORES	CORESET	Aggregation	Reference	Propagation	Antenna configuration	-	erence alue
num ber	Bandwidth	ET RB	duration	Aggregation level	Channel	Propagation Condition	and correlation Matrix	Pm- dsg (%)	SNR <sub>BB</sub> (dB)
1-1	100 MHz	60	1	2 CCE	R.PDCCH. 5-1.1 TDD	TDLA30-75	1x2 Low	1	[6.0]
1-2	100 MHz	60	1	4 CCE	R.PDCCH. 5-1.2 TDD	TDLA30-300	1x2 Low	1	[2.6]

#### 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		CORESE	CORESET	Aggragation	Reference	Propagation	Antenna configuration	-	erence alue
num ber	Bandwidth	TRB	duration	Aggregation level	Channel	Propagation Condition	and correlation Matrix	Pm- dsg (%)	SNR <sub>BB</sub> (dB)
2-1	100 MHz	60	1	8 CCE	R.PDCCH. 5-1.3 TDD	TDLA30-75	2x2 Low	1	[-0.4]
2-2	100 MHz	60	2	16 CCE	R.PDCCH. 5-2.1 TDD	TDLA30-75	2x2 Low	1	[-3.4]

### 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 TS 38.213 [11, Section 4.1]		
Note 2: as specified in TS 38.213 [11, Section 11.1]		

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

Γ	Test	Bandwidth	Reference	Propagation	Antenna configuration and	Referer	ce value
	number		channel	condition	correlation matrix	Pm- bch (%)	SNR <sub>BB</sub> (dB)
	1	100 MHz	R.PBCH.5	[TDLA30-300]	1 x 2 Low	1	[-6.1]
	2	100 MHz	R.PBCH.6	[TDLA30-75]	1 x 2 Low	1	TBD

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

Ī	Test	Bandwidth	Reference	Propagation	Antenna configuration and	Reference value	
	number		channel	condition	correlation matrix	Pm- bch (%)	PBCH SNR (dB)
	1	100 MHz	R.PBCH.5	TDLA30-300	1 x 2 Low	1	[-8]
	2	100 MHz	R.PBCH.6	TDLA30-75	1 x 2 Low	1	[-7.5]

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

<TBA>

# 8 CSI reporting requirements (Radiated requirements)

### 8.1 General

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

### 8.1.1 Applicability of requirements

<TBA>

### 8.1.2 Common test parameters

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

Table 8.1.2-1: Test parameters for CSI test cases

PDSCH transmission scheme  Duplex Mode EPRE ratio of PTRS to PDSCH Active DL BWP index Cyclic prefix Common Serving cell Parameters SSB periodicity  Transmission Scheme 1  TDD  AB  [0] Normal  Normal  First SSB in Slot parameters SSB periodicity Transmission Scheme 1  To D	
Duplex Mode TDD  EPRE ratio of PTRS to PDSCH dB [0]  Active DL BWP index 1  Cyclic prefix Normal  Common Physical Cell ID 0  serving cell SSB position in burst First SSB in Slot parameters SSB periodicity ms 20	#0
EPRE ratio of PTRS to PDSCH       dB       [0]         Active DL BWP index       1         Cyclic prefix       Normal         Common       Physical Cell ID       0         serving cell       SSB position in burst       First SSB in Slot         parameters       SSB periodicity       ms       20	#0
Active DL BWP index  Cyclic prefix  Common Serving cell parameters  SSB position in burst parameters  SSB periodicity  1 Normal 0 SFirst SSB in Slot parameters 20	#0
Cyclic prefix     Normal       Common serving cell parameters     Physical Cell ID SSB position in burst parameters     First SSB in Slot ms	#0
Common serving cell parameters     Physical Cell ID     0       SSB position in burst parameters     SSB periodicity     First SSB in Slot parameters	#0
serving cell SSB position in burst First SSB in Slot parameters SSB periodicity ms 20	#0
parameters SSB periodicity ms 20	#0
Slots for PDCCH monitoring Each slot	
Symbols with PDCCH 0,1	
PDCCH Number of PDCCH condidates	
configuration and aggregation levels 1/[8]	
DCI format 1_1	
TCI state #1	
Cross carrier scheduling Not configured	1
Mapping type Type A	
k0 0	
Starting symbol (S) 2	
Length (L) 12 PDSCH aggregation factor 1	
PDSCH PDSCH aggregation factor 1 PRB bundling type Static	
configuration PRB bundling type Static  PRB bundling size 2	
Resource allocation type 0	
VRB-to-PRB mapping type Non-interleave	d
VPR-to-PPR mapping interleaver	<u> </u>
bundle size	
DMRS Type Type 1	
Number of additional DMRS 1	
{1000} for Rank	
PDSCH DMRS DMRS ports indexes {1000,1001} for	r
configuration Rank2	
Length Single-symbol D	IVI-
Number of PDSCH DMRS CDM group(s) without data	
PTRS Frequency density (K <sub>PT-RS</sub> ) 2	
configuration Time density ( $L_{PT-RS}$ ) 1	
First subcarrier index in the PRB used for CSI-RS ( <i>k</i> <sub>0</sub> ) [0]	
First OFDM symbol in the PRB used for CSI-RS ( <i>l</i> <sub>0</sub> ) [4]	
Number of CSI-RS ports (X) 1	
CDM Type No CDM	
Density $(\rho)$ 3	
CSI-RS for CSI-RS periodicity slot 120kHz SCS: 1	
tracking 120 kHz SC	
80 for CSI-RS	
CSI-RS offset slot resource 1 and	_
81 for CSI-RS	
resource 3 and Start PRB 0	4
Frequency Occupation Number of PRE	_
BWP size	_
QCL info TCl state #0	
Start PRR 0	
NZP CSI-RS for CSI Frequency Occupation Number of Number	=
acquisition BWP size	
QCL Info	
ZP CSI-RS for Start PRB 0	
CSI acquisition Frequency Occupation Number of PRE BWP size	=
First subcarrier index in the PRB k <sub>0</sub> =0 for CSI-R	<u> </u>
used for CSI-RS resource 1,2	_

				$I_0 = 8$ for CSI-RS	
		symbol in the PRB		resource 1	
	used for CSI	-RS		$I_0 = 9$ for CSI-RS	
				resource 2	
	Number of C	SI-RS ports (X)		1 for CSI-RS	
	14diliber of 0	or ito ports (7t)		resource 1,2	
CSI-RS for	CDM Type			'No CDM' for CSI-RS	
beam	ODIVI Type			resource 1,2	
refinement	Density (ρ)			3 for CSI-RS	
Tomiomorit	Donoity (p)			resource 1,2	
				120 kHz SCS: 160	
	CSI-RS perio	odicity	Slots	for CSI-RS resource	
				1,2	
	CSI-RS offse	et	Slots	0 for CSI-RS	
				resource 1,2	
	Repetition	T = = = : :		ON	
	Type 1	SSB index		SSB #0	
	QCL				
	information	QCL Type		Type C	
TCI state #0				225 #2	
	Type 2	SSB index		SSB #0	
	QCL	00L T			
	information	QCL Type		Type D	
	Type 1 QCL information			CSI-RS resource 1	
				from 'CSI-RS for	
		CSI-RS resource		tracking'	
				configuration	
		QCL Type		Type A	
TCI state #1		QOL TYPO		CSI-RS resource 1	
	Type 2			from 'CSI-RS for	
	QCL	CSI-RS resource		tracking'	
	information			configuration	
		QCL Type		Type D	
Number of HARO	) Processes	1 QOL 1, po		8	
HARQ ACK/NAC				Multiplexed	
Redundancy ver		nuence		{0,2,3,1}	
rtoddindding von	olon coding co	4401100		For FR2.120-1:	
				[3] if mod $(i.5) = 0$ ,	
				[6] if $mod(i,5) = 0$ ,	
			For FR2.120-2:		
K1 value			[11] if $mod(i,8) = 0$ ,		
(PDSCH-to-HAR	Q-timing-indica		[7] if $mod(i,8) = 4$ ,		
( = = = = = = = = = = = = = = = = = = =	g		[6] if $mod(i,8) = 5$ ,		
			where i is slot index		
				per radio fame with	
				values 0-79.	
0 1 1 1	. 5			OCNG as specified	
Symbols for unus	sed Res		in A.5		

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.

# 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

< Editor's note: The requirements were introduced based on current results from companies; these requirements can be revised based on more results from companies.>

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

#### 8.2.2.2.1.1 Minimum requirement for periodic CQI reporting

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

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

Table 8.2.2.2.1.1-1 Test parameters

	Р	arameter	Unit	Test 1	Test 2
Bandwidth			MHz	100	100
Duplex Mode				TDD	TDD
TDD Slot Con	figura	ation		FR2.120-2 [Annex	FR2.120-2 [Annex
	3			A.1.3]	A.1.3]
DL BWP		First PRB Number of contiguous		0	0
configuration	<b>#1</b>	PRB		66	66
Comigaration	<i>IT</i> 1	Subcarrier spacing	kHz	120	120
SNR <sub>BB</sub>				[8] [9]	[14] [15]
Propagation of	hann	el		AWGN	AWGN
Antenna confi	gurat	ion		2x2 with static channel specified in [Annex B.1]	2x2 with static channel specified in [Annex B.1]
Beamforming	Mode	el		As specified in Section [Annex TBD]	As specified in Section [Annex TBD]
		-RS resource Type		Periodic	Periodic
		nber of CSI-RS ports (X)		4	4
ZP CSI-RS		M Type sity (ρ)		FD-CDM2	FD-CDM2
configuratio		sity (p) t subcarrier index in the		l	l
n		B used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		8	8
	Firs	t OFDM symbol in the PRB d for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		13	13
	CSI		slot	8/1	8/1
		-RS resource Type		Periodic	Periodic
	Number of CSI-RS ports (X)			2	2
		и Туре		fd-CDM2	fd-CDM2
NZP CSI-		sity (ρ)		1	1
RS for CSI		t subcarrier index in the 3 used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		6	6
acquisition	Firs	t OFDM symbol in the PRB d for CSI-RS (l <sub>0</sub> , l <sub>1</sub> )		13	13
	NZF	CSI-RS-timeConfig odicity and offset	slot	8/1	8/1
		-IM RE pattern		1	1
CSI-IM configuratio n		-IM Resource Mapping I-IM,IcsI-IM)		(8, 13)	(8, 13)
	CSI-IM timeConfig periodicity and offset		slot	8/1	8/1
ReportConfig	Туре			Periodic	Periodic
CQI-table				Table 1	Table 1
reportQuantity		N 184		cri-RI-PMI-CQI	cri-RI-PMI-CQI
		ChannelMeasurements		Not configured	Not configured
cgi-FormatInd		nterferenceMeasurements		Not configured Wideband	Not configured Wideband
pmi-Formating				Wideband Wideband	Wideband Wideband
Sub-band Siz		Л	RB	[8]	[8]
csi-Reporting			טיו	[111111111]	[111111111]
CSI-Report pe		city and offset	slot	8/1	8/1
aperiodicTrigg	gering	Offset		Not configured	Not configured
		debook Type		typel-SinglePanel	typel-SinglePanel
Codebook		debook Mode		1	1
configuration	N1	odebookConfig- ,CodebookConfig-N2)		Not configured	Not configured
		debookSubsetRestriction		[010000]	[010000]
<u> </u>		Restriction		[N/A]	[N/A]
Physical chan				[PUCCH]	[PUCCH]
Maximum		RI/PMI delay	ms	[8.375]	[8.375]
iviaximum nur	nber	of HARQ transmission		1 As specified in Table	1 As specified in Table
Measurement	chan	inel		A.4-1, TBS.1-2	A.4-1, TBS.1-2

#### 8.2.2.2.2 CQI reporting under fading conditions

#### 8.2.2.2.2.1 Minimum requirement for wideband CQI reporting

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

- SNR levels
- Test parameters
- Requirements values (BLER,  $\alpha$ ,  $\gamma$ )>

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

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

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

- a) a CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least  $\alpha$  % of the time, where  $\alpha$ % is specified in Table 8.2.2.2.1-2;
- 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 8.2.2.2.1-2;
- 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			MHz	100	100	
Duplex Mode				TDD	TDD	
TDD Slot Con	figura	ition		FR2.120-2 [Annex A.1.3]	FR2.120-2 [Annex A.1.3]	
		First PRB		0	0	
DL BWP configuration :	#1	Number of contiguous PRB		66	66	
Comiguration	# 1	Subcarrier spacing	kHz	120	120	
SNR <sub>BB</sub>		dB	6 7	12 13		
Propagation of	hann	el	ub.	[TDLA30-35]	[TDLA30-35]	
Antenna confi	gurat	ion		2×2 [ULA High]	2×2 [ULA High]	
Doomforming	Mode	.I		As specified in Section	As specified in Section	
Beamforming	IVIOUE	;ı		[Annex TBD]	[Annex TBD]	
	CSI	·RS resource Type		Aperiodic	Aperiodic	
		nber of CSI-RS ports (X)		4	4	
		If Type		FD-CDM2	FD-CDM2	
ZP CSI-RS		sity (ρ)		1	1	
configuratio		subcarrier index in the				
n		B used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		8	8	
	Firs	OFDM symbol in the PRB		13	13	
	CSI-	d for CSI-RS (l <sub>0</sub> , l <sub>1</sub> ) ·RS	-1-4	[0/4]	[0/4]	
		val and offset	slot	[8/1]	[8/1]	
		RS resource Type		Aperiodic	Aperiodic	
		nber of CSI-RS ports (X)		2	2	
	CDM Type			fd-CDM2	fd-CDM2	
NZP CSI-		sity (ρ)		1	1	
RS for CSI		subcarrier index in the		6	6	
acquisition	Firs	B used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )  OFDM symbol in the PRB		13	13	
		d for CSI-RS (I <sub>0</sub> , I <sub>1</sub> ) CSI-RS-timeConfig		FO/43	FO/43	
	interval and offset		slot	[8/1]	[8/1]	
001114	CSI	IM RE pattern		1	1	
CSI-IM configuratio	CSI-IM Resource Mapping (kcsi-im,lcsi-im)			(8, 13)	(8, 13)	
n				(0, 10)	(0, 10)	
	CSI-IM timeConfig interval and offset		slot	[8/1]	[8/1]	
ReportConfig		var arra orroot		Aperiodic	Aperiodic	
CQI-table	. , p o			Table 1	Table 1	
reportQuantity	/			cri-RI-PMI-CQI	cri-RI-PMI-CQI	
		ChannelMeasurements		Not configured	Not configured	
		nterferenceMeasurements		Not configured	Not configured	
cgi-FormatInd				Wideband	Wideband	
pmi-FormatIng				Wideband	Wideband	
Sub-band Size		-	RB	[8]	[8]	
csi-Reporting				[111111111]	[111111111]	
CSI-Report pe		city and offset	slot	8/1	8/1	
aperiodicTrigg			5.50	Not configured	Not configured	
		debook Type		typel-SinglePanel	typel-SinglePanel	
Codebook		debook Mode		1	1	
configuration	(Co	debookConfig-		Not configured	Not configured	
		CodebookConfig-N2) debookSubsetRestriction		[000001]	[000001]	
		Restriction		[000001] [N/A]	[000001] [N/A]	
Physical chan				[N/A] [PUSCH]	[N/A] [PUSCH]	
rnysical chan		r CSI report RI/PMI delay	mc	[PUSCH] [1.375]	[PUSCH] [1.375]	
Maximum nun		of HARQ transmission	ms	[1.375]	[1.375]	
Measurement				As specified in Table A.4-1, TBS.1-1	As specified in Table A.4-1, TBS.1-1	

Table 8.2.2.2.1-2 Minimum requirements

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

### 8.3 Reporting of Precoding Matrix Indicator (PMI)

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

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

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

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

### 8.3.1 1RX requirements

(Void)

### 8.3.2 2RX requirements

#### 8.3.2.1 FDD

(Void)

#### 8.3.2.2 TDD

#### 8.3.2.2.1 Single PMI with 2TX TypeI-SinglePanel Codebook

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

Table 8.3.2.2.1-1: Test parameters (single layer)

Pa	rameter	Unit	Test 1	Test 2	
Bandwidth		MHz	100	100	
	_		FR2.120-2 as	FR2.120-2 as	
TDD DL-UL configuration			specified in	specified in	
	First PRB		Annex A 0	Annex A 0	
DL BWP	Number of		U	0	
configuration	contiguous PRB		66	66	
#1	Subcarrier spacing	kHz	120	120	
Propagation char	nnel		[TDLA30-35]		
Antenna configur	ation		2 x 2 [ULA Low]	2 x 2 [ULA Low]	
Beamforming Mo			TBD		
	CSI-RS resource		Aperiodic	Aperiodic	
	Type Number of CSI-RS		-	·	
	ports (X)		4	4	
	CDM Type		FD-CDM2	FD-CDM2	
ZP CSI-RS	Density (ρ)		1	1	
configuration	First subcarrier				
J	index in the PRB		Row 4, (8,-)	Row 4, (8,-)	
	used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		, ( , ,	, , , ,	
	First OFDM symbol				
	in the PRB used for		(13,-)	(13,-)	
	CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		, , ,		
	CSI-RS	slot	8/1	5/1	
	interval and offset CSI-RS resource		G, .	G/ .	
	Type		Aperiodic	Aperiodic	
	Number of CSI-RS		2	2	
	ports (X)		2		
	CDM Type		FD-CDM2	FD-CDM2	
N7D 001 D0	Density (ρ)		1	1	
NZP CSI-RS for CSI	First subcarrier				
acquisition	index in the PRB used for CSI-RS		Row 3, (6,-)	Row 3, (6,-)	
	(k <sub>0</sub> , k <sub>1</sub> )				
	First OFDM symbol				
	in the PRB used for		(13,-)	(13,-)	
	CSI-RS (I <sub>0</sub> , I <sub>1</sub> )				
	interval and offset	slot	8/1	8/1	
	CSI-IM RE pattern				
	·		Patten 0	Patten 0	
CSI-IM					
configuration	CSI-IM Resource				
oormgaration	Mapping				
	(ксы-ім,Ісы-ім)		(8,13)	(8,13)	
	CSI-IM timeConfig		2//		
	interval and offset	slot	8/1	5/1	
ReportConfigTyp	е		Aperiodic	Aperiodic	
CQI-table			Table 1	Table 1	
reportQuantity			cri-RI-PMI-CQI	cri-RI-PMI-CQI	
timeRestrictionForChannelMeasureme			Not configured	Not configured	
nts timeRestrictionFo	orInterferenceMeasur				
ements			Not configured	Not configured	
cqi-FormatIndica	tor		Wideband	Wideband	
pmi-FormatIndica	ator		Wideband	Wideband	
Sub-band Size		RB	[8]	[8]	
csi-ReportingBar	nd		[111111111]	[111111111]	

CSI-Report	interval and offset	slot	8/1	5/1			
aperiodicTr	iggeringOffset		0	0			
Codebook	Codebook Type		typel- SinglePanel	typel- SinglePanel			
configuration	on Codebook Mode		1	1			
	(CodebookConfig- N1,CodebookConfi g-N2)		N/A	N/A			
	CodebookSubsetR estriction		001111	001111			
	RI Restriction		N/A	N/A			
Physical ch	annel for CSI report		PUSCH	PUSCH			
CQI/RI/PMI	delay	ms	1.375	1.75			
Maximum n transmissio	number of HARQ n		4	4			
Measureme	ent 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 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 eNB downlink before slot#[(n+4)].							
Note 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)

TBD.

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

### 8.4.1 1RX requirements

(Void)

### 8.4.2 2RX requirements

#### 8.4.2.1 FDD

(Void)

#### 8.4.2.2 TDD

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

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

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

Table 8.4.2.2-1: RI Test (TDD)

	P	arameter	Unit	Test 1	Test 2	Test 3
Bandwidth	<u> </u>	arameter .	MHz	100	100	100
Duplex Mode				TDD	TDD	TDD
TDD Slot Con	figura	ation		FR1.120-2	FR1.120-2	FR1.120-2
	<u> </u>	First PRB		0	0	0
DL BWP configuration	#1	Number of contiguous PRB		66	66	66
_		Subcarrier spacing	kHz	120	120	120
SNR			dB	[0]	[20]	[20]
Propagation of				[TDLA30-35]	[TDLA30-35]	[TDLA30-35]
Antenna confi	gurat	ion		ULA Low 2x2	ULA Low 2x2	XP High 2x2
Beamforming	Mode	el		As defined in Annex B.4.1	As defined in Annex B.4.1	As defined in Annex B.4.1
		-RS resource Type		Aperiodic	Aperiodic	Aperiodic
		nber of CSI-RS ports (X)		4	4	4
ZP CSI-RS		И Туре		FD-CDM2	FD-CDM2	FD-CDM2
configuratio		sity (ρ)		1	1	1
n	PRE	t subcarrier index in the B used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 4, (8,-)	Row 4, (8,-)	Row 4, (8,-)
	use	t OFDM symbol in the PRB d for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		(13,-)	(13,-)	(13,-)
	CSI inte	-RS rval and offset	slot	8/1	8/1	8/1
	CSI	-RS resource Type		Aperiodic	Aperiodic	Aperiodic
	Nun	nber of CSI-RS ports (X)		2	2	2
	CDI	И Туре		FD-CDM2	FD-CDM2	FD-CDM2
NZP CSI-	Density (ρ)			1	1	1
RS for CSI acquisition	PRE	t subcarrier index in the B used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 3 (6,-)	Row 3 (6,-)	Row 3 (6,-)
	use	t OFDM symbol in the PRB d for CSI-RS (l₀, l₁)		(13,-)	(13,-)	(13,-)
		CSI-RS-timeConfig	slot	8/1	8/1	8/1
	CSI	-IM RE pattern		Pattern 1	Pattern 1	Pattern 1
CSI-IM configuration		-IM Resource Mapping ı-ıм,Ісsı-ıм)		(8,13)	(8,13)	(8,13)
		-IM timeConfig rval and offset	slot	8/1	8/1	8/1
ReportConfig		TVALATIA CITOCO		Aperiodic	Aperiodic	Aperiodic
CQI-table	- 7			Table 1	Table 1	Table 1
reportQuantity	/			cri-RI-PMI-CQI	cri-RI-PMI- CQI	cri-RI-PMI- CQI
timeRestrictio	nFor(	ChannelMeasurements		not configured	not	not
timercomono	111 011	Sharmenveasarements		not configured	configured	configured
		nterferenceMeasurements		not configured	not configured	not configured
cqi-FormatInd				Wideband	Wideband	Wideband
pmi-FormatIn		or		Wideband	Wideband	Wideband
Sub-band Siz			RB	[8]	[8]	[8]
csi-Reporting				[111111111]	[111111111]	[111111111]
CSI-Report in			slot	8/1	8/1	8/1
aperiodicTrigg				0	0	0
0	Co	debook Type		typel-	typel-	typel-
Codebook		dobook Mode		SinglePanel	SinglePanel	SinglePanel
configuration		debook Mode		1	1	1
		odebookConfig- ,CodebookConfig-N2)		N/A	N/A	N/A
	141	debookSubsetRestriction			[000011 for	[000011 for
	00	debookSubsetivestriction		[010000 for	fixed rank 1,	fixed rank 1,
				fixed rank 2,	010011 for	010011 for
				010011 for	following	following
				following rank]	rank]	rank]
		Restriction		N/A	N/A	N/A
Physical chan		or CSI report		PUSCH	PUSCH	PUSCH
CQI/RI/PMI delay			ms	1.375	1.375	1.375

Maximum number of HARQ transmission	1	1	1
RI Configuration	Fixed RI = 2 and follow RI	Fixed RI = 1 and follow RI	Fixed RI = 1 and follow RI

Table 8.4.2.2-2: Minimum requirement (TDD)

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

## 9 Demodulation performance requirements for interworking

#### 9.1 General

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

#### 9.1.1 Applicability of requirements

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

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

### 9.1.2 LTE Pcell setup

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

#### 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 an LTE Pcell. One of test setup in Table 9.1.2.1-2 will be selected for the LTE Pcell depending on the maximum bandwidth of an LTE 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 TS36.101 [4, Annex C.3.2].

Table 9.1.2.1-1: Common Test Parameters (FDD)

Parameter	Unit	Value	
Cyclic prefix		Normal	
Physical Cell ID		0	
Number of PDCCH symbols	symbols	1	
PHICH Ng (Note 1)		1	
PHICH duration		Normal	
Number of HARQ processes per component carrier	Processes	[8]	
Maximum number of HARQ transmission		[4]	
Redundancy version coding sequence		{0,0,1,2} for [64QAM]	
Propagation condition		Static propagation condition  No external noise sources are applied	
Transmission mode		[3]	
Transmission time difference between LTE cell and NR cell(s)	μs	0	
Antenna configuration		2x2	
Codebook subset restriction		[10]	
Symbols for all unused Res		OCNG in Annex A.5	

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}$	б
1	5	-3	-3	0
2	10	-3	-3	0
3	15	-3	-3	0
4	20	-3	-3	0

#### 9.1.2.2 TDD

The parameters specified in Table 9.1.2.2-1 and Table 9.1.2.2-2 are used to setup an LTE Pcell. One of test setup in Table 9.1.2.2-2 will be selected for the LTE Pcell depending on the maximum bandwidth of an LTE 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 TS36.101 [4]. The physical channel setup with downlink power allocation is according to TS36.101 [4, Annex C.3.2].

Table 9.1.2.2-1: Common Test Parameters (TDD)

Parameter	Unit	Value	
UL DL configuration		2 (Note1)	
Special subframe configuration		7	
Number of PDCCH symbols	symbols	1	
PHICH Ng (Note 3)		1	
PHICH duration		Normal	
Cyclic prefix		Normal	
Cell ID		0	
Maximum number of HARQ transmission		[4]	
Redundancy version coding sequence		{0,0,1,2} for [64QAM]	
Propagation condition		Static propagation condition  No external noise sources are applied	
Transmission mode		[3]	
Transmission time difference between LTE cell and NR cell(s)	μs	0	
Antenna configuration		2x2	
Codebook subset restriction		[10]	
Symbols for all unused Res		OCNG in Annex A.5	

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

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

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

- 9.2 Void
- 9.2A PDSCH demodulation for CA
- 9.2A.1 NR CA between FR1 and FR2
- 9.2B PDSCH demodulation for DC
- 9.2B.1 EN-DC

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

#### 9.2B.1.1 EN-DC within FR1

#### 9.2B.1.1.1 PDSCH

The test setup for LTE Pcell is specified in Section 9.1.2. The NR PDSCH demodulation performance requirements for NR are specified in Section 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 LTE Pcell is specified in Section 9.1.2. The NR PDSCH demodulation performance requirements for NR are specified in Section 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 demodulation performance requirements are verified according to Section 9.2B.1.1 for EN-DC with FR1 NR carrier only and Section 9.2B.1.2 for EN-DC with FR2 NR carrier only. During the test for EN-DC with FR2 NR carriers, only demodulation performance requirements on the FR2 carriers are verified. No demodulation requirement for FR1 NR or LTE carriers is specified for EN-DC including FR2 carrier(s).

## 9.2B.2 NR DC between FR1 and FR2

## 9.3 Void

## 9.3A PDCCH demodulation for CA

## 9.3A.1 NR CA between FR1 and FR2

During the test, only the demodulation performance requirements on FR2 carriers are verified. The demodulation performance requirements for NR FR2 are specified in Section 7.3.

## 9.3B PDCCH demodulation for DC

#### 9.3B.1 EN-DC

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

### 9.3B.1.1 EN-DC within FR1

#### 9.3B.1.1.1 PDCCH

The test setup for LTE Pcell is specified in Section 9.1.2. The NR PDCCH demodulation performance requirements for NR are specified in Section 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 LTE Pcell is specified in Section 9.1.2. The NR PDCCH demodulation performance requirements are specified in Section 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 demodulation performance requirements are verified according to Section 9.3B.1.1 for EN-DC with FR1 NR carrier only and Section 9.3B.1.2 for EN-DC with FR2 NR carrier only. During the test for EN-DC with FR2 NR carriers, only demodulation performance requirements on the FR2 carriers are verified. No demodulation requirement for FR1 NR or LTE carriers is specified for EN-DC including FR2 carrier(s).

## 9.3B.2 NR DC between FR1 and FR2

## 9.4 Void

## 9.4A SDR test for CA

## 9.4A.1 NR CA between FR1 and FR2

During the test, only the demodulation performance requirements on FR2 carriers are verified. The demodulation performance requirements for FR2 are specified in Section 7.5.

## 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 test setup for LTE Pcell is specified in Section 9.1.2. The NR SDR tests are specified in Section 5.5. During the test, the PDSCH performance on both the NR cell(s) and LTE cell(s) shall be verified.

## 9.4B.1.2 EN-DC including FR2 NR carrier

#### 9.4B.1.2.1 SDR test

The test setup for LTE Pcell is specified in Section 9.1.2. The NR PDSCH SDR tests are specified in Section 7.5. During the test, only the PDSCH performance on the NR cell(s) on FR2 carriers is verified.

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

The SDR tests are verified according to Section 9.4B.1.1 for EN-DC with FR1 NR carrier only and Section 9.4B.1.2 for EN-DC with FR2 NR carrier only. During the test for EN-DC with FR2 NR carriers, only SDR tests on the FR2 carriers are verified. No SDR requirement for FR1 NR or LTE carriers is tested for EN-DC including FR2 carrier(s).

## 9.4B.2 NR DC between FR1 and FR2

## 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 TS38.101-3 [8, table 5.1-1].

## 10.1.1 Applicability of requirements

<TBA>

## 10.2 Void

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

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

## 10.2B.1 EN-DC

< Editor's note: FFS which test cases from SA will be applied for EN-DC >

## 10.2B.1.1 EN-DC within FR1

Unless otherwise stated, the configuration of LTE Pcell specified in [X] applies to LTE carrier.

Unless otherwise stated, NR CQI requirements and test configurations defined in Subclause 6.2 apply to NR cell(s).

Unless otherwise stated, only NR requirements on NR cell(s) shall be verified during test.

#### 10.2B.1.2 EN-DC including FR2 NR carrier

Unless otherwise stated, the configuration of LTE Pcell specified in [X] applies to LTE carrier.

Unless otherwise stated, NR CQI requirements and test configurations defined in Subclause 8.2 apply to NR cell(s).

Unless otherwise stated, only NR requirements on NR cell(s) shall be verified during test.

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

## 10.3 Void

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

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

## 10.3B.1 EN-DC

<Editor's note: FFS which test cases from SA will be applied for EN-DC >

### 10.3B.1.1 EN-DC within FR1

Unless otherwise stated, the configuration of LTE Pcell specified in [X] applies to LTE carrier.

Unless otherwise stated, NR PMI requirements and test configurations defined in Subclause 6.3 apply to NR cell(s).

Unless otherwise stated, only NR requirements on NR carrier(s) shall be verified during test.

## 10.3B.1.2 EN-DC including NR FR2 carrier

Unless otherwise stated, the configuration of LTE Pcell specified in [X] applies to LTE carrier.

Unless otherwise stated, NR PMI requirements and test configurations defined in Subclause 8.3 apply to NR cell(s).

Unless otherwise stated, only NR requirements on NR cell(s) shall be verified during test.

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

## 10.4 Void

## 10.4A Reporting of Rank Indicator (RI) for CA

## 10.4B Reporting of Rank Indicator (RI) for DC

### 10.4B.1 EN-DC

< Editor's note: FFS which test cases from SA will be applied for EN-DC >

#### 10.4B.1.1 EN-DC within FR1

Unless otherwise stated, the configuration of LTE Pcell specified in [X] applies to LTE carrier.

Unless otherwise stated, NR RI requirements and test configurations defined in Subclause 6.4 apply to NR cell(s).

Unless otherwise stated, only NR requirements on NR cell(s) shall be verified during test.

## 10.4B.1.2 EN-DC including NR FR2 carrier

Unless otherwise stated, the configuration of LTE Pcell specified in [X] applies to LTE carrier.

Unless otherwise stated, NR RI requirements and test configurations defined in Subclause 8.4 apply to NR cell(s) for EN-DC operation with NR carrier(s) in FR2.

Unless otherwise stated, only NR requirements on NR cell(s) shall be verified during test.

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

# 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 patterns for FR1

TDD UL-DL patterns 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 pattern for SCS 15 kHz

	Parameter	Unit	UL-DL pattern
	- arameter	Oilit	FR1.15-1
TDD Slot Configuration p	pattern (Note 1)		DDDSU
Special Slot Configuration	n (Note 2)		10D+2G+2U
UL-DL configuration	referenceSubcarrierSpacing	kHz	15
(tdd-UL-DL-	dl-UL-TransmissionPeriodicity	ms	5
ConfigurationCommon)	nrofDownlinkSlots		3
	nrofDownlinkSymbols		10
	nrofUplinkSlot		1
	nrofUplinkSymbols		2
K1 value			[4] if $mod(1,5) = 0$
(PDSCH-to-HARQ-timing	g-indicator)		[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 pattern for SCS 30 kHz

D.	Parameter		UL-DL pattern					
Pa	arameter	Unit	FR1.30-1	FR1.30-2	FR1.30-3	FR1.30-4	FR1.30-5	FR1.30-6
TDD Slot Configuration pa	attern (Note 1)		7DS2U	DDDSU	DDDSUDDSUU	SU	DDSU	DS <sub>1</sub> S <sub>2</sub> U
•			6D+4G+4U	10D+2G+2U	10D+2G+2U	12D+2G+0U	10D+2G+2U	S1:
Special Slot Configuration	(Note 2)							10D+2G+2U
Special Slot Configuration (Note 2)								S2:
								12D+2G+0U
UL-DL configuration	referenceSubcarrierSpacing	kHz	30	30	30	30	30	30
(tdd-UL-DL-	dl-UL-TransmissionPeriodicity	ms	5	2.5	2.5	1	2	1
ConfigurationCommon)	nrofDownlinkSlots		7	3	3	0	2	1
	nrofDownlinkSymbols		6	10	10	12	10	10
	nrofUplinkSlot		2	1	1	1	1	0
	nrofUplinkSymbols		4	2	2	0	2	2
UL-DL configuration2	referenceSubcarrierSpacing	kHz	N/A	N/A	30	N/A	N/A	30
(tdd-UL-DL-	dl-UL-TransmissionPeriodicity	ms	N/A	N/A	2.5	N/A	N/A	1
ConfigurationCommon2)	nrofDownlinkSlots		N/A	N/A	2	N/A	N/A	0
	nrofDownlinkSymbols		N/A	N/A	10	N/A	N/A	12
	nrofUplinkSlot		N/A	N/A	2	N/A	N/A	1
	nrofUplinkSymbols		N/A	N/A	2	N/A	N/A	0
K1 value			[7] if mod(i,10)	[4] if $mod(i,5) =$	[4] if mod(i,10)	[3] if $mod(i,2) =$	[3] if $mod(i,4) =$	[3] if mod(i,4)
(PDSCH-to-HARQ-timing-	-indicator)		= 0	0	= 0	0	0	= 0
			[6] if mod(i,10)	[3] if $mod(i,5) =$	[3] if mod(i,10)		[2] if $mod(i,4) =$	[2] if mod(i,4)
			= 1	1	= 1		1	= 1
			[5] if mod(i,10)	[2] if $mod(i,5) =$	[2] if mod(i,10)		[5] if $mod(i,4) =$	[3] if mod(i,4)
			= 2	2	= 2		3	= 3
			[5] if mod(i,10)	[6] if $mod(i,5) =$	[5] if mod(i,10)			
			= 3	3	= 3			
			[4] if mod(i,10)		[3] if mod(i,10)			
			= 4		= 5			
			[3] if mod(i,10)		[3] if mod(i,10)			
			= 5		= 6			
			[3] if mod(i,10)		[2] if mod(i,10)			
			= 6		= 7			
			[2] if mod(i,10)					
			= 7					

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

## A.1.3 TDD UL-DL patterns for FR2

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

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

D	arameter	Unit	UL-DL pattern
	arameter	Offic	FR2.60-1
TDD Slot Configuration p	pattern (Note 1)		DDSU
Special Slot Configuration	n (Note 2)		11D+3G+0U
UL-DL configuration	referenceSubcarrierSpacing	kHz	60
(tdd-UL-DL-	dl-UL-TransmissionPeriodicity	ms	1
ConfigurationCommon)	nrofDownlinkSlots		2
	nrofDownlinkSymbols		11
	nrofUplinkSlot		1
	nrofUplinkSymbols		0
K1 value			K1 = [3]  if  mod(i,4) = 0
(PDSCH-to-HARQ-timing	g-indicator)		K1 = [2]  if  mod(i,4) = 1
			K1 = [5]  if  mod(i,4) = 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;  $i = \{0,...,39\}$ 

Table A.3.1-5: TDD UL-DL pattern for SCS 120 kHz

D	arameter	Unit	UL-DL	pattern	
P	arameter	Unit	FR2.120-1	FR2.120-2	
TDD Slot Configuration p	pattern (Note 1)		DDDSU	DDSU	
Special Slot Configuratio	n (Note 2)		10D+2G+2U	11D+3G+0U	
UL-DL configuration	referenceSubcarrierSpacing	kHz	120	120	
(tdd-UL-DL-	dl-UL-TransmissionPeriodicity	ms	0.625	0.5	
ConfigurationCommon)	nrofDownlinkSlots		3	2	
	nrofDownlinkSymbols		10	11	
	nrofUplinkSlot		1	1	
	nrofUplinkSymbols		2	0	
K1 value			K1 = [4]  if mod(i,5) = 0	K1 = [3]  if mod(i,4) = 0	
(PDSCH-to-HARQ-timing	g-indicator)		K1 = [3]  if mod(i,5) = 1	K1 = [2]  if mod(i,4) = 1	
			K1 = [2]  if mod(i,5) = 2	K1 = [5]  if mod(i,4) = 3	
			K1 = [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;  $i = \{0,...,79\}$ 

## 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 TS 38.214 [12, Section 5.1.3.2].

[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			
Reference channel		R.PDSCH.	R.PDSCH.	R.PDSCH.	R.PDSCH.	R.PDSCH.	
Reference charmer		1-1.1 FDD	1-1.2 FDD	1-1.3 FDD	1-1.4 FDD	1-1.5 FDD	
Channel bandwidth	MHz	10	10	10	10	10	
Subcarrier spacing	kHz	15	15	15	15	15	
Number of allocated resource blocks	PRBs	52	6	52	52	52	
Number of consecutive PDSCH symbols		12	12	7	9	11	
Allocated slots per 2 frames	Slots	19	19	19	19	19	
MCS table		64QAM	64QAM	64QAM	64QAM	64QAM	
MCS index		4	4	4	4	4	
Modulation		QPSK	QPSK	QPSK	QPSK	QPSK	
Target Coding Rate		0.30	0.30	0.30	0.30	0.30	
Number of MIMO layers		1	1	1	1	1	
Number of DMRS rEs		18	12	12	12	12	
Overhead for TBS determination		0	0	0	18	18	
Information Bit Payload per Slot							
For Slot $i = 0$	Bits	N/A	N/A	N/A	N/A	N/A	
For Slots i = 1,, 19	Bits	3904	480	2280	2472	3240	
Transport block CRC per Slot							
For Slot $i = 0$	Bits	N/A	N/A	N/A	N/A	N/A	
For Slots i = 1,, 19	Bits	24	16	16	16	16	
Number of Code Blocks per Slot							
For Slot $i = 0$	CBs	N/A	N/A	N/A	N/A	N/A	
For Slots i = 1,, 19	CBs	1	1	1	1	1	
Binary Channel Bits Per Slot							
For Slot $i = 0$	Bits	N/A	N/A	N/A	N/A	N/A	
For Slots i = 10, 11	Bits	12480	1512	6864	7760	10256	
For Slots i = 3,, 9, 12,, 19	Bits	13104	1584	7488	8384	10880	
Max. Throughput averaged over 2 frames	Mbps	3.709	0.456	2.166	2.348	3.078	
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms							

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

Parameter	Unit			Value		
Deference showned		R.PDSCH.	R.PDSCH.	R.PDSCH.	R.PDSCH.	
Reference channel		1-2.1 FDD	1-2.2 FDD	1-2.3 FDD	1-2.4 FDD	
Channel bandwidth	MHz	10	10	10	10	
Subcarrier spacing	kHz	15	15	15	15	
Number of allocated resource blocks	PRBs	52	52	52	52	
Number of consecutive PDSCH symbols		12	12	12	12	
Allocated slots per 2 frames	Slots	19	19	19	19	
MCS table		64QAM	64QAM	64QAM	64QAM	
MCS index		13	13	13	13	
Modulation		16QAM	16QAM	16QAM	16QAM	
Target Coding Rate		0.48	0.48	0.48	0.48	
Number of MIMO layers		1	2	3	4	
Number of DMRS rEs		12	12	24	24	
Overhead for TBS determination		0	0	0	0	
Information Bit Payload per Slot						
For Slot i = 0	Bits	N/A	N/A	N/A	N/A	
For Slots i = 1,, 19	Bits	13064	26120	35856	48168	
Transport block CRC per Slot						
For Slot i = 0	Bits	N/A	N/A	N/A	N/A	
For Slots i = 1,, 19	Bits	24	24	24	24	
Number of Code Blocks per Slot						
For Slot i = 0	CBs	N/A	N/A	N/A	N/A	
For Slots i = 1,, 19	CBs	2	4	5	6	
Binary Channel Bits Per Slot						
For Slot i = 0	Bits	N/A	N/A	N/A	N/A	•
For Slots i = 10, 11	Bits	26208	52416	71136	94848	<u> </u>
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 Note 2: Slot i is slot index per 2 frames

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

Parameter	Unit		Value
Reference channel		R.PDSCH. 1-3.1 FDD	
Channel bandwidth	MHz	10	
Subcarrier spacing	kHz	15	
Number of allocated resource blocks	PRBs	52	
Number of consecutive PDSCH symbols		12	
Allocated slots per 2 frames	Slots	19	
MCS table		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 frames  Note 1: SS/PBCH block is transmitt	Mbps	39.915	

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

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

Parameter	Unit		Value
Reference channel		R.PDSCH.	
Reference channel		1-4.1 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		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/DBCH block is transmitte	l od in olot d	40 with pariadia	it. 00 mg

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

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

Parameter	Unit		Value
Reference channel		R.PDSCH.	
Reference channel		1-5.1 FDD	
Channel bandwidth	MHz	10	
Subcarrier spacing	kHz	15	
Number of allocated resource blocks	PRBs	52	
Number of consecutive PDSCH		12	
symbols		12	
Allocated slots per 2 frames	Slots	19	
MCS table		64QAM	
MCS index		13	
Modulation		16QAM	
Target Coding Rate		0.48	
Number of MIMO layers		2	
Number of DMRS rEs		12	
Overhead for TBS determination		0	
Information Bit Payload per Slot			
For Slot i = 0	Bits	N/A	
For Slots i = 1,, 19	Bits	26120	
Transport block CRC per Slot			
For Slot i = 0	Bits	N/A	
For Slots i = 1,, 19	Bits	24	
Number of Code Blocks per Slot			
For Slot i = 0	CBs	N/A	
For Slots i = 1,, 19	CBs	4	
Binary Channel Bits Per Slot			
For Slot i = 0	Bits	N/A	
For Slots i = 5, 15	Bits	50752	
For Slots i = 10	Bits	48256	
For Slots i = 11	Bits	52416	
For Slots $i = 1,,4,6,,$	Bits	54912	
9,12,14,16,,19	DIIS	0 <del>4</del> 812	
Max. Throughput averaged over 2	Mbps	24.814	
frames			

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

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

Parameter	Unit			Value
Deference channel		R.PDSCH.	R.PDSCH.	
Reference channel		1-6.1 FDD	1-6.2 FDD	
Channel bandwidth	MHz	10	10	
Subcarrier spacing	kHz	15	15	
Number of allocated resource blocks	PRBs	52	52	
Number of consecutive PDSCH		40	40	
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,		N1/A	N1/A	
i={0,,19}		N/A	N/A	
For Non CSI-RS Slot i, if mod (i,5)	D:4-	10010	24072	
={0,2,3,4}, i={1,19}	Bits	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}	DIIS	24	24	
Number of Code Blocks per Slot				
For Slot i = 0	CBs	N/A	N/A	
For CSI Slots i, if mod (i,5) =1,		N/A	N/A	
i={0,,19}		IN//A	IN/A	
For Non CSI-RS Slot i, if mod (i,5)	CBs	2	3	
={0,2,3,4}, i={1,,19}	ODS		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}	Dito	21000	10020	
Max. Throughput averaged over 2	Mbps	9.030	18.054	
frames  Note 1: SS/PBCH block is transmitted.	·			

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

Note 2:

Slot i is slot index per 2 frames

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

#### A.3.2.1.2 Reference measurement channels for SCS 30 kHz FR1

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

Parameter	Unit		Value
Reference channel		R.PDSCH.	
Reference channel		2-1.1 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,, 19	Bits	40976	
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	77112	
For Slots i = 1,, 9, 12,, 19	Bits	80784	
Max. Throughput averaged over 2 frames	Mbps	79.903	
Note 1: SS/PBCH block is transmitt	ed in slot #	#0 with periodic	city 20 ms

## 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 (QPSK)

Parameter	Unit			Value	
Poforonce channel		R.PDSCH.	R.PDSCH.	R.PDSCH.	
Reference channel		2-1.1 TDD	2-1.2 TDD	2-1.3 TDD	
Channel bandwidth	MHz	40	40	40	
Subcarrier spacing	kHz	30	30	30	
Allocated resource blocks	PRBs	106	6	106	
Number of consecutive PDSCH symbols					
For Slot i, if mod(i, 10) = 7 for i from				21/2	
{0,,39}		4	4	N/A	
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,\}$		10	10	7	
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 Slot i, if mod(i, 10) = 7 for i from		0	0	NI/A	
{0,,39}		6	6	N/A	
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,\}$		40	40	40	
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) =					
{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					
{0,,39}	Bits	2664	144	N/A	
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,\}$					
for i from {1,,39}	Bits	8064	480	4608	
Transport block CRC per Slot					
For Slots 0 and Slot i, if mod(i, 10) =					
{8,9} for i from {0,,39}	Bits	N/A	N/A	N/A	
For Slot i, if $mod(i, 10) = 7$ for i from					
{0,,39}	Bits	16	16	N/A	
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,\}$					
for i from {1,,39}	Bits	24	16	24	
Number of Code Blocks per Slot					
For Slots 0 and Slot i, if mod(i, 10) =					
{8,9} for i from {0,,39}	CBs	N/A	N/A	N/A	
For Slot i, if $mod(i, 10) = 7$ for i from					
{0,,39}	CBs	1	1	N/A	
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,\}\}$					
for i from $\{1,,39\}$	CBs	1	1	1	
Binary Channel Bits Per Slot					
For Slots 0 and Slot i, if mod(i, 10) =					
{8,9} for i from {0,,39}	Bits	N/A	N/A	N/A	
For Slots i = 20, 21	Bits	25440	1512	13992	
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) = $\{0,1,2,3,4,5,\}$		1			
for i from $\{1,,19,22,,39\}$	Bits	26712	1584	15264	
Max. Throughput averaged over 2		<del> </del>			
frames	Mbps	11.419	0.677	6.221	
Note 1: SS/PBCH block is transmitted in	n slot #0 w	ith periodicity	20 ms		
	i SiUL#U W	in penduicity	ZU 1110		
Note 2: Slot i is slot index per 2 frames					

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

Parameter	Unit			Value		
Reference channel		R.PDSCH.	R.PDSCH.	R.PDSCH.	R.PDSCH.	
Reference channel		2-2.1 TDD	2-2.2 TDD	2-2.3 TDD	2-2.4 TDD	
Channel bandwidth	MHz	40	40	40	40	
Subcarrier spacing	kHz	30	30	30	30	
Allocated resource blocks	PRBs	106	106	106	106	
Number of consecutive PDSCH						
symbols						
For Slot i, if mod(i, 10) = 7 for i from $\{0,,39\}$		4	4	4	4	
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,\}\}$ 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 rÉs						
For Slot i, if $mod(i, 10) = 7$ for i from $\{0,,39\}$		6	6	12	12	
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,\}\}$ for i from $\{1,,39\}$		12	12	24	24	
Overhead for TBS determination		0	0	0	0	
Information Bit Payload per Slot		0	0	U	0	
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}	Bits	N/A	N/A	N/A	N/A	
For Slot i, if mod(i, 10) = 7 for i from	Bits	8456	16896	22032	29192	
$\{0,,39\}$ For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,\}$	Bits	26632	53288	73776	98376	
for i from {1,,39}	Dito	20002	00200	70770	00070	
Transport block CRC per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}	Bits	N/A	N/A	N/A	N/A	
For Slot i, if $mod(i, 10) = 7$ for i from $\{0,,39\}$	Bits	24	24	24	24	
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,\}\}$ for i from $\{1,,39\}$	Bits	24	24	24	24	
Number of Code Blocks per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}	CBs	N/A	N/A	N/A	N/A	
For Slot i, if mod(i, 10) = 7 for i from	CBs	2	3	3	4	
$\{0,,39\}$ For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,\}$	CBs	4	7	9	12	
for i from {1,,39}	0.00		,		'-	
Binary Channel Bits Per Slot		ļ				
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}	Bits	N/A	N/A	N/A	N/A	
For Slots i = 20, 21	Bits	53424	106848	144008	193344	
For Slot i, if mod(i, 10) = 7 for i from $\{0,,39\}$	Bits	17808	35616	45792	61056	
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,\}\}$ for i from $\{1,,19,22,,39\}$	Bits	55968	111936	152640	203520	
Max. Throughput averaged over 2 frames	Mbps	37.644	75.318	104.719	138.646	
Note 1: SS/PBCH block is transmitted i	n elat #0 14	ith periodicity	20 ms	I	<u> </u>	
Note 2: Slot i is slot index per 2 frames		nui penouicity	20 1110			

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.	R.PDSCH.			
Reference channel		2-3.1 TDD	2-3.2 TDD			
Channel bandwidth	MHz	40	20			
Subcarrier spacing	kHz	30	30			
Allocated resource blocks	PRBs	106	51			
Number of consecutive PDSCH symbols						
For Slot i, if mod(i, 10) = 7 for i from		4	4			
{0,,39}		4	4			
For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,\}$ ) for i from $\{1,,39\}$		12	12			
Allocated slots per 2 frames		31	31			
MCS table		64QAM	64QAM			
MCS index		19	19			
Modulation		64QAM	64QAM			
Target Coding Rate		0.51	0.51			
Number of MIMO layers		2	2			
Number of DMRS rEs						
For Slot i, if mod(i, 10) = 7 for i from		6	6			
{0,,39}						
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,\}\}$		12	12			
for i from {1,,39}						
Overhead for TBS determination		0	0			
Information Bit Payload per Slot						
For Slots 0 and Slot i, if mod(i, 10) =	Bits	N/A	N/A			
{8,9} for i from $\{0,,39\}$ For Slot i, if mod(i, 10) = 7 for i from						
$\{0,,39\}$	Bits	27144	13064			
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,\}$						
for i from {1,,39}	Bits	83976	40976			
Transport block CRC per Slot						
For Slots 0 and Slot i, if mod(i, 10) =	D::	N1/0	N1/A			
{8,9} for i from {0,,39}	Bits	N/A	N/A			
For Slot i, if mod(i, 10) = 7 for i from	Bits	24	24			
{0,,39}	DIIS	24	24			
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,\})$	Bits	24	24			
for i from {1,,39}	Dito	24	27			
Number of Code Blocks per Slot						
For Slots 0 and Slot i, if mod(i, 10) =	CBs	N/A	N/A			
{8,9} for i from {0,,39}						
For Slot i, if mod(i, 10) = 7 for i from	CBs	4	2			
{0,,39}						
For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,\}$	CBs	10	5			
for i from {1,,39} Binary Channel Bits Per Slot					+	
For Slots 0 and Slot i, if mod(i, 10) =					+	
{8,9} for i from {0,,39}	Bits	N/A	N/A			
For Slots i = 20, 21	Bits	160272	77112		+	+
For Slot i, if mod(i, 10) = 7 for i from						
{0,,39}	Bits	53424	25704			
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,\}$		40===:	2257		1	
for i from {1,,19,22,,39}	Bits	167904	80784			
Max. Throughput averaged over 2	N 41c	440.700	F7.000			
frames	Mbps	118.796	57.930		<u> </u>	
Note 1: SS/PBCH block is transmitted in	n slot #0 w	ith periodicity	20 ms			
Note 2: Slot i is slot index per 2 frames						

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

Parameter	Unit		Value	
Reference channel		R.PDSCH.		
Neierence Chainlei		2-4.1 TDD		
Channel bandwidth	MHz	40		
Subcarrier spacing	kHz	30		
Allocated resource blocks	PRBs	106		
Number of consecutive PDSCH symbols				
For Slot i, if mod(i, 10) = 7 for i from		_		
{0,,39}		4		
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,\})$		12		
for i from {1,,39}		0.4		
Allocated slots per 2 frames		31		
MCS table		256QAM		
MCS index		24		
Modulation		256QAM		
Target Coding Rate		0.82		
Number of MIMO layers		1		
Number of DMRS rEs				
For Slot i, if $mod(i, 10) = 7$ for i from		6		
{0,,39}		U		
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,\}$ for i from $\{1,,39\}$		12		
Overhead for TBS determination		0		
Maximum number of HARQ				
transmissions		4		
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) = $\{0,1,2,3,4,5,\}$				
for i from $\{1,,39\}$	Bits	92200		
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				
	Bits	24		
{0,,39}				
For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,\}$	Bits	24		
for i from {1,,39}				
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 $mod(i, 10) = \{0,1,2,3,4,5,\})$	CBs	11		
for i from {1,,39}				
Binary Channel Bits Per Slot				
For Slots 0 and Slot i, if mod(i, 10) =	Bits	N/A		1
{8,9} for i from {0,,39}				
For Slots i = 20, 21	Bits	106848		
For Slot i, if $mod(i, 10) = 7$ for i from	Bits	35616		
{0,,39}	טונס	33010		
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,\}$ for i from $\{1,,19,22,,39\}$	Bits	111936		 
		<del>                                     </del>		
Max. Throughput averaged over 2	Mbps	130.308		

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

For Slot i, if mod(i, 5) = {0,1,}} for i from {12} {139}	Parameter	Unit		Value		
Channel bandwidth	Reference channel					
Subcarrier spacing						
Allocated resource blocks  For Slot i, if mod(i, 5) = 3 for i from (0,,39)  For Slot i, if mod(i, 5) = (0,1,)) for i from (1,,39)  Allocated slots per 2 frames  MCS table  MCS table  MCS index  Modulation  Allocated slots per 2 frames  Allocated slots per 2 frames  Allocated slots per 3 for i from (0,,39)  For Slot i, if mod(i, 5) = 3 for i from (0,,39)  For Slot i, if mod(i, 5) = {0,1,}} for i from (1,,39)  For Slot i, if mod(i, 5) = 3 for i from (0,,39)  For Slot i, if mod(i, 5) = 4 for i from (0,,39)  For Slot i, if mod(i, 5) = 4 for i from (1,,39)  Bits  Alfocated slots per Slot  For Slot 0 and Slot i, if mod(i, 5) = 4 for i from (1,,39)  Bits  Alfocated slots per Slot  For Slot 0 and Slot i, if mod(i, 5) = 4 for i from (1,,39)  Bits  Alfocated slots per Slot  For Slot 0 and Slot i, if mod(i, 5) = 4 for i from (1,,39)  Bits  Alfocated slots per Slot  For Slot 0 and Slot i, if mod(i, 5) = 4 for i from (1,,39)  Bits  Alfocated slots per Slot  For Slot 0 and Slot i, if mod(i, 5) = 4 for i from (1,,39)  Bits  Alfocated slots per Slot  CBs  Alfocated slots per Slot  For Slot 0 and Slot i, if mod(i, 5) = 4 for i from (1,,39)  Bits  Alfocated slots per Slot  For Slot i, if mod(i, 5) = 3 for i from (1,,39)  Bits  Alfocated slots per Slot  For Slot and Slot i, if mod(i, 5) = 4 for i from (1,,39)  Bits  Alfocated slots per Slot  CBs  Alfocated slots per Slot  For Slot 0 and Slot i, if mod(i, 5) = 4 for i from (1,,39)  Bits  Alfocated slots per Slot  For Slot i, if mod(i, 5) = 3 for i from (1,,39)  Bits  Alfocated slots per Slot  Bits  Alfocated slots p						
Number of Consecutive PDSCH symbols For Slot i, if mod(i, 5) = {0,1,}} for i from (0,,39) For Slot i, if mod(i, 5) = 3 for i from (1,,39) For Slot i, if mod(i, 5) = 3 for i from (1,,39) For Slot i, if mod(i, 5) = 3 for i from (1,,39) For Slot i, if mod(i, 5) = 3 for i from (1,,39) For Slot i, if mod(i, 5) = 3 for i from (1,,39) For Slot i, if mod(i, 5) = 3 for i from (1,,39) For Slot i, if mod(i, 5) = 3 for i from (1,,39) For Slot i, if mod(i, 5) = 3 for i from (1,,39) For Slot i, if mod(i, 5) = 3 for i from (1,,39) For Slot i, if mod(i, 5) = 3 for i from (1,,39) For Slot i, if mod(i, 5) = 3 for i from (1,,39) For Slot i, if mod(i, 5) = 3 for i from (1,,39) For Slot i, if mod(i, 5) = 4 for i from (0,,39) For Slot i, if mod(i, 5) = 4 for i from (0,,39) For Slot i, if mod(i, 5) = 3 for i from (1,,39) For Slot i, if mod(i, 5) = 3 for i from (1,,39) For Slot i, if mod(i, 5) = 3 for i from (1,,39) For Slot i, if mod(i, 5) = 3 for i from (1,,39) For Slot i, if mod(i, 5) = 3 for i from (1,,39) For Slot i, if mod(i, 5) = 3 for i from (1,,39) Bits  24  For Slot i, if mod(i, 5) = 3 for i from (1,,39) Bits  25  CBs  N/A  For Slot i, if mod(i, 5) = 4 for i from (0,,39) For Slot i, if mod(i, 5) = 4 for i from (0,,39) For Slot i, if mod(i, 5) = 4 for i from (0,,39) For Slot i, if mod(i, 5) = 3 for i from (1,,39) Bits  24  For Slot i, if mod(i, 5) = 3 for i from (1,,39) Bits  26  CBs  1  CBs  1  CBs  1  CBs  2  The Slot i, if mod(i, 5) = 4 for i from (0,,39) For Slot i, if mod(i, 5) = 4 for i from (0,,39) Bits  17808 For Slot i, if mod(i, 5) = 4 for i from (0,,39) For Slot i, if mod(i, 5) = 4 for i from (0,,39) Bits  17808 For Slot i, if mod(i, 5) = 4 for i from (0,,39) Bits  17808 For Slot i, if mod(i, 5) = 4 for i from (0,,39) Bits  17808						
For Slot i, if mod(i, 5) = 3 for i from (0,,39) For Slot i, if mod(i, 5) = (0,1,)) for i from (1,,39) ROS table (64QAM) MCS table (74QAM) MCS index (7		PRBS	106			
(0,39)						
Allocated slots per 2 frames   31   Allocated slots per 2 frames   31   Allocated slots per 2 frames   31   Allocated slots per 2 frames   34   Allocated slots per 2 frames   34   Allocated slots per 2 frames   34   Allocated slots per 3 for if slots   Allocated slots   Alloca	{0,,39}		8			
MCS table       4         MCS index       4         Modulation       QPSK         Target Coding Rate       0.30         Number of DMRS rEs       1         For Slot i, if mod(i, 5) = 3 for i from (039)       12         For Slot i, if mod(i, 5) = {0,1,}} for i from (139)       12         Overhead for TBS determination       0         Information Bit Payload per Slot       For Slot 0 and Slot i, if mod(i, 5) = 4 for if from (039)         For Slot i, if mod(i, 5) = 3 for i from (039)       Bits         For Slot i, if mod(i, 5) = {0,1,}} for i from (139)       Bits         For Slot i, if mod(i, 5) = {0,1,} for i from (139)       Bits         For Slot i, if mod(i, 5) = 3 for i from (039)       Bits         For Slot i, if mod(i, 5) = 3 for i from (039)       Bits         For Slot i, if mod(i, 5) = 3 for i from (039)       Bits         For Slot i, if mod(i, 5) = 4 for if from (139)       Bits         For Slot i, if mod(i, 5) = 4 for if from (039)       Bits         For Slot i, if mod(i, 5) = 3 for i from (039)       Bits         For Slot and Slot i, if mod(i, 5) = 4 for if from (039)       Bits         For Slot i, if mod(i, 5) = 3 for i from (039)       CBs         For Slot i, if mod(i, 5) = 3 for i from (039)       Bits <td>For Slot i, if <math>mod(i, 5) = \{0,1,\}\)</math> for i from <math>\{1,,39\}</math></td> <td></td> <td>12</td> <td></td> <td></td> <td></td>	For Slot i, if $mod(i, 5) = \{0,1,\}\)$ for i from $\{1,,39\}$		12			
MCS index     4       Modulation     QPSK       Target Coding Rate     0.30       Number of MIMO layers     1       Number of DMRS rEs     1       For Slot i, if mod(i, 5) = 3 for i from (0,,39)     12       For Slot i, if mod(i, 5) = {0,1,}} for i from (1,,39)     12       Overhead for TBS determination information Bit Payload per Slot     0       Information Bit Payload per Slot     0       For Slot 0 and Slot i, if mod(i, 5) = 4 for i from (0,,39)     Bits       For Slot i, if mod(i, 5) = 3 for i from (1,,39)     Bits       For Slot i, if mod(i, 5) = 4 for i from (10,,39)     Bits       For Slot and Slot i, if mod(i, 5) = 3 for i from (0,,39)     Bits       For Slot i, if mod(i, 5) = 0,1,} for i from (1,,39)     Bits       For Slot i, if mod(i, 5) = 4 for i from (0,,39)     Bits       For Slot i, if mod(i, 5) = 4 for i from (0,,39)     Bits       For Slot i, if mod(i, 5) = 4 for i from (0,,39)     Bits       For Slot i, if mod(i, 5) = 3 for i from (0,,39)     CBs       For Slot i, if mod(i, 5) = 4 for i from (0,,39)     CBs       For Slot i, if mod(i, 5) = 4 for i from (0,,39)     Bits       For Slot i, if mod(i, 5) = 4 for i from (0,,39)     CBs       For Slot i, if mod(i, 5) = 3 for i from (0,,39)     Bits       For Slot i, if mod(i, 5) = 3 for i from (0,,39)     B	Allocated slots per 2 frames		31			
Modulation         QPSK           Target Coding Rate         0.30           Number of MIMO layers         1           For Slot i, if mod(i, 5) = 3 for i from (0,,39)         12           For Slot i, if mod(i, 5) = 4 for i from (0,,39)         12           For Slot 0 and Slot i, if mod(i, 5) = 4 for i from (0,,39)         Bits           For Slot 0 and Slot i, if mod(i, 5) = 4 for i from (0,,39)         Bits           For Slot 0 and Slot i, if mod(i, 5) = 4 for i from (0,,39)         Bits           For Slot 0 i, if mod(i, 5) = 4 for i from (0,,39)         Bits           For Slot i, if mod(i, 5) = 4 for i from (0,,39)         Bits           For Slot i, if mod(i, 5) = 4 for i from (0,,39)         Bits           For Slot 0 and Slot i, if mod(i, 5) = 4 for i from (0,,39)         Bits           For Slot i, if mod(i, 5) = 4 for i from (0,,39)         Bits           For Slot 0 and Slot i, if mod(i, 5) = 4 for i from (0,,39)         CBs           For Slot i, if mod(i, 5) = 3 for i from (0,,39)         CBs           For Slot i, if mod(i, 5) = 4 for i from (0,,39)         CBs           For Slot i, if mod(i, 5) = 4 for i from (0,,39)         CBs           For Slot i, if mod(i, 5) = 3 for i from (0,,39)         Bits           For Slot i, if mod(i, 5) = 3 for i from (0,,39)         Bits           For Slo	MCS table		64QAM			
Target Coding Rate         0.30           Number of MIMO layers         1           Number of DMRS rEs         1           For Slot i, if mod(i, 5) = 3 for i from {0,,39}         12           For Slot i, if mod(i, 5) = {0,1,}} for i from {1,,39}         12           Overhead for TBS determination Information Bit Payload per Slot         0           Information Bit Payload per Slot         0           For Slot 0 and Slot i, if mod(i, 5) = 4 for ifrom {0,,39}         Bits           For Slot i, if mod(i, 5) = 3 for i from {0,,39}         Bits           For Slot 0 and Slot i, if mod(i, 5) = 4 for ifrom {0,,39}         Bits           For Slot i, if mod(i, 5) = 3 for i from {0,,39}         Bits           For Slot i, if mod(i, 5) = 3 for i from {0,,39}         Bits           For Slot i, if mod(i, 5) = 4 for ifrom {0,,39}         Bits           For Slot i, if mod(i, 5) = 4 for ifrom {0,,39}         Bits           For Slot i, if mod(i, 5) = 3 for i from {0,,39}         CBs           For Slot i, if mod(i, 5) = 4 for ifrom {0,,39}         CBs           For Slot i, if mod(i, 5) = 3 for i from {0,,39}         CBs           For Slot i, if mod(i, 5) = 3 for i from {0,,39}         Bits           For Slot i, if mod(i, 5) = 3 for i from {0,,39}         Bits           For Slot i, if mod(i, 5) = 3 for i from {0,	MCS index		4			
Number of MIMO layers   1   1     1	Modulation		QPSK			
Number of MIMO layers	Target Coding Rate		0.30			
For Slot i, if mod(i, 5) = 3 for i from (0,,39) For Slot i, if mod(i, 5) = {0,1,}} for i from {12}  {1,,39} Overhead for TBS determination   0   12  For Slot i, if mod(i, 5) = 4 for i from (0,,39) For Slot i, if mod(i, 5) = 3 for i from (0,,39) For Slot i, if mod(i, 5) = 3 for i from (1,,39) For Slot i, if mod(i, 5) = 4 for i from (0,,39) For Slot i, if mod(i, 5) = 4 for i from (0,,39) For Slot i, if mod(i, 5) = 3 for i from (1,,39) For Slot i, if mod(i, 5) = 3 for i from (1,,39) For Slot i, if mod(i, 5) = 3 for i from (1,,39) For Slot i, if mod(i, 5) = 4 for i from (1,,39) For Slot i, if mod(i, 5) = 4 for i from (0,,39) For Slot i, if mod(i, 5) = 4 for i from (0,,39) For Slot i, if mod(i, 5) = 4 for i from (0,,39) For Slot i, if mod(i, 5) = 3 for i from (0,,39) For Slot i, if mod(i, 5) = 3 for i from (0,,39) For Slot i, if mod(i, 5) = 4 for i from (0,,39) For Slot i, if mod(i, 5) = 4 for i from (0,,39) For Slot i, if mod(i, 5) = 4 for i from (0,,39) For Slot i, if mod(i, 5) = 4 for i from (0,,39) For Slot i, if mod(i, 5) = 4 for i from (0,,39) For Slot i, if mod(i, 5) = 4 for i from (0,,39) For Slot i, if mod(i, 5) = 3 for i from (0,,39) For Slot i, if mod(i, 5) = 4 for i from (0,,39) For Slot i, if mod(i, 5) = 4 for i from (0,,39) For Slot i, if mod(i, 5) = 4 for i from (0,,39) For Slot i, if mod(i, 5) = 4 for i from (0,,39) For Slot i, if mod(i, 5) = 3 for i from (0,,39) For Slot i, if mod(i, 5) = 3 for i from (0,,39) For Slot i, if mod(i, 5) = 3 for i from (0,,39) For Slot i, if mod(i, 5) = 3 for i from (0,,39) For Slot i, if mod(i, 5) = 4 for i from (0,,39) For Slot i, if mod(i, 5) = 3 for i from (0,,39) For Slot i, if mod(i, 5) = 3 for i from (3,,39) For Slot i, if mod(i, 5) = 4 for i from (3,,39) For Slot i, if mod(i, 5) = 3 for i from (3,,39) For Slot i, if mod(i, 5) = 3 for i from (3,,39) For Slot i, if mod(i, 5) = 4 for i from (3,,39) For Slot i, if mod(i, 5) = 4 for i from (3,,39) For	Number of MIMO layers		1			
(039) For Slot i, if mod(i, 5) = {0,1,}) for i from {1,139} Coverhead for TBS determination   0   0   0   0   Information Bit Payload per Slot   For Slot 0 and Slot i, if mod(i, 5) = 4 for i from {0,39} For Slot i, if mod(i, 5) = 3 for i from {0,39} For Slot i, if mod(i, 5) = 4 for i from {0,39} For Slot i, if mod(i, 5) = 4 for i from {0,39} For Slot i, if mod(i, 5) = 3 for i from {0,39} For Slot i, if mod(i, 5) = {0,1,}) for i from {1,39} For Slot i, if mod(i, 5) = {0,1,}) for i from {1,39} For Slot i, if mod(i, 5) = {0,1,}) for i from {1,39} For Slot i, if mod(i, 5) = {0,1,}) for i from {1,39} For Slot i, if mod(i, 5) = {0,1,}) for i from {1,39} For Slot i, if mod(i, 5) = 4 for i from {0,39} For Slot i, if mod(i, 5) = 3 for i from {1,39} For Slot i, if mod(i, 5) = 3 for i from {1,39} For Slot i, if mod(i, 5) = 4 for i from {0,39} For Slot i, if mod(i, 5) = 4 for i from {0,39} For Slot i, if mod(i, 5) = 4 for i from {0,39} For Slot i, if mod(i, 5) = 4 for i from {0,39} For Slot i, if mod(i, 5) = 4 for i from {0,39} For Slot i, if mod(i, 5) = 3 for i from {1,39} Binary Channel Bits Per Slot   Bits   26712   For Slot 0 and Slot i, if mod(i, 5) = 4 for i from {0,39} For Slot i, if mod(i, 5) = 3 for i from {1,39} For Slot i, if mod(i, 5) = 3 for i from {1,39} Binary Channel Bits Per Slot   Bits   26712   For Slot i, if mod(i, 5) = 3 for i from {1,39} For Slot i, if mod(i, 5) = 3 for i from {1,39} Binary Channel Bits Per Slot   Bits   26712   For Slot i, if mod(i, 5) = 3 for i from {1,39} Bits   27984   11,, 19,22,39} Max. Throughput averaged over 2	Number of DMRS rEs					
For Slot i, if mod(i, 5) = {0,1,}} for i from {1,2,3}}  Overhead for TBS determination 0 0			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)           For Slot i, if mod(i, 5) = 3 for i from (0,,39)         Bits         5376           For Slot i, if mod(i, 5) = (0,1,) 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,) for i from (1,,39)         Bits         24           Number of Code Blocks per Slot         CBs         N/A           For Slot 0 and Slot i, if mod(i, 5) = 4 for i from (0,,39)         CBs         1           For Slot i, if mod(i, 5) = (0,1,) for i from (1,,39)         CBs         1           For Slot 0 and Slot i, if mod(i, 5) = 4 for i from (0,,39)         CBs         2           For Slot i i mod(i, 5) = 3 for i from (0,,39)         Bits         N/A           For Slot i, if mod(i, 5) = 3 for i from (0,,39)         Bits         26712           For Slot i, if mod(i, 5) = 3 for i from (0,,39)         Bits         27984           For Slot i, if mod(i, 5) = (0,1,) for i from (1,,19,22,,39)         Max. Throughput averaged over 2         Mbps         11,875 <td>For Slot i, if <math>mod(i, 5) = \{0,1,\}</math>) for i from</td> <td></td> <td>12</td> <td></td> <td></td> <td></td>	For Slot i, if $mod(i, 5) = \{0,1,\}$ ) for i from		12			
Information Bit Payload per Slot	Overhead for TBS determination		0		_	
For Slot 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = \{0,1,\}\}$ for i from $\{1,,39\}$ For Slot 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = \{0,1,\}\}$ for i from $\{1,,39\}$ Number of Code Blocks per Slot For Slot 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = \{0,1,\}\}$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = \{0,1,\}\}$ for i from $\{0,,39\}$ Binary Channel Bits Per Slot For Slot 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,39\}$ For Slot 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,39\}$ Binary Channel Bits Per Slot For Slot 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,39\}$ For Slot i = 20, 21 For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = 3$			0			
i from {0,,39}  For Slot i, if mod(i, 5) = 3 for i from {0,,39}  For Slot i, if mod(i, 5) = {0,1,}} for i from Bits 5376  {1,,39}  Transport block CRC per Slot 507  For Slot 0 and Slot i, if mod(i, 5) = 4 for i from {0,,39}  For Slot i, if mod(i, 5) = 3 for i from {1,,39}  For Slot i, if mod(i, 5) = 3 for i from {1,,39}  Number of Code Blocks per Slot 507  For Slot 1, if mod(i, 5) = {0,1,}} for i from {1,,39}  For Slot i, if mod(i, 5) = 4 for i from {1,,39}  For Slot i, if mod(i, 5) = 3 for i from {1,,39}  For Slot i, if mod(i, 5) = 3 for i from {1,,39}  For Slot i, if mod(i, 5) = 3 for i from {1,,39}  For Slot i, if mod(i, 5) = {0,1,}} for i from {1,,39}  For Slot i, if mod(i, 5) = 4 for i from {1,,39}  For Slot i, if mod(i, 5) = 4 for i from {1,,39}  Binary Channel Bits Per Slot 507  For Slot 0 and Slot i, if mod(i, 5) = 4 for i from {1,,39}  Bits 26712  For Slot i = 20, 21 507  For Slot i, if mod(i, 5) = 3 for i from {1,,39}  For Slot i, if mod(i, 5) = 3 for i from {1,,39}  For Slot i, if mod(i, 5) = 3 for i from {1,,39}  For Slot i, if mod(i, 5) = 3 for i from {1,,39}  For Slot i, if mod(i, 5) = 3 for i from {1,,39}  For Slot i, if mod(i, 5) = 3 for i from {1,,39}  Bits 27984  Max. Throughput averaged over 2 Mbps 11,875						
{0,,39}       Bits       5376         For Slot i, if mod(i, 5) = {0,1,}) for i from {1,,39}       Bits       8456         Transport block CRC per Slot       Bits       N/A         For Slot 0 and Slot i, if mod(i, 5) = 3 for i from {0,,39}       Bits       24         For Slot i, if mod(i, 5) = {0,1,}) for i from {1,,39}       Bits       24         Number of Code Blocks per Slot       Bits       N/A         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,}) for i from {1,,39}       CBs       2         Bits per Slot 0 and Slot i, if mod(i, 5) = 4 for i from {0,,39}       CBs       2         For Slot i, if mod(i, 5) = {0,1,}) for i from {1,,39}       CBs       2         Bits per Slot 0 and Slot i, if mod(i, 5) = 3 for i from {0,,39}       Bits       N/A         For Slot i = 20, 21       Bits       26712         For Slot i, if mod(i, 5) = 3 for i from {0,,39}       Bits       27984         For Slot i, if mod(i, 5) = {0,1,}) for i from {1,,1,22,,39}       Bits       27984         Max. Throughput averaged over 2       Mbps       11,875	i from {0,,39}	Bits	N/A			
{1,,39}       Bits       8456         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,}} for i from {1,,39}       Bits       24         Number of Code Blocks per Slot       CBs       N/A         For Slot 0 and Slot i, if mod(i, 5) = 4 for i from {0,,39}       CBs       1         For Slot i, if mod(i, 5) = {0,1,}} for i from {0,,39}       CBs       2         For Slot i, if mod(i, 5) = {0,1,} for i from {1,,39}       Bits       N/A         Binary Channel Bits Per Slot       Bits       N/A         For Slot 0 and Slot i, if mod(i, 5) = 4 for i from {0,,39}       Bits       N/A         For Slot i = 20, 21       Bits       26712         For Slot i, if mod(i, 5) = 3 for i from {0,,39}       Bits       17808         For Slot i, if mod(i, 5) = {0,1,} for i from {0,,39}       Bits       27984         Max. Throughput averaged over 2       Mbbs       11,875	{0,,39}	Bits	5376			
$ \begin{array}{llllllllllllllllllllllllllllllllllll$	For Slot i, if $mod(i, 5) = \{0,1,\}\)$ for i from $\{1,,39\}$	Bits	8456			
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 $mod(i, 5) = \{0,1,\}$ ) for i from $\{1,,39\}$ Bits       24         Number of Code Blocks per Slot       CBs       N/A         For Slot 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,39\}$ CBs       1         For Slot i, if $mod(i, 5) = \{0,1,\}$ ) for i from $\{0,,39\}$ CBs       2         Binary Channel Bits Per Slot       Bits       N/A         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       17808         For Slot i, if $mod(i, 5) = \{0,1,\}$ ) for i from $\{0,,39\}$ Bits       27984         Max. Throughput averaged over 2       Mbps       11,875	Transport block CRC per Slot					
For Slot i, if $mod(i, 5) = 3$ for i from $\{0, \dots, 39\}$ For Slot i, if $mod(i, 5) = \{0, 1, \}$ ) for i from $\{1, \dots, 39\}$ Number of Code Blocks per Slot For Slot 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0, \dots, 39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0, \dots, 39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0, \dots, 39\}$ For Slot i, if $mod(i, 5) = \{0, 1, \}$ ) for i from $\{1, \dots, 39\}$ Binary Channel Bits Per Slot For Slot 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0, \dots, 39\}$ For Slot i = $20$ , $21$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0, \dots, 39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0, \dots, 39\}$ Bits For Slot i, if $mod(i, 5) = 3$ for i from $\{0, \dots, 39\}$ Bits For Slot i, if $mod(i, 5) = 3$ for i from $\{0, \dots, 39\}$ Bits To Slot i, if $mod(i, 5) = \{0, 1, \}$ ) for i from $\{0, \dots, 39\}$ Bits To Slot i, if $mod(i, 5) = \{0, 1, \}$ ) for i from $\{0, \dots, 39\}$ Bits To Slot i, if $mod(i, 5) = \{0, 1, \}$ ) for i from $\{0, \dots, 39\}$ Bits To Slot i, if $mod(i, 5) = \{0, 1, \}$ ) for i from $\{0, \dots, 39\}$ Bits To Slot i, if $mod(i, 5) = \{0, 1, \}$ ) for i from $\{0, \dots, 39\}$ Bits Throughput averaged over 2		Bits	N/A			
For Slot i, if $mod(i, 5) = \{0,1,\}$ ) for i from $\{1,,39\}$ Number of Code Blocks per Slot  For Slot 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = \{0,1,\}$ ) for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = \{0,1,\}$ ) for i from $\{1,,39\}$ Binary Channel Bits Per Slot  For Slot 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,39\}$ For Slot i = 20, 21  For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ Bits 17808  For Slot i, if $mod(i, 5) = \{0,1,\}$ ) for i from $\{0,,39\}$ Bits 27984  Max. Throughput averaged over 2	For Slot i, if $mod(i, 5) = 3$ for i from	Bits	24			
Number of Code Blocks per Slot  For Slot 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,, 39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 39\}$ For Slot i, if $mod(i, 5) = \{0, 1, \}$ ) for i from $\{1,, 39\}$ Binary Channel Bits Per Slot  For Slot 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,, 39\}$ For Slot i = 20, 21  For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 39\}$ For Slot i, if $mod(i, 5) = \{0, 1, \}$ ) for i from $\{1,, 19, 22,, 39\}$ Max. Throughput averaged over 2  Mhps  11, 875	For Slot i, if $mod(i, 5) = \{0,1,\}$ ) for i from	Bits	24			
For Slot 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = \{0,1,\}$ ) for i from $\{1,,39\}$ Binary Channel Bits Per Slot  For Slot 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,39\}$ For Slot i = 20, 21  For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ Bits  For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ Bits  17808  For Slot i, if $mod(i, 5) = \{0,1,\}$ ) for i from $\{0,,39\}$ Bits  27984  Max. Throughput averaged over 2						
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ For Slot i, if $mod(i, 5) = \{0,1,\}$ ) for i from $\{1,,39\}$ 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  For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ Bits 17808  For Slot i, if $mod(i, 5) = \{0,1,\}$ ) for i from $\{0,,39\}$ Bits 27984  Max. Throughput averaged over 2  May 11, 875	For Slot 0 and Slot i, if mod(i, 5) = 4 for	CBs	N/A			
For Slot i, if $mod(i, 5) = \{0,1,\}$ ) for i from $\{1,,39\}$ Binary Channel Bits Per Slot  For Slot 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,39\}$ For Slot $i = 20, 21$ For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ Bits  Dists  Bits  Dists  Dis	For Slot i, if $mod(i, 5) = 3$ for i from	CBs	1			
Binary Channel Bits Per SlotBitsN/AFor Slot 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,39\}$ BitsN/AFor Slot $i = 20, 21$ Bits26712For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ Bits17808For Slot i, if $mod(i, 5) = \{0,1,\}$ ) for i from $\{1,,19,22,,39\}$ Bits27984Max. Throughput averaged over 2Mbps11.875	For Slot i, if $mod(i, 5) = \{0,1,\}$ ) for i from	CBs	2			
For Slot 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,39\}$ For Slot i = 20, 21  For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ Bits 26712  Bits 2788  For Slot i, if $mod(i, 5) = \{0,1,\}$ ) for i from $\{1,,19,22,,39\}$ Max. Throughput averaged over 2  Max. Throughput averaged over 2	Rinary Channel Rite Der Slot		+		+	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$			+		+	
For Slot i = 20, 21 Bits 26712  For Slot i, if mod(i, 5) = 3 for i from $\{0,,39\}$ Bits 17808  For Slot i, if mod(i, 5) = $\{0,1,\}$ ) for i from $\{1,,19,22,,39\}$ Bits 27984  Max. Throughput averaged over 2 Mbps 11,875		Bits	N/A			
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$ Bits 17808  For Slot i, if $mod(i, 5) = \{0,1,\}$ ) for i from $\{1,,19,22,,39\}$ Bits 27984  Max. Throughput averaged over 2 Mbps 11.875		Bits	26712			
For Slot i, if mod(i, 5) = {0,1,}) for i from {1,,19,22,,39}  Max. Throughput averaged over 2  Mbps 11,875	For Slot i, if $mod(i, 5) = 3$ for i from					
Max. Throughput averaged over 2 Mbps 11.875	For Slot i, if $mod(i, 5) = \{0,1,\}\)$ for i from $\{1,,19,22,,39\}$	Bits	27984			
	Max. Throughput averaged over 2	Mbps	11.875			

Table A.3.2.2.2-6: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-3

Parameter	Unit		Value		
Reference channel		R.PDSCH. 2-6.1 TDD			
Channel bandwidth	MHz	40			
Subcarrier spacing	kHz	30			
Allocated resource blocks	PRBs	106			
Number of consecutive PDSCH symbols					
For Slot i, if $mod(i, 10) = \{3,7\}$ for i from		8			
{0,,39}		0			
For Slot i, if $mod(i, 10) = \{0,1,2,5,\}$ for i		12			
from {1,,39}					
Allocated slots per 2 frames		27			
MCS table		64QAM			
MCS index		4			
Modulation		QPSK			
Target Coding Rate		0.30			
Number of MIMO layers		1			
Number of DMRS rEs					
For Slot i, if $mod(i, 10) = \{3,7\}$ for i from		12			
$\{0,,39\}$ For Slot i, if mod(i, 10) = $\{0,1,2,5,\}$ ) for i					
For Slot i, if fried(i, 10) = $\{0,1,2,5,\}$ ) for i from $\{1,,39\}$		12			
Overhead for TBS determination		0			
Maximum number of HARQ					
transmissions		4			
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 $mod(i, 10) = \{0,1,2,5,\}$ for i	D:4-	0.450			
from {1,,39}	Bits	8456			
Transport block CRC per Slot					
For Slot 0 and Slot i, if mod(i, 10) =	Bits	N/A			
{4,8,9} for i from {0,,39}	סונס	19/7			
For Slot i, if $mod(i, 10) = \{3,7\}$ for i from	Bits	24			
{0,,39}	D.1.0				
For Slot i, if mod(i, 10) = $\{0,1,2,5,\}$ ) for i	Bits	24			
from {1,,39}					
Number of Code Blocks per Slot For Slot 0 and Slot i, if mod(i, 10) =					
, , , ,	CBs	N/A			
$\{4,8,9\}$ for i from $\{0,,39\}$ For Slot i, if mod(i, 10) = $\{3,7\}$ for i from					
$\{0,,39\}$	CBs	1			
For Slot i, if mod(i, 10) = $\{0,1,2,5,\}$ ) 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 $mod(i, 10) = \{0,1,2,5,\}$ ) for i	Dito	27094			
from {1,,19,22,,39}	Bits	27984		_	
Max. Throughput averaged over 2	Mbps	10.184			
frames	-				
Note 1: SS/PBCH block is transmitted in	n slot #0 wi	ith periodicity 2	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.	
		2-7.1 TDD	
Channel bandwidth	MHz	40	
Subcarrier spacing	kHz	30	
Allocated resource blocks	PRBs	106	
Number of consecutive PDSCH symbols			
For Slot i, if $mod(i, 10) = 7$ for i from $\{0,,39\}$		4	
For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,\}$			
for i from {1,,39}		12	
Allocated slots per 2 frames		31	
MCS table		64QAM	
MCS index		13	
Modulation		16QAM	
Target Coding Rate		0.48	
Number of MIMO layers		2	
Number of DMRS rEs			
For Slot i, if $mod(i, 10) = 7$ for i from		6	
{0,,39}			
For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,\}$		12	
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			
{0,,39}	Bits	16896	
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,\}$	D::	50000	
for i from {1,,39}	Bits	53288	
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}	Dito	IN/A	
For Slot i, if $mod(i, 10) = 7$ for i from	Bits	24	
{0,,39}			
For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,\}$ 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	3	
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,\}$	CDo	7	
for i from {1,,39}	CBs	7	
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}	Dito	14//	
For Slot i, if $mod(i, 10) = \{0,\}$ ) for i from	Bits	103456	
{1,,19,22,,39}			
For Slots i = 20	Bits	98368	
For Slots i = 21  For Slot i, if mod(i, 10) = 7 for i from	Bits	106848	
For Slot 1, if $\text{mod}(1, 10) = 7$ for 1 from $\{0,, 39\}$	Bits	35616	
For Slot i, if $mod(i, 10) = \{1,2,3,4,\}$ ) for i			
from {1,,19,22,,39}	Bits	111936	
Max. Throughput averaged over 2			<del>                                     </del>
frames	Mbps	75.318	
Note 1: SS/PBCH block is transmitted in	n slot #0 wi	ith periodicity	20 ms
Note 2: Slot i is slot index per 2 frames		. ,	

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

Parameter	Unit			Value	
Reference channel		R.PDSCH.	R.PDSCH.		
Reference channel		2-8.1 TDD	2-8.2 TDD		
Channel bandwidth	MHz	40	40		
Subcarrier spacing	kHz	30	30		
Allocated resource blocks	PRBs	106	106		
Number of consecutive PDSCH 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) =	Dito	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	Dito	NI/A	NI/A		
from {0,,39}	Bits	N/A	N/A		
For Slot i = 20	Bits	24576	49176		
For Slot i, if $mod(i, 10) = \{0,2,3,4,5,6\}$		24576	49176		
for i from {1,,19,22,,39}		24376	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		N/A	N/A		
from {0,,39}		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}	Dito	24	27		
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}	003	14// (	14// (		
For CSI-RS Slot i, if mod(i,10) =1 for i		N/A	N/A		
from {0,,39}					
For Slot i = 20	CBs	3	6		
For Slot i, if $mod(i, 10) = \{0,2,3,4,5,6\}$	CBs	3	6		
for i from {1,,19,22,,39}	050	Ŭ	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}		,	,		
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}					
Max. Throughput averaged over 2	Mbps	28.2624	56.5524		
frames  Note 1: SS/PBCH block is transmitted in	-				

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

Note 2:

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

## A.3.2.2.3 Reference measurement channels for SCS 60 kHz FR1

## A.3.2.2.4 Reference measurement channels for SCS 60 kHz FR2

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

Reference channel	
Channel bandwidth	
Subcarrier spacing	
Allocated resource blocks   PRBs   66	
Number of consecutive PDSCH symbols	
Symbols	
For Slot i, if mod(i, 4) = 2 for i from (1,,79)	
1	
(1,, 79)	
1   1   1   1   1   1   1   1   1   1	
1   1   1   1   1   1   1   1   1   1	
MCS table         64QAM           MCS index         13           Modulation         16QAM           Target Coding Rate         0.48           Number of MIMO layers         2           Number of DMRS rEs         For Slot i, if mod(i, 4) = 2 for i from (1,, 79)           For Slot i, if mod(i, 4) = 2 for i from (1,, 79)         12           For Slot i, if mod(i, 4) = 8 (0,)) for i from (1,, 79)         12           For Slots 0 and Slot i, if mod(i, 4) = 3 for i from (0,, 79)         Bits           For Slot i, if mod(i, 4) = 2 for i from (1,, 79)         Bits           For Slot i, if mod(i, 4) = 2 for i from (1,, 79)         Bits           For Slot i, if mod(i, 4) = 2 for i from (1,, 79)         Bits           For Slot i, if mod(i, 4) = 2 for i from (1,, 79)         Bits           For Slot i, if mod(i, 4) = 2 for i from (1,, 79)         Bits           For Slot i, if mod(i, 4) = 2 for i from (1,, 79)         Bits           For Slot i, if mod(i, 4) = 2 for i from (1,, 79)         Bits           For Slot i, if mod(i, 4) = 2 for i from (1,, 79)         CBs           For Slot i, if mod(i, 4) = 2 for i from (1,, 79)         CBs           For Slot i, if mod(i, 4) = 2 for i from (1,, 79)         CBs           For Slot i, if mod(i, 4) = 2 for i from (1,, 79)         CBs	
MCS index         13           Modulation         16QAM           Target Coding Rate         0.48           Number of MIMO layers         2           Number of DMRS rEs         5           For Slot i, if mod(i, 4) = 2 for i from {1,, 79}         12           Vernead for TBS determination         6           Information Bit Payload per Slot         6           For Slots 0 and Slot i, if mod(i, 4) = 3 for i from {0,, 79}         Bits           For Slot i, if mod(i, 4) = 2 for i from {1,, 79}         Bits           For Slot i, if mod(i, 4) = {0,}) for i from {1,, 79}         Bits           For Slot i, if mod(i, 4) = 2 for i from {1,, 79}         Bits           For Slot i, if mod(i, 4) = 2 for i from {1,, 79}         Bits           For Slot i, if mod(i, 4) = 2 for i from {1,, 79}         Bits           For Slot i, if mod(i, 4) = 2 for i from {1,, 79}         Bits           For Slot i, if mod(i, 4) = 2 for i from {1,, 79}         Bits           For Slot i, if mod(i, 4) = 2 for i from {1,, 79}         CBs           For Slot i, if mod(i, 4) = 2 for i from {1,, 79}         CBs           For Slot i, if mod(i, 4) = 2 for i from {1,, 79}         CBs           For Slot i, if mod(i, 4) = 2 for i from {1,, 79}         CBs         5           For Slot i, if mod(i, 4) =	
Modulation         16QAM           Target Coding Rate         0.48           Number of MIMO layers         2           Number of DMRS rEs         2           For Slot i, if mod(i, 4) = 2 for i from {1,79}         12           For Slot i, if mod(i, 4) = {0,}} for i from {1,79}         12           Overhead for TBS determination Information Bit Payload per Slot         6           For Slots 0 and Slot i, if mod(i, 4) = 3 for i from {1,79}         Bits           For Slot i, if mod(i, 4) = 2 for i from {1,79}         Bits           For Slot i, if mod(i, 4) = 2,0,} for i from {1,79}         Bits           For Slot i, if mod(i, 4) = 2 for i from {1,79}         Bits           For Slot i, if mod(i, 4) = 2 for i from {1,79}         Bits           For Slot i, if mod(i, 4) = 2 for i from {1,79}         Bits           For Slot i, if mod(i, 4) = 2 for i from {1,79}         Bits           For Slot i, if mod(i, 4) = {0,} for i from {1,79}         Bits           For Slot i, if mod(i, 4) = 2 for i from {1,79}         Bits           For Slot i, if mod(i, 4) = 2 for i from {1,79}         CBs           For Slot i, if mod(i, 4) = 2 for i from {1,79}         CBs           For Slot i, if mod(i, 4) = 2 for i from {1,79}         CBs           For Slot i, if mod(i, 4) = 3 for i from {1,79}	
Target Coding Rate         0.48           Number of MIMO layers         2           Number of DMRS rEs         12           For Slot i, if mod(i, 4) = 2 for i from {1,79}         12           For Slot i, if mod(i, 4) = {0,}} for i from {1,79}         12           Overhead for TBS determination         6           Information Bit Payload per Slot         6           For Slots 0 and Slot i, if mod(i, 4) = 3 for i from {0,,79}         Bits           For Slot i, if mod(i, 4) = 2 for i from {1,79}         Bits           For Slot i, if mod(i, 4) = {0,}} for i from {1,79}         Bits           For Slots 0 and Slot i, if mod(i, 4) = 3 for i from {0,,79}         Bits           For Slot i, if mod(i, 4) = 2 for i from {1,79}         Bits           For Slot i, if mod(i, 4) = 2 for i from {1,79}         Bits           For Slot i, if mod(i, 4) = 2 for i from {1,79}         Bits           For Slot i, if mod(i, 4) = {0,}} for i from {1,79}         Bits           For Slot i, if mod(i, 4) = 2 for i from {1,79}         CBs           For Slot i, if mod(i, 4) = 2 for i from {1,79}         CBs           For Slot i, if mod(i, 4) = 2 for i from {1,79}         CBs           For Slot i, if mod(i, 4) = 2 for i from {1,79}         CBs           For Slot i, if mod(i, 4) = 3 for i from {1,79}         <	
Number of MIMO layers	
Number of DMRS rEs	
For Slot i, if mod(i, 4) = 2 for i from (1,, 79)	
1	
1,,79  Overhead for TBS determination	
1,, r/9   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,, r9}   Bits   25608	
$ \begin{array}{ c c c } \hline \text{Information Bit Payload per Slot} \\ \hline For Slots 0 \ and \ Slot \ i, \ if \ mod(i, 4) = 3 \\ \hline for \ i \ from \ \{0,,79\} \\ \hline For Slot \ i, \ if \ mod(i, 4) = 2 \ for \ i \ from \\ \{1,,79\} \\ \hline For Slot \ i, \ if \ mod(i, 4) = \{0,\}\} \ for \ i \ from \\ \{1,,79\} \\ \hline Transport \ block \ CRC \ per \ Slot \\ \hline For \ Slot \ 0 \ and \ Slot \ i, \ if \ mod(i, 4) = 3 \\ for \ i \ from \ \{0,,79\} \\ \hline For \ Slot \ i, \ if \ mod(i, 4) = 2 \ for \ i \ from \\ \{1,,79\} \\ \hline For \ Slot \ i, \ if \ mod(i, 4) = 2 \ for \ i \ from \\ \{1,,79\} \\ \hline Number \ of \ Code \ Blocks \ per \ Slot \\ \hline For \ Slot \ i, \ if \ mod(i, 4) = 3 \\ for \ i \ from \ \{0,,79\} \\ \hline For \ Slot \ i, \ if \ mod(i, 4) = 2 \ for \ i \ from \\ \{1,,79\} \\ \hline For \ Slot \ i, \ if \ mod(i, 4) = 2 \ for \ i \ from \\ \{1,,79\} \\ \hline For \ Slot \ i, \ if \ mod(i, 4) = 2 \ for \ i \ from \\ \{1,,79\} \\ \hline For \ Slot \ i, \ if \ mod(i, 4) = \{0,\}) \ for \ i \ from \\ \hline CBs \\ \{1,,79\} \\ \hline Binary \ Channel \ Bits \ Per \ Slot \\ \hline For \ Slot \ i, \ if \ mod(i, 4) = 3 \\ for \ i \ from \ \{0,,79\} \\ \hline Binary \ Channel \ Bits \ Per \ Slot \\ \hline For \ Slot \ i = 40, 41 \\ \hline Bits \ 69960 \\ \hline \end{array}$	
For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0, \dots, 79\}$ For Slot i, if $mod(i, 4) = 2$ for i from $\{1, \dots, 79\}$ For Slot i, if $mod(i, 4) = 2$ for i from $\{1, \dots, 79\}$ Bits 25608  For Slot i, if $mod(i, 4) = \{0,\}$ ) for i from $\{1, \dots, 79\}$ Transport block CRC per Slot  For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0, \dots, 79\}$ For Slot i, if $mod(i, 4) = 2$ for i from $\{1, \dots, 79\}$ For Slot i, if $mod(i, 4) = 2$ for i from $\{1, \dots, 79\}$ Bits 24  For Slot i, if $mod(i, 4) = \{0,\}$ ) for i from $\{1, \dots, 79\}$ Number of Code Blocks per Slot  For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0, \dots, 79\}$ For Slot i, if $mod(i, 4) = 2$ for i from $\{1, \dots, 79\}$ For Slot i, if $mod(i, 4) = 2$ for i from $\{1, \dots, 79\}$ For Slot i, if $mod(i, 4) = \{0,\}$ ) for i from $\{1, \dots, 79\}$ For Slot i, if $mod(i, 4) = \{0,\}$ ) for i from $\{1, \dots, 79\}$ Binary Channel Bits Per Slot  For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0, \dots, 79\}$ Bits N/A  For Slot i = 40, 41  Bits 69960	
For Slot i, if mod(i, 4) = 2 for i from $\{1,,79\}$ For Slot i, if mod(i, 4) = $\{0,\}$ ) for i from $\{1,,79\}$ For Slot i, if mod(i, 4) = $\{0,\}$ ) for i from $\{1,,79\}$ Transport block CRC per Slot  For Slots 0 and Slot i, if mod(i, 4) = 3 for i from $\{0,,79\}$ For Slot i, if mod(i, 4) = 2 for i from $\{1,,79\}$ For Slot i, if mod(i, 4) = $\{0,\}$ ) for i from $\{1,,79\}$ Number of Code Blocks per Slot  For Slots 0 and Slot i, if mod(i, 4) = 3 for i from $\{0,,79\}$ For Slot i, if mod(i, 4) = 2 for i from $\{1,,79\}$ For Slot i, if mod(i, 4) = 2 for i from $\{1,,79\}$ For Slot i, if mod(i, 4) = 2 for i from $\{1,,79\}$ For Slot i, if mod(i, 4) = $\{0,\}$ ) for i from $\{1,,79\}$ For Slot i, if mod(i, 4) = $\{0,\}$ ) for i from $\{1,,79\}$ Binary Channel Bits Per Slot  For Slots 0 and Slot i, if mod(i, 4) = 3 for i from $\{0,,79\}$ Binary Channel Bits Per Slot  For Slots 0 and Slot i, if mod(i, 4) = 3 for i from $\{0,,79\}$ Binary Channel Bits Per Slot  For Slot i = 40, 41  Bits 69960	
For Slot i, if mod(i, 4) = {0,}) for i from {1,,79} For Slots 0 and Slot i, if mod(i, 4) = 3 for i from {2,,79} For Slot i, if mod(i, 4) = 2 for i from {1,,79} For Slot i, if mod(i, 4) = 2 for i from {1,,79} For Slot i, if mod(i, 4) = {0,}) for i from {1,,79} Number of Code Blocks per Slot For Slots 0 and Slot i, if mod(i, 4) = 3 for i from {0,,79} For Slot i, if mod(i, 4) = 2 for i from {1,,79} For Slot i, if mod(i, 4) = 2 for i from {1,,79} For Slot i, if mod(i, 4) = 2 for i from {1,,79} For Slot i, if mod(i, 4) = {0,}) for i from {1,,79} For Slot i, if mod(i, 4) = {0,}) for i from {1,,79} Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 4) = 3 for i from {0,,79} For Slot i = 40, 41 Bits 69960	
For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0, \dots, 79\}$ For Slot i, if $mod(i, 4) = 2$ for i from $\{1, \dots, 79\}$ For Slot i, if $mod(i, 4) = 2$ for i from $\{1, \dots, 79\}$ For Slot i, if $mod(i, 4) = \{0,\}$ ) for i from $\{1, \dots, 79\}$ Number of Code Blocks per Slot  For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0, \dots, 79\}$ For Slot i, if $mod(i, 4) = 2$ for i from $\{1, \dots, 79\}$ For Slot i, if $mod(i, 4) = 2$ for i from $\{1, \dots, 79\}$ For Slot i, if $mod(i, 4) = \{0,\}$ ) for i from $\{1, \dots, 79\}$ Binary Channel Bits Per Slot  For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0, \dots, 79\}$ Bits N/A  Bits N/A  For Slots 0 and Slot i, if $mod(i, 4) = 3$ Bits N/A  For Slot i = 40, 41  Bits 69960	
For Slot i, if $mod(i, 4) = \{0,\}$ ) for i from $\{1, \dots, 79\}$ Number of Code Blocks per Slot  For Slots 0 and Slot i, if $mod(i, 4) = 3$	
$\begin{array}{ c c c c c }\hline \text{Number of Code Blocks per Slot} & & & & & \\ \hline For Slots 0 \text{ and Slot i, if mod(i, 4) = 3} & & & & \\ for i from \{0,,79\} & & & \\ \hline For Slot i, if mod(i, 4) = 2 \text{ for i from} & & \\ \{1,,79\} & & & \\ \hline For Slot i, if mod(i, 4) = \{0,\}) for i from \{1,,79\} & & \\ \hline Binary Channel Bits Per Slot & & \\ \hline For Slots 0 \text{ and Slot i, if mod(i, 4) = 3} & & \\ for i from \{0,,79\} & & \\ \hline For Slot i = 40, 41 & & \\ \hline Bits & & 69960 & \\ \hline \end{array}$	
For Slot i, if $mod(i, 4) = \{0,\}$ for i from $\{1,,79\}$	
\[ \begin{array}{c ccccccccccccccccccccccccccccccccccc	
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 i from {0,,79}  For Slot i = 40, 41  Bits 69960	
For Slot i = 40, 41 Bits 69960	
For Slot i, if $mod(i, A) = 2$ 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	
May Throughput averaged over 2	
frames Mbps 93.499	
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms	

#### A.3.2.2.5 Reference measurement channels for SCS 120 kHz FR2

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

Parameter	Unit		Value
Reference channel		R.PDSCH.	
Reference charmer		5-1.1 TDD	
Channel bandwidth	MHz	100	
Subcarrier spacing	kHz	120	
Allocated resource blocks	PRBs	66	
Number of consecutive PDSCH			
symbols			
For Slot i, if $mod(i, 5) = 3$ for i from		9	
{0,, 159}			
For Slot i, if $mod(i, 5) = \{0,1,\})$ for i from		13	
{1,,159}		407	
Allocated slots per 2 frames		127	
MCS table		64QAM	
MCS index Modulation		4 QPSK	
Target Coding Rate		0.30	
Number of MIMO layers		1	
Number of DMRS rEs		ı	
For Slot i, if mod(i, 5) = 3 for i from			
{0,, 159}		12	
For Slot i, if mod(i, 5) = $\{0,1,\}$ ) for i from			
{1,,159}		12	
Overhead for TBS determination		6	
Information Bit Payload per Slot		Ŭ	
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	D:4	0004	
{0,, 159}	Bits	3624	
For Slot i, if $mod(i, 5) = \{0,1,\}$ ) for i from	D:4-	5504	
{1,,159}	Bits	5504	
Transport block CRC per Slot			
For Slots 0 and Slot i, if mod(i, 5) = 4	Bits	N/A	
for i from {0,,159}	Dito	14/71	
For Slot i, if mod(i, 5) = 3 for i from	Bits	16	
{0,, 159}			
For Slot i, if $mod(i, 5) = \{0,1,\})$ for i from	Bits	24	
{1,,159}			
Number of Code Blocks per Slot			
For Slots 0 and Slot i, if $mod(i, 5) = 4$	CBs	N/A	
for i from {0,,159}			
For Slot i, if mod(i, 5) = 3 for i from $\{0,, 159\}$	CBs	1	
For Slot i, if $mod(i, 5) = \{0,1,\}\)$ for i from			
$\{1,,159\}$	CBs	1	
Binary Channel Bits Per Slot			
For Slots 0 and Slot i, if $mod(i, 5) = 4$	D:-	N1/0	
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,, 159}	Bits	12210	
For Slot i, if $mod(i, 5) = \{0,1,\})$ for i from	Bits	18282	
{1,,79,82,,159}	סווט	10202	
Max. Throughput averaged over 2	Mbps	31.942	
frames	•		
Note 1: SS/PBCH block is transmitted in	n slot #0 w	nth periodicity 2	20 ms

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

Parameter	Unit			Value	
Reference channel		R.PDSCH.	R.PDSCH.	R.PDSCH.	
Channal handwidth	N 41 1-	5-2.1 TDD	5-2.2 TDD	5-2.3 TDD	
Channel bandwidth	MHz	100	100	200	
Subcarrier spacing Allocated resource blocks	kHz	120 66	120 66	120 132	
Number of consecutive PDSCH	PRBs	00	00	132	
symbols					
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 159\}$		9	9	9	
For Slot i, if $mod(i, 5) = \{0,1,\})$ for i from $\{1,,159\}$		13	13	13	
Allocated slots per 2 frames		127	127	127	
MCS table		64QAM	64QAM	64QAM	
MCS index		13	13	13	
Modulation		16QAM	16QAM	16QAM	
Target Coding Rate		0.48	0.48	0.48	
Number of MIMO layers		1	2	2	
Number of DMRS rEs				_	
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 159\}$		12	12	12	
For Slot i, if $mod(i, 5) = \{0,1,\}\)$ for i from $\{1,,159\}$		12	12	12	
Overhead for TBS determination		6	6	6	
Information Bit Payload per Slot		0	0	0	
For Slots 0 and Slot i, if $mod(i, 5) = 4$					
for i from {0,,159}	Bits	N/A	N/A	N/A	
For Slot i, if mod(i, 5) = 3 for i from $\{0,, 159\}$	Bits	11272	22536	45096	
For Slot i, if $mod(i, 5) = \{0,1,\}\)$ for i from $\{1,,159\}$	Bits	17424	34816	69672	
Transport block CRC per Slot					
For Slots 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,159\}$	Bits	N/A	N/A	N/A	
For Slot i, if $mod(i, 5) = 3$ for i from	Bits	24	24	24	
{0,, 159} For Slot i, if mod(i, 5) = {0,1,}) 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,}) for i					_
from {1,,159}	CBs	3	5	9	
Binary Channel Bits Per Slot For Slots 0 and Slot i, if mod(i, 5) = 4				+	
for i from $\{0,,159\}$	Bits	N/A	N/A	N/A	
For Slots i = 80, 81	Bits	34980	69960	139920	
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,\}\)$ for i from $\{1,,79,82,,159\}$	Bits	36564	73128	146256	
Max. Throughput averaged over 2	Mbps	100.799	201.434	403.096	
frames				403.090	
Note 1: SS/PBCH block is transmitted Note 2: Slot i is slot index per 2 frame:		with periodicity	20 ms		

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

Parameter	Unit		Value			
Reference channel		R.PDSCH. 5-3.1 TDD				
Channel bandwidth	MHz	100				
Subcarrier spacing	kHz	120				
Allocated resource blocks	PRBs	66				
Number of consecutive PDSCH						
symbols						
For Slot i, if mod(i, 5) = 3 for i from $\{0,, 159\}$		9				
For Slot i, if $mod(i, 5) = \{0,1,\}\)$ for i from $\{1,,159\}$		13				
Allocated slots per 2 frames		127				
MCS table		64QAM				
MCS index		18				
Modulation		64QAM				
Target Coding Rate		0.46				
Number of MIMO layers		1				
Number of DMRS rEs						
For Slot i, if mod(i, 5) = 3 for i from $\{0,, 159\}$		12				
For Slot i, if $mod(i, 5) = \{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 $mod(i, 5) = 4$ 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) = $\{0,1,\}$ ) 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) = $\{0,1,\}$ ) 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) = $\{0,1,\}$ ) 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	<del>                                     </del>			
For Slot i, if mod(i, 5) = 3 for i from {0,, 159}	Bits	36630				
For Slot i, if mod(i, 5) = $\{0,1,\}$ ) for i from $\{1,,79,82,,159\}$	Bits	54846				
Max. Throughput averaged over 2	Mbps	145.062				
frames  Note 1: SS/DBCH block is transmitted in		ith poriodicity	20 mc			
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms Note 2: Slot i is slot index per 2 frames						

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

Parameter	Unit		Value		
Reference channel		R.PDSCH. 5-4.1 TDD			
Channel bandwidth	MHz	100			
Subcarrier spacing	kHz	120			
Allocated resource blocks	PRBs	6			
Number of consecutive PDSCH					
symbols					
For Slot i, if mod(i, 4) = 2 for i from $\{1,, 159\}$		10			
For Slot i, if $mod(i, 4) = \{0,\}$ ) for i from $\{1,,159\}$		13			
Allocated slots per 2 frames		119			
MCS table		64QAM			
MCS index		4			
Modulation		QPSK			
Target Coding Rate		0.30			
Number of MIMO layers		2			
Number of DMRS rEs					
For Slot i, if mod(i, 4) = 2 for i from $\{1,, 159\}$		12			
For Slot i, if $mod(i, 4) = \{0,\}$ ) for i from $\{1,,159\}$		12			
Overhead for TBS determination		6			
Information Bit Payload per Slot		-			
For Slots 0 and Slot i, if $mod(i, 4) = 3$	D::	N1/A			
for i from {0,,159}	Bits	N/A			
For Slot i, if $mod(i, 4) = 2$ for i from $\{1,, 159\}$	Bits	736			
For Slot i, if $mod(i, 4) = \{0,\}$ ) 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	Bits	16			
{1,, 159} For Slot i, if mod(i, 4) = {0,}) for i from	Bits	16			
{1,,159}	2.10				
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 $mod(i, 4) = \{0,\}$ ) for i from $\{1,,159\}$	CBs	1			
Binary Channel Bits Per Slot					
For Slots 0 and Slot i, if $mod(i, 4) = 3$					
for i from {0,,159}	Bits	N/A			
For Slot i = 80, 81	Bits	3180			
For Slot i, if $mod(i, 4) = 2$ for i from $\{4,, 159\}$	Bits	2496			
For Slot i, if mod(i, 4) = $\{0,\}$ ) for i from $\{1,,79,82,,159\}$	Bits	3324			
Max. Throughput averaged over 2	N Ale :	E E 40			
frames	Mbps	5.548			
Note 1: SS/PBCH block is transmitted		ith periodicity 2	20 ms		
Note 2: Slot i is slot index per 2 frames					

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

Parameter	Unit			Value						
Reference channel		R.PDSCH.	R.PDSCH.							
		5-5.1 TDD	5-5.2 TDD							
Channel bandwidth	MHz	100	50							
Subcarrier spacing	kHz	120	120							
Allocated resource blocks	PRBs	66	32							
Number of consecutive PDSCH										
symbols  For Slot i, if mod(i, 4) = 2 for i from					_					
{1,, 159}		10	10							
For Slot i, if $mod(i, 4) = \{0,\}$ ) 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 Slot i, if $mod(i, 4) = 2$ for i from		12	12							
{1,, 159}			12							
For Slot i, if $mod(i, 4) = \{0,\}$ ) for i from		12	12							
{1,,159} Overhead for TBS determination		6	6							
Information Bit Payload per Slot		6	6							
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 $mod(i, 4) = \{0,\}$ ) for i from	D:4-	24040	40000		-					
{1,,159}	Bits	34816	16896							
Transport block CRC per Slot										
For Slots 0 and Slot i, if $mod(i, 4) = 3$	Bits	N/A	N/A							
for i from {0,,159}	Dito	1471	14//							
For Slot i, if $mod(i, 4) = 2$ for i from	Bits	24	24							
$\{1,, 159\}$ For Slot i, if mod(i, 4) = $\{0,\}$ ) for i from										
For Siot 1, if flood(1, 4) = $\{0,\}$ ) for 1 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	CBs	4	2							
{1,, 159}	CDS	4	2							
For Slot i, if $mod(i, 4) = \{0,\}$ ) for i from	CBs	5	3							
{1,,159}	OD3	3	J							
Binary Channel Bits Per Slot										
For Slots 0 and Slot i, if $mod(i, 4) = 3$	Bits	N/A	N/A							
for i from {0,,159}										
For Slot $i = 80, 81$ For Slot i, if mod(i, 4) = 2 for i from	Bits	69960	33920							
{4,, 159}	Bits	54912	26624							
For Slot i, if $mod(i, 4) = \{0,\}$ ) for i from										
$\{1,,79,82,,159\}$	Bits	73128	35456							
Max. Throughput averaged over 2		100 700	04.040							
frames	Mbps	188.739	91.843							
	in slot #0 w	vith periodicity 2	20 ms	<u> </u>						
Note 2: Slot i is slot index per 2 frames										

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

Parameter	Unit		Value
Reference channel		R.PDSCH. 5-6.1 TDD	
Channel bandwidth	MHz	100	
Subcarrier spacing	kHz	120	
Allocated resource blocks	PRBs	66	
Number of consecutive PDSCH			
symbols			
For Slot i, if mod(i, 4) = 2 for i from $\{1,, 159\}$		10	
For Slot i, if $mod(i, 4) = \{0,\}$ ) for i from $\{1,,159\}$		13	
Allocated slots per 2 frames		119	
MCS table		64QAM	
MCS index		17	
Modulation		64QAM	
Target Coding Rate		0.43	
Number of MIMO layers		2	
Number of DMRS rEs			
For Slot i, if mod(i, 4) = 2 for i from $\{1,, 159\}$		12	
For Slot i, if $mod(i, 4) = \{0,\}$ ) for i from $\{1,,159\}$		12	
Overhead for TBS determination		6	
Information Bit Payload per Slot			
For Slots 0 and Slot i, if $mod(i, 4) = 3$	5.4	21/2	
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) = $\{0,\}$ ) 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 $mod(i, 4) = \{0,\}$ ) 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	CBs	5	
$\{1,, 159\}$ For Slot i, if mod(i, 4) = $\{0,\}$ ) for i from	CBs	6	
{1,,159}			
Binary Channel Bits Per Slot	-		
For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$	Bits	N/A	
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 $mod(i, 4) = \{0,\}$ ) for i from $\{1,,79,82,,159\}$	Bits	109692	
Max. Throughput averaged over 2	Mbps	255.724	
frames   Note 1: SS/PBCH block is transmitted	-	ith poriodicity	20 mc
Note 1: SS/PBCH block is transmitted Note 2: Slot i is slot index per 2 frames		nin penodicity 2	20 1115

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)		6		
Overhead for TBS determination		4		
Information Bit Payload per Slot		-		
For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,,39}	Bits	N/A		
For CSI-RS Slot i, if mod(i,10) =1 for i from {0,,39}	Bits	14344		
For Slot i = 20	Bits	N/A		-
For Slot i, if $mod(i, 10) = \{0,2,3,4,5,6\}$	Dito			_
for i from {1,,19,22,,39}		14344		
Transport block CRC per Slot				=
For Slots 0 and Slot i, if mod(i, 10) =				
{7,8,9} for i from {0,,39}	Bits	N/A		
For CSI-RS Slot i, if mod(i,10) =1 for i		0.4		_
from {0,,39}		24		
For Slot i = 20	Bits	N/A		
For Slot i, if $mod(i, 10) = \{0,2,3,4,5,6\}$				
for i from {1,,19,22,,39}	Bits	24		
Number of Code Blocks per Slot				
For Slots 0 and Slot i, if mod(i, 10) =	CD.	NI/A		
{7,8,9} for i from {0,,39}	CBs	N/A		
For CSI-RS Slot i, if mod(i,10) =1 for i		2		
from {0,,39}				
For Slot i = 20	CBs	N/A		
For Slot i, if $mod(i, 10) = \{0,2,3,4,5,6\}$ for i from $\{1,,19,22,,39\}$	CBs	2		
Binary Channel Bits Per Slot				
For Slots 0 and Slot i, if mod(i, 10) =				$\exists$
{7,8,9} for i from {0,,39}	Bits	N/A		
For CSI-RS Slot i, if $mod(i,10) = 1$ for i		00770		=
from {0,,39}	Bits	28776		
For Slot i = 20	Bits	N/A		
For Slot i, if $mod(i, 10) = \{0,2,3,4,5,6\}$ for				
i from {1,,19,22,,39}	Bits	30360		
Max. Throughput averaged over 2	Mbps	45.1836		
frames				
Note 1: SS/PRCH block is transmitted in	s clot #0 wi	ith pariadiaity	20 mg	

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

Note 2:

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

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

Parameter	Unit		Value
Reference channel		R.PDSCH. 5-8.1 TDD	
Channel bandwidth	MHz	100	
Subcarrier spacing	kHz	120	
Allocated resource blocks	PRBs	66	
Number of consecutive PDSCH symbols		12	
Allocated slots per 2 frames		59	
MCS table		64QAM	
MCS index		13	
Modulation		16QAM	
Target Coding Rate		0.48	
Number of MIMO layers		1	
Number of DMRS rEs (Note 3)		6	
Overhead for TBS determination		4	
Information Bit Payload per Slot		-	
For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,,39}	Bits	N/A	
For CSI-RS Slot i, if mod(i,10) =1 for i from {0,,39}	Bits	14344	
For Slot i = 20	Bits	N/A	
For Slot i, if mod(i, 10) = $\{0,2,3,4,5,6\}$ for i from $\{1,,19,22,,39\}$		14344	
Transport block CRC per Slot			
For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,,39}	Bits	N/A	
For CSI-RS Slot i, if mod(i,10) =1 for i from {0,,39}		24	
For Slot i = 20	Bits	N/A	
For Slot i, if $mod(i, 10) = \{0,2,3,4,5,6\}$	טונס		
for i from {1,,19,22,,39}	Bits	24	
Number of Code Blocks per Slot			
For Slots 0 and Slot i, if mod(i, 10) = $\{7,8,9\}$ for i from $\{0,,39\}$	CBs	N/A	
For CSI-RS Slot i, if $mod(i,10) = 1$ for i from $\{0,,39\}$		2	
For Slot i = 20	CBs	N/A	
For Slot i, if $mod(i, 10) = \{0,2,3,4,5,6\}$ for i from $\{1,,19,22,,39\}$	CBs	2	
Binary Channel Bits Per Slot			
For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,,39}	Bits	N/A	
For CSI-RS Slot i, if mod(i,10) =1 for i from {0,,39}	Bits	28776	
For Slot i = 20	Bits	N/A	
For Slot i, if mod(i, 10) = {0,2,3,4,5,6}for i from {1,,19,22,,39}	Bits	30360	
Max. Throughput averaged over 2 frames	Mbps	42.3148	
Note 1: SS/PBCH block is transmitted in	s clot #0 wi	ith poriodicity	20 mg

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

Note 2:

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

# A.3.3 Reference measurement channels for PDCCH performance requirements

## A.3.3.1 FDD

## A.3.3.1.1 Reference measurement channels for SCS 15 kHz FR1

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

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

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

Parameter	Unit			Va	lue		
Reference		R.PDCCH.	R.PDCCH.	R.PDCCH.	R.PDCCH.	R.PDCCH.	R.PDCCH.
channel		1-2.1 FDD	1-2.2 FDD	1-2.3 FDD	1-2.4 FDD	1-2.5 FDD	1-2.6 FDD
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 level		2	4	2	4	8	16
DCI Format		1_0	1_0	1_1	1_1	1_1	1_0
Payload (without CRC)	Bits	39	39	512	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	ue	
Reference		R.PDCCH.2-	R.PDCCH.2-	R.PDCCH.2-		
channel		1.1 FDD	1.2 FDD	1.3 FDD		
Subcarrier	kHz	30	30	30		
spacing						
CORESET		[102]	[102]	90		
frequency domain						
allocation						
CORESET time		1	1	1		
domain allocation						
Aggregation level		2	4	8		
DCI Format		1_0	1_1	1_1		
Payload (without	Bits	41	53	53		
CRC)						

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

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

## A.3.3.2 TDD

## A.3.3.2.1 Reference measurement channels for SCS 15 kHz FR1

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

Parameter	Unit		Value						
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.	R.PDCCH.	R.PDCCH.	R.PDCCH.	R.PDCCH.	R.PDCCH.
channel		1-2.1 TDD	1-2.2 TDD	1-2.3 TDD	1-2.4 TDD	1-2.5 TDD	1-2.6 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 level		2	4	2	4	8	16
DCI Format		1_0	1_0	1_1	1_1	1_1	1_0
Payload (without	Bits	39	39	52	52	52	39
CRC)							

## A.3.3.2.2 Reference measurement channels for SCS 30 kHz FR1

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

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

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

Parameter	Unit		Value				
Reference		R.PDCCH.					
channel		2-2.1 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.	R.PDCCH.	R.PDCCH.			
channel		5-1.1 TDD	5-1.2 TDD	5-1.3 TDD			
Subcarrier	kHz	120	120	120			
spacing							
CORESET		60	60	60			
frequency domain							
allocation							
CORESET time		1	1	1			
domain allocation							
Aggregation level		2	4	8			
DCI Format		1_0	1_1	1_1			
Payload (without	Bits	40	56	56			
CRC)							

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

Parameter	Unit	Value			
Reference		R.PDCCH.			
channel		5-2.1 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 related PBCH payload bits)	bits	24	24	

## A.3.4.2 Reference measurement channels for FR2

Table A.3.4.2-1: PBCH Reference Channel

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

## A.4 CSI reference measurement channels

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

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

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

TBS Schem	е			TBS.1-1	TBS.1-2				
MCS table						640	QAM		
Number of allocated PDSCH resource blocks			66	66					
Number of o	consecutive PI	DSCH symbo	ls	12	12				
Number of F	PDSCH MIMO	layers		1	2				
Number of [	OMRS rEs (No	ote 1)		24	24				
Overhead for	or TBS determ	ination		6	6				
Available RI	E-s			7920	7920				
CQI index	Spectral	MCS	Modulatio		Infor	mation Bit	Payload pe	er Slot	
	efficiency	index	n						_
0	OOR	OOR	OOR	N/A	N/A				
1	0.1523	0		1800	3624				
2	0.2344	0		1800	3624				
3	0.3770	2	QPSK	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	64QAM	29192	58384				
13	4.5234	24	04QAW	33816	67584				
14	5.1152	26		38936	77896				
15	5.5547	28		42016	83976				
Note 1: N	lumber of DMI	RS rEs includ	es the overhe	ad of the D	M-RS CDM	l groups wi	thout data	•	

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

TBS Schem	3S Scheme			TBS.2-1	TBS.2-2	TBS.2-3	TBS.2-4		
MCS table	MCS table					2560	QAM		
Number of a	Number of allocated PDSCH resource blocks			52	52	106	106		
Number of c	onsecutive PI	OSCH symbo	ls	12	12	12	12		
Number of F	DSCH MIMO	layers		1	2	1	2		
Number of E	MRS rEs (No	te 1)		24	24	24	24		
Overhead for	r TBS determ	ination		0	0	0	0		
Available RE	E-s for PDSCH	1		7920	7920	12720	12720		
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		
1	0.1523	0		1480	2976	2976	5896		
2	0.3770	1	QPSK	2408	4744	4744	9480		
3	0.8770	3		5504	11016	11016	22536		
4	1.4766	5		9224	18432	18960	37896		
5	1.9141	7	16QAM	12040	24072	24576	49176		
6	2.4063	9		15112	30216	30728	61480		
7	2.7305	11		16896	33816	34816	69672		
8	3.3223	13		20496	40976	42016	83976		
9	3.9023	15	64QAM	24576	49176	49176	98376		
10	4.5234	17		28168	56368	57376	114776		
11	5.1152	19		31752	63528	65576	131176		
12	5.5547	21		34816	69672	69672	139376		
13	6.2266	23	256QAM	38936	77896	79896	159880		
14	6.9141	25	ZOUQAW	43032	86040	88064	176208		
15	7.4063	27		46104	92200	94248	188576		
Note 1: N	umber of DMI	RS rEs includ	es the overhe	ad of the D	M-RS CDM	groups wit	hout data		

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

#### OCNG Patterns for FDD A.5.1

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

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 COR	ESETS appointed by the search s	paces in use.

#### 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

Inused rEs (Note 1) PDCCH elated pseudo random SK modulated data Tx port transmission	All unused rEs (Note 2)  PDSCH  Uncorrelated pseudo random QPSK modulated data  Spatial multiplexing using any
PDCCH elated pseudo random SK modulated data	PDSCH Uncorrelated pseudo random QPSK modulated data
elated pseudo random SK modulated data	Uncorrelated pseudo random QPSK modulated data
SK modulated data	modulated data
Tx port transmission	Cnatial multiplaying using any
TX port trainer income.	precoding matrix with dimensions same as the precoding matrix for PDSCH
	Same as for RMC PDSCH in the active BWP
( DIMO DD 0011	Same as for RMC PDSCH
	as for RMC PDCCH in the active BWP as for RMC PDCCH

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 in channel bandwidth.

Note 2: Unused available rEs refer to rEs in PRBs not allocated for any physical channels, CORESETs, synchronization signals or reference signals 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 subclause 7.7.3 in TR 38.901 [5].
- Step 4: Apply the quantization to the delay resolution 5 ns. This is done simply by rounding the tap delays to the nearest multiple of the delay resolution.
- Step 5: If multiple taps are rounded to the same delay bin, merge them by calculating their linear power sum.
- Step 6: If there are more than 12 taps in the quantized model, merge the taps as follows
- Find the weakest tap from all taps (both merged and unmerged taps are considered)
  - If there are two or more taps having the same value and are the weakest, select the tap with the smallest delay as the weakest tap.
- When the weakest tap is the first delay tap, merge taps as follows
  - Update the power of the first delay tap as the linear power sum of the weakest tap and the second delay tap.
  - Remove the second delay tap.
- When the weakest tap is the last delay tap, merge taps as follows
  - Update the power of the last delay tap as the linear power sum of the second-to-last tap and the last tap.
  - Remove the second-to-last tap.
- Otherwise
  - For each side of the weakest tap, identify the neighbour tap that has the smaller delay difference to the weakest tap.

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

Note: Some values of the delay profile created by the simplification steps may differ from the values in tables B.2.1.1-2, B.2.1.1-3, B.2.1.1-4, B.2.1.2-2, and B.2.1.1-3 for the corresponding model.

#### 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	$R_{gNB} = 1$	$R_{gNB} = \begin{pmatrix} 1 & \alpha \\ \alpha^* & 1 \end{pmatrix}$	$R_{gNB} = \begin{pmatrix} 1 & \alpha^{\frac{1}{9}} & \alpha^{\frac{4}{9}} & \alpha \\ \alpha^{\frac{1}{9}*} & 1 & \alpha^{\frac{1}{9}} & \alpha^{\frac{4}{9}} \\ \alpha^{\frac{4}{9}*} & \alpha^{\frac{1}{9}*} & 1 & \alpha^{\frac{1}{9}} \\ \alpha^* & \alpha^{\frac{4}{9}*} & \alpha^{\frac{1}{9}*} & 1 \end{pmatrix}$

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

Table B.2.3.1.1-2 UE correlation matrix

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

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

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

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

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

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

The  $\alpha$  and  $\beta$  for different correlation types are given in Table B.2.3.1.2-1.

Table B.2.3.1.2-1: The  $\alpha$  and  $\beta$  parameters for ULA MIMO correlation matrices

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

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

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

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

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

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

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

1x2 case	$R_{high} = \begin{pmatrix} 1 & 0.9 \\ 0.9 & 1 \end{pmatrix}$										
2x1 case	$R_{high} = \begin{pmatrix} 1 & 0.9 \\ 0.9 & 1 \end{pmatrix}$										
2x2 case	$R_{high} = \begin{pmatrix} 1 & 0.9 & 0.9 & 0.81 \\ 0.9 & 1 & 0.81 & 0.9 \\ 0.9 & 0.81 & 1 & 0.9 \\ 0.81 & 0.9 & 0.9 & 1 \end{pmatrix}$										
4x2 case	$R_{high} = \begin{bmatrix} 1.0000 & 0.8999 & 0.9883 & 0.8894 & 0.9542 & 0.8587 & 0.8999 & 0.8099 \\ 0.8999 & 1.0000 & 0.8894 & 0.9883 & 0.8587 & 0.9542 & 0.8099 & 0.8999 \\ 0.9883 & 0.8894 & 1.0000 & 0.8999 & 0.9883 & 0.8894 & 0.9542 & 0.8587 \\ 0.8894 & 0.9883 & 0.8999 & 1.0000 & 0.8894 & 0.9883 & 0.8587 & 0.9542 \\ 0.9542 & 0.8587 & 0.9883 & 0.8894 & 1.0000 & 0.8999 & 0.9883 & 0.8894 \\ 0.8587 & 0.9542 & 0.8894 & 0.9883 & 0.8999 & 1.0000 & 0.8894 & 0.9883 \\ 0.8999 & 0.8099 & 0.9542 & 0.8587 & 0.9883 & 0.8894 & 1.0000 & 0.8999 \\ 0.8099 & 0.8099 & 0.8587 & 0.9542 & 0.8894 & 0.9883 & 0.8999 & 1.0000 \end{bmatrix}$										
4x4 case	$R_{high} = \begin{bmatrix} 1.0000 \ 0.9882 \ 0.9541 \ 0.8999 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.8894 \ 0.9541 \ 0.9430 \ 0.9105 \ 0.8587 \ 0.8999 \ 0.8894 \ 0.8587 \ 0.8099 \ 0.8882 \ 1.0000 \ 0.9882 \ 0.9541 \ 0.9767 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.9430 \ 0.9541 \ 0.9430 \ 0.9541 \ 0.9430 \ 0.8587 \ 0.8894 \ 0.8587 \ 0.8894 \ 0.8587 \ 0.8999 \ 0.8894 \ 0.8587 \ 0.8999 \ 0.8894 \ 0.9767 \ 0.9882 \ 0.9767 \ 0.9105 \ 0.9430 \ 0.9541 \ 0.9430 \ 0.9541 \ 0.8099 \ 0.8587 \ 0.8894 \ 0.8999 \ 0.8894 \ 0.8999 \ 0.8894 \ 0.9430 \ 0.9767 \ 0.9882 \ 0.9767 \ 0.9430 \ 0.9541 \ 0.9430 \ 0.9541 \ 0.9430 \ 0.9541 \ 0.9430 \ 0.9541 \ 0.9430 \ 0.9541 \ 0.9430 \ 0.9541 \ 0.9430 \ 0.9541 \ 0.9430 \ 0.9541 \ 0.9430 \ 0.9541 \ 0.9430 \ 0.9767 \ 0.9882 \ 0.9767$										

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

1x2 case	N/A									
2x1	N/A									
2x2 case	$R_{medium} = \begin{pmatrix} 1 & 0.9 & 0.3 & 0.27 \\ 0.9 & 1 & 0.27 & 0.3 \\ 0.3 & 0.27 & 1 & 0.9 \\ 0.27 & 0.3 & 0.9 & 1 \end{pmatrix}$ $\begin{pmatrix} 1.0000 & 0.9882 & 0.9541 & 0.8999 & 0.3000 & 0.2965 & 0.2862 & 0.2700 \\ 0.9882 & 1.0000 & 0.9882 & 0.9541 & 0.2965 & 0.3000 & 0.2965 & 0.2862 \\ 0.9541 & 0.9882 & 1.0000 & 0.9882 & 0.2862 & 0.2965 & 0.3000 & 0.2965 \\ 0.8999 & 0.9541 & 0.9882 & 1.0000 & 0.2700 & 0.2862 & 0.2965 & 0.3000 \end{pmatrix}$									
2x4 case	$R_{medium} = \begin{pmatrix} 0.3999 & 0.9341 & 0.9682 & 1.0000 & 0.2700 & 0.2862 & 0.2903 & 0.3000 \\ 0.3000 & 0.2965 & 0.2862 & 0.2700 & 1.0000 & 0.9882 & 0.9541 & 0.8999 \\ 0.2965 & 0.3000 & 0.2965 & 0.2862 & 0.9882 & 1.0000 & 0.9882 & 0.9541 \\ 0.2862 & 0.2965 & 0.3000 & 0.2965 & 0.9541 & 0.9882 & 1.0000 & 0.9882 \\ 0.2700 & 0.2862 & 0.2965 & 0.3000 & 0.8999 & 0.9541 & 0.9882 & 1.0000 \end{pmatrix}$									
4x2 case	$R_{medium} = \left( \begin{array}{cccccccccccccccccccccccccccccccccccc$									
4x4 case	1.0000   0.9882   0.9541   0.8999   0.8747   0.8645   0.8347   0.7872   0.5855   0.5787   0.5588   0.5270   0.3000   0.2965   0.2862   0.2700   0.9882   1.0000   0.9882   0.9541   0.8645   0.8747   0.8645   0.8347   0.5787   0.5855   0.5787   0.5588   0.2965   0.3000   0.2965   0.2862   0.9541   0.9882   1.0000   0.9882   0.8347   0.8645   0.8747   0.8645   0.8747   0.5855   0.5787   0.5855   0.5787   0.2862   0.2965   0.3000   0.2965   0.8999   0.9541   0.9882   1.0000   0.7872   0.8347   0.8645   0.8747   0									

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

	1				,												
				1	1.0000	0.90	000 0	.6561	0.3874	0.300	00 0.2	2700	0.1968	0.1162	2)		
					0.900	0 1.00	000 0	.9000	0.6561	0.270	0.3	8000	0.2700	0.196	8		
					0.656	1 0.90	000 1.	.0000	0.9000	0.196	68 0.2	2700	0.3000	0.2700	)		
04					0.387	4 0.6	561 0	.9000	1.0000	0.116	52 0.1	.968	0.2700	0.3000	)		
2x4 case			$R_{med}$	$_{lium A} =$	0.300												
Case					0.300				0.1162				0.6561	0.3874	+		
					0.270	0.30	000 0	.2700	0.1968	0.900	00 1.0	0000	0.9000	0.656	1		
					0.196	8 0.2	700 0	.3000	0.2700	0.650	51 0.9	9000	1.0000	0.9000	)		
					0.116	2 0.19	968 0	.2700	0.3000	0.387	74 0.0	6561	0.9000	1.0000	)		
		1.0000	0.9000	0.6561	0.3874	0.8748	0.7873	0.5739	0.3389	0.5856	0.5270	0.3842	0.2269	0.3000	0.2700	0.1968	0.1162
		0.9000	1.0000	0.9000	0.6561	0.7873	0.8748	0.7873	0.5739	0.5270	0.5856	0.5270	0.3842	0.2700	0.3000	0.2700	0.1968
		0.6561	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	0.2700
		0.3874	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	0.3000
		0.8748	0.7873	0.5739	0.3389	1.0000	0.9000	0.6561	0.3874	0.8748	0.7873	0.5739	0.3389	0.5856	0.5270	0.3842	0.2269
		0.7873	0.8748	0.7873	0.5739	0.9000	1.0000	0.9000	0.6561	0.7873	0.8748	0.7873	0.5739	0.5270	0.5856	0.5270	0.3842
		0.5739	0.7873	0.8748	0.7873	0.6561	0.9000	1.0000	0.9000	0.5739	0.7873	0.8748	0.7873	0.3842	0.5270	0.5856	0.5270
4x4	n	0.3389	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	0.5856
case	$R_{medium\ A} =$	0.5856	0.5270	0.3842	0.2269	0.8748	0.7873	0.5739	0.3389	1.0000	0.9000	0.6561	0.3874	0.8748	0.7873	0.5739	0.3389
		0.5270	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	0.5739
		0.3842	0.5270	0.5856	0.5270	0.5739	0.7873	0.8748	0.7873	0.6561	0.9000	1.0000	0.9000	0.5739	0.7873	0.8748	0.7873
		0.2269	0.3842	0.5270	0.5856	0.3389	0.5739	0.7873	0.8748	0.3874	0.6561	0.9000	1.0000	0.3389	0.5739	0.7873	0.8748
		0.3000	0.2700	0.1968	0.1162	0.5856	0.5270	0.3842	0.2269	0.8748	0.7873	0.5739	0.3389	1.0000	0.9000	0.6561	0.3874
		0.2700	0.3000	0.2700	0.1968	0.5270	0.5856	0.5270	0.3842	0.7873	0.8748	0.7873	0.5739	0.9000	1.0000	0.9000	0.6561
		0.1968	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	0.9000
		0.1162	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	1.0000
<u> </u>	l																•

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 +/-45 degrees polarization slant angles are deployed at gNB and cross-polarized antenna elements with +90/0 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:

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

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

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

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

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

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

where

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

The matrix  $\Gamma$  is defined as

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

A permutation matrix P elements are defined as

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

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

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

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

where

- -  $R_{gNB\_Dim,1}$  is the correlation matrix of antenna elements in first dimension with same polarization, and

-  $R_{gNB\_Dim,2}$  is the correlation matrix of antenna elements in second dimension with same polarization.

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

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

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

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

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

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

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

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

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

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

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

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

The spatial correlation matrices at UE side are as follows:

- For 1 antenna element with the same polarization,

$$R_{UE} = 1$$
.

- For 2 antenna elements with the same polarization,

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

#### B.2.3.2.2 MIMO Correlation Matrices using cross polarized antennas

The values for parameters  $\alpha$ ,  $\beta$  and  $\gamma$  for the cross polarized antenna models are given in Table B.2.3.2.2-1.

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

Corr	elation Model	$\alpha_1$	0⁄2	β	γ		
Mediu	m Correlation A	0.3	N/A	0.6	0.2		
	h Correlation	0.9	0.9	0.9	0.3		
Note 1:	Value of $\alpha_1$ applies when more than one pair of cross-polarized antenna elements in first dimension at gNB side. Value of $\alpha_2$ applies when more than one pair of cross-polarized						
Note 3:	antenna elements in second dimension at gNB side.						

For the 1D cross polarized antenna array at gNB side, the correlation matrices for high spatial correlation and medium correlation A 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 insure the correlation matrix is positive semi-definite after round-off to 4 digit precision. This is done using the equation:

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

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

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

				1.0	000	0.0000	0.90	00 (	0.0000	-0.30	000 0	0.0000	- 0.27	700 (	0.0000		
				0.0	000 1	1.0000	0.00	00 (	0.9000	0.00	000 0	0.3000	0.00	000 (	).2700		
						0.0000	1.00		0.0000	-0.27		0.0000	-0.30		0.0000		
4x2			$R_{high} =$			0.9000			1.0000	0.00		).2700	0.00		0.3000		
case			mgn	-0.3	000 (	0.0000	-0.2	700 (	0.0000	1.000	00 0	0.0000	0.90	00 (	0.0000		
				0.0	000	0.3000	0.0	000	0.2700	0.00	00 1	.0000	0.00	00 (	0.9000		
				-0.2	700 (	0.0000	- 0.30	000	0.0000	0.90	00 0	.0000	1.00	00 (	0.0000		
				0.0	000	0.2700	0.0	000	0.3000	0.00	00 0	.9000	0.00	000 1	.0000		
		1.0000	0.0000	0.9883	0.0000	0.9542	0.0000	0.8999	0.0000	-0.3000	0.0000	-0.2965	0.0000	-0.2862	0.0000	-0.2700	0.0000
		0.0000	1.0000	0.0000	0.9883	0.0000	0.9542	0.0000	0.8999	0.0000	0.3000	0.0000	0.2965	0.0000	0.2862	0.0000	0.2700
		0.9883	0.0000	1.0000	0.0000	0.9883	0.0000	0.9542	2 0.0000	-0.2965	0.0000	-0.3000	0.0000	-0.2965	0.0000	-0.2862	0.0000
		0.0000	0.9883	0.0000	1.0000	0.0000	0.9883	0.0000	0.9542	0.0000	0.2965	0.0000	0.3000	0.0000	0.2965	0.0000	0.2862
		0.9542	0.0000	0.9883	0.0000	1.0000	0.0000	0.9883	0.0000	-0.2862	0.0000	-0.2965	0.0000	-0.3000	0.0000	-0.2965	0.0000
		0.0000	0.9542	0.0000	0.9883	0.0000	1.0000	0.0000	0.9883	0.0000	0.2862	0.0000	0.2965	0.0000	0.3000	0.0000	0.2965
		0.8999	0.0000	0.9542	0.0000	0.9883	0.0000	1.0000	0.0000	-0.2700	0.0000	-0.2862	0.0000	-0.2965	0.0000	-0.3000	0.0000
8x2	$R_{high} =$	0.0000	0.8999	0.0000	0.9542	0.0000	0.9883	0.0000	1.0000	0.0000	0.2700	0.0000	0.2862	0.0000	0.2965	0.0000	0.3000
case	- nign	-0.3000		-0.2965					0.0000				0.0000		0.0000	0.8999	0.0000
		0.0000		0.0000		0.0000				0.0000	1.0000			0.0000		0.0000	0.8999
		-0.2965		-0.3000		0, 00		00	2 0.0000		0.0000		0.0000		0.0000		
		0.0000							0.2862		0.9883			0.0000		0.0000	
		-0.2862		-0.2965					5 0.0000		0.0000		0.0000	1.0000		0.9883	0.0000
		0.0000		0.0000	0.2965				0.2965					0.0000	1.0000	0.0000	0.7002
		-0.2700		-0.2862					0.0000		0.0000			0.9883	0.0000		
		0.0000	0.2/00	0.0000	0.2862	0.0000	0.2965	0.000	0.3000	0.0000	0.8999	0.0000	0.9542	0.0000	0.9883	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.
- $D_{ heta_{k,1}, heta_{k,2}}$  is the steering matrix,
- $D_{\theta_{i,1}}(N_1)$  is the steering matrix in first dimension with same polarization,
- $D_{\theta_{1,2}}(N_2)$  is the steering matrix in second dimension with same polarization,
- $N_1$  is the number of antenna elements in first dimension with same polarization,
- $N_2$  is the number of antenna elements in second dimension with same polarization,
- For antenna array with only one direction, number of antenna element in second direction  $N_2$  equals 1.

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

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

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

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

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

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

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

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

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

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

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

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

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

Variation Step	Value (rad/ms)
$\Delta  heta$	1.2566×10 <sup>-3</sup>

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

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

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

in continuous time  $(t,\tau)$  representation, with  $\tau_d$  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.4 Beamforming Model

### B.4.1 Generic beamforming model

The transmission on antenna port(s)  $p = p_0, p_0 + 1, \ldots, p_0 + N_p - 1$  is defined by using a precoder matrix W(i) of size  $N_{ANT} \times N_p$ , where  $N_{ANT}$  is the number of physical transmit antenna elements configured per test,  $N_p$  is the number of ports for a reference signal or physical channel configured per test, and  $p_0$  is the first port for that reference signal or physical channel as defined in clauses 7.3 and 7.4 in TS 38.211 [9]. This precoder takes as an input a block of signals for antenna port(s)  $p = p_0, p_0 + 1, \ldots, p_0 + N_p - 1, y^{(p)}(i) = \left[y^{(p_0)}(i) \ y^{(p_0+1)}(i) \ \ldots \ y^{(p_0+N_p-1)}(i)\right]^T$ ,  $i = 0,1,\ldots,M_{\text{symb}}^{\text{ap}} - 1$ , with  $M_{\text{symb}}^{\text{ap}}$  being the number of modulation symbols per antenna port including the reference signal symbols, and generates a block of signals  $y_{bf}^{(q)}(i) = \left[y_{bf}^{(0)}(i) \ y_{bf}^{(1)}(i) \ \ldots \ y_{bf}^{(N_{ANT}-1)}(i)\right]^T$  the elements of which are to be mapped onto the frequency-time index pair (k,l) as per the test configuration but transmitted on different physical antenna elements:

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

The precoder matrix W(i) is specific to the test case configuration.

# 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

< Editor's note: OCNG for DMRS is FFS in Annex A.>

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
SSS transmit power	W	Test specific
EPRE ratio of PSS to SSS	dB	0
EPRE ratio of PBCH DMRS to SSS	dB	0
EPRE ratio of PBCH to PBCH DMRS	dB	0
EPRE ratio of PDCCH DMRS to SSS	dB	0
EPRE ratio of PDCCH to PDCCH DMRS	dB	0
EPRE ratio of PDSCH DMRS to SSS	dB	0
EPRE ratio of PDSCH to PDSCH DMRS	dB	0
EPRE ratio of CSI-RS to SSS	dB	0
EPRE ratio of OCNG to SSS	dB	0

# 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

< Editor's note: OCNG for DMRS is FFS in Annex A.>

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
SSS transmit power	W	Test specific
EPRE ratio of PSS to SSS	dB	0
EPRE ratio of PBCH DMRS to SSS	dB	0
EPRE ratio of PBCH to PBCH DMRS	dB	0
EPRE ratio of PDCCH DMRS to SSS	dB	0
EPRE ratio of PDCCH to PDCCH DMRS	dB	0
EPRE ratio of PDSCH DMRS to SSS	dB	0
EPRE ratio of PDSCH to PDSCH DMRS	dB	0
EPRE ratio of CSI-RS to SSS	dB	0
EPRE ratio of PTRS to PDSCH	dB	Test specific
EPRE ratio of OCNG to SSS	dB	0

# 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 full temperature range of:

**Table E.2.1-1 Temperature conditions** 

+15°C to +35°C	For normal conditions (with relative humidity of 25 % to 75 %)
-10°C to +55°C	For extreme conditions (see IEC publications 68-2-1 and 68-2-2)

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 TS 38.101-1 [6, Section 6.2] for extreme operation.

### E.2.2 Voltage

The UE shall fulfil all the requirements in the full voltage range, i.e. the voltage range between the extreme voltages.

The manufacturer shall declare the lower and higher extreme voltages and the approximate shutdown voltage. For the equipment that can be operated from one or more of the power sources listed below, the lower extreme voltage shall not be higher, and the higher extreme voltage shall not be lower than that specified below.

Table E.2.2-1 Voltage conditions

Power source	Lower extreme	Higher extreme	Normal conditions
	voltage	voltage	voltage
AC mains	0,9 * nominal	1,1 * nominal	nominal
Regulated lead acid battery	0,9 * nominal	1,3 * nominal	1,1 * nominal
Non regulated batteries:			
Leclanché	0,85 * nominal	Nominal	Nominal
Lithium	0,95 * nominal	1,1 * Nominal	1,1 * Nominal
Mercury/nickel & cadmium	0,90 * nominal		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, Section 6.2] for extreme operation. In particular, the UE shall inhibit all RF transmissions when the power supply voltage is below the manufacturer declared shutdown voltage.

#### E.2.3 Vibration

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

**Table E.2.3-1 Vibration conditions** 

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

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

## E.3 Environmental (Radiated)

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

#### E.3.1 Temperature

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

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

Table E.3.1-1: Temperature conditions

+ 25 °C ± 10 °C	For normal (room temperature) conditions with relative humidity of 25% to 75%
-10°C to +55°C	For extreme conditions

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 TS38.101-2 [7, Section 6.2] for extreme operation.

### E.3.2 Voltage

#### E.3.3 Void

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

# Annex L (informative): Change history

Data	Mooting	4Daa	CD	Day	Cot	Change history   Subject/Comment	Now
Date	Meeting	tDoc	CR	Rev	Cat	Subject/Comment	New version
2018-07	RAN4 AH18-07	R4-1809554				Draft skeleton	0.0.1
2018-08	RAN4#88	R4-1811357				Skeleton update	0.0.2
2018-08 2018-10	RAN4#88 RAN4#88 bis	R4-1811357 R4-1814237				Approved Text Proposal in RAN4#88bis: 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 section 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"	0.0.2
2018-11	RAN4#89	R4-1816559				R4-1814023, "TP to TS38.101-4 Annex C: Downlink physical channels" R4-1814024, "TP to TS38.101-4 Annex E: Environmental conditions"  Approved Text Proposal in RAN4#89:	0.2.0
						R4-1814053, "TP on performance specification 38.101-4 Chapter 4 general part" R4-1814487, "TP for TS38.101-4 section 2 (Reference)" R4-1814488, "TP for TS38.101-4 section 3 (Definitions, symbols and abbreviations)" R4-1814579, "TP to TS 38.101-4: Annex A Measurement channels – PDSCH" R4-1814580, "TP to TS 38.101-4: Annex A Measurement channels – DL Control" R4-1814581, "TP to TS 38.101-4: Annex A Measurement channels – CSI" R4-1816395, "FR2 demod: Noc, Band groups and Ref point - TP for TS 38.101-4" R4-1816692, "TP to TS 38.101-4: Requirements applicability" R4-1816693, "TP for performance requirements for interworking (9)" R4-1816694, "TP to TS 38.101-4: FR1 PDSCH demodulation requirements (5.2)" R4-1816695, "Draft TP on FR2 PDSCH Demodulation Performance Requirements" R4-1816697, "TP for updating FR1 PDCCH requirements in TS 38.101-4 section 5.3" R4-1816699, "TP to TS 38.101-4: 5.4 FR1 PBCH demodulation requirements" R4-1816700, "TP to TS 38.101-4: 7.4 FR2 PBCH demodulation requirements" R4-1816700, "TP to TS 38.101-4: FR2 CQI requirement (6.2)" R4-1816703, "Draft TP on FR1 Rank Indication Reporting Performance Requirements" R4-1816704, "Draft TP on FR2 Rank Indication Reporting Performance Requirements" R4-1816705, "TP for TS 38.101-4 FR1 PMI test requirement" R4-1816704, "Draft TP on FR2 Rank Indication Reporting Performance Requirements" R4-1816704, "Draft TP on FR2 Rank Indication Reporting Performance Requirements" R4-1816704, "Draft TP on TS 38.101-4 FR2 PMI requirements" R4-1816704, "TP to TS 38.101-4 FR2 PMI requirements" R4-1816705, "TP to TS 38.101-4 FR2 PMI requirements" R4-1816703, "TP to TS 38.101-4 FR2 PMI requirements" R4-18167012, "TP to TS 38.101-4 FR2 PMI requirements" R4-1816703, "TP to TS 38.101-4 FR2 PMI requirements" R4-1816714, "TP for TS 38.101-4 FR2 PMI requirements" R4-1816714, "TP for TS 38.101-4 FR2 PMI requirements" R4-1816714, "TP for TS 38.101-4 FR2 PMI requirements"	
2018-12 2018-12	RAN#82	RP-182408	1	<u> </u>		V1.0.0 is submitted to RAN for 1-step approval	1.0.0
0040 40	RAN#82	RP-182704	1	1	Ì	V1.0.1 with editorial changes	1.0.1

2019-03	RAN#83	RP-190403	000	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)	
					R4-1902418, Draft CR on FR2 CSI Reporting Tests (Qualcomm	
					Incorporated)	
					R4-1902419, Draft CR on FR1 CSI Reporting Tests (Qualcomm	
					Incorporated) R4-1900105, Draft CR on NR CSI reporting (Intel Corporation)	
					R4-1902058, Draft CR for update of FR1 CQI reporting test (Huawei,	
					HiSilicon)	
					R4-1902059, Draft CR for update of FR2 CQI reporting test (Intel)	
					R4-1902426, Draft CR for PMI test cases: 6.2, 8.2, A.3.2.2.2, A.3.2.2.5 (Samsung)	
					R4-1902425, Draft CR for FR1 and FR2 RI test cases (Qualcomm)	
					Annex	
					R4-1900369, Draft CR on PDSCH FRC (Intel Corporation)	
					R4-1900370, Draft CR on PDCCH FRC (Intel Corporation) R4-1902424, Corrections to 38.101-4 subclause B.2.1 Delay profile	
					calculation (Huawei, HiSilicon)	
					R4-1902575, Draft CR on Beamforming Model (Qualcomm)	
					Additional modifications:	
					- Compared to endorsed CR R4-1902414, requirements for several	
					FR1 PDSCH test cases were modified to correct stat error	
					- Correct the format for Annex A.x - Correct table number under PDSCH section 5.2.3.1.3	
					- Some minor editorial changes	
					Editorial changes after RAN#83	
					To align the annex numbering with other specifications (TS 38.101-x	
					series), annexes J and K were added and Change history was	
					numbered as annex L.	

# History

Document history						
V15.0.0	April 2019	Publication				
V15.1.0	May 2019	Publication				