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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.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.
- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] 3GPP TS 38.521-4: "NR; User Equipment (UE) radio transmission and reception; Part 4: Performance requirements".
- [3] Recommendation ITU-R M.1545: "Measurement uncertainty as it applies to test limits for the 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".
- [5] 3GPP TR 38.901: "Study on channel model for frequencies from 0.5 to 100 GHz".
- [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]

 $N_{\rm oc}$  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.

## 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.

Table 4.3-1: Definition of suffixes

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

A terminal which supports the above features needs to meet the requirement defined in the additional 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:

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

 $N_{RX}$  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.

 $E_s$  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.

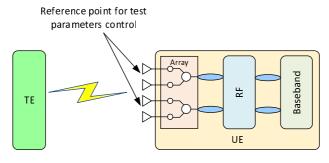


Figure 4.5.1-1: Reference point for radiated Demodulation and CSI requirements

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:

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

 $N_{RX}$  denotes the number of receiver reference points, and the super script receiver reference point j.

The above SNR definition assumes that the REs are not precoded, and does not account for any gain which can be associated to the precoding operation.

 $\hat{E}_{\langle signal \rangle}$  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 120kHz.

PRBs<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 in Group Y is rounded to -155 dBm/Hz.

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

 $Noc(Band_X, PC_Y) = -155 dBm/Hz + Refsens_{PC_Y, Band_X, 50MHz} - Refsens_{PC3, n260, 50MHz}$ 

## 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

## 5.2 PDSCH demodulation requirements

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

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

	Parameter	Unit	Value
PDSCH transmission scheme			Transmission scheme 1
EPRE ratio of PTRS	to PDSCH	dB	N/A
DL BWP configuration #1	Cyclic prefix		Normal
	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
	Slots for PDCCH monitoring		Each slot
PDCCH	Symbols with PDCCH	Symbols	0, 1
configuration	Number of PDCCH candidates and aggregation levels		TBD
	DCI format		TBD
Cross carrier schedu	ling		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		$I_0 = 6$ for CSI-RS resource 1 and 3
	CSI-RS		$I_0 = 10$ for CSI-RS resource 2 and 4
	Number of CSI-RS ports (X)		1 for CSI-RS resource 1,2,3,4
	CDM Type		'No CDM' for CSI-RS resource 1,2,3,4
	Density (ρ)		3 for CSI-RS resource 1,2,3,4
001 00 ( )			15 kHz SCS: 20 for CSI-RS resource 1,2,3,4
CSI-RS for tracking	CSI-RS periodicity	Slots	30 kHz SCS: 40 for CSI-RS resource 1,2,3,4
	CSI-RS offset	Slots	15 kHz SCS: 10 for CSI-RS resource 1 and 2 11 for CSI-RS resource 3 and 4
			30 kHz SCS: 20 for CSI-RS resource 1 and 2 21 for CSI-RS resource 3 and 4
	First subcarrier index in the PRB used for CSI-RS		$k_0 = 0$
	First OFDM symbol in the PRB used for CSI-RS		I <sub>0</sub> = 12
NZP CSI-RS for	Number of CSI-RS ports (X)		Same as number of transmit antenna
CSI acquisition	CDM Type		'FD-CDM2'
	Density (ρ)		1
	CSI-RS periodicity	Slots	15 kHz SCS: 20 30 kHz SCS: 40
	CSI-RS offset	Slots	0
	First subcarrier index in the PRB used for CSI-RS		k <sub>0</sub> = 4
	First OFDM symbol in the PRB used for CSI-RS		l <sub>0</sub> = 12
ZP CSI-RS for CSI	Number of CSI-RS ports (X)		4
acquisition	CDM Type		'FD-CDM2'
	Density (p)		1
		CI-4	15 kHz SCS: 20
	CSI-RS periodicity	Slots	30 kHz SCS: 40
	CSI-RS offset	Slots	0
			{1000} for Rank 1 tests
PDSCH DMRS configuration	Antenna ports indexes		{1000, 1001} for Rank 2 tests {1000-1002} for Rank 3 tests {1000-1003} for Rank 4 tests
Johngaration	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
PTRS configuration			PTRS is not configured
Maximum number of code block groups for ACK/NACK feedback			1
Maximum number of			4
Redundancy version			{0,2,3,1}
•	<u> </u>		SP Type I, Random per slot with PRB
Precoding configurat	ion		bundling granularity

Symbols for all unused Res	OCNG Annex A.5

## 5.2.1 1RX requirements

(Void)

## 5.2.2 2RX requirements

#### 5.2.2.1 FDD

## 5.2.2.1.1 Minimum requirements for PDSCH Mapping Type A

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

The test purposes are specified in Table 5.2.2.1.1-1.

Table 5.2.2.1.1-1: Tests purpose

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

Table 5.2.2.1.1-2: Test parameters

	Parameter	Unit	Value
Channel bandwidth		MHz	20 for Test 2-3
<b>D</b> 1		+	10 for other tests
Duplex mode			FDD
Active DL BWP inde		+	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
	Length		Single symbol
Number of HARQ F			8 for Tests 1-4, [2-1] [4 for other tests]
K1 value (PDSCH-to-HARQ-	timing-indicator)		TBD

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	[-0.9]
1-2	R.PDSCH.1-1.2 FDD	QPSK, 0.30	TDLC300-100	2x2, ULA Low	70	[0.5]
1-3	R.PDSCH.1-4.1 FDD	256QAM, 0.82	TDLA30-10	2x2, ULA Low	70	[24.5]
1-4	R.PDSCH.1-2.1 FDD	16QAM, 0.48	TDLC300-100	2x2, ULA Low	30	[1.3]

Table 5.2.2.1.1-4: Minimum performance for Rank 2

<b>T</b>		Modulation	B	Correlation matrix	Reference value	
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	2x2, ULA Low	70	TBD
2-2	R.PDSCH.1-2.2 FDD	16QAM, 0.48	TDLA30-10	2x2, ULA Medium	70	[17.5]
2-3	R.PDSCH.2-1.1 FDD	64QAM, 0.51	TDLA30-10	2x2, ULA Low	70	TBD

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

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

The test purposes are specified in Table 5.2.2.1.2-1.

Table 5.2.2.1.2-1: Tests purpose

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

Table 5.2.2.1.2-2: Test parameters

	Parameter	Unit	Value
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
configuration #1	Subcarrier spacing	kHz	15
PDCCH configuration	Number of PRBs in CORESET	PRBs	48
	Mapping type		Туре А
	k0		0
	Starting symbol (S)		2
	Length (L)		12
PDSCH	PDSCH aggregation factor		1
configuration	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
DD00U 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		l <sub>0</sub> = 13
CSI acquisition	CSI-RS periodicity		5
ZP CSI-RS for CSI	Subcarrier index in the PRB used for CSI-RS		$(k_0, k_1, k_2, k_3)=(2, 4, 6, 8)$
acquisition	Number of CSI-RS ports (X)		8
	CSI-RS periodicity		5
Number of HARQ Pro	ocesses		4
K1 value (PDSCH-to-HARQ-tin			TBD

Table 5.2.2.1.2-3: Minimum performance for Rank 2

Toot		Modulation Branchis Correlation n		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.1-5.1 FDD	16QAM, 0.48	TDLC300-100	2x2, ULA Low	70	[14.7]

## 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 receive antenna conditions]	[1-1]

Table 5.2.2.1.3-2: 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		N/A
	size		IV/A
PDSCH DMRS	DMRS Type		Type 1
configuration	Number of additional DMRS		1
	Length		1
Number of HARQ Pro	ocesses		4
K1 value (PDSCH-to-HARQ-tin	ming-indicator)		2

Table 5.2.2.1.3-3: Minimum performance for Rank 1

Toot		Modulation B		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	2x2, ULA Low	70	[-1.0]	

#### 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 matching configured]	[1-1]

#### 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
DL BWP	First PRB		0
configuration #1	Number of contiguous PRB	PRBs	52
•	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]
PDSCH	PDSCH aggregation factor		1
	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 DMD0	DMRS Type		Type 1
PDSCH DMRS	Number of additional DMRS		1
configuration	Length		1
	LTE carrier Center		[Same as NR carrier]
CRS for rate	LTE carrier BW	MHz	10
matching	Number of antenna ports		4
	v-shift		0
Number of HARQ Pr	ocesses		4
K1 value (PDSCH-to-HARQ-ti	ming-indicator)		2

## Table 5.2.2.1.4-3: Minimum performance for Rank 1

Test	Reference Mo	Modulation Brangation		Correlation matrix and	Reference value	
num.	channel	format and code rate	Propagation condition	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	[-0.8]

## 5.2.2.2 TDD

## 5.2.2.2.1 Minimum requirements for PDSCH Mapping Type A

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

The test purposes are specified in Table 5.2.2.2.1-1.

## Table 5.2.2.2.1-1: Tests purpose

Purpose	Test index
[Verify the PDSCH mapping Type A normal performance under 2 receive antenna conditions and with different	[1-1, 1-2, 1-3, 1-5, 1-6, 2-1]
channel models, MCSs and number of MIMO layers]	
[Verify the PDSCH mapping Type A HARQ soft	[1-4]
combining performance under 2 receive antenna	
conditions.]	
[Verify the PDSCH mapping Type A enhanced	[2-2]
performance requirement Type X under 2 receive	
antenna conditions and with 2 MIMO layers.]	

## Table 5.2.2.2.1-2: Test parameters

	Parameter		Value
Channel bandwidth		MHz	20 for Test 2-3
Channel bandwidth		IVITZ	40 for other tests
Duplex mode	Duplex mode		TDD
Active DL BWP index			1
	First PRB		0
DL BWP configuration #1	Number of contiguous PRB	PRBs	51 for Test 2-3 106 for other tests
J	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

	Maddatan			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)
1-1	R.PDSCH.2- 1.1 TDD	QPSK, 0.30	FR1.30-1	TDLB100-400	2x2, ULA Low	70	[-0.9]
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	TBD
1-4	R.PDSCH.2- 2.1 TDD	16QAM, 0.48	FR1.30-1	TDLC300-100	2x2, ULA Low	30	[1.5]
1-5	[R.PDSCH.2- 5.1 TDD]	QPSK, 0.3	FR1.30-2	TDLA30-10	2x2, ULA Low	70	[-0.9]
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

Test num.	Reference channel	Modulation format and code rate	TDD UL-DL pattern	Propagation condition	Correlation matrix and antenna configuration	Reference v Fraction of maximum throughput	SNR (dB)
					comiguration	(%)	(ub)
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- 2.2 TDD	16QAM, 0.48	FR1.30-1	TDLA30-10	2x2, ULA Medium	70	[18.0]
2-3	R.PDSCH.2- 3.2 TDD	64QAM, 0.51	FR1.30-1	TDLA30-10	2x2, ULA Low	70	[19.2]

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

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

The test purposes are specified in Table 5.2.2.2.1.

Table 5.2.2.2.1: Tests purpose

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

Table 5.2.2.2-2: Test parameters

	Parameter	Unit	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
	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		l <sub>0</sub> = 13
CSI acquisition	CSI-RS periodicity		5
ZP CSI-RS for CSI	Subcarrier index in the PRB used for CSI-RS		$(k_0, k_1, k_2, k_3)=(2, 4, 6, 8)$
acquisition	Number of CSI-RS ports (X)		8
•	CSI-RS periodicity		5
Number of HARQ Pr			8
K1 value (PDSCH-to-HARQ-ti	ming-indicator)		Specific to each UL-DL pattern

Table 5.2.2.2-3: 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)
1-1	R.PDSCH.2- 7.1 TDD	16QAM, 0.48	FR1.30-1	TDLC300-100	2x2, ULA Low	70	TBD

## 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		Value
Channel bandwidth		MHz	40
Duplex mode	Duplex mode		FDD
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		N/A
	size		·
PDSCH DMRS	DMRS Type		Type 1
configuration	Number of additional DMRS		1
	Length		1
Number of HARQ Pro	ocesses		4
K1 value (PDSCH-to-HARQ-tir	ming-indicator)		2

Table 5.2.2.2.3-3: Minimum performance for Rank 1

Toot	Deference	Modulation	TDD UL-	Dramanation	Correlation	Reference val	ue
Test num.	Reference channel	format and code rate	DL pattern	Propagation condition	matrix and antenna configuration	Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH,2- 1.3 TDD	QPSK, 0.30	FR1.30-1	TDLA30-10	2x2, ULA Low	70	[-1.0]

## 5.2.3 4RX requirements

#### 5.2.3.1 FDD

## 5.2.3.1.1 Minimum requirements for PDSCH Mapping Type A

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

The test purposes are specified in Table 5.2.3.1.1-1.

Table 5.2.3.1.1-1: Tests purpose

Purpose	Test index
[Verify the PDSCH mapping Type A normal performance	[1-1, 1-2, 1-3, 2-1, 2-2, 3-1, 4-1]
under 4 receive antenna conditions and with different	
channel models, MCSs and number of MIMO layers]	
[Verify the PDSCH mapping Type A HARQ soft	[1-4]
combining performance under 4 receive antenna	
conditions.]	
[Verify the PDSCH mapping Type A enhanced	[3-2]
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
Channel bandwidth		MHz	20 for Test 2-2
Chamici Banawatti		1711 12	10 for other tests
Duplex mode			FDD
Active DL BWP ind			1
	First PRB		0
DL BWP	Number of contiguous PRB	PRBs	51 for Test 2-2 52 for other tests
configuration #1			30 for Test 2-2
	Subcarrier spacing	kHz	15 for other tests
PDCCH			51 for Test 2-2
configuration	Number of PRBs in CORESET	PRBs	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
configuration	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 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 F	Processes		8 for Test 1-4, [2-1]
			4 for other tests
K1 value (PDSCH-to-HARQ-	timing-indicator)		2

Table 5.2.3.1.1-3: Minimum performance for Rank 1

T1		Modulation	Doggana	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.1-1.1 FDD	QPSK, 0.30	TDLB100-400	2x4, ULA Low	70	[-3.7]
1-2	R.PDSCH.1-1.2 FDD	QPSK, 0.30	TDLC300-100	2x4, ULA Low	70	[-2.7]
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	[-1.5]

Table 5.2.3.1.1-4: Minimum performance for Rank 2

T1		Modulation	Doggodina	Correlation matrix	Reference val	ue
Test num.	Reference channel	format and code rate	Propagation condition	and antenna Fraction of configuration 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	TBD

Table 5.2.3.1.1-5: Minimum performance for Rank 3

T1		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)
3-1	R.PDSCH.1-2.3 FDD	16QAM, 0.48	TDLA30-10	4x4, ULA Low	70	[10.9]
3-2	R.PDSCH.1-2.3 FDD	16QAM, 0.48	TDLA30-10	4x4, ULA Medium A	70	[22.2]

Table 5.2.3.1.1-6: Minimum performance for Rank 4

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

## 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	(		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
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
DD0011 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		$(k_0, k_1, k_2, k_3)=(2, 4, 6, 8)$
acquisition	Number of CSI-RS ports (X)		8
	CSI-RS periodicity		5
Number of HARQ Processes			4
K1 value (PDSCH-to-HARQ-timing-indicator)			TBD

Table 5.2.3.1.2-3: Minimum performance for Rank 2

	Tool		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)
Ī	1-1	R.PDSCH.1-5.1 FDD	16QAM, 0.48	TDLC300-100	4x4, ULA Low	70	[9.0]

## 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	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		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		IV/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)		2

Table 5.2.3.1.3-3: Minimum performance for Rank 1

Toet		Modulation	Dramanation	Correlation matrix	Reference value	
Test num.	Reference channel	format and code rate	Propagation condition	and antenna Fraction of configuration maximum throughput (		SNR (dB)
1-1	R.PDSCH.1-1.4 FDD	QPSK, 0.30	TDLA30-10	4x4, ULA Low	70	[-4.0]

## 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 5.2.3.1.3-1: Tests purpose

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

Table 5.2.3.1.3-2: Test parameters

	Parameter	Unit	Value
Channel bandwidth		MHz	10
Duplex mode			FDD
Active DL BWP index	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	PDSCH aggregation factor		Type A
configuration	PRB bundling type		0
Corniguration	PRB bundling size		3
	Resource allocation type		[9]
	VRB-to-PRB mapping type		1
	VRB-to-PRB mapping interleaver bundle size		Static
	DMRS Type		2
PDSCH DMRS	Number of additional DMRS		Type 0
configuration	Length		Non-interleaved
	LTE carrier Center		[Same as NR carrier]
CRS for rate	LTE carrier BW	MHz	10
matching	Number of antenna ports		4
	v-shift		0
Number of HARQ Pr	ocesses		4
K1 value (PDSCH-to-HARQ-ti	ming-indicator)		2

Table 5.2.3.1.3-3: Minimum performance for Rank 1

Test		Modulation	Dranagation	Correlation matrix	Reference value		
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	[-3.9]	

## 5.2.3.2 TDD

## 5.2.3.2.1 Minimum requirements for PDSCH Mapping Type A

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

The test purposes are specified in Table 5.2.3.2.1-1.

Table 5.2.3.2.1-1: Tests purpose

Purpose	Test index
[Verify the PDSCH mapping Type A normal performance	[1-1, 1-2, 1-3, 1-5, 1-6, 2-1, 2-2, 3-1, 4-1]
under4 receive antenna conditions and with different	
channel models, MCSs and number of MIMO layers]	
[Verify the PDSCH mapping Type A HARQ soft	[1-4]
combining performance under 4 receive antenna	
conditions.]	
[Verify the PDSCH mapping Type A enhanced	[3-2]
performance requirement Type X under 4 receive	
antenna conditions and with 3 MIMO layers.]	

Table 5.2.3.2.1-2: Test parameters

Parameter			Value
Channel bandwidth		MHz	20 for Test 2-2
Charinei bandwidth		IVITZ	40 for other tests
Duplex mode			TDD
Active DL BWP ind	ex		1
	First PRB		0
DL BWP	Number of continuous DDD	PRBs	51 for Test 2-2
configuration #1	Number of contiguous PRB	PRDS	106 for other tests
	Subcarrier spacing	kHz	30
PDCCH	Number of PRBs in CORESET	PRBs	48 for Test 2-2
configuration	Nulliber of PRBS III CORESET	FRDS	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	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		N/A
	size		IN/A
	DMRS Type		Type 1
PDSCH DMRS	Number of additional DMRS		2 for Tests 1-1
configuration	Number of additional DIVING		1 for other tests
	Length		1
Number of HAPO	Number of UADO Processes		16 for Test 1-4, [2-1]
Number of HARQ Processes			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

			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)
1-1	R.PDSCH.2- 1.1 TDD	QPSK, 0.30	FR1.30-1	TDLB100-400	2x4, ULA Low	70	[-3.9]
1-2	R.PDSCH.2- 1.2 TDD	QPSK, 0.30	FR1.30-1	TDLC300-100	2x4, ULA Low	70	[-2.7]
1-3	R.PDSCH.2- 4.1 TDD	256QAM, 0.82	FR1.30-1	TDLA30-10	2x4, ULA Low	70	[TBD]
1-4	R.PDSCH.2- 2.1 TDD	16QAM, 0.48	FR1.30-1	TDLC300-100	2x4, ULA Low	30	[-1.1]
1-5	[R.PDSCH.2- 5.1 TDD]	QPSK, 0.3	FR1.30-2	TDLA30-10	2x4, ULA Low	70	[-3.9]
1-6	[R.PDSCH.2- 6.1 TDD]	QPSK, 0.30	FR1.30-3	TDLA30-10	2x4, ULA Low	70	[-3.9]

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

		Madadata			Propagation Correlation matrix and condition antenna configuration	Reference value	
Test num.	Reference channel	Modulation format and code rate	TDD UL-DL pattern			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	[13.8]

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

		Ma dedation				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)	
3-1	R.PDSCH.2- 2.3 TDD	16QAM, 0.48	FR1.30-1	TDLA30-10	4x4, ULA Low	70	[11.4]	
3-2	R.PDSCH.2- 2.3 TDD	16QAM, 0.48	FR1.30-1	TDLA30-10	4x4, ULA Medium A	70	[22.9]	

## Table 5.2.3.2.1-6: Minimum performance for Rank 4

		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)	
4-1	R.PDSCH.2- 2.4 TDD	16QAM, 0.48	FR1.30-1	TDLA30-10	4x4, ULA Low	70	[16.1]	

## 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			Value
Channel bandwidth		MHz	40
Duplex mode			TDD
Active DL BWP index	(		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 A
	k0		0
	Starting symbol (S)		2
	Length (L)		12
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
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 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

				Andria Com			Correla	Cor	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	TBD				

## 5.2.3.2.3 Minimum requirements for PDSCH Mapping Type B

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

The test purposes are specified in Table 5.2.3.2.3-1.

## Table 5.2.3.2.3-1: Tests purpose

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

#### Table 5.2.3.2.3-2: Test parameters

	Parameter	Unit	Value
Channel bandwidth		MHz	40
Duplex mode			FDD
Active DL BWP index	X		1
DL BWP	First PRB		0
configuration #1	Number of contiguous PRB	PRBs	106
configuration #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		N/A
	size		
PDSCH DMRS	DMRS Type		Type 1
configuration	Number of additional DMRS		1
Length			1
Number of HARQ Pr	ocesses		8
K1 value (PDSCH-to-HARQ-ti	ming-indicator)		Specific to each UL-DL pattern

Table 5.2.3.2.3-3: Minimum performance for Rank 1

Test num.	Reference channel	Modulation format and code rate	TDD UL-DL pattern	Propagation condition	Correlation matrix and antenna configuration	Reference value	
						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	[-4.0]

## 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** 

	Parameter	Unit	Value
DL BWP			
configuration	Cyclic prefix		Normal
#1			
Common	Physical Cell ID		0
serving cell	SSB position in burst		1
parameters	SSB periodicity	ms	20
PDCCH	Slots for PDCCH monitoring		TBD
configuration	Number of PDCCH candidates		TBD
	First subcarrier index in the PRB		0
	used for CSI-RS (k <sub>0</sub> )		, and the second
			CSI-RS resource 1:
			4
			CSI-RS resource 2:
	First OFDM symbol in the PRB		8
	used for CSI-RS (Io)		CSI-RS resource 3:
			4
			CSI-RS resource 4:
	Number of CSI-RS ports (X)		8
	CDM Type		No CDM
CSI-RS for	Density (ρ)		3
tracking	• " /		15 kHz SCS: 20
tracking	CSI-RS periodicity	Slots	30 kHz SCS: 40
			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
			SP Type I, Random
			per slot with REG
Precoding config	guration		bundling granularity
			for number of Tx
Oursels als fam. "	war at Dan		larger than 1
Symbols for all u	inused Kes		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.	TDLA30-10	1x2 Low	1	[8.2]
					1-2.1 FDD				
2	10 MHz	24	2	2	R.PDCCH.	TDLC300-	1x2 Low	1	[8.1]
					1-2.3 FDD	100			
3	10 MHz	48	2	4	R.PDCCH.	TDLA30-10	1x2 Low	1	[5.7]
					1-2.4 FDD				
4	10 MHz	48	1	4	R.PDCCH.	TDLA30-10	1x2 Low	1	[4.6]
					1-1.1 FDD				
5	10MHz	48	2	16	R.PDCCH.	TDLA30-10	1x2 Low	1	TBD
					1-2.6 FDD				

### 5.3.2.1.2 2 Tx Antenna performances

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

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

			CORES				Antenna	Reference value	
Test numbe r	Bandw idth	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	[1.6]
					1-2.2 FDD	100			
2	10 MHz	48	2	8	R.PDCCH.	TDLC300-	2x2 Low	1	[-1.6]
					1-2.5 FDD	100			
3	10 MHz	48	1	8	R.PDCCH.	TDLA30-10	2x2 Low	1	TBD
					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 Ai					
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 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.	TDLA30-10	1x2 Low	1	[7.0]
					2-1.1 TDD				
2	40 MHz	102	1	4	R.PDCCH.	TDLC300-	1x2 Low	1	[3.2]
					2-1.2 TDD	100			[3.2]
3	40 MHz	48	2	16	R.PDCCH.	TDLC300-	1x2 Low	1	[ 4 5]
3	40 IVIDZ	40		10	2-2.1 TDD	100	IXZ LOW	ı	[-4.5]

### 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	TBD

## 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	apping type nonInterleaved				
REG bundle size		6			
Shift index		0			

### 5.3.3.1.1 1 Tx Antenna performances

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

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

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

### 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	[-4.9]
					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		2	6			
Shift Index		0				

#### 5.3.3.2.1 1 Tx Antenna performances

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

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

			CORES				Antenna	Reference	e value
Test numb r	Bandwidth	CORE SET RB	ET duratio	Aggregati on level	Reference Channel	Propagation Condition	configurat ion and correlatio	Pm-dsg (%)	SNR (dB)
							n Matrix		

#### 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	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	90	1	8	TBD	TDLC300- 100	2x4 Low	1	TBD

# 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. 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	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 2 Low	1	TBD

### 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. 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	Bandwidth	width 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	TBD	

# 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:

Procedure to select CA bandwidth combination in multiple combinations have same largest data rate

Sustained rate minimum duration

PDCCH configuration (AL and DCI format)

MCS values for requirements

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 TBD
- 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 within 10 ms.

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

	Parameter	Unit	Value
PDSCH transmission		-	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	1	Normal
	Slots for PDCCH monitoring		Each slot
	Symbols with PDCCH		Symbols #0
PDCCH configuration	Number of PRBs in CORESET		Table 5.5A-4
o o sun garranten	Number of PDCCH candidates and aggregation levels		TBD
	DCI format		TBD
	Mapping type		Type A
	k0		0
	PDSCH aggregation factor		1
PDSCH	PRB bundling type		Static
configuration	PRB bundling size		WB
Comigaration	Resource allocation type		Type 0
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
	DMRS Type		Type 1
	Number of additional DMRS		1
	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
	without data		2 for 4 Layers CCs
PTRS configuration			PTRS is not configured
	Subcarrier indexes in the PRB used for CSI-RS		$k_0 = 3$ for CSI-RS resource 1,2,3,4
	OFDM symbols in the PRB used for CSI-RS		$I_0 = 6$ for CSI-RS resource 1 and 3 $I_0 = 10$ for CSI-RS resource 2 and 4
	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
			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
			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
NZP CSI-RS for	Subcarrier indexes in the PRB used for	1	
CSI acquisition	CSI-RS		$k_0 = 4$

	OFDM symbols in the PRB used for CSI-RS	l <sub>0</sub> = 12
	Number of CSI-RS ports (X)	Same as number of transmit antenna
	CDM Type	'FD-CDM2'
	Density (p)	1
	CSI-RS periodicity	15 kHz SCS: 20 30 kHz SCS: 40
	CSI-RS offset	0
	Subcarrier indexes in the PRB used for CSI-RS	$k_0 = 0$
	OFDM symbols in the PRB used for CSI-RS	l <sub>0</sub> = 12
ZP CSI-RS for CSI	Number of CSI-RS ports (X)	4
acquisition	CDM Type	'FD-CDM2'
	Density (ρ)	1
	CSI-RS periodicity	15 kHz SCS: 20 30 kHz SCS: 40
	CSI-RS offset	0
Maximum number of	code block groups for ACK/NACK feedback	1
Maximum number of		4
HARQ ACK/NACK b	undling	
Redundancy version	coding sequence	{0,2,3,1}
Precoding configurat	ion	SP Type I, Random per slot with PRB bundling granularity
Symbols for all unuse	ed Res	OCNG Annex A.5
Propagation condition		Static propagation condition  No external noise sources are applied
Antenna	1 layer CCs	[1x2 or 1x4]
configuration	2 layers CCs	[2x2 or 2x4]
Comgulation	4 layers CCs	[4x4]

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

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

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

SCS (kHz)	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	TBD
1	8	0.8	TBD
1	8	0.75	TBD
1	8	0.4	TBD
1	6	1	TBD
1	6	0.8	TBD
1	6	0.75	TBD
1	6	0.4	TBD
1	4	1	TBD
1	4	0.8	TBD
1	4	0.75	TBD
1	4	0.4	TBD
1	2	1	TBD
1	2	0.8	TBD
1	2	0.75	TBD
1	2	0.4	TBD
2	8	1	TBD
2	8	0.8	TBD
2	8	0.75	TBD
2	8	0.4	TBD
2	6	1	TBD
2	6	0.8	TBD
2	6	0.75	TBD
2	6	0.4	TBD
2	4	1	TBD
2	4	0.8	TBD
2	4	0.75	TBD
2	4	0.4	TBD
2	2	1	TBD
2	2	0.8	TBD
2	2	0.75	TBD
2	2	0.4	TBD
4	8	1	TBD
4	8	0.8	TBD
4	8	0.75	TBD
4	8	0.4	TBD
4	6	1	TBD
4	6	0.8	TBD
4	6	0.75	TBD
4	6	0.4	TBD
4	4	1	TBD
4	4	0.8	TBD
4	4	0.75	TBD
4	4	0.4	TBD
4	2	1	TBD
4	2	0.8	TBD
4	2	0.75	TBD
4	2	0.4	TBD
7		0.7	יטטי

# 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
EPRE ratio of PT	DS to DDSCH	dB	scheme 1
Active DL BWP in		ub.	1
Cyclic prefix	idox		Normal
Common	Physical Cell ID		0
serving cell	SSB position in burst		First SSB in Slot #0
parameters	SSB periodicity	ms	20
	Slots for PDCCH monitoring		Each slot
PDCCH	Symbols with PDCCH		0,1
configuration	Number of PDCCH candidates and aggregation levels		TBD
	DCI format		TBD
Cross carrier sch			Not configured
	Mapping type		Type A
	kO		0
	Starting symbol (S)		2
	Length (L)		12
PDSCH	PDSCH aggregation factor		1
configuration	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type VRB-to-PRB mapping type		0 Non-interleaved
	VRB-to-PRB mapping interleaver		
	bundle size		TBD
	DMRS Type		Type 1
	Number of additional DMRS		1
	Length		Single-symbol DM- RS
PDSCH DMRS configuration	DMRS ports indexes		{1000} for Rank1 {1000,1001} for Rank2 {1000,1001,1002} for Rank3 {1000,1001,1002,100 3} for Rank4
	Number of PDSCH DMRS CDM group(s) without data		2
PTRS	Frequency density (K <sub>PT-RS</sub> )		N/A
configuration	Time density ( <i>L<sub>PT-RS</sub></i> )		N/A
	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 (ρ)		3
	CSI-RS periodicity	slot	15 kHz SCS: 20 30 kHz SCS: 40
CSI-RS for tracking	CSI-RS offset	slot	15 kHz SCS: 10 for CSI-RS resource 1 and 2 11 for CSI-RS resource 3 and 4
		Sidt	30 kHz SCS: 20 for CSI-RS resource 1 and 2 21 for CSI-RS resource 3 and 4
Number of HARC	Q Processes		4 For FDD
HARQ ACK/NAC			8 for TDD TBD
	k bundling sion coding sequence		{0,2,3,1}
Rodullation velo	non Journy Joquonioo	l	(5,2,5,1)

K1 value (PDSCH-to-HARQ-timing-indicator)	2 for FDD TBD for TDD
	OCNG as specified in
Symbols for unused Res	A.5

# 6.2 Reporting of Channel Quality Indicator (CQI)

< 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

	P	arameter	Unit	Test 1	Test 2	
Bandwidth			MHz	10	)	
Duplex Mode				FD	D	
•	- 4.5	First PRB		0		
DL BWP configura	ation	Number of contiguous PRB		52		
#1		Subcarrier spacing	kHz	15	5	
SNR			dB	[8] [9]	[14] [15]	
Propagation chan	nel			AWO	GN	
Antenna configura	ation			2x2 with static cha		
				Annex		
Beamforming Mod				TB		
		RS resource Type		Perio		
		ber of CSI-RS ports (X)		4		
		Type		FD-CI	DM2	
ZP CSI-RS		ity (p)		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-I		slot	5/	1	
		RS resource Type		Perio	odic	
		per of CSI-RS ports (X)		2		
		Type		FD-CI		
		ity (p)		1	31VIL	
NZP CSI-RS for		subcarrier index in the PRB			(2.)	
CSI acquisition	used	for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 3	,(6,-)	
	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> )			13	3	
	NZP	CSI-RS-timeConfig dicity and offset	slot	5/	1	
		M RE pattern		0		
CSI-IM		M Resource Mapping				
configuration		м,lcsi-iм)		(4,	9)	
		M timeConfig	slot	5/	1	
ReportConfigType		dicity and offset		Perio	odic	
CQI-table	<del>,</del>			Tabl		
reportQuantity				cri-RI-PI		
timeRestrictionFor	rChann	nelMeasurements		Not con		
		renceMeasurements		Not con		
cqi-FormatIndicate		rencemeasurements		Widek		
pmi-FormatIndicat				Widek		
Sub-band Size	.01		RB	N/A		
CSI-Report period	licity ar	nd offset	slot	5/		
aperiodicTriggerin			5101	Not con		
aponodio miggerin		ebook Type		typel-Sing		
Codebook		ebook Mode		1,750.0	J. G. G. 10.	
configuration	(Co	debookConfig- CodebookConfig-N2)		Not con	figured	
		ebookSubsetRestriction		[0100	0001	
		Restriction		[N//		
Physical channel				[PUC		
. Hydrodi dilatilidi		RI/PMI delay	ms	8	•	
Maximum number			.,,,,	1		
Measurement cha				[TB		

### 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  $\geq \gamma$ , where  $\gamma$  is specified in Table 6.2.2.1.2.1-2;
- c) When transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater than or equal to [0.02].

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

	Parameter		Unit	Test 1	Test 2
Bandwidth			MHz	1(	)
Duplex Mode	Duplex Mode			FD	D
DL BWP configura	ntion	First PRB		0	
#1	ation	Number of contiguous PRB		52	
		Subcarrier spacing	kHz	15	
SNR			dB	[6] [7]	[12] [13]
Propagation chann				TDLA	
Antenna configura				2×	
Correlation configu				ULA	
Beamforming Mod				TB	
		RS resource Type		Perio	
		per of CSI-RS ports (X)		4 FD C	
7D CCL DC		Type		FD-C	DIVIZ
ZP CSI-RS configuration		ity (p) subcarrier index in the PRB		1	
Configuration	used	for CSI-RS (k <sub>0</sub> )		Row	5,4
		OFDM symbol in the PRB used SI-RS (I <sub>0</sub> )		g	ı
	CSI-F	RS dicity and offset	slot	5/	1
		RS resource Type		Perio	odic
		per of CSI-RS ports (X)		2	
		Type		FD-C	DM2
		ity (ρ)		1	
NZP CSI-RS for CSI acquisition		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> )			1:	3
	NZP	CSI-RS-timeConfig dicity and offset	slot	5/	1
		M RE pattern		C	
CSI-IM	CSI-I	M Resource Mapping			
configuration		м,Icsi-iм)		(4,	9)
		M timeConfig dicity and offset	slot	5/	1
ReportConfigType		aria erreet		Perio	odic
CQI-table				Tab	
reportQuantity				cri-RI-P	
timeRestrictionFor	Chann	elMeasurements		Not con	figured
timeRestrictionFor	Interfe	renceMeasurements		Not con	figured
cqi-FormatIndicato				Widel	band
pmi-FormatIndicat	or			Widel	
Sub-band Size			RB	N/	
CSI-Report period			slot	5/	
aperiodicTriggerin				Not con	
		ebook Type		typel-Sin	
Codebook		ebook Mode		1	
configuration		debookConfig- CodebookConfig-N2)		Not con	figured
		ebookSubsetRestriction		0000	
		estriction		[N/	
Physical channel f				[PUC	•
		RI/PMI delay	ms	8	
Maximum number		RQ transmission		1	
Measurement cha	nnel			TB	IJ

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.

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	Duplex Mode			FD	D
DL BWP configura	First PR			0	
#1	Number	of contiguous PRB		52	<u> </u>
	Subcarr	ier spacing	kHz	15	
SNR			dB	TBD TBD	TBD TBD
				[Two tap model sp	
Propagation chan	nel			B.2.4 with <i>a</i> =1,	
Antenna configura	tion			τ <sub>d</sub> =0.4	
Correlation configura				TB	
Beamforming Mod				TB	
Beaminonning wide	CSI-RS resour	ce Type		Perio	
	Number of CSI	-RS ports (X)		4	
	CDM Type	110 porto (71)		FD-CI	
ZP CSI-RS	Density (ρ)			1	
configuration		r index in the PRB		D	
	used for CSI-R	S (k <sub>0</sub> )		Row	5,4
		mbol in the PRB used		9	
	for CSI-RS (I <sub>0</sub> )			9	
	CSI-RS		slot	5/-	1
	periodicity and		0.01		
	CSI-RS resour			Perio	
	Number of CSI	-RS ports (X)		2	
	CDM Type Density (ρ)			FD-CI	
NZP CSI-RS for	First subcarrier index in the PRB			1	
CSI acquisition	used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )			Row 3	,(6,-)
Coracquisition	First OFDM symbol in the PRB used				
	for CSI-RS (I <sub>0</sub> )			13	3
	NZP CSI-RS-ti	meConfia		F/4	
	periodicity and		slot	5/1	
	CSI-IM RE pat			0	
CSI-IM	CSI-IM Resour	ce Mapping			
configuration	(k <sub>CSI-IM</sub> ,I <sub>CSI-IM</sub> )			(4,	9)
	001.1147	,,			
	CSI-IM timeCo		slot	5/·	1
Dan ant Cantin Tuna	periodicity and	onset		Davis	
ReportConfigType CQI-table				Perio Tabl	
reportQuantity				cri-RI-PI	
timeRestrictionFor	ChannelMeasur	aments		Not conf	
timeRestrictionFor				Not conf	
cqi-FormatIndicate		iodicinonio		Subb	
pmi-FormatIndicat				Widek	
Sub-band Size	-		RB	8	
CSI-Report period	icity and offset		slot	5/·	
aperiodicTriggerin				Not conf	
	Codebook Ty	pe		typel-Sing	
Codebook	Codebook Mo			1	<u> </u>
configuration	(CodebookCo			Not conf	figured
	N1,Codebook				
		osetRestriction		0000	
<u> </u>	RI Restriction			[N//	
Physical channel t				TB	
Maxima	CQI/RI/PMI de		ms	8	
Maximum number		HISSION		1 TD	
Measurement channel TBD				l IB	ט

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

	P	arameter	Unit	Test 1 Test 2		st 2	
Bandwidth	ndwidth MHz 40				)		
Duplex Mode					TD	D	
TDD UL-DL patte	rn				FR1.	30-1	
DL BWP configura	ation	First PRB		0			
#1	20011	Number of contiguous PRB			10		
		Subcarrier spacing	kHz		30		
SNR			dB	[8]	[9]	[14]	[15]
Propagation chan	nei			22.14	AW th static cha		oified in
Antenna configura				ZXZ WI	Anne	x B.1	ecinea in
Beamforming Mod		_			TB		
		RS resource Type			Perio		
		ber of CSI-RS ports (X)			<u>4</u>		
7D CCL DC		Type			FD-C		
ZP CSI-RS configuration		subcarrier index in the PRB			1		
Corniguration		for CSI-RS (k <sub>0</sub> )			Row	5,4	
		OFDM symbol in the PRB used					
		SI-RS (I <sub>0</sub> )			9	1	
	CSI-F				4.0		
		dicity and offset	slot		10	/1	
	CSI-F	RS resource Type			Perio	odic	
	Numl	ber of CSI-RS ports (X)			2		
		Туре		FD-CDM2			
	Density (ρ)				1		
NZP CSI-RS for	First subcarrier index in the PRB				Row 3	3.(6)	
CSI acquisition	used	for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )					
	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> )				13	3	
		CSI-RS-timeConfig dicity and offset	slot	10/1			
	CSI-I	M RE pattern			0	)	
CSI-IM		M Resource Mapping					
configuration	-	ım,lcsı-ım)		(4, 9)			
		M timeConfig dicity and offset	slot		10.	/1	
ReportConfigType		alony and oneot			Perio	odic	
CQI-table					Tabl		
reportQuantity					cri-RI-P	MI-CQI	
timeRestrictionFo	rChann	nelMeasurements			Not con		
		renceMeasurements			Not con		
cqi-FormatIndicate					Widel		
pmi-FormatIndica	tor				Widel		
Sub-band Size		1 "	RB		N/		
CSI-Report period			slot		10.		
aperiodicTriggerin		t lebook Type			Not con typel-Sing		
Codebook		lebook Type lebook Mode			typer-om	gieranei	
configuration		debook Config-			I		
3594.44.011		CodebookConfig-N2)			Not con	figured	
		lebookSubsetRestriction			[0100	0001	
		Restriction			[N/		
Physical channel					[PUC		
		RI/PMI delay	ms		[9.		
Maximum number		RQ transmission			1		
Measurement cha	nnel				TB	D	

### 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  $\geq \gamma$ , where  $\gamma$  is specified in Table 6.2.2.2.1-2;
- 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 TBD.

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

	P	arameter	Unit	Test 1	Test 2	
Bandwidth	andwidth			40	)	
Duplex Mode				TD	D	
TDD UL-DL patter	'n			FR1.30-1		
DL BWP configura	ation	First PRB		0		
#1	allOH	Number of contiguous PRB		10		
		Subcarrier spacing	kHz	30	,,	
SNR			dB	TBD TBD	TBD TBD	
Propagation chan				[TDLA	•	
Antenna configura				2×		
Correlation config	<u>uration</u>			ULA		
Beamforming Mod		OC recovered Tyres		TB		
		RS resource Type		Perio		
		ber of CSI-RS ports (X)		4 FD C		
ZP CSI-RS		Type		FD-C		
configuration		ity (p) subcarrier index in the PRB				
Comiguration		for CSI-RS (k <sub>0</sub> )		Row	5,4	
İ		OFDM symbol in the PRB used				
		SI-RS (I <sub>0</sub> )		9		
	CSI-F					
		dicity and offset	slot	10	/1	
		RS resource Type		Perio	odic	
		per of CSI-RS ports (X)		2		
	CDM	Type		FD-C	DM2	
		ity (ρ)		1		
NZP CSI-RS for	First subcarrier index in the PRB			Row 3	) (C )	
CSI acquisition	used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )			Kow 3	5,(6,-)	
	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		
	CSI-I	M RE pattern		0		
CSI-IM configuration		M Resource Mapping м,lcsı-ıм)		(4,	9)	
		M timeConfig dicity and offset	slot	t 10/1		
ReportConfigType		alony and offeet		Perio	odic	
CQI-table				Tabl		
reportQuantity				cri-RI-PI	MI-CQI	
timeRestrictionFo	rChann	elMeasurements		Not con		
timeRestrictionFo	rInterfe	renceMeasurements		Not con	figured	
cqi-FormatIndicate	or			Widel	pand	
pmi-FormatIndicat	tor			Widel	pand	
Sub-band Size			RB	N/.		
CSI-Report period			slot	10		
aperiodicTriggerin				Not con		
		ebook Type		typel-SinglePanel		
Codebook		ebook Mode		1		
configuration		debookConfig- CodebookConfig-N2)		Not con	figured	
		ebookSubsetRestriction		0000		
		Restriction		[N/		
Physical channel				[PUC		
		RI/PMI delay	ms	[9.:		
Maximum number		RQ transmission		1 1		
Measurement cha	nnel			TB	ט	

Table 6.2.2.2.1-2: Minimum requirements

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

### 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 6.2.2.2.2.2-2;
- 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.

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

Bandwidth	d in Annex
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	d in Annex
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	d in Annex
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	d in Annex
#1	d in Annex
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	d in Annex
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	d in Annex
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	iz, and
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	
CSI-RS resource Type	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	
ZP CSI-RS configuration  CDM Type FD-CDM2  Density (p) 1  First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> )  Row 5,4	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	
configuration First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> ) Row 5,4	
used for CSI-RS (k <sub>0</sub> )	
FIIST OF DIVI SYMBOLIM THE PKB USEG	
for CSI-RS (lo)	
CSI-RS slot 10/1	
periodicity and offset	
CSI-RS resource Type Periodic	
Number of CSI-RS ports (X) 2	
CDM Type FD-CDM2	
Density (ρ) 1	
NZP CSI-RS for First subcarrier index in the PRB  CSI acquisition First subcarrier index in the PRB  Row 3,(6,-)	
Collacquisition   used for Coll-Ro (k0, k1)	
First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> )	
NZP CSI-RS-timeConfig	
periodicity and offset slot 10/1	
CSI-IM RE pattern 0	
CSI-IM CSI-IM Resource Mapping	
configuration $(k_{CSI-IM}, I_{CSI-IM})$ (4, 9)	
CSI-IM timeConfig slot 10/1	
periodicity and offset	
ReportConfigType Periodic	
CQI-table Table 2	
reportQuantity cri-RI-PMI-CQI	
timeRestrictionForChannelMeasurements  Not configured	
timeRestrictionForInterferenceMeasurements  Not configured	
cqi-FormatIndicator     Subband       pmi-FormatIndicator     Wideband	
Sub-band Size RB 16	
CSI-Report periodicity and offset slot 10/1	
aperiodicTriggeringOffset Slot Not configured	
Codebook Type typel-SinglePane	
Codebook Codebook Mode 1	<del></del>
configuration (Codebook Config-	
Not configured N1,CodebookConfig-N2)	l
CodebookSubsetRestriction 000001	
RI Restriction [N/A]	
Physical channel for CSI report TBD	
CQI/RI/PMI delay ms [9.5]	
Maximum number of HARQ transmission 1	
Measurement channel TBD	

Table 6.2.2.2.2-2: Minimum requirements

Parameters	Test 1	Test 2
a [%]	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	allOH	Number of contiguous PRB		52		
		Subcarrier spacing	kHz	15	5	
SNR			dB	[5] [6]	[11] [12]	
Propagation chan	nel			AW		
Antenna configura	ation			2×4 with static cha		
Beamforming Mod				Anne: TB		
Dearmorning Woo		RS resource Type		Perio		
		ber of CSI-RS ports (X)		4		
		Type		FD-C		
ZP CSI-RS		ity (ρ)		1 1		
configuration		subcarrier index in the PRB				
garana.		for CSI-RS (k <sub>0</sub> )		Row	5,4	
		OFDM symbol in the PRB used		0		
	for C	SI-RS (I <sub>0</sub> )		9	1	
	CSI-I	RS	slot	5/	1	
		dicity and offset	3101	3/	1	
		RS resource Type		Perio		
		ber of CSI-RS ports (X)		2		
		Туре		FD-C		
		ity (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> )			10	3	
	NZP	CSI-RS-timeConfig dicity and offset	slot	5/	1	
		M RE pattern		0		
CSI-IM configuration		M Resource Mapping м,Ісзнм)		(4,	9)	
		M timeConfig dicity and offset	slot	5/	1	
ReportConfigType				Perio	odic	
CQI-table				Tabl	e 2	
reportQuantity				cri-RI-P	MI-CQI	
timeRestrictionFo				Not con		
		renceMeasurements		Not con		
cqi-FormatIndicate				Widel		
pmi-FormatIndica	tor			Widel		
Sub-band Size		1 "	RB	N/		
CSI-Report period			slot	5/		
aperiodicTriggerin		t lebook Type		Not con		
Codebook		lebook Type lebook Mode		typel-Sing		
configuration	(Co	debook Mode debookConfig- CodebookConfig-N2)		Not con		
		lebookSubsetRestriction		[0100	2001	
		Restriction		[0100		
Physical channel				[PUC		
. Hydrodi dilatillet		RI/PMI delay	ms	8		
Maximum number			0	1		
Measurement cha				TB	D	
-						

### 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 ≥ γ, where γ is specified in Table 6.2.3.1.2.1-2;
- c) When transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater than or equal to TBD.

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

Parameter			Unit	Test 1	Test 2	
Bandwidth			MHz	10		
Duplex Mode				FDD		
DL BWP configuration First PRB				0		
#1	uon	Number of contiguous PRB		52	<u>)</u>	
Subcarrier spacing			kHz	15		
SNR			dB	TBD TBD	TBD TBD	
Propagation chann				TDLA	30-5	
Antenna configura				2x		
Correlation configu				XP High		
Beamforming Mod				TB		
		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		Row	5.4	
		for CSI-RS (k <sub>0</sub> )				
		OFDM symbol in the PRB used		9		
		SI-RS (I <sub>0</sub> )		_		
	CSI-F		slot	5/·	1	
		dicity and offset		Dorie	dia	
		RS resource Type		Perio		
		ber of CSI-RS ports (X)		2 FD-CI		
		Type ity (ρ)		1 1	JIVIZ	
NZP CSI-RS for		subcarrier index in the PRB		I		
CSI acquisition	used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )			Row 3	,(6,-)	
	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> )  NZP CSI-RS-timeConfig periodicity and offset			13	}	
			slot	5/	1	
	CSI-IM RE pattern			0		
CSI-IM	CSI-IM Resource Mapping (kcsi-im,lcsi-im)  CSI-IM timeConfig					
configuration				(4,	9)	
			slot	5/	 1	
		dicity and offset	3101			
ReportConfigType	1			Perio		
CQI-table				Tabl		
reportQuantity	<u> </u>			cri-RI-PI		
timeRestrictionFor				Not conf		
		renceMeasurements		Not con		
cqi-FormatIndicato				Widek		
pmi-FormatIndicat	or			Widek		
Sub-band Size		-1 -#4	RB	N/A		
CSI-Report periodicity and offset		slot	5/			
aperiodicTriggeringOffse				Not conf		
Codebook configuration	Codebook Type Codebook Mode (CodebookConfig-			typel-Sing	jieranei	
				1		
	Ν1,0	CodebookConfig-N2)		Not conf		
		ebookSubsetRestriction		0000		
	RI Restriction			[N//		
Physical channel for CSI report				[PUC	CH]	
CQI/RI/PMI delay			ms	8		
Maximum number	Maximum number of HARQ transmission			1		
Measurement channel				TB		

Table 6.2.3.1.2.1-2: Minimum requirements

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

#### 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.

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

Bandwidth	Parameter			Unit	Test 1	Test 2	
DL BWP configuration #1				MHz	10		
Number of contiguous PRB   S12   Subcarrier spacing   Shr	Duplex Mode				FDD		
SNR	DL BWP configure						
Subcarrier spacing	_	Number of Co					
Two tap model specified in Annex B.2.4 with a=1, fi.e. 5Hz, and fig=0.45µg		Subcarrier sp	pacing				
Propagation channel	SNR			dB			
Antenna configuration							
Antenna configuration	Propagation chan	iei					
Correlation configuration	Antenna configura	tion					
CSI-RS resource Type							
CSI-RS resource Type							
Number of CSI-RS ports (X)	Boarmonning wee		rpe				
CDM Type		Number of CSI-RS	ports (X)				
Density (p)			\				
Used for CSI-RS (k <sub>0</sub> )	ZP CSI-RS						
Selective CSI-RS   Since   S	configuration	First subcarrier inde	x in the PRB		Pow	5.4	
for CSI-RS (lo)   Solot   S		used for CSI-RS (k <sub>0</sub>	)		NOW	5,4	
Tot CSI-RS   (a)			in the PRB used		9		
Periodicity and offset							
CSI-RS resource Type				slot	5/ <sup>-</sup>	1	
Number of CSI-RS ports (X)   2   CDM Type   FD-CDM2					Dorio	dia	
CDM Type							
NZP CSI-RS for CSI acquisition			JUITS (X)				
NZP CSI-RS for CSI acquisition   First subcarrier index in the PRB used for CSI-RS (ko, kr)					i		
Used for CSI-RS (ko, k1)	NZP CSI-RS for				-	·- ·	
First OFDM symbol in the PRB used for CSI-RS (Io)					Row 3	,(6,-)	
for CSI-RS (lo)   NZP CSI-RS-timeConfig periodicity and offset   Slot   S/1	•				10	<u> </u>	
Deriodicity and offset   Siot   S/1					13	<b>)</b>	
CSI-IM CSI-IM Resource Mapping CSI-IM Resource Mapping (KcsI-IM, IcsI-IM)  CSI-IM timeConfig periodicity and offset  ReportConfigType  CQI-table  ReportQuantity  timeRestrictionForChannelMeasurements  timeRestrictionForInterferenceMeasurements  cqi-FormatIndicator  mi-FormatIndicator  Subband Sub-band Size  CSI-Report periodicity and offset  Codebook  Codebook Type  Codebook Config-N1, CodebookConfig-N1, CodebookConfig-N1, CodebookConfig-N2)  CQIRI/PMI delay  Maximum number of HARQ transmission  (4, 9)  Periodic  CSI-IM Resource Mapping  (4, 9)  Periodic  Slot  5/1  Periodic  Cri-RI-PMI-CQI  Table 2  reportQuantity  cri-RI-PMI-CQI  Not configured  timeRestrictionForInterferenceMeasurements  Not configured  Not configured  1  Not configured  Not configured  1  Not configured  1  Not configured  1  Not configured  1  Not configured  Not configured  1  Not configured  1  Not configured  1  Not configured  Not configured  1  Not confi				elot	5/-	1	
CSI-IM Resource Mapping (kcsi-im, lcsi-im) (4, 9)  CSI-IM timeConfig periodicity and offset slot slot sold slot speriodic slot slot since configuration  ReportConfigType				3101			
configuration  (KcsI-IM, IcsI-IM)  (CSI-IM timeConfig periodicity and offset  ReportConfigType  CQI-table reportQuantity timeRestrictionForChannelMeasurements timeRestrictionForInterferenceMeasurements timeRestrictionForInterferenceMeasurements timeRestrictionForInterferenceMeasurements cqi-FormatIndicator subband pmi-FormatIndicator Subband pmi-FormatIndicator Subband Sub-band Size  CSI-Report periodicity and offset aperiodicTriggeringOffset  Codebook configuration  Codebook Codebook Config-N1, CodebookConfig-N1, CodebookConfig-N2) CodebookSubsetRestriction RI Restriction RI Restriction CQI/RI/PMI delay Maximum number of HARQ transmission  Slot  5/1 Not configured typeI-SinglePanel Codebook Not configured Not configured TBD CQI/RI/PMI delay Ms  8  Maximum number of HARQ transmission	001.114				0		
CSI-IM timeConfig periodicity and offset  ReportConfigType CQI-table reportQuantity timeRestrictionForChannelMeasurements timeRestrictionForInterferenceMeasurements Cqi-FormatIndicator pmi-FormatIndicator Subband Sub-band Size CSI-Report periodicity and offset aperiodicTriggeringOffset Codebook configuration  Codebook Codebook Configuration RI Restriction RI Restriction RI Restriction CQI/RI/PMI delay Maximum number of HARQ transmission  Periodic Slot Slot Table 2 Periodic Cri-Report Slot And configured Wideband Not configured Sub-band Size RB					(4	0)	
ReportConfigType	Corniguration				(4,	9)	
ReportConfigType		CSI-IM timeConfig					
ReportConfigType         Periodic           CQI-table         Table 2           reportQuantity         cri-RI-PMI-CQI           timeRestrictionForChannelMeasurements         Not configured           timeRestrictionForInterferenceMeasurements         Not configured           cqi-FormatIndicator         Subband           pmi-FormatIndicator         Wideband           Sub-band Size         RB         8           CSI-Report periodicity and offset         slot         5/1           aperiodicTriggeringOffset         Not configured           Codebook         Codebook Type         typel-SinglePanel           Codebook         Codebook Mode         1           configuration         (CodebookConfig-N2)         Not configured           Not configured         Not configured           Not configured         Not configured           Tabel         Not configured           Not configured         Not configured           Not configured         Not configured           Tabel         Not configured			ıt	slot	5/	1	
CQI-table         Table 2           reportQuantity         cri-RI-PMI-CQI           timeRestrictionForChannelMeasurements         Not configured           timeRestrictionForInterferenceMeasurements         Not configured           cqi-FormatIndicator         Subband           pmi-FormatIndicator         Wideband           Sub-band Size         RB         8           CSI-Report periodicity and offset         slot         5/1           aperiodicTriggeringOffset         Not configured           Codebook Type         typel-SinglePanel           Codebook Mode         1           (Codebook Mode         1           (CodebookConfig-N2)         Not configured           N1,CodebookConfig-N2)         Not configured           RI Restriction         [N/A]           Physical channel for CSI report         TBD           CQI/RI/PMI delay         ms         8           Maximum number of HARQ transmission         1	ReportConfigType	porrounding arra orros	•		Perio	odic	
timeRestrictionForChannelMeasurements timeRestrictionForInterferenceMeasurements Cqi-FormatIndicator Subband  pmi-FormatIndicator Sub-band Size CSI-Report periodicity and offset aperiodicTriggeringOffset Codebook Configuration  CodebookConfig-N1,CodebookConfig-N1,CodebookConfig-N2) CodebookSubsetRestriction RI Restriction Physical channel for CSI report CQI/RI/PMI delay Maximum number of HARQ transmission  Not configured N	CQI-table						
timeRestrictionForChannelMeasurements timeRestrictionForInterferenceMeasurements Cqi-FormatIndicator Subband  pmi-FormatIndicator Sub-band Size CSI-Report periodicity and offset aperiodicTriggeringOffset Codebook Configuration  CodebookConfig-N1,CodebookConfig-N1,CodebookConfig-N2) CodebookSubsetRestriction RI Restriction Physical channel for CSI report CQI/RI/PMI delay Maximum number of HARQ transmission  Not configured N	reportQuantity				cri-RI-PI	VI-CQI	
cqi-FormatIndicator         Subband           pmi-FormatIndicator         Wideband           Sub-band Size         RB         8           CSI-Report periodicity and offset         slot         5/1           aperiodicTriggeringOffset         Not configured           Codebook Type         typel-SinglePanel           Codebook         Codebook Mode         1           (Codebook Config-N1, CodebookConfig-N2)         Not configured           N1,CodebookConfig-N2)         Not configured           CodebookSubsetRestriction         000001           RI Restriction         [N/A]           Physical channel for CSI report         TBD           CQI/RI/PMI delay         ms         8           Maximum number of HARQ transmission         1	timeRestrictionFor						
pmi-FormatIndicator         Wideband           Sub-band Size         RB         8           CSI-Report periodicity and offset aperiodicTriggeringOffset         slot         5/1           AperiodicTriggeringOffset         Not configured           Codebook Type         typel-SinglePanel           Codebook         1           Codebook Mode configuration         1           (CodebookConfig-N2)         Not configured           N1,CodebookConfig-N2)         Not configured           CodebookSubsetRestriction         000001           RI Restriction         [N/A]           Physical channel for CSI report         TBD           CQI/RI/PMI delay         ms         8           Maximum number of HARQ transmission         1			ments				
Sub-band Size         RB         8           CSI-Report periodicity and offset         slot         5/1           aperiodicTriggeringOffset         Not configured           Codebook Type         typel-SinglePanel           Codebook Mode         1           configuration         (Codebook Config-N2)           N1,CodebookConfig-N2)         Not configured           CodebookSubsetRestriction         000001           RI Restriction         [N/A]           Physical channel for CSI report         TBD           CQI/RI/PMI delay         ms         8           Maximum number of HARQ transmission         1							
CSI-Report periodicity and offset         slot         5/1           aperiodicTriggeringOffset         Not configured           Codebook Codebook Configuration         Codebook Mode Codebook Mode Codebook Config-N2)         1           (CodebookConfig-N2) CodebookSubsetRestriction RI Restriction         000001           Physical channel for CSI report CQI/RI/PMI delay         TBD           Maximum number of HARQ transmission         1		or					
aperiodicTriggeringOffset         Not configured           Codebook configuration         Codebook Mode (Codebook Config-N2) (CodebookConfig-N1, CodebookConfig-N2) (CodebookSubsetRestriction (NA) (NA)         Not configured (NA)           Physical channel for CSI report (CQI/RI/PMI delay)         TBD           Maximum number of HARQ transmission         1							
Codebook configuration         Codebook Mode (CodebookConfig-N1,CodebookConfig-N2)         Not configured           Physical channel for CSI report         RI Restriction         TBD           CQI/RI/PMI delay         RS           Maximum number of HARQ transmission         typel-SinglePanel           1         1           Not configured         000001           RI Restriction         [N/A]           TBD         000001           TBD				siot			
Codebook configuration         Codebook Mode (CodebookConfig-N1,CodebookConfig-N2)         Not configured           CodebookSubsetRestriction RI Restriction         000001           Physical channel for CSI report CQI/RI/PMI delay         TBD           Maximum number of HARQ transmission         1							
configuration         (CodebookConfig-N1,CodebookConfig-N2)         Not configured           CodebookSubsetRestriction         000001           RI Restriction         [N/A]           Physical channel for CSI report         TBD           CQI/RI/PMI delay         ms         8           Maximum number of HARQ transmission         1	Codebook	Codebook Mode			• • • • • • • • • • • • • • • • • • • •	jieranel	
N1,CodebookConfig-N2)					-		
CodebookSubsetRestriction         000001           RI Restriction         [N/A]           Physical channel for CSI report         TBD           CQI/RI/PMI delay         ms         8           Maximum number of HARQ transmission         1	20920001		ia-N2)		Not conf	iigured	
RI Restriction         [N/A]           Physical channel for CSI report         TBD           CQI/RI/PMI delay         ms         8           Maximum number of HARQ transmission         1					0000	001	
Physical channel for CSI report TBD  CQI/RI/PMI delay ms 8  Maximum number of HARQ transmission 1							
CQI/RI/PMI delay ms 8  Maximum number of HARQ transmission 1							
Maximum number of HARQ transmission 1		CQI/RI/PMI delay					
Measurement channel TRD	Maximum number	Maximum number of HARQ transmission			1		
Nicasarchioni chaillei	Measurement cha	Measurement channel			TB	D	

Table 6.2.3.1.2.2-2: Minimum requirements

Parameters	Test 1	Test 2
α [%]	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

Parameter			Unit	Test 1 Test 2		Test 2	
Bandwidth			MHz	40			
Duplex Mode					TDD		
TDD UL-DL patter	rn			FR1.30-1			
DL BWP configuration First PRB					0		
#1	20011	Number of contiguous PRB			10		
		Subcarrier spacing	kHz	30			
SNR			dB	[5]	[6]	[11] [12]	
Propagation chan	nei			24	AW(		
Antenna configura				ZX4 WIL	n static cha Annex	annel specified in B.1	
Beamforming Mod					TB		
		RS resource Type		Periodic			
		per of CSI-RS ports (X)		4			
		Type		FD-CDM2			
ZP CSI-RS		ity (ρ)			1		
configuration		subcarrier index in the PRB			Row 5,4		
		for CSI-RS (k <sub>0</sub> )				,	
		OFDM symbol in the PRB used			9		
	CSI-F	SI-RS (I <sub>0</sub> )					
		dicity and offset	slot		10/	/1	
		RS resource Type			Perio	odic	
		ber of CSI-RS ports (X)			2		
		Type			FD-CDM2		
		ity (p)		1			
NZP CSI-RS for	First subcarrier index in the PRB			D 0 (0 )		(0.)	
CSI acquisition	used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )				Row 3	,(6,-)	
·		OFDM symbol in the PRB used		13			
	for CSI-RS (I <sub>0</sub> )  NZP CSI-RS-timeConfig				13	)	
			slot	10/1		/1	
	periodicity and offset		3101				
001.114	CSI-IM RE pattern				0		
CSI-IM	CSI-IM Resource Mapping				/4	0)	
configuration	(KCSI-I	m,lcsi-im)		(4, 9)			
	CSI-I	M timeConfig					
		dicity and offset	slot	10/1		/1	
ReportConfigType		dioity and onoct			Perio	odic	
CQI-table					Tabl		
reportQuantity					cri-RI-PI		
timeRestrictionFo	rChann	elMeasurements			Not conf		
		renceMeasurements			Not conf		
cqi-FormatIndicate	or				Widek		
pmi-FormatIndicat	tor				Widek	oand	
Sub-band Size			RB	N/A		A	
CSI-Report periodicity and offset			slot	10/1			
aperiodicTriggeringOffset				Not conf			
	Codebook Type Codebook Mode				typel-Sing	glePanel	
Codebook					1		
configuration		debookConfig- CodebookConfig-N2)			Not conf	figured	
		ebookSubsetRestriction			[0100	0001	
		RI Restriction			[N//		
Physical channel for CSI report					[PUC	•	
. Hydrodi dridiiildi	CQI/RI/PMI delay			[9.5]			
Maximum number			ms		1		
Measurement channel					TB		
	1	1					

### 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 TBD.

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

Parameter			Unit	Test 1 Test 2		st 2	
Bandwidth			MHz		40		
Duplex Mode				TDD			
TDD UL-DL patter	TDD UL-DL pattern  First PRB			FR1.30-1			
DL BWP configur		0					
DL BWP configuration #1  Number of contiguous PRB				106			
	kHz	30					
SNR			dB	TBD	TBD	TBD	TBD
Propagation chan					[TDLA		
Antenna configura					2x		
Correlation config					XP F		
Beamforming Mod		_		TBD			
	CSI-I	RS resource Type		Periodic			
		ber of CSI-RS ports (X)		4			
70.001.00		Type		FD-CDM2			
ZP CSI-RS		ity (ρ)		1			
configuration		subcarrier index in the PRB			Row	5,4	
	Eirct	for CSI-RS (k <sub>0</sub> ) OFDM symbol in the PRB used					
		SI-RS (10)			9	)	
	CSI-F						
		dicity and offset	slot		10.	/1	
		RS resource Type			Perio	odic	
		ber of CSI-RS ports (X)			2		
		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> )				Row 3	3,(6,-)	
	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> )  NZP CSI-RS-timeConfig				1:	3	
			slot	10/1			
	periodicity and offset		SIUL		10,	/ 1	
	CSI-IM RE pattern CSI-IM Resource Mapping (kcsi-im,lcsi-im) CSI-IM timeConfig				0		
CSI-IM configuration					(4,	9)	
			slot	slot 10/1		/1	
		dicity and offset	0.01				
ReportConfigType	9			Periodic			
CQI-table					Table 2 cri-RI-PMI-CQI		
reportQuantity	-0	-104					
timeRestrictionFo					Not con		
		renceMeasurements			Not con Widel		
cqi-FormatIndicate pmi-FormatIndicate					Widel		
	ıUI		RB				
	Sub-band Size			N/A 10/1			
CSI-Report periodicity and offset aperiodicTriggeringOffset		slot		Not con			
		lebook Type			typel-Sing		
Codebook	Codebook Type  Codebook Mode				typer-only	gier arier	
configuration	(Co	debook Mode debookConfig- CodebookConfig-N2)			Not con	figured	
		lebookSubsetRestriction			0000	<u> </u>	
	RI Restriction				[N/		
Physical channel for CSI report					-		
i riyolcar channer	CQI/RI/PMI delay			[PUCCH] [9.5]			
Maximum number	Maximum number of HARQ transmission				<u>[</u> 9.	_	
	Measurement channel				 TB		
nododiomon ondino				1			

Table 6.2.3.2.2.1-2: Minimum requirements

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

#### 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.

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

Parameter		Unit	Test 1	Test 2	
Bandwidth			MHz	40	)
Duplex Mode				TD	
TDD UL-DL patter	'n			FR1.30-1	
DL BWP configura	ation	First PRB		0	
#1	ation	Number of contiguous PRB		10	
		Subcarrier spacing	kHz	30	)
SNR			dB	TBD TBD	TBD TBD
Propagation chan	പ			[Two tap model sp B.2.4 with a=1,	
i ropagation onam	.0.			т <sub>d</sub> =0.11	
Antenna configura	tion			TB	
Correlation configu				TB	
Beamforming Mod				[TB	
		RS resource Type		Perio	•
		ber of CSI-RS ports (X)		4	
		Type		FD-C	DM2
ZP CSI-RS		ity (p)		1	
configuration		subcarrier index in the PRB		_	- 4
		for CSI-RS (k <sub>0</sub> )		Row	5,4
		OFDM symbol in the PRB used		0	
		SI-RS (l₀)		9	
	CSI-F	_	slot	10	/1
		dicity and offset	3101		
		RS resource Type		Perio	
		per of CSI-RS ports (X)		2	
		Type		FD-CDM2	
		ity (ρ)		1	
NZP CSI-RS for		subcarrier index in the PRB		Row 3,(6,-)	
CSI acquisition		for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )			
		OFDM symbol in the PRB used		13	
	NZD	SI-RS (I <sub>0</sub> ) CSI-RS-timeConfig			
		dicity and offset	slot	10	/1
		M RE pattern		0	
CSI-IM		M Resource Mapping			
configuration		м,I <sub>CSI-IM</sub> )		(4,	9)
( 33, 33)			( ',	-,	
	CSI-I	M timeConfig	alat	10	/4
	perio	dicity and offset	slot	10	/1
ReportConfigType	<b>!</b>			Perio	
CQI-table				Tabl	e 2
reportQuantity				cri-RI-PI	
timeRestrictionFor				Not con	
		renceMeasurements		Not con	
	cqi-FormatIndicator			Subb	
pmi-FormatIndicator			Widel		
Sub-band Size		RB	16		
CSI-Report periodicity and offset		slot	10,		
aperiodicTriggerin				Not con	
Codebook Type			typel-Sing	giePanel	
Codebook		ebook Mode		1	
configuration		debookConfig-		Not con	figured
		CodebookConfig-N2)			-
CodebookSubsetRestriction			0000		
RI Restriction Physical channel for CSI report			[N/.	•	
rnysicai channei i			m-0	TB	
Maximum numbar	CQI/RI/PMI delay Maximum number of HARQ transmission		ms	[9.	•
Measurement cha		ng nansinission		1 TB	
ivicasurement cha	mei		1	] 10	U

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:

$$\gamma = \frac{t_{ue, follow 1, follow 2}}{t_{rnd1, rnd2}}$$

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 Typel-SinglePanel Codebook

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

Table 6.3.2.1.1-1: Test parameters (single layer)

Pai	rameter	Unit	Test 1
Bandwidth		MHz	10
Duplex Mode			FDD
	First PRB		0
DL BWP	Number of		52
configuration	contiguous PRB		
#1 	Subcarrier	kHz	15
Propagation cha	spacing		TDLA30-5
			High XP 4 x 2
Antenna configu	uration		(N1,N2) = (2,1)
Beamforming M	lodel		TBD
	CSI-RS resource		Aperiodic
	Type		Aperiodic
	Number of CSI-		4
	RS ports (X)		
	CDM Type		FD-CDM2 1
ZP CSI-RS	Density (ρ) First subcarrier		I.
configuration	index in the PRB		
l comigation	used for CSI-RS		Row 5, (4,-)
	$(k_0, k_1)$		
	First OFDM		
	symbol in the PRB		(9,-)
	used for CSI-RS		(0, )
	(l <sub>0</sub> , l <sub>1</sub> )		
	CSI-RS	slot	5/1
	interval and offset CSI-RS resource		
	Type		Aperiodic
	Number of CSI-		
	RS ports (X)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
NZP CSI-RS	First subcarrier		
for CSI	index in the PRB		Row 4, (0,-)
acquisition	used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		, , ,
	First OFDM		
	symbol in the PRB		(40.)
	used for CSI-RS		(13,-)
	$(I_0, I_1)$		
	CSI-RS		5/1
	interval and offset		
	CSI-IM RE pattern		Patten 0
	CSI-IM Resource		
CSI-IM	Mapping (kcsі-ім,lcsі-ім)		(4,9)
configuration	(NCSI-IM,ICSI-IM)		
	CSI-IM timeConfig	-1.1	E./4
	interval and offset	slot	5/1
ReportConfigTy	pe	-	Aperiodic
CQI-table	CQI-table		Table 1
reportQuantity	- 01		cri-RI-PMI-CQI
	ForChannelMeasure		Not configured
ments timePestriction	ForInterferenceMeas		
urements	onnenerenceivieas		Not configured
cqi-FormatIndic	ator		Wideband
pmi-FormatIndicator			Wideband
	CSI-Report interval and offset		5/1
aperiodicTriggeringOffset		slot	0
	Codebook Type	-	typel-SinglePanel
Codebook	Codebook Mode		1
configuration	(CodebookConfig-		(0.4)
	N1,CodebookConf		(2,1)
	ig-N2)		

	CodebookSubset Restriction		11111111
	RI Restriction		0000001
Physical channel for CSI report			PUSCH
CQI/RI/P	MI delay	ms	8
Maximum number of HARQ transmission			4
Measurement channel			MCS 13, TBD for reference channel
Note 1: For random precoder selection, the precoder shall be updated in each slot (1 ms granularity).			recoder shall be updated in each
Note 2:	Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#[(n-4)], this reported PMI cannot be applied at the eNB downlink before slot#[(n+4)].		
Note 3: Randomization of the principle beam direction shall be used as specified in TBD.			direction shall be used as

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
DI DIVID	First PRB		0
DL BWP configuration	Number of contiguous PRB		52
#1	Subcarrier		
	spacing	kHz	15
Propagation cha			TDLA30-5
Antenna configu	uration		High XP 8 x 2
			(N1,N2) = (4,1) TBD
Beamforming M	CSI-RS resource		
	Type		Aperiodic
	Number of CSI-		4
	RS ports (X)		
	CDM Type		FD-CDM2
ZP CSI-RS	Density (ρ)		1
configuration	First subcarrier index in the PRB		
Comigaration	used for CSI-RS		Row 5, (4,-)
	(k <sub>0</sub> , k <sub>1</sub> )		
	First OFDM		
	symbol in the PRB		(9,-)
	used for CSI-RS		(-, /
	(l <sub>0</sub> , l <sub>1</sub> ) CSI-RS		
	interval and offset	slot	5/1
	CSI-RS resource		Aperiodic
	Туре		Aperiodic
	Number of CSI-		8
	RS ports (X) CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
NZD OOL DO	First subcarrier		•
NZP CSI-RS for CSI	index in the PRB		Row 8, (4,6)
acquisition	used for CSI-RS		Now 8, (4,0)
	(k <sub>0</sub> , k <sub>1</sub> ) First OFDM		
	symbol in the PRB		
	used for CSI-RS		(5,-)
	(l <sub>0</sub> , l <sub>1</sub> )		
	CSI-RS	slot	5/1
	interval and offset	0.00	
	CSI-IM RE pattern CSI-IM Resource		Patten 0
	Mapping		
CSI-IM	(kcsi-im,lcsi-im)		(4,9)
configuration	,		
	CSI-IM timeConfig	slot	5/1
PoportConfigTv	interval and offset		Aperiodic
ReportConfigTy CQI-table	pe		Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasure			
ments			Not configured
	ForInterferenceMeas		Not configured
urements cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
	CSI-Report interval and offset		5/1
aperiodicTriggeringOffset		slot	0
	Codebook Type		typel-SinglePanel
Codebook	Codebook Mode		1
configuration	(CodebookConfig- N1,CodebookConf		(4,1)
	ig-N2)		(4,1)
L	·g · ·-/		

	CodebookSubset Restriction		0x FFFF
	RI Restriction		0000010
Physical channel for CSI report			PUSCH
CQI/RI/P	MI delay	ms	8
Maximum number of HARQ transmission			4
Measurement channel			MCS13, TBD for reference channel
Note 1: For random precoder selection slot (1 ms granularity).		ction, the p	recoder shall be updated in each
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)].			nk slot not later than slot#[(n-4)],
Note 3: Randomization of the principle beam direction shall be used as specified in TBD.		direction shall be used as	

Table 6.3.2.1.2-2: Minimum requirement

Parameter	Test 1
γ	TBD

#### 6.3.2.2 TDD

## 6.3.2.2.1 Single PMI with 4TX TypeI-SinglePanel Codebook

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

Table 6.3.2.2.1-1: Test parameters (single layer)

Par	rameter	Unit	Test 1
Bandwidth		MHz	40
Duplex Mode	Duplex Mode		TDD
TDD DL-UL con	figuration		FR1.30-1 as specified in Annex A
	First PRB		0
DL BWP	Number of		Ţ.
configuration	contiguous PRB		106
#1	Subcarrier	kHz	30
Drawa wation abo	spacing	141.12	
Propagation cha			TDLA30-5 High XP 4 x 2
Antenna configu	uration		(N1,N2) = (2,1)
Beamforming M	lodel		TBD
	CSI-RS resource		Aperiodic
	Type		7 (201100110
	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		2, ( , ,
	(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		
	Type		Aperiodic
	Number of CSI-		4
	RS ports (X)		•
	CDM Type		FD-CDM2
	Density (ρ) First subcarrier		1
NZP CSI-RS for CSI	index in the PRB		D 4 (0 )
acquisition	used for CSI-RS		Row 4, (0,-)
aoquioinon	(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	slot	10/1
	interval and offset		
	CSI-IM RE pattern CSI-IM Resource		Patten 0
	Mapping		(1.5)
CSI-IM	(kcsi-im,lcsi-im)		(4,9)
configuration			
	CSI-IM timeConfig	slot	10/1
ReportConfigTy	interval and offset		Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionF	orChannelMeasure		Not configured
ments timeRestrictionForInterferenceMeas			. 13t 35tmgaraa
timeRestrictionF urements	-orinterrerenceivleas		Not configured
cqi-FormatIndic	ator		Wideband
	pmi-FormatIndicator		Wideband
CSI-Report interval and offset		slot	10/1
aperiodicTrigge			0
	Codebook Type		typel-SinglePanel
	Codebook Mode		1

Codebook configuration	(CodebookConfig- N1,CodebookConf ig-N2)		(2,1)
	CodebookSubset Restriction		11111111
	RI Restriction		0000001
Physical char	nel for CSI report		PUSCH
CQI/RI/PMI delay		ms	9.5
Maximum number of HARQ transmission			4
Measurement channel			MCS13, TBD for reference channel
	Note 1: For random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity).		
ba 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-6)], this reported PMI cannot be applied at the eNB downlink before slot#[(n+6)].		
	ote 3: Randomization of the principle beam direction shall be used as 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)

Pai	rameter	Unit	Test 1
Bandwidth		MHz	40
Duplex Mode			TDD
TDD DL-UL cor	TDD DL-UL configurations		FR1.30-1 as specified in Annex A
	First PRB		0
DL BWP	Number of		400
configuration	contiguous PRB		106
#1	Subcarrier	kHz	30
Propagation cha	spacing		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-		
	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		Row 5, (4,-)
	(k <sub>0</sub> , k <sub>1</sub> )		
	First OFDM		
	symbol in the PRB		(9,-)
	used for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		(=, ,
	CSI-RS		
	interval and offset	slot	10/1
	CSI-RS resource		Aperiodic
	Type		Aperiodic
	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		Row 8, (4,6)
acquisition	used for CSI-RS (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		
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 timeRestrictionForlChannelMeasur			cri-RI-PMI-CQI
ements			Not configured
timeRestrictionForInterferenceMeas			Not configured
urements			-
cqi-FormatIndic			Wideband
pmi-FormatIndio		slot	Wideband 10/1
aperiodicTrigge		3101	0
	Codebook Type		typel-SinglePanel
	Codebook Mode		1

Codebook configuration	(CodebookConfig- N1,CodebookConf ig-N2)		(4,1)
	CodebookSubset Restriction		0x FFFF
	RI Restriction		0000010
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	9.5
Maximum number of HARQ transmission			4
Measurement channel			MCS13, TBD for reference channel
Note 1: For random precoder selection, th slot (0.5 ms granularity).		ction, the p	recoder shall be updated in each
ba th	If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#[(n-6)], this reported PMI cannot be applied at the eNB downlink before slot#[(n+6)].		
Note 3: Randomization of the principle beam direction shall be used as specified in TBD.		direction shall be used as	

Table 6.3.2.2.2-2: Minimum requirement

Parameter	Test 1
γ	TBD

# 6.3.3 4RX requirements

#### 6.3.3.1 FDD

#### 6.3.3.1.1 Single PMI with 4TX TypeI-SinglePanel Codebook

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

Table 6.3.3.1.1-1: Test parameters (single layer)

Parameter		Unit	Test 1
Bandwidth		MHz	10
Duplex Mode	T =- = = =		FDD
	First PRB		0
DL BWP configuration	Number of contiguous PRB		52
#1	Subcarrier	1.11-	45
	spacing	kHz	15
Propagation cha	annel		TDLA30-5
Antenna configu	uration		High XP 4 x 4 (N1,N2) = (2,1)
Beamforming M	lodel		TBD
Boarmonning iv	CSI-RS resource		
	Туре		Aperiodic
	Number of CSI-		4
	RS ports (X) CDM Type		FD-CDM2
	Density (ρ)		1 D-CDINZ
ZP CSI-RS	First subcarrier		'
configuration	index in the PRB		
3	used for CSI-RS		Row 5, (4,-)
	$(k_0, k_1)$		
	First OFDM		
	symbol in the PRB		(9,-)
	used for CSI-RS		(9,-)
	(l <sub>0</sub> , l <sub>1</sub> )		
	CSI-RS	slot	5/1
	interval and offset CSI-RS resource		
	Туре		Aperiodic
	Number of CSI-		4
	RS ports (X)		
	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		(12.)
	used for CSI-RS		(13,-)
	(l <sub>0</sub> , l <sub>1</sub> )		
	CSI-RS	slot	5/1
	interval and offset	0.00	
	CSI-IM RE pattern		Patten 0
	CSI-IM Resource		
CSI-IM	Mapping		(4,9)
configuration	(k <sub>CSI-IM</sub> ,l <sub>CSI-IM</sub> )		
Johngaradon	CSI-IM timeConfig		
	interval and offset	slot	5/1
	ReportConfigType		Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
	orChannelMeasure		Not configured
ments			3
timeRestrictionForInterferenceMeas urements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndio	cator		Wideband
CSI-Report interval and offset		slot	5/1
aperiodicTrigge			0
	Codebook Type		typeI-SinglePanel
Codebook	Codebook Mode		1
configuration	(CodebookConfig-		(0.4)
	N1,CodebookConf		(2,1)
	ig-N2)		

	CodebookSubset Restriction		11111111
	RI Restriction		0000001
Physical channel for CSI report			PUSCH
CQI/RI/P	MI delay	ms	8
Maximum number of HARQ transmission			4
Measurement channel			MCS13, TBD for reference channel
Note 1:	slot (1 ms granularity).		
Note 2:	Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#[(n-4)], this reported PMI cannot be applied at the eNB downlink before slot#[(n+4)].		
Note 3: Randomization of the principle beam direction shall be used as specified in TBD.			direction shall be used as

Table 6.3.3.1.1-2: Minimum requirement

Parameter	Test 1
γ	[1.3]

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

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

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

Par	rameter	Unit	Test 1
Bandwidth		MHz	10
Duplex Mode			FDD
	First PRB		0
DL BWP	Number of		52
configuration	contiguous PRB		
#1	Subcarrier	kHz	15
Propagation cha	spacing		TDI A20 5
			TDLA30-5 High XP 8 x 4
Antenna configu	ıration		(N1,N2) = (4,1)
Beamforming M	odel		TBD
-	CSI-RS resource		A maria dia
	Type		Aperiodic
	Number of CSI-		4
	RS ports (X)		
	CDM Type		FD-CDM2
7D CCL DC	Density (ρ)		1
ZP CSI-RS configuration	First subcarrier 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,-)
	(l <sub>0</sub> , l <sub>1</sub> )		
	CSI-RS	slot	5/1
	interval and offset	0.01	G/ .
	CSI-RS resource		Aperiodic
	Type Number of CSI-		
	RS ports (X)		8
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
NZP CSI-RS	First subcarrier		
for CSI	index in the PRB		Row 8, (4,6)
acquisition	used for CSI-RS		NOW 6, (4,6)
aoquiomon	(k <sub>0</sub> , k <sub>1</sub> )		
	First OFDM		
	symbol in the PRB used for CSI-RS		(5,-)
	(l <sub>0</sub> , l <sub>1</sub> )		
	CSI-RS		
	interval and offset	slot	5/1
	CSI-IM RE pattern		Patten 0
	CSI-IM Resource		
	Mapping		(4,9)
CSI-IM	(k <sub>CSI-IM</sub> ,l <sub>CSI-IM</sub> )		(1,0)
configuration	CCL IM time a Countil		
	CSI-IM timeConfig interval and offset	slot	5/1
ReportConfigTy			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasure			
ments			Not configured
timeRestrictionForInterferenceMeas			Not configured
urements			-
	cqi-FormatIndicator		Wideband
pmi-FormatIndio		olot	Wideband 5/4
CSI-Report inte aperiodicTrigge		slot	5/1 0
apenouic mgge	Codebook Type		typel-SinglePanel
Codebook	Codebook Type  Codebook Mode		typer-onigier affer
configuration	(CodebookConfig-		1
	N1,CodebookConf		(4,1)
	ig-N2)		

	CodebookSubset Restriction		0x FFFF
	RI Restriction		0000010
Physical channel for CSI report			PUSCH
CQI/RI/P	MI delay	ms	8
Maximum number of HARQ transmission			4
Measurement channel			MCS13, TBD for reference channel
Note 1: Note 2:	slot (1 ms granularity).  If the UE reports in an ava based on PMI estimation a	ilable uplinl at a downlin	recoder shall be updated in each k reporting instance at slot#n hk slot not later than slot#[(n-4)], at the eNB downlink before
Note 3: Randomization of the principle beam direction shall be used as specified in TRD		direction shall be used as	

Table 6.3.3.1.2-2: Minimum requirement

Parameter	Test 1
γ	TBD

#### 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)

Par	rameter	Unit	Test 1
Bandwidth			40
Duplex Mode			TDD
TDD DL-UL con	figuration		FR1.30-1 as specified in Annex
	First PRB		A 0
DL BWP	Number of		
configuration	contiguous PRB		106
#1	Subcarrier	kHz	30
	spacing	KI IZ	
Propagation cha	annel		TDLA30-5
Antenna configu	ıration		High XP 4 x 4 (N1,N2) = (2,1)
Beamforming M	lodel		TBD
G	CSI-RS resource		Apariadia
	Туре		Aperiodic
	Number of CSI-		4
	RS ports (X)		
	CDM Type		FD-CDM2
ZP CSI-RS	Density (ρ) First subcarrier		1
configuration	index in the PRB		
comigaration	used for CSI-RS		Row 5, (4,-)
	$(k_0, k_1)$		
	First OFDM		
	symbol in the PRB		(9,-)
	used for CSI-RS		(0, )
	(l <sub>0</sub> , l <sub>1</sub> ) CSI-RS		
	interval and offset	slot	10/1
	CSI-RS resource		
	Type		Aperiodic
	Number of CSI-		4
	RS ports (X)		•
	CDM Type		FD-CDM2
	Density (ρ)		1
NZP CSI-RS	First subcarrier 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		(13 -)
	used for CSI-RS		(13,-)
	(l <sub>0</sub> , l <sub>1</sub> )		
	CSI-RS interval and offset		10/1
	CSI-IM RE pattern		Patten 0
	CSI-IM Resource		1 diten 0
	Mapping		(4.0)
CSI-IM	(ксы-ім,Ісы-ім)		(4,9)
configuration			
	CSI-IM timeConfig	slot	10/1
Donort Config Tv	interval and offset		
ReportConfigType CQI-table			Aperiodic Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasure			
ments			Not configured
	timeRestrictionForInterferenceMeas		Not configured
urements			-
cqi-FormatIndic			Wideband
pmi-FormatIndio		clot	Wideband
CSI-Report inte aperiodicTrigge		slot	10/1
apenouic mgge	Codebook Type		typel-SinglePanel
	Codebook Type  Codebook Mode		1
1			· ·

Codebook configuration	(CodebookConfig- N1,CodebookConfig- ig-N2)		(2,1)
	CodebookSubset Restriction		11111111
	RI Restriction		0000001
Physical cha	annel for CSI report		PUSCH
CQI/RI/PMI delay		ms	9.5
Maximum number of HARQ transmission			4
Measurement channel			MCS13, TBD for reference channel
Note 1: For random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity).			recoder shall be updated in each
b: th	Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#[(n-6)], this reported PMI cannot be applied at the eNB downlink before slot#[(n+6)].		k slot not later than slot#[(n-6)],
	: 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 con	figurations		FR1.30-1 as specified in Annex
	First PRB		A 0
DL BWP	Number of		
configuration	contiguous PRB		106
#1	Subcarrier	kHz	30
	spacing	KHZ	
Propagation cha	annel		TDLA30-5
Antenna configu	ıration		High XP 8 x 4
Beamforming M	lodel		(N1,N2) = (4,1) TBD
Dodinionning W	CSI-RS resource		
	Туре		Aperiodic
	Number of CSI-		4
	RS ports (X)		
	CDM Type		FD-CDM2
ZP CSI-RS	Density (ρ) First subcarrier		1
configuration	index in the PRB		
Comigaration	used for CSI-RS		Row 5, (4,-)
	$(k_0, k_1)$		
	First OFDM		
	symbol in the PRB		(9,-)
	used for CSI-RS		(0, )
	(l <sub>0</sub> , l <sub>1</sub> ) CSI-RS		
	interval and offset	slot	10/1
	CSI-RS resource		Amoriodio
	Туре		Aperiodic
	Number of CSI-		8
	RS ports (X)		
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ) First subcarrier		1
NZP CSI-RS	index in the PRB		5
for CSI acquisition	used for CSI-RS		Row 8, (4,6)
acquisition	(k <sub>0</sub> , k <sub>1</sub> )		
	First OFDM		
	symbol in the PRB used for CSI-RS		(5,-)
	(I <sub>0</sub> , I <sub>1</sub> )		
	CSI-RS		10/1
	interval and offset	slot	10/1
	CSI-IM RE pattern		Patten 0
	CSI-IM Resource		
CSI-IM	Mapping		(4,9)
configuration	(ксы-ім,Ісы-ім)		, ,
garadon	CSI-IM timeConfig		
	interval and offset	slot	10/1
ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
ements	ForChannnelMeasur		Not configured
	orInterferenceMeas		
urements	S.III.GITOTOTOGINGAS		Not configured
cqi-FormatIndic	ator		Wideband
pmi-FormatIndio	cator		Wideband
CSI-Report inte		slot	10/1
aperiodicTrigge			0
	Codebook Type		typel-SinglePanel
	Codebook Mode		1

Codebook configuration	(CodebookConfig- N1,CodebookConf ig-N2)		(4,1)	
	CodebookSubset Restriction		0x FFFF	
	RI Restriction		0000010	
Physical cha	annel for CSI report		PUSCH	
CQI/RI/PMI	delay	ms	9.5	
Maximum no transmission	umber of HARQ n		4	
Measureme	nt channel		MCS13, TBD for reference channel	
	or random precoder selection (0.5 ms granularity).	ction, the p	recoder shall be updated in each	
Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#[(n-6)], this reported PMI cannot be applied at the eNB downlink before slot#[(n+6)].				
Note 3: Randomization of the principle beam direction shall be used as specified in TBD.				

Table 6.3.3.2.2-2: Minimum requirement

Parameter	Test 1
γ	TBD

## 6.4 Reporting of Rank Indicator (RI)

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

#### 6.4.1 1RX requirements

(Void)

## 6.4.2 2RX requirements

#### 6.4.2.1 FDD

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

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

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

Table 6.4.2.1-1: RI Test (FDD)

Parameter		Unit	Test 1	Test 2	Test 3	
Bandwidth			MHz	10	10	10
Duplex Mode				FDD	FDD	FDD
		First PRB		0	0	0
DL BWP configuration	#1	Number of contiguous PRB		52	52	52
		Subcarrier spacing	kHz	15	15	15
SNR		, ,	dB	TBD	TBD	TBD
Propagation of	chann	el		TDLA30-5	TDLA30-5	TDLA30-5
Antenna conf	igurat	tion		ULA Low 2x2	ULA Low 2x2	ULA High 2x2
Beamforming	Mode	el		TBD	TBD	TBD
		-RS resource Type		Periodic	Periodic	Periodic
	Nur	nber of CSI-RS ports (X)		4	4	4
ZP CSI-RS		И Туре		FD-CDM2	FD-CDM2	FD-CDM2
configuratio		nsity (ρ)		1	1	1
n		t subcarrier index in the 3 used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 5, (4,-)	Row 5, (4,-)	Row 5, (4,-)
		t OFDM symbol in the PRB d for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		(9,-)	(9,-)	(9,-)
	CSI	-RS odicity and offset	slot	5/1	5/1	5/1
		-RS resource Type		Periodic	Periodic	Periodic
		nber of CSI-RS ports (X)		2	2	2
	CDI	И Туре		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,-)
	use	t OFDM symbol in the PRB d for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		(13,-)	(13,-)	(13,-)
		CSI-RS-timeConfig odicity and offset	slot	5/1	5/1	5/1
		-IM RE pattern		Pattern 0	Pattern 0	Pattern 0
CSI-IM configuratio n		-IM Resource Mapping si-im,Icsi-im)		(4,9)	(4,9)	(4,9)
		-IM timeConfig odicity and offset	slot	5/1	5/1	5/1
ReportConfig				Periodic	Periodic	Periodic
CQI-table				Table 2	Table 2	Table 2
reportQuantity	у			cri-RI-PMI-CQI	cri-RI-PMI- CQI	cri-RI-PMI- CQI
timeRestrictio	nFor	ChannelMeasurements		not configured	not configured	not configured
timeRestrictio	nForl	nterferenceMeasurements		not configured	not configured	not configured
cqi-FormatInd	licato	r		Wideband	Wideband	Wideband
pmi-FormatIn				Wideband	Wideband	Wideband
CSI-Report po		city and offset	slot	5/1	5/1	5/1
Codebook	Co	debook Type		typel- SinglePanel	typel- SinglePanel	typel- SinglePanel
configuration	Co	debook Mode		1	1	1
		odebookConfig- ,CodebookConfig-N2)		N/A	N/A	N/A
		debookSubsetRestriction		TBD	TBD	TBD
	RI	Restriction		N/A	N/A	N/A
Physical char				PUCCH	PUCCH	PUCCH
CQI/RI/PMI d	elay		ms	8	8	8
Maximum nur	nber	of HARQ transmission		1	1	1
RI Configurat	ion			Fixed RI = 2 and follow RI	Fixed RI = 1 and follow RI	Fixed RI = 1 and follow RI

Table 6.4.2.1-2: Minimum requirement (FDD)

	Test 1	Test 2	Test 3
<i>γ</i> 1	N/A	TBD	TBD
72	TBD	N/A	N/A

#### 6.4.2.2 TDD

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

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

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

Table 6.4.2.2-1: RI Test (TDD)

Parameter		Unit	Test 1	Test 2	Test 3	
Bandwidth			MHz	40	40	40
Duplex Mode				TDD	TDD	TDD
TDD Slot Cor	nfigura			FR1.30-1	FR1.30-1	FR1.30-1
		First PRB		0	0	0
DL BWP configuration	#1	Number of contiguous PRB		106	106	106
		Subcarrier spacing	kHz	30	30	30
SNR			dB	TBD	TBD	TBD
Propagation of	chann	el		TDLA30-5	TDLA30-5	TDLA30-5
Antenna conf				ULA Low 2x2	ULA Low 2x2	ULA High 2x2
Beamforming	Mode	el		TBD	TBD	TBD
		-RS resource Type		Periodic	Periodic	Periodic
	Nun	nber of CSI-RS ports (X)		4	4	4
ZP CSI-RS	CDI	M Туре		FD-CDM2	FD-CDM2	FD-CDM2
	Den	sity (ρ)		1	1	1
configuratio n		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,-)
	CSI peri	-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
		M Туре		FD-CDM2	FD-CDM2	FD-CDM2
NZP CSI-	Den	sity (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 (I <sub>0</sub> , I <sub>1</sub> )		(13,-)	(13,-)	(13,-)
		CSI-RS-timeConfig odicity and offset	slot	10/1	10/1	10/1
	CSI	-IM RE pattern		Pattern 0	Pattern 0	Pattern 0
CSI-IM configuration		-IM Resource Mapping I-IM, IcsI-IM)		(4,9)	(4,9)	(4,9)
		-IM timeConfig odicity and offset	slot	10/1	10/1	10/1
ReportConfig	Туре			Periodic	Periodic	Periodic
CQI-table				Table 2	Table 2	Table 2
reportQuantit	у			cri-RI-PMI-CQI	cri-RI-PMI- CQI	cri-RI-PMI- CQI
timeRestrictio	nFor(	ChannelMeasurements		not configured	not configured	not configured
		nterferenceMeasurements		not configured	not configured	not configured
cqi-FormatInd				Wideband	Wideband	Wideband
pmi-FormatIn				Wideband	Wideband	Wideband
CSI-Report po		city and offset	slot	10/1	10/1	10/1
Codebook		debook Type		typel- SinglePanel	typel- SinglePanel	typel- SinglePanel
configuration		debook Mode		1	1	1
	Ň1	odebookConfig- ,CodebookConfig-N2)		N/A	N/A	N/A
		debookSubsetRestriction		TBD	TBD	TBD
		Restriction		N/A	N/A	N/A
Physical char	nel fo	or CSI report		PUCCH	PUCCH	PUCCH
CQI/RI/PMI d	elay	·	ms	9.5	9.5	9.5
Maximum nur	nber (	of HARQ transmission		1	1	1
RI Configurat				Fixed RI = 2 and follow RI	Fixed RI = 1 and follow RI	Fixed RI = 1 and follow RI

Table 6.4.2.2-2: Minimum requirement (TDD)

	Test 1	Test 2	Test 3
<i>γ</i> 1	N/A	TBD	TBD
<i>γ</i> 2	TBD	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)

Bandwidth   Duplex Mode		Parameter	Unit	Test 1	Test 2	Test 3	Test 4
Disable	Bandwidth		MHz				
Number of contiguous   S2   S2   S2   S2   S2   S2   S2   S	Duplex Mode						FDD
configuration #1         PRB         Subcarrier spacing         kHz         15         15         15         15           SNR         Jub Carrier spacing         kHz         15         15         15         15         15           SNR         Jub Carrier spacing         MB         TBD         TBD         TBD         TBD         TDLA30-5				0	0	0	0
Silvarier spacing				52	52	52	52
SNR	Configuration		kH7	15	15	15	15
Propagation channel	SNR	- Subcarrier spacing					
Antenna configuration   But Au Duck 2x4   ULA Low 2x4   ULA Low 2x4   ULA Low 4x4   Each of TBD   TB							
Beamforming   Model   Fib   TBD							
CSI-RS resource Type   Periodic   PRB used for CSI-RS (6, h)   PRB used for CSI-RS (6,							
Number of CSI-RS ports (X)							
ZP CSI-RS   Configuration   Density (p)   Density (p)   Density (p)   FD-CDM2   FD-C							
Density (p)	70 001 00	, , ,		FD-CDM2	FD-CDM2	FD-CDM2	FD-CDM2
Pirist subcarrier mote in the PRB used for CSI-RS (kg, k)   First OFDM symbol in the PRB used for CSI-RS (kg, k)   Periodic   Peri							
First OFDM symbol in the PRB used for CSI-RS (b, h)   S/1	-			Daw 5 (4 )	Daw 5 (4 )	Daw 5 (4 )	Daw 5 (4 )
Used for CSi-RS (lo, l.)   (9, r.)   (1, r.)	П	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,-)
CSI-RS   Second   CSI-RS   Second   CSI-RS   Second   S				(0.)	(0.)	(0.)	(0.)
periodicity and offset				(9,-)	(9,-)	(9,-)	(9,-)
Definition   Def			slot	5/1	5/1	5/1	5/1
Number of CSI-RS ports (X)   2   2   2   4			3101				
NZP CSI- RS for CSI   First subcarrier index in the PRB used for CSI-RS (ko, kr)   First subcarrier index in the PRB used for CSI-RS (ko, kr)   Row 3 (6,-)   Row 3 (6,-							
NZP CSI- RS for CSI acquisition				_		_	
RS for CSI   acquisition				FD-CDM2	FD-CDM2	FD-CDM2	FD-CDM2
PRB used for CSI-RS (ko, k )   ROW 3 (b, -)   ROW 4 (U, -)   ROW 3 (b, -)   ROW 4 (U, -)   ROW				1	1	1	1
First OFDM symbol in the PRB used for CSI-RS (lo, lr)   NZP CSI-RS-timeConfig periodicity and offset   Sol				Row 3 (6)	Row 3 (6)	Row 3 (6)	Row 4 (0)
Used for CSI-RS (lo, lt)   NZP CSI-RS-timeConfig periodicity and offset   Slot   S/1   S	acquisition			11011 0 (0, )	11011 0 (0, )	11011 0 (0, )	11011 1 (0, )
Section   CSI-RS-timeConfig periodicity and offset   Slot   S/1				(13)	(13)	(13)	(13)
Deriodicity and offset				(10, )	(, )	(, )	(10, )
Denication of the CSI-IM RE pattern   Pattern 0   Pa			slot	5/1	5/1	5/1	5/1
CSI-IM   Configuration   CSI-IM Resource Mapping   (4,9)				D. (( )	D " 0	D " 0	D " 0
CSI-IM timeConfig periodicity and offset   Slot   S/1   S/	CCLIM			Pattern 0	Pattern 0	Pattern 0	Pattern 0
CSI-IM timeConfig periodicity and offset   S/1	configuratio			(4,9)	(4,9)	(4,9)	(4,9)
ReportConfigType			slot	5/1	5/1	5/1	5/1
CQI-table         Table 2         Cri-RI-PMI-CQI         CCI-RI-PMI-CQI         CQI-RI-PMI-CQI         CQI         CCQI         CQI	ReportConfig			Periodic	Periodic	Periodic	Periodic
Tri-RI-PMI-CQI		1,400					
TeportQuantity   Cri-Ri-PMi-CQi   CQi   CQi   CQi   CQi   timeRestrictionForChannelMeasurements   not configured   not configured   not configured   not configured   not configured   co							
timeRestrictionForChannelMeasurements         not configured         not configured configured         configured         not configured         configured         configured         not configured         configured         configured         configured         not configured         configured         configured         not configured         configured         not configured	reportQuantity	/		cri-RI-PMI-CQI			
timeRestrictionForInterferenceMeasurements    Not configured   Not configured wideband Wideband Wideband Wideband Wideband Wideband Wideband Videband Videba	time - Dtoi-ti-						
timeRestrictionForinterrerenceMeasurements	timeRestrictio	nForGnannelivieasurements		not configured	configured	configured	configured
cqi-FormatIndicator         Wideband         Videband         Videband </td <td>timoDostriatio</td> <td>n For Interference Magaziromento</td> <td></td> <td>not configured</td> <td></td> <td>not</td> <td></td>	timoDostriatio	n For Interference Magaziromento		not configured		not	
Description	umeresmono	nronntenerenceweasurements		not configured			configured
Color   Colo							
Codebook configuration							
Codebook   Codebook Mode	CSI-Report pe		slot				
Configuration         Codebook Mode (CodebookConfig- N1,CodebookConfig- N1,CodebookConfig-N2)         N/A         N/A         N/A         N/A         N/A         N/A         V/A         V/A         V/A         V/A         V/A         V/A         V/A         V/A         V/A         N/A		Codebook Type					typel-
(CodebookConfig-N1,CodebookConfig-N2)         N/A         N/A         N/A         N/A         (2,1)           CodebookSubsetRestriction         TBD         TBD         TBD         11111111           RI Restriction         N/A         N/A         N/A         N/A           N/A         N/A         N/A         N/A         N/A           Physical channel for CSI report         PUCCH         PUCCH         PUCCH         PUCCH           CQI/RI/PMI delay         ms         8         8         8           Maximum number of HARQ transmission         1         1         1         1           PI Configuration         Fixed RI = 2         Fixed RI = 1         Fixed RI = 1         Fixed RI = 2					SinglePanel		SinglePanel
N1,CodebookConfig-N2)	configuration			1	1	1	1
N1,CodebookConing-N2)				N/A	N/A	N/A	(2.1)
RI Restriction							
N/A				IRD	IRD	IRD	
N/A   N/A   N/A   and   00001111 for   follow RI		RI Restriction					
Description				NI/A	NI/A	NI/A	
Physical channel for CSI report         PUCCH				111/74	IN/A	IN/A	
Physical channel for CSI report         PUCCH							
CQI/RI/PMI delay         ms         8         8         8           Maximum number of HARQ transmission         1         1         1         1           PL Configuration         Fixed RI = 2         Fixed RI = 1         Fixed RI = 1         Fixed RI = 2	Physical chan	nel for CSI report		PLICCH	PLICCH	PLICCH	
Maximum number of HARQ transmission     1     1     1     1       RI Configuration     Fixed RI = 2     Fixed RI = 1     Fixed RI = 1     Fixed RI = 2			me				
PL Configuration Fixed RI = 2 Fixed RI = 1 Fixed RI = 2	Maximum nun	nber of HARO transmission	1113	1	1	1	1
				Fixed RI = 2	Fixed RI = 1	Fixed RI = 1	Fixed RI = 2
	RI Configurati	on		and follow RI	and follow RI	and follow RI	and follow RI

Table 6.4.3.1-2: Minimum requirement (FDD)

	Test 1	Test 2	Test 3	Test 4
21	N/A	TBD	TBD	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		MHz	40	40	40	40
Duplex Mode			TDD	TDD	TDD	TDD
TDD Slot Con	figuration		FR1.30-1	FR1.30-1	FR1.30-1	FR1.30-1
	First PRB		0	0	0	0
DL BWP configuration	Number of contiguous PRB		106	106	106	106
J	Subcarrier spacing	kHz	30	30	30	30
SNR	, ,	dB	TBD	TBD	TBD	TBD
Propagation of	channel		TDLA30-5	TDLA30-5	TDLA30-5	TDLA30-5
Antenna confi	guration		ULA Low 2x4	ULA Low 2x4	ULA High 2x4	ULA Low 4x4
Beamforming			TBD	TBD	TBD	TBD
	CSI-RS resource Type		Periodic	Periodic	Periodic	Periodic
	Number of CSI-RS ports (X)		4	4	4	4
ZP CSI-RS	CDM Type		FD-CDM2	FD-CDM2	FD-CDM2	FD-CDM2
configuratio	Density (ρ)		1	1	1	1
n	First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 5, (4,-)	Row 5, (4,-)	Row 5, (4,-)	Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (I <sub>0</sub> , I <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,-)
aoquioinori	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	slot	10/1	10/1	10/1	10/1
	periodicity and offset		D-#0	D-#0	D-#0	
CSI-IM	CSI-IM RE pattern		Pattern 0	Pattern 0	Pattern 0	Pattern 0
configuratio	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	CQI-table		Table 2	Table 2	Table 2	Table 2
ranartOuantitu			cri-RI-PMI-CQI	cri-RI-PMI-	cri-RI-PMI-	cri-RI-PMI-
reportQuantity	y		CII-RI-PIVII-CQI	CQI	CQI	CQI
timeRestrictio	timeRestrictionForChannelMeasurements		not configured	not configured	not configured	not configured
timeRestrictio	nForInterferenceMeasurements		not configured	not	not	not
				configured	configured	configured
cqi-FormatInd			Wideband	Wideband	Wideband	Wideband
pmi-FormatIn		1 .	Wideband	Wideband	Wideband	Wideband
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
Comiguration	(CodebookConfig-		1	l l	l l	I
	N1,CodebookConfig-N2)		N/A	N/A	N/A	(2,1)
	CodebookSubsetRestriction	-	TBD	TBD	TBD	11111111
	RI Restriction					00000010 for
			NI/A	NI/A	NI/A	fixed Rank 2
			N/A	N/A	N/A	and 00001111 for
						follow RI
Physical chan	nel for CSI report		PUCCH	PUCCH	PUCCH	PUCCH
CQI/RI/PMI d		ms	9.5	9.5	9.5	9.5
	mber of HARQ transmission	1113	1	1	1	1
		-	Fixed RI = 2	Fixed RI = 1	Fixed RI = 1	Fixed RI = 2
RI Configurati	ion		and follow RI	and follow RI	and follow RI	and follow RI

Table 6.4.3.2-2: Minimum requirement (TDD)

	Test 1	Test 2	Test 3	Test 4
γı	N/A	TBD	TBD	N/A
72	TBD	N/A	N/A	TBD

# 7 Demodulation performance requirements (Radiated requirements)

## 7.1 General

# 7.1.1 Applicability of requirements

# 7.2 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
DL BWP   Common serving   Common servi	PDSCH transmission	on scheme		Transmission scheme 1
configuration #1         Cyclic period.         Normal Processor           Common serving cell parameters         Physical Cell ID SSB position in burst SSB periodicity ms 20         3           SSD periodicity First DMRS position for Type A PDSCH mapping Siots for PDCCH monitoring TBD Symbols with PDCCH Configuration         TBD           PDCCH configuration         Number of PDCCH candidates and aggregation levels DCI format TBD DCI for CSI-RS resource 1:6 CSI-RS resource 3:6 Tand 2:6	EPRE ratio of PTRS	S to PDSCH	dB	0
Private   Designation   Desi		Cyclic prefix		Normal
Common serving cell parameters         SSB position in burst         1           SSB periodicity         ms         20           First DMRS position for Type A         2           PDCCH         Slots for PDCCH monitoring         TBD           Symbols with PDCCH         0           Number of PDCCH candidates and aggregation levels         TBD           Cross carrier scheduling         Not configured           First subcarrier index in the PRB used for CSI-RS (k)         0           First OFDM symbol in the PRB used for CSI-RS (k)         CSI-RS resource 1: 6           CSI-RS for tracking         Number of CSI-RS ports (X)         CSI-RS resource 2: 10           CSI-RS resource 3: 6         CSI-RS resource 3: 6           CSI-RS resource 3: 6         CSI-RS resource 3: 6           CSI-RS for tracking         Number of CSI-RS ports (X)         1           CSI-RS resource 3: 6         Slots         160           CSI-RS resource 3: 6         Slots         160           CSI-RS for CSI-RS (k)         3         3           CSI-RS for CSI-RS (k)         10         3           NZP CSI-RS for CSI-RS (k)         12         1           NZP CSI-RS for CSI-RS (k)         12         1           NUMBER of CSI-RS ports (X)         2 <td< td=""><td>comigaration // 1</td><td>Physical Cell ID</td><td></td><td>0</td></td<>	comigaration // 1	Physical Cell ID		0
Sest Periodicals           First DMRS position for Type A PDSCH mapping         2           PDCCH configuration         Slots for PDCCH monitoring         TBD           Symbols with PDCCH Symbols with PDCCH configuration         Number of PDCCH candidates and aggregation levels         TBD           Cross carrier scheduling         Not configured         0           Cross carrier scheduling         Not configured           First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> )         0           CSI-RS resource 1: 6         CSI-RS resource 2: 10           CSI-RS for tracking         Number of CSI-RS (k <sub>0</sub> )           CSI-RS periodicity         Slots           CSI-RS periodicity         Slots           CSI-RS periodicity         Slots           CSI-RS fest         Slots           NZP CSI-RS for CSI-RS (k <sub>0</sub> )         Tirst OFDM symbol in the PRB used for CSI-RS (k <sub>0</sub> )           NZP CSI-RS for CSI acquisition         First OFDM symbol in the PRB used for CSI-RS (k <sub>0</sub> )           NZP CSI-RS for CSI acquisition         CSI-RS periodicity           ZP CSI-RS for CSI acquisition         CSI-RS periodicity           ZP CSI-RS for CSI acquisition         Tirst Subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> )           Post of CSI-RS (k <sub>0</sub> )         1           CSI-RS offset         0 <t< td=""><td></td><td></td><td></td><td></td></t<>				
Post Mapping		•	ms	20
Solts for PDCCH monitoring	ceil parameters	First DMRS position for Type A		2
PDCCH configuration   Number of PDCCH candidates and aggregation levels   DCI format   TBD		Slots for PDCCH monitoring		TBD
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$				
Aggregation levels   DCI format   TBD		-		TRD
Cross carrier scheduling         Not configured           First subcarrier index in the PRB used for CSI-RS (k₀)         0           First OFDM symbol in the PRB used for CSI-RS (k₀)         CSI-RS resource 1: 6 CSI-RS resource 2: 10 CSI-RS resource 3: 6 CSI-RS resource 3: 6 CSI-RS resource 4: 10           CSI-RS for tracking         Number of CSI-RS ports (X)         1           CDM Type         No CDM           Density (ρ)         3           CSI-RS periodicity         Slots           CSI-RS offset         Slots           NZP CSI-RS for CSI-RS for CSI-RS (k₀)         1           NZP CSI-RS for CSI-RS (k₀)         0           NZP CSI-RS for CSI-RS (k₀)         0           CSI-RS (k₀)         0           NZP CSI-RS for CSI-RS (k₀)         0           CSI-RS (k₀)         1           Density (ρ)         1           CSI-RS periodicity         Slots           CSI-RS for CSI-RS ports (X)         2           CDM Type         FD-CDM2           Density (ρ)         1           CSI-RS for CSI-RS ports (X)         4           CSI-RS for CSI-RS ports (X)         4           CSI-RS periodicity         Slots           CSI-RS periodicity         12           CDM Type         FD-CDM2 <td></td> <td></td> <td></td> <td></td>				
First subcarrier index in the PRB used for CSI-RS (k <sub>0</sub> )				
for CSI-RS (k <sub>0</sub> )	Cross carrier sched			Not configured
First OFDM symbol in the PRB used for CSI-RS resource 2: 10   CSI-RS resource 3: 6   CSI-RS resource 4: 10   CSI-RS periodicity   Slots   Sl				
CDM Type		for CSI-RS (I <sub>0</sub> )		CSI-RS resource 2: 10 CSI-RS resource 3: 6
Density (ρ)   Slots   160	CSI-RS for			·
CSI-RS periodicity   Slots   160	tracking			No CDM
CSI-RS offset				
CSI-RS offset		CSI-RS periodicity	Slots	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		CSI-RS offset	Slots	1 and 2 81 for CSI-RS resource
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$				
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		First OFDM symbol in the PRB used		12
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	NZP CSI-RS for			2
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$				_
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$				
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$			01.4	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$			Slots	
				0
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		for CSI-RS (k <sub>0</sub> )		4
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$				12
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$				4
Density (ρ)         1           CSI-RS periodicity         Slots         160           CSI-RS offset         0           PDSCH DMRS configuration         Antenna ports indexes         {1000, 1001} for Rank 1 tests           Number of PDSCH DMRS CDM group(s) without data         1           PTRS configuration         Frequency density (K <sub>PT-RS</sub> )         2           Imaximum number of code block groups for ACK/NACK feedback         1           Maximum number of HARQ transmission         4           HARQ ACK/NACK bundling         Multiplexed           Redundancy version coding sequence         {0,2,3,1}           SP Type I, Random per slot with PRB bundling granularity	CSI acquisition			
CSI-RS periodicity         Slots         160           CSI-RS offset         0           PDSCH DMRS configuration         Antenna ports indexes         {1000, 1001} for Rank 1 tests {1000, 1001} for Rank 2 tests           Number of PDSCH DMRS CDM group(s) without data         1           PTRS configuration         Frequency density (K <sub>PT-RS</sub> )         2           Imaximum number of code block groups for ACK/NACK feedback         1           Maximum number of HARQ transmission         4           HARQ ACK/NACK bundling         Multiplexed           Redundancy version coding sequence         {0,2,3,1}           SP Type I, Random per slot with PRB bundling granularity				
CSI-RS offset  PDSCH DMRS configuration  Antenna ports indexes  Antenna ports indexes  Antenna ports indexes  [1000, 1001] for Rank 1 tests [1000, 1001] for Rank 2 tests  [1000, 1001] for Rank 2 tests  [1000, 1001] for Rank 2 tests  [1000, 1001] for Rank 2 tests  [1000, 1001] for Rank 2 tests  [1000, 1001] for Rank 2 tests  [1000, 1001] for Rank 2 tests  [1000, 1001] for Rank 2 tests  [1000, 1001] for Rank 2 tests  [1000, 1001] for Rank 2 tests  [1000, 1001] for Rank 1 tests  [1000, 1001] for Rank 2 tests  [1000, 1001] fo			Slote	
PDSCH DMRS configuration  Antenna ports indexes  Antenna ports indexes  Antenna ports indexes  Antenna ports indexes  [1000, 1001] for Rank 2 tests  [1000, 1001] for Rank 1 tests  [1000, 1001] for Rank 2 tests  [1000, 1001] for Rank 1 tests  [1000, 1001] for Rank 2 tests  [1000,			CiOlo	
PDSCH DMRS configuration  Antenna ports indexes  Antenna ports indexes  I (1000, 1001) for Rank 2 tests  Number of PDSCH DMRS CDM group(s) without data  PTRS  Frequency density (K <sub>PT-RS</sub> )  Configuration  Time density (L <sub>PT-RS</sub> )  Maximum number of code block groups for ACK/NACK feedback  Maximum number of HARQ transmission  HARQ ACK/NACK bundling  Redundancy version coding sequence  Precoding configuration  Antenna ports indexes  {1000, 1001} for Rank 2 tests  1  A Unit density (L <sub>PT-RS</sub> )  A Unit plexed  {10,2,3,1}  SP Type I, Random per slot with PRB bundling granularity		COLING GIRCE		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		Antenna ports indexes		tests {1000, 1001} for
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$				1
configuration Time density (L <sub>PT-RS</sub> )  Maximum number of code block groups for ACK/NACK feedback  Maximum number of HARQ transmission  HARQ ACK/NACK bundling  Redundancy version coding sequence  Precoding configuration  Time density (L <sub>PT-RS</sub> )  1  Multiplexed  (0,2,3,1)  SP Type I, Random per slot with PRB bundling granularity	PTRS			2
Maximum number of code block groups for ACK/NACK feedback  Maximum number of HARQ transmission  HARQ ACK/NACK bundling  Redundancy version coding sequence  Precoding configuration  Multiplexed  {0,2,3,1}  SP Type I, Random per slot with PRB bundling granularity	configuration	Time density ( $L_{PT-RS}$ )		
Maximum number of HARQ transmission     4       HARQ ACK/NACK bundling     Multiplexed       Redundancy version coding sequence     {0,2,3,1}       Precoding configuration     SP Type I, Random per slot with PRB bundling granularity	Maximum number of code block groups for ACK/NACK			
HARQ ACK/NACK bundling Redundancy version coding sequence  Precoding configuration  Multiplexed  {0,2,3,1}  SP Type I, Random per slot with PRB bundling granularity		of HARQ transmission		4
Redundancy version coding sequence {0,2,3,1}  SP Type I, Random per slot with PRB bundling granularity				
Precoding configuration  SP Type I, Random per slot with PRB bundling granularity				
				SP Type I, Random per slot with PRB bundling
	Symbols for all unu	sed Res		

# 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
TBD	TBD

Table 7.2.2.1-2: Test Parameters

	Parameter	Unit	Value
Channel bandwidth		MHz	50 for 2-3 and 2-5, 200 for 2-4, 100 for other tests
Duplex mode			TDD
Active DL BWP index			1
	First PRB		0
DL BWP configuration #1	Number of contiguous PRB		32 for 2-3, 132 for 2-4, 66 for other tests
	Subcarrier spacing	kHz	120
PDCCH configuration	Number of PRBs in CORESET	PRBs	66
	Mapping type		Type A
	k0		0
	Starting symbol (S)		1
	Length (L)		As defined in Annex A.1.3
DDCCIIfiti	PDSCH aggregation factor		1
PDSCH configuration	PRB bundling type		Static
	PRB bundling size		TBD
	Resource allocation type		Type 1
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
	DMRS Type		Type 1
	Number of additional DMRS		1
PDSCH DMRS	Length		Single-symbol DM- RS
configuration	Antenna ports indexes		{1000} for Rank1 {1000,1001} for Rank2
	Number of PDSCH DMRS CDM group(s) without data		1
Number of HARQ Proce		8 for Test 1-1, 1-3, 2-4 10 for Test 2-1, 2-3, 2-5, 2-6, 3-1 16 for Test 1-2 TBD for Test 2-2	
K1 value (PDSCH-to-HARQ-timir	ng-indicator)		As defined in Annex A.1.3

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

		Madelette.			Correlation	Reference	value
Test num.	Reference channel	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	TBD	QPSK, 0.30	FR2.120-1	TDLC60-300	2x2 ULA Low	70	[-0.5]
1-2	TBD	16QAM, 0.48	FR2.120-1	TDLA30-300	2x2 ULA Low	30	[1.6]
1-3	TBD	64QAM, 0.45	FR2.120-1	TDLA30-300	2x2 XPL Med- A	70	[TBD]

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

		Madulation		Madulation			Correlation	Reference value		
Test num.	Reference channel	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	TBD	QPSK, 0.30	FR2.120-2	TDLA30-75	2x2 ULA Low	70	[TBD]			
2-2	TBD	16QAM, 0.48	FR2.120-1	TDLA30-300	2x2 ULA Low	70	[TBD]			
2-3	TBD	16QAM,0.48	FR2.120-2	TDLA30-75	2x2 ULA Low	70	[13 .9]			
2-4	TBD	16QAM, 0.48	FR2.120-1	TDLA30-300	2x2 ULA Low	70	[TBD]			
2-5	TBD	16QAM, 0.48	FR2.60-1	TDLA30-75	2x2 ULA Low	70	[14.3]			
2-6	TBD	64QAM, 0.43	FR2.120-2	TBD	2x2 ULA Low	70	[TBD]			

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

		Madulation			Correlation	Reference	value
Test num.	Reference channel	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	TBD	16QAM, 0.48	FR2.120-2	TDLA30-75	2x2 ULA Med	70	[19.5]

# 7.3 PDCCH demodulation requirements

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

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

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

	Parameter	Unit	Value
DL BWP configuration #1	Cyclic prefix		Normal
Common	Physical Cell ID		0
serving cell	SSB position in burst		1
parameters	SSB periodicity	ms	20
PDCCH	Slots for PDCCH monitoring		TBD
configuration	Number of PDCCH candidates		TBD
	First subcarrier index in the PRB used for CSI-RS (k0)		0
CSI-RS for tracking	First OFDM symbol in the PRB used for CSI-RS (I0)		CSI-RS resource 1: 4 CSI-RS resource 2: 8 CSI-RS resource 3: 4 CSI-RS resource 4: 8
3	Number of CSI-RS ports (X)		1
	CDM Type		No CDM
	Density (ρ)		3
	CSI-RS periodicity	Slots	160
	CSI-RS offset	Slots	80 for CSI-RS resource 1 and 2 81 for CSI-RS resource 3 and 4
Precoding configu	uration		SP Type I, Random per slot with REG bundling granularity for number of Tx larger than 1
Symbols for all ur	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	2	
Interlegyer size		3 for test 1-1	2	
Interleaver size		2 for test 1-2	3	
Shift index		0		

## 7.3.2.2.1 1 Tx Antenna performances

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

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

Test		CORES	CORESET	Aggragation	Reference	Propagation	Antenna configuration		erence value
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	TBD
1-2	100 MHz	60	1	4 CCE	R.PDCCH. 5-1.2 TDD	TDLA30-300	1x2 Low	1	TBD

#### 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	Aggregation	Deference	Dranagation	Antenna configuration	_	erence alue
num ber	Bandwidth	CORESE T RB	CORESET duration	Aggregation level	Reference Channel	Propagation Condition			SNR <sub>BB</sub> (dB)
2-1	100 MHz	60	1	8 CCE	R.PDCCH. 5-1.3 TDD	TDLA30-75	2x2 Low	1	[-0.3]
2-2	100 MHz	60	2	16 CCE	R.PDCCH. 5-2.1 TDD	TDLA30-75	2x2 Low	1	[-3.6]

# 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

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

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

## 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. The downlink physical setup is in accordance with Annex C.5.1.

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

Test	Bandwidth	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	TBD
2	100 MHz	R.PBCH.6	[TDLA30-75]	1 x 2 Low	1	TBD

# 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

	Parameter	Unit	Value
PDSCH transmis	ssion scheme		Transmission scheme 1
Duplex Mode			TDD
EPRE ratio of PT	RS to PDSCH	dB	TBD
Active DL BWP i			1
Cyclic prefix			Normal
Common	Physical Cell ID		0
serving cell	SSB position in burst		First SSB in Slot #0
parameters	SSB periodicity	ms	20
	Slots for PDCCH monitoring		Each slot
PDCCH	Symbols with PDCCH		0,1
configuration	Number of PDCCH candidates		TBD
Comigaration	and aggregation levels		
	DCI format		TBD
Cross carrier sch			Not configured
	Mapping type		Type A
	kO		0
	Starting symbol (S)		2
	Length (L)		12
PDSCH	PDSCH aggregation factor		1
configuration	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		0 Non-interlegued
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		TBD
	DMRS Type		Type 1
	Number of additional DMRS		1 1 1
PDSCH DMRS	DMRS ports indexes		{1000} for Rank1 {1000,1001} for Rank2
configuration	Length		Single-symbol DM- RS
	Number of PDSCH DMRS CDM group(s) without data		2
PTRS	Frequency density (K <sub>PT-RS</sub> )		TBD
configuration	Time density ( $L_{PT-RS}$ )		TBD
	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
001 00 (	CDM Type		No CDM
CSI-RS for	Density (ρ)		3
tracking	CSI-RS periodicity	slot	120kHz SCS: 160
			120 kHz SCS: 80 for CSI-RS
	CSI-RS offset	slot	resource 1 and 2 81 for CSI-RS resource 3 and 4
Number of HARO	Q Processes		8
HARQ ACK/NAC	CK bundling		TBD
Redundancy vers	sion coding sequence		{0,2,3,1}
K1 value	Q-timing-indicator)		TBD
Symbols for unus			OCNG as specified in A.5

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

Table 8.2.2.2.1.1-1 Test parameters

Parameter		Unit	Test 1		Test 2		
Bandwidth			MHz	100		100	
Duplex Mode				TDD		TDD	
TDD Slot Con	figura	ation		FR2.120-2 [Ann	ex	FR2.120-2 [/	Annex
		First PRB		A.1.3] [TBD]		A.1.3] [TBD]	
DL BWP		Number of contiguous					
configuration a	#1	PRB		[TBD]		[TBD]	
0.115		Subcarrier spacing	kHz	120		120	
SNR <sub>BB</sub> Propagation c	honn	ol.	dB	[8] [9 AWGN	)]	[14] AWGN	[15]
Propagation C	Halli	еі		2×2 with static cha	nnel	2×2 with static	
Antenna confi	gurat	ion		specified in [Ann		specified in [	
				TBD]		TBD]	
Beamforming	Mode	el		[TBD]		[TBD]	
I	CSI	-RS resource Type		Periodic		Periodi	<u> </u>
		nber of CSI-RS ports (X)		4		4	<u> </u>
70.001.00		M Type		FD-CDM2		FD-CDN	12
ZP CSI-RS configuratio	Den	sity (ρ)		1		1	
n		t subcarrier index in the		8		8	
	PRE	3 used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> ) t OFDM symbol in the PRB		-		_	
		d for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		13		13	
	CSI	-RS	alat	0/4		0/4	
		odicity and offset	slot	8/1		8/1	
		-RS resource Type		Periodic		Periodi	С
		nber of CSI-RS ports (X)		2 fd-CDM2		2 fd-CDM	10
		M Type sity (ρ)		10-CDIVIZ		1 1	2
NZP CSI-		t subcarrier index in the					
RS for CSI acquisition	PRE	B used for CSI-RS $(k_0, k_1)$		6		6	
acquisition		t OFDM symbol in the PRB		13		13	
-		d for CSI-RS (I <sub>0</sub> , I <sub>1</sub> ) CSI-RS-timeConfig					
		odicity and offset	slot	8/1		8/1	
	CSI	-IM RE pattern		1		1	
CSI-IM		-IM Resource Mapping		(0.40)		(0.40)	
configuratio n	(Kcs	ı-ıм, <b>І</b> сsı-ıм)		(8, 13)		(8, 13)	
''	CSI	-IM timeConfig	1.4	0/4		0/4	
		odicity and offset	slot	8/1		8/1	
ReportConfig	Гуре			Periodic		Periodi	
CQI-table				Table 1	.,	Table 1	
reportQuantity		ChannelMeasurements		cri-RI-PMI-CQ Not configured		cri-RI-PMI- Not config	
		nterferenceMeasurements		Not configured		Not config	
cqi-FormatInd				Wideband		Widebai	
pmi-FormatInd		or		Wideband		Widebar	nd
Sub-band Size			RB	N/A		N/A	
CSI-Report per aperiodicTrigg			slot	8/1 Not configured	7	8/1 Not config	urod
apenduicing		debook Type		typel-SinglePan		typeI-Single	
Codebook		debook Node		1		1	
configuration	(Co	odebookConfig-		Not configured	1	Not config	ured
		,CodebookConfig-N2)					
		debookSubsetRestriction		[010000] [N/A]		[010000 [N/A]	Ŋ
Physical chan		Restriction or CSI report		[N/A] [PUCCH]		[PUCCH	41
. Hyoroar orian		RI/PMI delay	ms	[TBD]		[TBD]	.1
Maximum nun		of HARQ transmission		1		1	
Measurement	char	nnel		[TBD]		[TBD]	

#### 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;
- 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;
- 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 TBD.

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	figuration		FR2.120-2 [Annex	FR2.120-2 [Annex
155 0101 0011			A.1.3]	A.1.3]
D. D	First PRB		[TBD]	[TBD]
DL BWP configuration	Number of contiguous PRB		[TBD]	[TBD]
Corniguration	Subcarrier spacing	kHz	120	120
SNR <sub>BB</sub>	Cubcarrior opaoing	dB	[TBD] [TBD]	[TBD] [TBD]
Propagation of	channel		[TDLA30-35]	[TDLA30-35]
Antenna confi			2×2	2×2
	<u> </u>		[ULA High]	[ULA High]
Beamforming	Model		[TBD]	[TBD]
	001.00		A mania dia	A ma via dia
	CSI-RS resource Type Number of CSI-RS ports (X)		Aperiodic 4	Aperiodic 4
	CDM Type		FD-CDM2	FD-CDM2
ZP CSI-RS	Density (ρ)		1 D-0DIVIZ	1
configuratio	First subcarrier index in the		•	·
n	PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		8	8
	First OFDM symbol in the PRB		40	40
	used for CSI-RS (lo, l1)		13	13
	CSI-RS	slot	[8/1]	[8/1]
	interval and offset	0.01		
	CSI-RS resource Type		Aperiodic	Aperiodic
	Number of CSI-RS ports (X) CDM Type		2 fd-CDM2	2 fd-CDM2
	Density (ρ)		10-CDIVIZ	10-CDIVIZ
NZP CSI-	First subcarrier index in the		•	I
RS for CSI	PRB used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		6	6
acquisition	First OFDM symbol in the PRB		40	40
	used for CSI-RS (lo, l1)		13	13
	NZP CSI-RS-timeConfig	slot	[8/1]	[8/1]
	interval and offset	0.00		
CSI-IM	CSI-IM RE pattern		1	1
configuratio	CSI-IM Resource Mapping (kcsi-im,lcsi-im)		(8, 13)	(8, 13)
n	(NCSI-IM,ICSI-IM)		(0, 13)	(0, 13)
	CSI-IM timeConfig	-1-4	[0/4]	[0/4]
	interval and offset	slot	[8/1]	[8/1]
ReportConfig	Туре		Aperiodic	Aperiodic
CQI-table			Table 1	Table 1
reportQuantity			cri-RI-PMI-CQI	cri-RI-PMI-CQI
	nForChannelMeasurements		Not configured	Not configured
	nForInterferenceMeasurements		Not configured	Not configured
cqi-FormatInd			Wideband Wideband	Wideband Wideband
pmi-FormatIng Sub-band Siz		RB	N/A	N/A
	eriodicity and offset	slot	8/1	8/1
aperiodicTrigg		3.01	Not configured	Not configured
- op one one one	Codebook Type		typel-SinglePanel	typel-SinglePanel
Codebook	Codebook Mode		1	1
configuration	(CodebookConfig-		Not configured	Not configured
	N1,CodebookConfig-N2)			-
	CodebookSubsetRestriction		[000001]	[000001]
Dhypical ab - :-	RI Restriction		[N/A]	[N/A]
Pnysical chan	nel for CSI report	ma	[PUSCH]	[PUSCH]
Maximum nur	CQI/RI/PMI delay nber of HARQ transmission	ms	[1.375] 1	[1.375]
Measurement			TBD]	[TBD]
IVICASUI EI II EI II	. Granitei	1	[וטטו	[חמו]

Table 8.2.2.2.1-2 Minimum requirements

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

# 8.3 Reporting of Precoding Matrix Indicator (PMI)

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

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

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

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

8.3.1 1RX requirements

(Void)

8.3.2 2RX requirements

8.3.2.1 FDD

(Void)

8.3.2.2 TDD

8.3.2.2.1 Single PMI with 2TX Typel-SinglePanel Codebook

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

Table 8.3.2.2.1-1: Test parameters (single layer)

Parameter		Unit	Test 1
Bandwidth		MHz	100
TDD DL-UL cor	TDD DL-UL configuration		FR2.120-2 as specified in Annex A
	First PRB		0
DL BWP configuration	Number of contiguous PRB		66
#1	Subcarrier spacing	kHz	120
Propagation ch			[TDLA30-35]
Antenna config	uration		TBD
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 4, (8,-)
	First OFDM symbol in the PRB used for CSI-RS (lo, l <sub>1</sub> )		(13,-)
	CSI-RS interval and offset	slot	8/1
	CSI-RS resource Type		Aperiodic
	Number 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, (6,-)
	First OFDM symbol in the PRB used for CSI-RS (l <sub>0</sub> , l <sub>1</sub> )		(13,-)
	CSI-RS interval and offset	slot	8/1
	CSI-IM RE pattern		Patten 0
CSI-IM configuration	CSI-IM Resource Mapping (k <sub>CSI-IM</sub> ,l <sub>CSI-IM</sub> )		(8,13)
	CSI-IM timeConfig interval and offset	slot	8/1
ReportConfigTy	/pe		Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasure ments			Not configured
timeRestrictionForInterferenceMeas urements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndi		slot	Wideband
	CSI-Report interval and offset		8/1
aperiodicTrigge	Codebook Type		0 typel-SinglePanel
Codebook	Codebook Node		1 (1996) 1 (1996) 1 (1996)
configuration	(CodebookConfig- N1,CodebookConfig- ig-N2)		N/A

	CodebookSubset Restriction		001111	
	RI Restriction		N/A	
Physical c	hannel for CSI report		PUSCH	
CQI/RI/PM	l delay	ms	1.375	
Maximum number of HARQ transmission			4	
Measurem	Measurement channel		MCS13, TBD for reference channel	
	For random precoder selection, the precoder shall be updated in each slot (0.125 ms granularity).			
	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-12)], this reported PMI cannot be applied at the eNB downlink before slot#[(n+12)].			
	Randomization of the principle beam direction shall be used as specified in TBD.			

Table 8.3.2.2.1-2: Minimum requirement

Parameter	Test 1
γ	TBD

# 8.4 Reporting of Rank Indicator (RI)

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

## 8.4.1 1RX requirements

(Void)

## 8.4.2 2RX requirements

#### 8.4.2.1 FDD

(Void)

#### 8.4.2.2 TDD

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

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

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

Table 8.4.2.2-1: RI Test (TDD)

Parameter		Unit	Test 1	Test 2	Test 3	
Bandwidth			MHz	100	100	100
Duplex Mode				TDD	TDD	TDD
TDD Slot Cor	nfigura			FR1.120-2	FR1.120-2	FR1.120-2
DL BWP		First PRB		0	0	0
configuration	#1	Number of contiguous PRB		66	66	66
		Subcarrier spacing	kHz	120	120	120
SNR			dB	TBD	TBD	TBD
Propagation of				[TDLA30-35]	[TDLA30-35]	[TDLA30-35]
Antenna conf				ULA Low 2x2	ULA Low 2x2	XP High 2x2
Beamforming				TBD	TBD	TBD
		-RS resource Type		Aperiodic	Aperiodic	Aperiodic
		nber of CSI-RS ports (X)		4	4	4
ZP CSI-RS		M Type		FD-CDM2	FD-CDM2	FD-CDM2
configuratio		nsity (ρ)		1	1	1
n		t subcarrier index in the 3 used for CSI-RS (k <sub>0</sub> , k <sub>1</sub> )		Row 4, (8,-)	Row 4, (8,-)	Row 4, (8,-)
	Firs use	t OFDM symbol in the PRB d for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		(13,-)	(13,-)	(13,-)
		-RS rval and offset	slot	8/1	8/1	8/1
		-RS resource Type		Aperiodic	Aperiodic	Aperiodic
	Nur	nber of CSI-RS ports (X)		2	2	2
	CDI	И Туре		FD-CDM2	FD-CDM2	FD-CDM2
NZP CSI-	Der	nsity (ρ)		1	1	1
RS for CSI acquisition	PRE	t subcarrier index in the $B$ used for CSI-RS ( $k_0$ , $k_1$ )		Row 3 (6,-)	Row 3 (6,-)	Row 3 (6,-)
		t OFDM symbol in the PRB d for CSI-RS (I <sub>0</sub> , I <sub>1</sub> )		(13,-)	(13,-)	(13,-)
		CSI-RS-timeConfig rval and offset	slot	8/1	8/1	8/1
		-IM RE pattern		Pattern 1	Pattern 1	Pattern 1
CSI-IM configuratio n	(kcs	-IM Resource Mapping BI-IM, ICSI-IM)		(8,13)	(8,13)	(8,13)
		-IM timeConfig rval and offset	slot	8/1	8/1	8/1
ReportConfig	Туре			Aperiodic	Aperiodic	Aperiodic
CQI-table				Table 1	Table 1	Table 1
reportQuantity	у			cri-RI-PMI-CQI	cri-RI-PMI- CQI	cri-RI-PMI- CQI
timeRestrictio	nFor	ChannelMeasurements		not configured	not configured	not configured
timeRestrictio	nForl	nterferenceMeasurements		not configured	not configured	not configured
cqi-FormatInd				Wideband	Wideband	Wideband
pmi-FormatIn				Wideband	Wideband	Wideband
CSI-Report in			slot	TBD	TBD	TBD
aperiodicTrigg				0	0	0
Codebook	Co	debook Type		typel- SinglePanel	typel- SinglePanel	typel- SinglePanel
configuration	Co	debook Mode		1	1	1
		odebookConfig- ,CodebookConfig-N2)		N/A	N/A	N/A
		debookSubsetRestriction		TBD	TBD	TBD
		Restriction		N/A	N/A	N/A
Physical char				PUSCH	PUSCH	PUSCH
CQI/RI/PMI d		<u>1</u>	ms	1.375	1.375	1.375
		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	TBD	TBD
72	TBD	N/A	TBD

# 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
  - The sustained downlink data rate tests specified in Section 5.5 for SA and in Section 9.4B 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)		ownlir power cation	
	, ,	$ ho_{\scriptscriptstyle A}$	$ ho_{\scriptscriptstyle B}$	۵
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		7
configuration		r
Number of PDCCH	symbols	1
symbols	Зуппооіз	'
PHICH Ng (Note 3)		1
PHICH duration		Normal
Cyclic prefix		Normal
Cell ID		0
Maximum number of		[4]
HARQ transmission		[4]
Redundancy version		{0,0,1,2} for [64QAM]
coding sequence		, , , , , , , , , , , , , , , , , , , ,
Propagation condition		Static propagation condition
1 Topagation condition		No external noise sources are applied
Transmission mode		[3]
Transmission time		
difference between LTE	μs	0
cell and NR cell(s)		
Antenna configuration		2x2
Codebook subset		[10]
restriction		[10]
Symbols for all unused		OCNG in Annex A.5
Res		OCNO III AIIIICA A.O

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	Bandwidth		nlink p cation	
setup	(MHz)	$ 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 <u>Section</u> 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
Г	- ai ai i letei	Oilit	FR1.15-1
TDD Slot Configuration p		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

ъ.		11	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	DS₁S₂U	
•			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 Cornigulation	(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	1		1			

Note 1: D denotes a slot with all DL symbols; S denotes a slot with a mix of DL, UL and guard symbols; U denotes a slot with all UL symbols. The field is for information. Note 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
			FR2.60-1
TDD Slot Configuration p	pattern (Note 1)		DDSU
Special Slot Configuration	Special Slot Configuration (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-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	Parameter		UL-DL	pattern
	arameter	Unit	FR2.120-1	FR2.120-2
TDD Slot Configuration pattern (Note 1)			DDDSU	DDSU
Special Slot Configuration	n (Note 2)		10D+2G+2U	11D+3G+0U
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-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					
Deference showned		R.PDSCH.	R.PDSCH.	R.PDSCH.	R.PDSCH.		
Reference channel		1-1.1 FDD	1-1.2 FDD	1-1.3 FDD	1-1.4 FDD		
Channel bandwidth	MHz	10	10	10	10		
Subcarrier spacing	kHz	15	15	15	15		
Number of allocated resource blocks	PRBs	52	6	52	52		
Number of consecutive PDSCH symbols		12	12	7	[9]		
Allocated slots per 2 frames	Slots	19	19	19	19		
MCS table		64QAM	64QAM	64QAM	64QAM		
MCS index		4	4	4	4		
Modulation		QPSK	QPSK	QPSK	QPSK		
Target Coding Rate		0.30	0.30	0.30	0.30		
Number of MIMO layers		1	1	1	1		
Number of DMRS rEs		18	12	12	12		
Overhead for TBS determination		0	0	0	18		
Information Bit Payload per Slot							
For Slot i = 0	Bits	N/A	N/A	N/A	N/A		
For Slots i = 1,, 19	Bits	3904	480	2280	[2472]		
Transport block CRC per Slot							
For Slot i = 0	Bits	N/A	N/A	N/A	N/A		
For Slots i = 1,, 19	Bits	24	16	16	16		
Number of Code Blocks per Slot							
For Slot i = 0	CBs	N/A	N/A	N/A	N/A		
For Slots i = 1,, 19	CBs	1	1	1	1		
Binary Channel Bits Per Slot							
For Slot i = 0	Bits	N/A	N/A	N/A	N/A		
For Slots i = 10, 11	Bits	12480	1512	6864	[7760]		
For Slots i = 3,, 9, 12,, 19	Bits	13104	1584	7488	[8384]		
Max. Throughput averaged over 2 frames  Note 1: SS/PBCH block is transmitted.	Mbps	3.709	0.456	2.166	[2.348]		

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	it 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.	
Reference channel		1-3.1 FDD	
Channel bandwidth	MHz	10	
Subcarrier spacing	kHz	15	
Number of allocated resource blocks	PRBs	52	
Number of consecutive PDSCH		12	
symbols		. –	
Allocated slots per 2 frames	Slots	19	
MCS table		64QAM	
MCS index		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	Mhna	39.915	
frames	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 transmitted	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 transmitted in slot #0 with periodicity 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				
Reference 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		4	4	[N/A]				
{0,,39}		4	7	[14/74]				
For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,\}$ 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 $\{0,,39\}$		6	6	[N/A]				
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,\}\}$ for i from $\{1,,39\}$		18	12	12				
Overhead for TBS determination		0	0	0				
Information Bit Payload per Slot		,	Ŭ					
For Slots 0 and Slot i, if mod(i, 10) =								
{8,9} for i from {0,,39}	Bits	N/A	N/A	N/A				
For Slot i, if $mod(i, 10) = 7$ for i from								
{0,,39}	Bits	2664	144	[N/A]				
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,\}$	D::	2224	400	4000				
for i from {1,,39}	Bits	8064	480	4608				
Transport block CRC per Slot								
For Slots 0 and Slot i, if mod(i, 10) =	D:4-	NI/A	NI/A	NI/A				
{8,9} for i from {0,,39}	Bits	N/A	N/A	N/A				
For Slot i, if mod(i, 10) = 7 for i from	Dito	16	16	ΓN1/Λ1				
{0,,39}	Bits	16	16	[N/A]				
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,\}$	Bits	24	16	24				
for i from {1,,39}	סונס	24	10	24				
Number of Code Blocks per Slot								
For Slots 0 and Slot i, if mod(i, 10) =	CBs	N/A	N/A	N/A				
{8,9} for i from {0,,39}	CD3	IN/A	IN//A	IN//A				
For Slot i, if mod(i, 10) = 7 for i from	CBs	1	1	[N/A]				
{0,,39}	000	'	'	[14//1]				
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,\}$	CBs	2	1	2				
for i from {1,,39}				_				
Binary Channel Bits Per Slot		ļ						
For Slots 0 and Slot i, if mod(i, 10) =	Bits	N/A	N/A	N/A				
{8,9} for i from {0,,39}								
For Slots i = 20, 21	Bits	25440	1512	13992				
For Slot i, if $mod(i, 10) = 7$ for i from	Bits	8904	504	[N/A]				
{0,,39}			-					
For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,\}$	Bits	26712	1584	15264				
for i from {1,,19,22,,39}		1						
Max. Throughput averaged over 2	Mbps	11.419	0.677	[6.221]				
frames     Note 1:   SS/PBCH block is transmitted in	n slot #0 ···	ith periodicity	20 ms					
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms								

Table A.3.2.2.2: 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 charmer		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								
For Siot 1, if flood(1, 10) = 7 for 1 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 rEs								
For Slot i, if $mod(i, 10) = 7$ for i from $\{0,,39\}$		6	6	12	12			
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,\}$		12	12	24	24			
for i from {1,,39}  Overhead for TBS determination		0	0	0	0			
Information Bit Payload per Slot		0	0	0	0			
For Slots 0 and Slot i, if mod(i, 10) =								
{8,9} for i from {0,,39}	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}	Dito	0430	10030	22002	23132			
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,\}\}$ for i from $\{1,,39\}$	Bits	26632	53288	73776	98376			
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	5.4		0.4	0.4	0.4			
{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	1	2	3	4			
{0,,39}		-	=	_				
For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,\}$ for i from $\{1,,39\}$	CBs	4	7	10	13			
Binary Channel Bits Per Slot								
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,,39}	Bits	N/A	N/A	N/A	N/A			
For Slots i = 20, 21	Bits	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) = $\{0,1,2,3,4,5,\}$	D:4-	55000	444000	450040	202520			
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 slot #0 w	ith periodicity	20 ms	l	<u> </u>			
Note 2: Slot i is slot index per 2 frames								

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

Parameter	Unit			Value		
Reference channel		R.PDSCH.	R.PDSCH.			
Reference charmer		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 $\{0,,39\}$		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 $\{0,,39\}$		6	6			
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		U	0		+	
For Slots 0 and Slot i, if mod(i, 10) =					+	
{8,9} for i from {0,,39}	Bits	N/A	N/A			
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) =						
{8,9} for i from {0,,39}	Bits	N/A	N/A			
For Slot i, if $mod(i, 10) = 7$ for i from $\{0,,39\}$	Bits	24	24			
For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,\}$ for i from $\{1,,39\}$	Bits	24	24			
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	CDo	2	2			
{0,,39}	CBs	3	2			
For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,\}$ for i from $\{1,,39\}$	CBs	10	5			
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 $mod(i, 10) = \{0,1,2,3,4,5,\}$	Bits	167904	80784			
for i from {1,,19,22,,39}  Max. Throughput averaged over 2						
frames	Mbps	118.796	57.930			
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.			
Reference channel		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 $mod(i, 10) = \{0,1,2,3,4,5,\}$					
for i from $\{1,,39\}$		12			
Allocated slots per 2 frames		31			
MCS table		256QAM			
MCS index		24			
Modulation		256QAM			
Target Coding Rate		0.82			
Number of MIMO layers		1			
Number of DMRS rEs					
For Slot i, if $mod(i, 10) = 7$ for i from		6			
{0,,39}		<u> </u>			
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,\})$		12			
for i from {1,,39}		12			
Overhead for TBS determination		0			
Maximum number of HARQ		4			
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}	<u> </u>	14/73			
For Slot i, if $mod(i, 10) = 7$ for i from	CBs	3			
{0,,39}	CDS	3			
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,\}$	CDo	11			
for i from {1,,39}	CBs	11			
Binary Channel Bits Per Slot					
For Slots 0 and Slot i, if mod(i, 10) =	D.,	NI/A			
{8,9} for i from {0,,39}	Bits	N/A			
For Slots i = 20, 21	Bits	106848			
For Slot i, if $mod(i, 10) = 7$ for i from					
{0,,39}	Bits	35616			
For Slot i, if mod(i, 10) = $\{0,1,2,3,4,5,\}$		+			
for i from $\{1,,19,22,,39\}$	Bits	111936			
Max. Throughput averaged over 2		+		+	
	Mbps	130.308			
frames	•	l l ith periodicity 20 m			

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

Parameter	Unit	_	Value	 
Reference channel		R.PDSCH.		
		2-5.1 TDD		
Channel bandwidth	MHz	40		
Subcarrier spacing	kHz	30		
Allocated resource blocks	PRBs	106		
Number of consecutive PDSCH symbols				
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$		8		
For Slot i, if $mod(i, 5) = \{0,1,\}\)$ for i from $\{1,,39\}$		12		
Allocated slots per 2 frames		31		
MCS table		64QAM		
MCS index		4		
Modulation		QPSK		
Target Coding Rate		0.30		
Number of MIMO layers		1		
Number of DMRS rEs				
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		0		
Information Bit Payload per Slot		0		
For Slot 0 and Slot i, if $mod(i, 5) = 4$ for				
i from {0,,39}	Bits	N/A		
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$	Bits	5376		
For Slot i, if $mod(i, 5) = \{0,1,\}\)$ 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				
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	CBs	1		
$\{0,,39\}$ For Slot i, if mod(i, 5) = $\{0,1,\}$ ) for i from	CBs	2		
{1,,39}	-			
Binary Channel Bits Per Slot For Slot 0 and Slot i, if mod(i, 5) = 4 for	Bits	N/A		
i from {0,,39}				
For Slot i = 20, 21	Bits	26712		
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,,39\}$	Bits	17808		
For Slot i, if $mod(i, 5) = \{0,1,\}\)$ for i from $\{1,,19,22,,39\}$	Bits	27984		
Max. Throughput averaged over 2 frames	Mbps	11.875		
Note 1: SS/PBCH block is transmitted in	a alat #0	ith pariodicity 20 r	me	 

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

Parameter	Unit		Value	)	
Reference channel		R.PDSCH.			
		2-6.1 TDD			
Channel bandwidth	MHz	40			
Subcarrier spacing	kHz	30			
Allocated resource blocks	PRBs	106			
Number of consecutive PDSCH symbols					
For Slot i, if $mod(i, 10) = \{3,7\}$ for i from		8			
{0,,39}					
For Slot i, if $mod(i, 10) = \{0,1,2,5,\}$ for i		12			
from {1,,39}		07			
Allocated slots per 2 frames		27			
MCS table MCS index		64QAM 4			
Modulation		QPSK			
Target Coding Rate Number of MIMO layers		0.30			
Number of DMRS rEs		' '			
For Slot i, if $mod(i, 10) = \{3,7\}$ for i from					
$\{0,,39\}$		12			
For Slot i, if mod(i, 10) = $\{0,1,2,5,\}$ ) 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) =	D::	N1/A			
{4,8,9} for i from {0,,39}	Bits	N/A			
For Slot i, if $mod(i, 10) = \{3,7\}$ for i from	Bits	F276			
{0,,39}	Bits	5376			
For Slot i, if $mod(i, 10) = \{0,1,2,5,\}$ ) for i	Bits	8456			
from {1,,39}	DIIS	0430			
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}	5.1.0	1071			
For Slot i, if $mod(i, 10) = \{3,7\}$ for i from	Bits	24			
{0,,39}	2.10				
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) =					
$\{4,8,9\}$ for i from $\{0,,39\}$	CBs	N/A			
For Slot i, if mod(i, 10) = $\{3,7\}$ for i from					
$\{0,,39\}$	CBs	1			
For Slot i, if mod(i, 10) = $\{0,1,2,5,\}$ ) for i	_				
from {1,,39}	CBs	2			
Binary Channel Bits Per Slot					
For Slot 0 and Slot i, if mod(i, 10) =	D.:	N1/0			
{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	D:+o	27004			
from {1,,19,22,,39}	Bits	27984			
Max. Throughput averaged over 2	Mbps	10.184			
frames	IVIDPS	10.104			
Note 1: SS/PBCH block is transmitted in					

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) = $\{0,1,2,3,4,5,\}$ ) for i from $\{1,,39\}$		12			
Overhead for TBS determination		0			
Information Bit Payload per Slot		0			
For Slots 0 and Slot i, if mod(i, 10) =					
{8,9} for i from {0,,39}	Bits	N/A			
For Slot i, if $mod(i, 10) = 7$ for i from	D:1-	40000			
{0,,39}	Bits	16896			
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,\}$	Bits	53288			
for i from {1,,39}	DIIS	33200			
Transport block CRC per Slot					
For Slots 0 and Slot i, if mod(i, 10) =	Bits	N/A			
{8,9} for i from {0,,39}		,, .			
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	CBs	2			
{0,,39}	CDS	2			
For Slot i, if $mod(i, 10) = \{0,1,2,3,4,5,\})$	CBs	7			
for i from {1,,39}	003	,			
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}		<del>                                     </del>		+	
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	Bits	106848			
For Slot i, if mod(i, 10) = 7 for i from					
{0,,39}	Bits	35616			
For Slot i, if $mod(i, 10) = \{1,2,3,4,\})$ for i	Dito	111006			
from {1,,19,22,,39}	Bits	111936			
Max. Throughput averaged over 2	Mbps	75.318			
frames					
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					ļ

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

Reference channel  Channel bandwidth  Subcarrier spacing  Allocated resource blocks  Number of consecutive PDSCH symbols  Allocated slots per 2 frames  MCS table  MCS index  Modulation  Target Coding Rate  Number of MIMO layers  Number of DMRS rEs (Note 3)  Overhead for TBS determination  Information Bit Payload per Slot  For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,,39}  For CSI-RS Slot i, if mod(i,5) =1 for i from {0,,39}  For Slot i = 20  Bits	R.PDSCH. 2-8.1 TDD 40 30 106 12 21 64QAM 13 16QAM 0.48 1 24 0	R.PDSCH. 2-8.2 TDD 40 30 106 12 21 64QAM 13 16QAM 0.48 2 24 0		
Channel bandwidth  Subcarrier spacing  Allocated resource blocks  Number of consecutive PDSCH symbols  Allocated slots per 2 frames  MCS table  MCS index  Modulation  Target Coding Rate  Number of MIMO layers  Number of DMRS rEs (Note 3)  Overhead for TBS determination  Information Bit Payload per Slot  For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,,39}  For CSI-RS Slot i, if mod(i,5) =1 for i from {0,,39}  For Slot i = 20  Bits	40 30 106 12 21 64QAM 13 16QAM 0.48 1	40 30 106 12 21 64QAM 13 16QAM 0.48 2 24		
Subcarrier spacing Allocated resource blocks Number of consecutive PDSCH symbols Allocated slots per 2 frames MCS table MCS index Modulation Target Coding Rate Number of MIMO layers Number of DMRS rEs (Note 3) Overhead for TBS determination Information Bit Payload per Slot For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,,39} For CSI-RS Slot i, if mod(i,5) =1 for i from {0,,39} For Slot i = 20 Bits	30 106 12 21 64QAM 13 16QAM 0.48 1 24	30 106 12 21 64QAM 13 16QAM 0.48 2		
Allocated resource blocks  Number of consecutive PDSCH symbols  Allocated slots per 2 frames  MCS table  MCS index  Modulation  Target Coding Rate  Number of MIMO layers  Number of DMRS rEs (Note 3)  Overhead for TBS determination  Information Bit Payload per Slot  For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,,39}  For CSI-RS Slot i, if mod(i,5) =1 for i from {0,,39}  For Slot i = 20  Bits	106 12 21 64QAM 13 16QAM 0.48 1 24	106 12 21 64QAM 13 16QAM 0.48 2		
Number of consecutive PDSCH symbols  Allocated slots per 2 frames  MCS table  MCS index  Modulation  Target Coding Rate  Number of MIMO layers  Number of DMRS rEs (Note 3)  Overhead for TBS determination  Information Bit Payload per Slot  For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,,39}  For CSI-RS Slot i, if mod(i,5) =1 for i from {0,,39}  For Slot i = 20  Bits	12 21 64QAM 13 16QAM 0.48 1 24 0	12 21 64QAM 13 16QAM 0.48 2 24		
Allocated slots per 2 frames  MCS table  MCS index  Modulation  Target Coding Rate  Number of MIMO layers  Number of DMRS rEs (Note 3)  Overhead for TBS determination  Information Bit Payload per Slot  For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,,39}  For CSI-RS Slot i, if mod(i,5) =1 for i from {0,,39}  For Slot i = 20  Bits	21 64QAM 13 16QAM 0.48 1 24 0	21 64QAM 13 16QAM 0.48 2 24		
MCS table  MCS index  Modulation  Target Coding Rate  Number of MIMO layers  Number of DMRS rEs (Note 3)  Overhead for TBS determination  Information Bit Payload per Slot  For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,,39}  For CSI-RS Slot i, if mod(i,5) =1 for i from {0,,39}  For Slot i = 20  Bits	64QAM 13 16QAM 0.48 1 24 0	64QAM 13 16QAM 0.48 2 24		
MCS index  Modulation  Target Coding Rate  Number of MIMO layers  Number of DMRS rEs (Note 3)  Overhead for TBS determination  Information Bit Payload per Slot  For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,,39}  For CSI-RS Slot i, if mod(i,5) =1 for i from {0,,39}  For Slot i = 20  Bits	13 16QAM 0.48 1 24 0	13 16QAM 0.48 2 24		
Modulation Target Coding Rate Number of MIMO layers Number of DMRS rEs (Note 3) Overhead for TBS determination Information Bit Payload per Slot For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,,39} For CSI-RS Slot i, if mod(i,5) =1 for i from {0,,39} For Slot i = 20 Bits	16QAM 0.48 1 24 0	16QAM 0.48 2 24		
Target Coding Rate  Number of MIMO layers  Number of DMRS rEs (Note 3)  Overhead for TBS determination  Information Bit Payload per Slot  For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,,39}  For CSI-RS Slot i, if mod(i,5) =1 for i from {0,,39}  For Slot i = 20  Bits	0.48 1 24 0	0.48 2 24		
Number of MIMO layers  Number of DMRS rEs (Note 3)  Overhead for TBS determination  Information Bit Payload per Slot  For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,,39}  For CSI-RS Slot i, if mod(i,5) =1 for i from {0,,39}  For Slot i = 20  Bits	1 24 0	2 24		
Number of DMRS rEs (Note 3)  Overhead for TBS determination  Information Bit Payload per Slot  For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,,39}  For CSI-RS Slot i, if mod(i,5) = 1 for i from {0,,39}  For Slot i = 20  Bits	24 0	24		
	0			
		0		
	N/A			
For Slots 0 and Slot i, if $mod(i, 10) = \{7,8,9\}$ for i from $\{0,,39\}$ For CSI-RS Slot i, if $mod(i,5) = 1$ for i from $\{0,,39\}$ For Slot i = 20 Bits	N/A			
For CSI-RS Slot i, if $mod(i,5) = 1$ for i from $\{0,,39\}$ Bits  Bits		N/A		
For Slot i = 20 Bits	N/A	N/A		
	24576	49176		
For Slot i, if $mod(i, 10) = \{0,2,3,4,\})$ for i				
from {1,,19,22,,39}	24576	49176		
Transport block CRC per Slot				
For Slots 0 and Slot i if mod(i 10) -	N1/A	21/2		
{7,8,9} for i from {0,,39}	N/A	N/A		
For CSI-RS Slot i, if mod(i,5) =1 for i	<b>N1/A</b>	<b>N</b> 1/A		
from {0,,39}	N/A	N/A		
For Slot i = 20 Bits	24	24		
For Slot i, if mod(i, 10) = {0,2,3,4,}) for i from {1,,19,22,,39}	24	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}	N/A	N/A		
For CSI-RS Slot i, if mod(i,5) =1 for i from {0,,39}	N/A	N/A		
For Slot i = 20 CBs	3	6		
For Slot i, if mod(i, 10) = {0,2,3,4,}) for i from {1,,19,22,,39}	3	6		
Binary Channel Bits Per Slot				
For Slots 0 and Slot i, if mod(i, 10) -				
{7,8,9} for i from {0,,39}	N/A	N/A		
For CSI-RS Slot i, if mod(i,5) =1 for i from {0,,39}	N/A	N/A		
For Slot i = 20 Bits	48336	96672		
For Slot i, if mod(i, 10) = $\{0,2,3,4,\}$ ) for i  Bits	50880	101760		
from {1,,19,22,,39}	55550	101700		
Max. Throughput averaged over 2  Mbps		51.6348	I	
frames   Note 1: SS/PBCH block is transmitted in slot #0 wit	25.8048	2 I D.348		

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

Note 2: Slot i is slot index per 2 frames

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

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

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

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

Parameter	Unit		Value	
Reference channel		R.PDSCH.		
		4-1.1 TDD		
Channel bandwidth	MHz	50		
Subcarrier spacing	kHz	60		
Allocated resource blocks	PRBs	66		
Number of consecutive PDSCH				
symbols				
For Slot i, if $mod(i, 4) = 2$ for i from		10		
{1,, 79}				
For Slot i, if $mod(i, 4) = \{0,\}$ ) for i from		13		
{1,,79}		50		
Allocated slots per 2 frames		59		
MCS table		64QAM		
MCS index		13		
Modulation		16QAM		
Target Coding Rate		0.48		
Number of MIMO layers		2		
Number of DMRS rEs For Slot i, if mod(i, 4) = 2 for i from				
		12		
$\{1,,79\}$ For Slot i, if mod(i, 4) = $\{0,\}$ ) for i from				
$\{1,,79\}$		12		
Overhead for TBS determination		6		
Information Bit Payload per Slot		0		
For Slots 0 and Slot i, if $mod(i, 4) = 3$				
for i from {0,,79}	Bits	N/A		
For Slot i, if $mod(i, 4) = 2$ for i from				
{1,, 79}	Bits	25608		
For Slot i, if $mod(i, 4) = \{0,\}$ ) for i from	D:	0.404.0		
{1,,79}	Bits	34816		
Transport block CRC per Slot				
For Slots 0 and Slot i, if mod(i, 4) = 3	Dito	NI/A		
for i from {079}	Bits	N/A		
For Slot i, if mod(i, 4) = 2 for i from	Bits	24		
{1,, 79}	Dita	24		
For Slot i, if $mod(i, 4) = \{0,\}$ ) for i from	Bits	24		
{1,,79}	Dito	27		
Number of Code Blocks per Slot				
For Slots 0 and Slot i, if $mod(i, 4) = 3$	CBs	N/A		
for i from {0,,79}		-		
For Slot i, if $mod(i, 4) = 2$ for i from	CBs	4		
{1,, 79}				
For Slot i, if $mod(i, 4) = \{0,\}$ ) for i from	CBs	5		
{1,,79} Binary Channel Bits Per Slot				
For Slots 0 and Slot i, if $mod(i, 4) = 3$	Bits	N/A		
for i from {0,,79} For Slot i = 40, 41	Bits	69960		
For Slot i, if $mod(i, 4) = 2$ for i from		09900		
{4,, 79}	Bits	54912		
For Slot i, if $mod(i, 4) = \{0,\}$ ) for i from	_			
{1,,39,42,,79}	Bits	73128		
Max. Throughput averaged over 2	<b></b>			
frames	Mbps	93.499		
Note 1: SS/PBCH block is transmitted	in slot #0 w	ith periodicity 2	0 ms	I
Note 2: Slot i is slot index per 2 frames		, <u>-</u>	-	
11010 Z. GIOLTIO SIOLITIUEN PET Z ITAITIES				

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

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. 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 $\{0,, 159\}$		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		4		
Modulation		QPSK		
Target Coding Rate		0.30		
Number of MIMO layers		1		
Number of DMRS rEs				
For Slot i, if mod(i, 5) = 3 for i from $\{0,, 159\}$		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	3624		
For Slot i, if mod(i, 5) = $\{0,1,\}$ ) for i from $\{1,,159\}$	Bits	5504		
Transport block CRC per Slot				
For Slots 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,159\}$	Bits	N/A		
For Slot i, if mod(i, 5) = 3 for i from	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 $mod(i, 5) = 4$ for i from $\{0,,159\}$	CBs	N/A		
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 159\}$	CBs	1		
For Slot i, if $mod(i, 5) = \{0,1,\}\)$ for i from $\{1,,159\}$	CBs	1		
Binary Channel Bits Per Slot				
For Slots 0 and Slot i, if $mod(i, 5) = 4$ for i from $\{0,,159\}$	Bits	N/A		
For Slots i = 80, 81	Bits	17490		
For Slot i, if $mod(i, 5) = 3$ for i from $\{0,, 159\}$	Bits	12210		
For Slot i, if $mod(i, 5) = \{0,1,\}\)$ for i from $\{1,,79,82,,159\}$	Bits	18282		
Max. Throughput averaged over 2 frames	Mbps	31.942		
Note 1: SS/PBCH block is transmitted i	n slot #0 w	ith periodicity ?	l l l l l l l l l l l l l l l l l l l	
Note 2: Slot i is slot index per 2 frames	11 3101 #U W	na pendulcity z	o mo	

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.	
		5-2.1 TDD	5-2.2 TDD	5-2.3 TDD	
Channel bandwidth	MHz	100	100	200	
Subcarrier spacing	kHz	120	120	120	
Allocated resource blocks	PRBs	66	66	132	
Number of consecutive PDSCH symbols					
For Slot i, if mod(i, 5) = 3 for i from $\{0,, 159\}$		9	9	9	
For Slot i, if $mod(i, 5) = \{0,1,\}\)$ 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 rÉs					
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		
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 $\{0,, 159\}$	Bits	24	24	24	
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 $mod(i, 5) = 4$					
for i from {0,,159} For Slot i, if mod(i, 5) = 3 for i from	CBs	N/A	N/A	N/A	
For Slot i, if mod(i, 5) = 3 for i from $\{0,, 159\}$	CBs	2	3	6	
For Slot i, if $mod(i, 5) = \{0,1,\})$ 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  Note 1: SS/PBCH block is transmitted	·	with periodicity	20 ms		
Note 1: SS/PBCH block is transmitted Note 2: Slot i is slot index per 2 frame:		with periodicity	ZU 1115		

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	3	
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	+ + + + + + + + + + + + + + + + + + + +
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	
rames  Note 1: SS/PBCH block is transmitted i		ith poriodicity ?	20 mc
Note 1: SS/PBCH block is transmitted i Note 2: Slot i is slot index per 2 frames	11 SIUL #U W	nin penodicity 2	201110

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. 5-5.1 TDD	R.PDSCH. 5-5.2 TDD		
Channel bandwidth	MHz	100	50		
Subcarrier spacing	kHz	120	120		
Allocated resource blocks	PRBs	66	32		
Number of consecutive PDSCH	TILDO	00	02		
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 {1,, 159}		12	12		
For Slot i, if $mod(i, 4) = \{0,\}$ ) for i from $\{1,,159\}$		12	12		
Overhead for TBS determination		6	6		
Information Bit Payload per Slot					
For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$	Bits	N/A	N/A		
For Slot i, if mod(i, 4) = 2 for i from {1,, 159}	Bits	25608	12552		
For Slot i, if mod(i, 4) = $\{0,\}$ ) for i from $\{1,,159\}$	Bits	34816	16896		
Transport block CRC per Slot					
For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$	Bits	N/A	N/A		
For Slot i, if mod(i, 4) = 2 for i from {1,, 159}	Bits	24	24		
For Slot i, if mod(i, 4) = $\{0,\}$ ) for i from $\{1,,159\}$	Bits	24	24		
Number of Code Blocks per Slot					
For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$	CBs	N/A	N/A		
For Slot i, if mod(i, 4) = 2 for i from {1,, 159}	CBs	4	2		
For Slot i, if mod(i, 4) = $\{0,\}$ ) for i from $\{1,,159\}$	CBs	5	3		
Binary Channel Bits Per Slot					
For Slots 0 and Slot i, if $mod(i, 4) = 3$ for i from $\{0,,159\}$	Bits	N/A	N/A		
For Slot i = 80, 81	Bits	69960	33920		
For Slot i, if mod(i, 4) = 2 for i from {4,, 159}	Bits	54912	26624		
For Slot i, if $mod(i, 4) = \{0,\}$ ) for i from $\{1,,79,82,,159\}$	Bits	73128	35456		
Max. Throughput averaged over 2 frames	Mbps	188.739	91.843		
Note 1: SS/PBCH block is transmitted Note 2: Slot i is slot index per 2 frames		vith periodicity 2	20 ms	<u> </u>	

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

Parameter	Unit		Va	alue	
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 $mod(i, 4) = 3$	Bits	N/A			
for i from {0,,159}	2.10	. 47.1			
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 {1,, 159}	CBs	5			
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 $mod(i, 4) = 3$			<del>                                     </del>		
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 frames	Mbps	255.724			
Note 1: SS/PBCH block is transmitted	in slot #0 w	ith periodicity ?	1		
Note 2: Slot i is slot index per 2 frames		in pendulony z	.0 1113		

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

## A.3.3 Reference measurement channels for PDCCH performance requirements

#### A.3.3.1 FDD

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

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

Parameter	Unit			Valu	ue
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 CRC)	Bits	39	[51]	[51]	

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	[51]	[51]	[51]	39

#### A.3.3.1.2 Reference measurement channels for SCS 30 kHz FR1

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

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

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

Parameter	Unit		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			Valu	ue
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]	[51]	[51]	
CRC)		_	_	-	

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

Parameter	Unit			Va	lue		
Reference channel		R.PDCCH. 1-2.1 TDD	R.PDCCH. 1-2.2 TDD	R.PDCCH. 1-2.3 TDD	R.PDCCH. 1-2.4 TDD	R.PDCCH. 1-2.5 TDD	R.PDCCH. 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 CRC)	Bits	[39]	[39]	[51]	[51]	[51]	[39]

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

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

Parameter	Unit			Val	lue
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 CRC)	Bits	[41]	[53]	[53]	

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			Val	lue	
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	41	[52]	[52]		
CRC)						

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

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

## A.3.4 Reference measurement channels for PBCH demodulation requirements

#### A.3.4.1 Reference measurement channels for FR1

Table A.3.4.1-1: PBCH Reference Channel

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

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

Table A.3.4.2-1: PBCH Reference Channel

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

#### A.4 CSI reference measurement channels

This 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 a	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	QPSK	1800	3624				
3	0.3770	2		2856	5640				
4	0.6016	4		4480	8968				
5	0.8770	6		6528	13064				
6	1.1758	8		8712	17928				
7	1.4766	11		11016	22032				
8	1.9141	13	16QAM	14343	28680				
9	2.4063	15		17928	35856				
10	2.7305	18		20496	40976				
11	3.3223	20		25104	50184				
12	3.9023	22	64QAM	29192	58384				
13	4.5234	24	04QAIVI	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	е			TBS.2-1	TBS.2-2	TBS.2-3	TBS.2-4		
MCS table						2560	QAM		
Number of a	Number of allocated PDSCH resource blocks			52	52	106	106		
Number of c	consecutive PI	DSCH symbo	ls	12	12	12	12		
Number of F	PDSCH MIMO	layers		1	2	1	2		
Number of D	OMRS rEs (No	te 1)		24	24	24	24		
Overhead for	r TBS determ	ination		0	0	0	0		
Available R	E-s for PDSCI	1		7920	7920	12720	12720		
CQI index	Spectral	MCS	Modulatio		Infor	mation Bit I	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	ZOOQAM	43032	86040	88064	176208		
15	7.4063	27		46104	92200	94248	188576		
Note 1: N									

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

#### A.5.1 OCNG Patterns for FDD

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

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

Control Region	Data Region
(CORESET)	
All unused rEs (Note 1)	All unused rEs (Note 2)
PDCCH	PDSCH
Uncorrelated pseudo random QPSK modulated data	Uncorrelated pseudo random QPSK modulated data
Single Tx port transmission	Spatial multiplexing using any precoding matrix with dimensions same as the precoding matrix for PDSCH
Same as for RMC PDCCH in the active BWP	Same as for RMC PDSCH in the active BWP
Same as for RMC PDCCH	Same as for RMC PDSCH
	All unused rEs (Note 1) PDCCH Uncorrelated pseudo random QPSK modulated data Single Tx port transmission  Same as for RMC PDCCH in the active BWP

Note 1: All unused rEs in the active CORESETS appointed by the search spaces 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

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

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

Note 2: Unused available rEs refer to rEs in PRBs not allocated for any physical channels, CORESETs, synchronization signals or reference signals 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 section 7.7.3 in TR38.901.
- 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

- Keep first tap as such, and the last tap delay as such.
- Merge two parallel taps with different delays (average delay, sum power) starting from the weakest ones. If the average delay is not in the sampling grid, round up/down it towards the direction of the higher power original 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)
- Continue as long as 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.

#### B.2.1.1 Delay profiles for FR1

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

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

Model	Number of channel taps	Delay spread (r.m.s.)	Maximum excess tap delay (span)	Delay resolution
TDLA30	12	30 ns	290 ns	5 ns
TDLB100	12	100 ns	480 ns	5 ns
TDLC300	12	300 ns	2595 ns	5 ns

Table B.2.1.1-2 TDLA30 (DS = 30 ns)

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

Table B.2.1.1-3 TDLB100 (DS = 100ns)

Tap#	Delay [ns]	Power [dB]	Fading distribution
1	0	0	Rayleigh
2	10	-2.2	Rayleigh
3	20	-0.6	Rayleigh
4	30	-0.6	Rayleigh
5	35	-0.3	Rayleigh
6	45	-1.2	Rayleigh
7	55	-5.9	Rayleigh
8	120	-2.2	Rayleigh
9	170	-0.8	Rayleigh
10	245	-6.3	Rayleigh
11	330	-7.5	Rayleigh
12	480	-7.1	Rayleigh

Table B.2.1.1-4 TDLC300 (DS = 300 ns)

Tap#	Delay [ns]	Power [dB]	Fading distribution
1	0	-6.9	Rayleigh
2	65	0	Rayleigh
3	70	-7.7	Rayleigh
4	190	-2.5	Rayleigh
5	195	-2.4	Rayleigh
6	200	-9.9	Rayleigh
7	240	-8.0	Rayleigh
8	325	-6.6	Rayleigh
9	520	-7.1	Rayleigh
10	1045	-13.0	Rayleigh
11	1510	-14.2	Rayleigh
12	2595	-16.0	Rayleigh

## B.2.1.2 Delay profiles for FR2

The delay profiles for FR2 are specified in B.2.1.2-1 and the tapped delay line models are specified in Tables B.2.1.2-2 and table B.2.1.2-3.

Table B.2.1.2-1: Delay profiles for NR channel models

Model	Number of channel taps	Delay spread (r.m.s.)	Maximum excess tap delay (span)	Delay resolution
TDLA30	12	30 ns	290 ns	5 ns
TDLC60	12	60 ns	520 ns	5 ns

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

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

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

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

## B.2.2 Combinations of channel model parameters

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

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

Table B.2.2-1 Channel model parameters for FR1

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

Table B.2.2-2 Channel model parameters for FR2

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

#### B.2.3 MIMO Channel Correlation Matrices

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

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

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

#### B.2.3.1.1 Definition of MIMO Correlation Matrices

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

Table B.2.3.1.1-1 gNB correlation matrix

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

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

Table B.2.3.1.1-2 UE correlation matrix

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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)		
					0.9000	1.00	000 0	.9000	0.6561	0.270	0.3	8000	0.2700	0.196	8		
					0.656	0.90	000 1	.0000	0.9000	0.196	68 0.2	2700	0.3000	0.2700	О		
254					0.3874	4 0.6	561 0	.9000	1.0000	0.116	52 0.1	.968	0.2700	0.3000	)		
2x4 case			$R_{\scriptscriptstyle med}$	$_{lium A} =$	0.300												
Case									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	C		
					0.116	2 0.19	968 0	.2700	0.3000	0.387	74 0.0	5561	0.9000	1.0000	0)		
		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  $\pm 1.45$  degrees polarization slant angles are deployed at gNB and cross-polarized antenna elements with  $\pm 1.45$  degrees polarization slant angles are deployed at UE.

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

-  $N_1$  is the number of antenna elements in first dimension with same polarization,

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

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

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

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:

$$R_{snat} = P(R_{oNB} \otimes \Gamma \otimes R_{UE})P^{T}$$

where

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

The matrix  $\Gamma$  is defined as

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

A permutation matrix P elements are defined as

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

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

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

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

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,

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

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

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

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

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

$$R_{UF}=1$$
.

- For 2 antenna elements with the same polarization,

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

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

The values for parameters  $\alpha$ ,  $\beta$  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	
<b>High Correlation</b> 0.9 0.9 0.9 0.3						
Note 1: Note 2:	<ul> <li>Note 1: Value of α₁ applies when more than one pair of cross-polarized antenna elements in first dimension at gNB side.</li> <li>Note 2: Value of α₂ applies when more than one pair of cross-polarized</li> </ul>					
antenna elements in second dimension at gNB side. Note 3: Value of $\beta$ applies when more than one pair of cross-polarized antenna elements at UE side.						

For the 1D cross polarized antenna array at gNB side, the correlation matrices for high spatial correlation and medium correlation 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

				1.00	000	0.0000	0.90	00	0.0000	- 0.30	00 0	.0000	-0.27	700	0.0000		
				0.0	000	.0000	0.00	00	0.9000	0.00	000 0	.3000	0.00	000	0.2700		
4x2 case				0.9	000	0.0000	1.00	00	0.0000	-0.27	00 0	.0000	-0.30	000	0.0000		
			_	0.0	000	0.9000	0.00	000	1.0000	0.00	000 0	.2700	0.00	00 (	0.3000		
			$R_{high} =$	-0.3	000	0.0000			0.0000	1.000	0 00	.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		
						0.2700			0.3000	0.00		.9000	0.00		.0000		
		1.0000	0.0000	L ***					0.0000						-	-0.2700	0.0000
		0.0000		0.0000					0.8999			0.0000					
		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	3 0.0000	-0.2862	0.0000	-0.2965	0.0000	-0.3000	0.0000	-0.2965	0.0000
		0.0000		0.0000					0.9883			0.0000					
		0.8999		0.9542						-0.2700		-0.2862			0.0000		0.0000
8x2	$R_{high} =$	0.0000	0.8999		0.9542				1.0000						0.2965	0.0000	
case		-0.3000 0.0000	0.0000	-0.2965 0.0000					0.0000		0.0000		0.0000	0.9542		0.8999	0.0000
		-0.2965							2 0.0000		0.0000					0.0000	0.0000
		0.0000							0.0000				1.0000			0.0000	
		-0.2862							5 0.0000				0.0000	1.0000			0.0000
		0.0000	0.2862						0.2965	0.0000				0.0000		0.0000	0.9883
		-0.2700	0.0000	-0.2862	0.0000	-0.2965	0.0000	-0.3000	0.0000	0.8999	0.0000	0.9542	0.0000	0.9883	0.0000	1.0000	0.0000
		0.0000	0.2700	0.0000	0.2862	0.0000	0.2965	0.0000	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.
- $D_{\theta_{k,1},\theta_{k,2}}$  is the steering matrix,
- $D_{\theta_{i,1}}(N_1)$  is the steering matrix in first dimension with same polarization,
- $D_{\theta_{k,2}}(N_2)$  is the steering matrix in second dimension with same polarization,
- $N_1$  is the number of antenna elements in first dimension with same polarization,
- $N_2$  is the number of antenna elements in second dimension with same polarization,
- For antenna array with only one direction, number of antenna element in second direction  $N_2$  equals 1.

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

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

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  $1/(\mu+1)$  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:

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

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

## 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: 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: Void

Annex H: Void

Annex I: Void

# Annex J (informative): Change history

Change history								
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	
2018-10	RAN4#88 bis	R4-1814237				Approved Text Proposal in RAN4#88bis: R4-1814053, "TP on performance specification 38.101-4 Chapter 4 general part" R4-1814054, "TP to TS 38.101-4: FR1 PDSCH demodulation requirements (5.2)"	0.1.0	
						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" R4-1814023, "TP to TS38.101-4 Annex C: Downlink physical channels"		
						R4-1814024, "TP to TS38.101-4 Annex E: Environmental conditions"		
2018-11	RAN4#89	R4-1816559				Approved Text Proposal in RAN4#89: R4-1814053, "TP on performance specification 38.101-4 Chapter 4 general part" R4-1814487, "TP for TS38.101-4 section 2 (Reference)" R4-1814488, "TP for TS38.101-4 section 3 (Definitions, symbols and abbreviations)" R4-1814579, "TP to TS 38.101-4: Annex A Measurement channels – PDSCH" R4-1814580, "TP to TS 38.101-4: Annex A Measurement channels – DL Control" R4-1814581, "TP to TS 38.101-4: Annex A Measurement channels – CSI" R4-1816395, "FR2 demod: Noc, Band groups and Ref point - TP for TS 38.101-4" R4-1816692, "TP to TS 38.101-4: Requirements applicability" R4-1816693, "TP for performance requirements for interworking (9)" R4-1816694, "TP to TS 38.101-4: FR1 PDSCH demodulation requirements (5.2)" R4-1816695, "Draft TP on FR2 PDSCH Demodulation Performance Requirements" R4-1816697, "TP for updating FR1 PDCCH requirements in TS 38.101-4 section 5.3" R4-1816699, "TP to TS 38.101-4: 5.4 FR1 PBCH demodulation requirements" R4-1816700, "TP to TS 38.101-4: 7.4 FR2 PBCH demodulation requirements" R4-1816701, "TP of introduction of FR1 CQI requirement (6.2)" R4-1816703, "Draft TP on FR1 Rank Indication Reporting Performance Requirements" R4-1816704, "Draft TP on FR2 Rank Indication Reporting Performance Requirements" R4-1816705, "TP for TS 38.101-4: FR1 PMI test requirement" R4-1816706, "TP to TS 38.101-4 FR2 PMI requirements" R4-1816706, "TP to TS 38.101-4 FR1 PMI test requirement" R4-1816706, "TP to TS 38.101-4 FR2 PMI requirements" R4-1816707, "TP for TS 38.101-4 FR1 PMI test requirement" R4-1816706, "TP to TS 38.101-4 FR2 PMI requirements" R4-1816707, "TP for TS 38.101-4 FR2 PMI requirements" R4-1816707, "TP for TS 38.101-4 FR1 PMI test requirements" R4-1816714, "TP for TS 38.101-4 FR2 PMI requirements"	0.2.0	

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