6 CSI reporting requirements (Conducted requirements)

6.1 General

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

6.1.1 Applicability of requirements

6.1.1.1 General

The minimum performance requirements are applicable to all FR1 operating bands defined in TS 38.101-1 [2].

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

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

6.1.1.2 Applicability of requirements for different number of RX antenna ports

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

The UE shall support 2 or 4 RX antenna ports for different RF operating bands. The operating bands, where 4 RX antenna ports shall be the baseline, are defined in Clause 7.2 of TS 38.101-1 [2]. The UE requirements applicability for UEs with different number of RX antenna ports is defined in Table 6.1.1.2-1.

Table 6.1.1.2-1: Requirements applicability

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

6.1.1.3 Applicability of requirements for optional UE features

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

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

UE feature/capability [14]	Test type		Test list	Applicability notes
CQI table with target BLER of 10^-5New CQI table (cqi-TableAlt)	FR1 FDD	CQI	Clause 6.2.2.1.1.2 Clause 6.2.3.1.1.2	
	FR1 TDD	CQI	Clause 6.2.2.2.1.2 Clause 6.2.3.2.1.2	
Alternative 64QAM MCS table for PDSCH New 64QAM MCS table for PDSCH (*dl-64QAM-MCS-TableAlt*)	FR1 FDD	CQI	Clause 6.2.2.1.1.2 Clause 6.2.3.1.1.2	
	FR1 TDD	CQI	Clause 6.2.2.2.1.2 Clause 6.2.3.2.1.2	

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

Table 6.1.1.3-2: Requirements applicability for optional UE features

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

6.1.1.4 Applicability of requirements for mandatory UE features with capability signalling

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

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

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

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

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

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

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

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

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

The performance requirement for CA CQI tests in clause 6.2A are defined independent of CA configurations and bandwidth combination sets specified in clause 5.5A in TS 38.101-1 [2].

For UEs supporting multiple CA capabilities, test any one of the supported CA capabilities with largest aggregated CA bandwidth combination. The categorization of CA capability is specified in clause 5.1.1.5.1.

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

A single uplink CC is configured for all tests.

6.1.1.5.3 Test coverage for different number of component carriers

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

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

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

6.1.2 Common test parameters

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

Table 6.1.2-1: Test parameters for CSI test cases

Parameter		Unit	Value
PDSCH transmission scheme			Transmission scheme 1
Actual carrier configuration	Offset between Point A and the lowest usable subcarrier on this carrier (Note 3)	RBs	0
	Subcarrier spacing	kHz	15 or 30
DL BWP configuration #1	Cyclic prefix		Normal
	RB offset	RBs	0
	Number of contiguous PRB	PRBs	Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-1 [2] for tested channel bandwidth and subcarrier spacing
Additional PDCCH Configuration for Aperiodic Reporting (Note 4)	Slots for PDCCH monitoring		Each slot
	Symbols with PDCCH		0,1
	Number of PDCCH candidates and aggregation levels		1/AL8
	DCI format		0_1
	TCI state		TCI state #1
	PDCCH & PDCCH DMRS Precoding configuration		Multi-path fading propagation conditions: Single Panel Type I, Random per slot with equal probability of each applicable i1, i2 combination, and with REG bundling granularity for number of Tx larger than 1
Active DL BWP index			1
Common serving cell parameters	Physical Cell ID		0
	SSB position in burst		First SSB in Slot #0
	SSB periodicity	ms	20
PDCCH configuration	Slots for PDCCH monitoring		Each slot
	Symbols with PDCCH		0,1
	Number of PDCCH candidates and aggregation levels		1/AL8
	DCI format		1_1
	TCI state		TCI state #1
Cross carrier scheduling			Not configured
PDSCH configuration	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		12
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		type 0
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
	PDCCH & PDCCH DMRS Precoding configuration		Multi-path fading propagation conditions: Single Panel Type I, Random per slot with equal probability of each applicable i1, i2 combination, and with REG bundling granularity for number of Tx larger than 1 Static propagation conditions: Single Panel Type I, Random precoder chosen from precoder index 0 and 2, selection updated per slot

PDSCH DMRS configuration	DMRS Type			Type 1
	Number of additional DMRS			1
	Maximum number of OFDM symbols for DL front loaded DMRS			1
	DMRS ports indexes			{1000} for Rank1 {1000,1001} for Rank2 {1000,1001,1002} for Rank3 {1000,1001,1002,1003} for Rank4
	Number of PDSCH DMRS CDM group(s) without data			2
PTRS configuration	Frequency density (K_{PT-RS})			N/A
	Time density (L_{PT-RS})			N/A
CSI-RS for tracking	First subcarrier index in the PRB used for CSI-RS (k_0)			0 for CSI-RS resource 1,2,3,4
	First OFDM symbol in the PRB used for CSI-RS (l_0)			4 for CSI-RS resource 1 and 3 8 for CSI-RS resource 2 and 4
	Number of CSI-RS ports (X)			1 for CSI-RS resource 1,2,3,4
	CDM Type			'No CDM' for CSI-RS resource 1,2,3,4
	Density (ρ)			3 for CSI-RS resource 1,2,3,4
	CSI-RS periodicity		slot	15 kHz SCS: 20 for CSI-RS resource 1,2,3,4 30 kHz SCS: 40 for CSI-RS resource
	CSI-RS offset		slot	15 kHz SCS: 10 for CSI-RS resource 1 and 2 11 for CSI-RS resource 3 and 4 30 kHz SCS: 20 for CSI-RS resource 1 and 2 21 for CSI-RS resource 3 and 4
	Frequency Occupation			Start PRB 0 Number of PRB = BWP size
	QCL info			TCI state #0
NZP CSI-RS for CSI acquisition	Frequency Occupation			Start PRB 0 Number of PRB = BWP size
	QCL info			TCI state #1
ZP CSI-RS for CSI acquisition	Frequency Occupation			Start PRB 0 Number of PRB = BWP size
TCI state #0	Type 1 QCL information	SSB index		SSB #0
		QCL Type		Type C
	Type 2 QCL information	SSB index		N/A
		QCL Type		N/A
TCI state #1	Type 1 QCL information	CSI-RS resource		CSI-RS resource 1 from 'CSI-RS for tracking' configuration
		QCL Type		Type A
	Type 2 QCL information	CSI-RS resource		N/A
		QCL Type		N/A
Number of HARQ Processes				4 For FDD 8 for TDD
HARQ ACK/NACK bundling				Multiplexed
Redundancy version coding sequence				{0,2,3,1}
K1 value (PDSCH-to-HARQ-timing-indicator)				2 for FDD For FR1.30-1: 8 if mod(i,10) = 0 6 if mod(i,10) = 2 5 if mod(i,10) = 3 5 if mod(i,10) = 4 4 if mod(i,10) = 5 3 if mod(i,10) = 6 Where i is slot index per radio frame with 0~19 For FR1.30-7: 8 if mod(i,10) = 0 7 if mod(i,10) = 1 6 if mod(i,10) = 2

		5 if mod(i,10) = 3 4 if mod(i,10) = 4 3 if mod(i,10) = 5 2 if mod(i,10) = 6 Where i is the slot index of all slots in every 5ms i = {0,…,9}
Symbols for unused REs		OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1
Physical signals, channels mapping and precoding		As specified in Annex B.4.1
Note 1: PDSCH is not scheduled on slots containing CSI-RS or slots which are not full DL. Note 2: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH transmission. Note 3: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-1 [2] for tested channel bandwidth and subcarrier spacing. Note 4: Additional PDCCH configuration for aperiodic reporting is only for test cases with aperiodic CSI reporting configured.		

6.2 Reporting of Channel Quality Indicator (CQI)

6.2.1 1RX requirements (Void)

6.2.2 2RX requirements

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 2Rx FDD FR1 periodic CQI reporting under AWGN conditions for both SA and NSA

6.2.2.1.1.1.1 Test Purpose

The purpose of this test is to verify the variance of the wideband CQI reports is within the limits defined and a PDSCH BLER of 10% falls between the transport format based median CQI-1 and median CQI or the transport format based median CQI and median CQI +1.

6.2.2.1.1.1.2 Test Applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

6.2.2.1.1.1.3 Minimum requirement for periodic CQI reporting

For the parameters specified in Table 6.2.2.1.1.1.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

a) The reported CQI value according to the reference channel shall be in the range of ±1 of the reported median more than 90% of the time.

b) If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 0.1.

Table 6.2.2.1.1.1.3-1: CQI reporting definition test

Parameter		Unit	Test 1	Test 2		
Bandwidth		MHz	10			
Duplex Mode			FDD			
Subcarrier spacing		kHz	15			
SNR		dB	8	9	14	15
Propagation channel			AWGN			
Antenna configuration			2×2 with static channel specified in Annex B.1			
Beamforming Model			As specified in Section Annex B.4.1			
ZP CSI-RS configuration	CSI-RS resource Type		Periodic			
	Number of CSI-RS ports (*X*)		4			
	CDM Type		FD-CDM2			
	Density (ρ)		1			
	First subcarrier index in the PRB used for CSI-RS (k_0)		Row 5,4			
	First OFDM symbol in the PRB used for CSI-RS (l_0)		9			
	CSI-RS periodicity and offset	slot	5/1			
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Periodic			
	Number of CSI-RS ports (*X*)		2			
	CDM Type		FD-CDM2			
	Density (ρ)		1			
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 3,(6,-)			
	First OFDM symbol in the PRB used for CSI-RS (l_0)		13			
	NZP CSI-RS-timeConfig periodicity and offset	slot	5/1			
CSI-IM configuration	CSI-IM resource Type		Periodic			
	CSI-IM RE pattern		0			
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4, 9)			
	CSI-IM timeConfig periodicity and offset	slot	5/1			
ReportConfigType			Periodic			
CQI-table			Table 2			
reportQuantity			cri-RI-PMI-CQI			
timeRestrictionForChannelMeasurements			Not configured			
timeRestrictionForInterferenceMeasurements			Not configured			
cqi-FormatIndicator			Wideband			
pmi-FormatIndicator			Wideband			
Sub-band Size		RB	8			
CSI-reportingBand			1111111			
CSI-Report periodicity and offset		slot	5/0			
aperiodicTriggeringOffset			Not configured			
Codebook configuration	Codebook Type		typeI-SinglePanel			
	Codebook Mode		1			
	(CodebookConfig-N1,CodebookConfig-N2)		Not configured			
	CodebookSubsetRestriction		010000			
	RI Restriction		N/A			
Physical channel for CSI report			PUCCH			
CQI/RI/PMI delay		ms	8			
Maximum number of HARQ transmission			1			
Measurement channel			As specified in Table A.4-2, TBS.2-2			

The normative reference for this requirement is TS 38.101-4 [5] clause 6.2.2.1.1.1.

6.2.2.1.1.1.4 Test Description

6.2.2.1.1.1.4.1 Initial Conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D.

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7 for TE diagram and section A.3.2.3 for UE diagram.

2. The parameter settings for the NR cell are set up according to Table 6.1.2-1 and 6.2.2.1.1.1.3-1 as appropriate.

3. Downlink signals for the NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 , and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].

4. Propagation conditions for the NR cell are set according to Annex B.1.

5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR for SA with *Connected without release On, Test Mode On* or EN-DC, DC bearer *MCG* and *SCG, Connected without release On, Test Mode* On for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.2.2.1.1.1.4.3.

6.2.2.1.1.1.4.2 Test Procedure

1. Set the parameters of bandwidth, SCS, reference Channel, the propagation condition, antenna configuration and the SNR according to Table 6.2.2.2.1.1.3-1.

2. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to CQI value 2 and keep it regardless of the wideband CQI value sent by the UE. The SS sends downlink MAC padding bits on the DL RMC. Continue transmission of the PDSCH until 2000 wideband CQI reports have been gathered. In this process the SS collects wideband CQI reports every 5 ms and also cases where UE transmits nothing in its CQI timing are also counted as wideband CQI reports.

3. Set up a relative frequency distribution for the reported wideband CQI-values, Calculate the median value (wideband Median CQI is the wideband CQI that is at or crosses 50% distribution from the lower wideband CQI side). This CQI-value is declared as wideband Median CQI value.

4. If Median CQI is not equal to 1 or 15 and [1800] or more of the wideband CQI values are in the range (Median CQI - 1) ≤ Median CQI ≤ (Median CQI + 1) then continue with step 5, otherwise go to step 8.

5. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to the wideband median-CQI value and shall not react to the UE's wideband CQI reports. The SS sends downlink MAC padding bits on the DL RMC. For any PDSCH transmitted by the SS, record the associated ACK, NACK and statDTX responses. The responses are then filtered as follows: for the sequence of responses for each HARQ process, discard all the statDTX responses. Continue to gather data until the number of filtered ACK+NACK responses reaches 1000.

   For the filtered ACK and NACK responses if the ratio (NACK / ACK + NACK) ≤ 0.1 then go to step 6, otherwise go to step 7.

6. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to the wideband median-CQI+1 value and shall not react to the UE's wideband CQI reports. The SS sends

downlink MAC padding bits on the DL RMC. For any PDSCH, transmitted by the SS, record and filter the ACK, NACK and statDTX responses as in step 5 until 1000 filtered ACK+NACK responses are gathered.

If the ratio (NACK /ACK + NACK) > 0.1

then pass the UE for this test and go to step 9, otherwise go to step 8.

7. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to the wideband median-CQI-1 value and shall not react to the UE's wideband CQI reports. The SS sends downlink MAC padding bits on the DL RMC. For any PDSCH, transmitted by the SS, record and filter the ACK, NACK and statDTX responses as in step 5 until 1000 filtered ACK+NACK responses are gathered.

   If the ratio (NACK /ACK + NACK) ≤ 0.1

   then pass the UE for this test and go to step 9, otherwise go to step 8.

8. If both SNR points of the test have not been tested, then repeat the same procedure (steps 1 to 7) for the other SNR point as appropriate. Otherwise fail the UE.

9. Repeat step 1 to 8 for Test2.

6.2.2.1.1.1.4.3 Message contents

Message contents are according to TS 38.508 [6] clause 5.4.2 with the following exceptions:

6.2.2.1.1.1.4.3_1 Message exceptions for SA

Table 6.2.2.1.1.1.4.3_1-1: Void

Table 6.2.2.1.1.1.4.3_1-2: *Void*

6.2.2.1.1.1.4.3_2 Message exceptions for NSA

Same as specified in 6.2.2.1.1.1.4.3_1.

6.2.2.1.1.5 Test Requirements

The pass fail decision is as specified in the test procedure in clause 6.2.2.1.1.1.4.2.

There are no parameters in the test setup or measurement process whose variation impacts the results so there are no applicable test tolerances for this test.

6.2.2.1.1.2 2Rx FDD FR1 periodic CQI reporting with Table 3 under AWGN conditions for both SA and NSA

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

- Whether to adopt minimum sample for pass/fail verdict needs further study.

6.2.2.1.1.2.1 Test Purpose

The purpose of this test is to verify the variance of the wideband CQI reports is within the limits defined and a PDSCH BLER of 10^{-5} falls between the transport format based median CQI-1 and median CQI or the transport format based median CQI and median CQI +1.

6.2.2.1.1.2.2 Test Applicability

This test applies to all types of NR UE release 16 supporting *cqi-TableAlt*.

This test also applies to all types of EUTRA UE release 16 and forward supporting EN-DC and *cqi-TableAlt*.

6.2.2.1.1.2.3 Minimum requirement for periodic CQI reporting with Table 3

For the parameters specified in Table 6.2.2.1.1.2.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

a) The reported CQI value according to the reference channel shall be in the range of ±1 of the reported median more than 90% of the time.

b) If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 10^{-5}, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 10^{-5}. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 10^{-5}, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 10^{-5}.

c) The reported CQI value according to the reference channel shall be ≥ 1.

Table 6.2.2.1.1.2.3-1: CQI reporting test parameters

Parameter		Unit	Test 1
Bandwidth		MHz	10
Duplex Mode			FDD
Subcarrier spacing		kHz	15
SNR		dB	1 | 2
Propagation channel			AWGN
Antenna configuration			1×2 with static channel specified in Annex B.1
Beamforming Model			As specified in Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (*X*)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0)		Row 5,4
	First OFDM symbol in the PRB used for CSI-RS (l_0)		9
	CSI-RS periodicity and offset	slot	5/1
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (*X*)		1
	CDM Type		No CDM
	Density (ρ)		3
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 1,(0,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0)		13
	NZP CSI-RS-timeConfig periodicity and offset	slot	5/1
CSI-IM configuration	CSI-IM resource Type		Periodic
	CSI-IM RE pattern		0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4, 9)
	CSI-IM timeConfig periodicity and offset	slot	5/1

ReportConfigType			Periodic
CQI-table			Table 3
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	8
Csi-ReportingBand			1111111
CSI-Report periodicity and offset		slot	5/0
aperiodicTriggeringOffset			Not configured
Codebook configuration	Codebook Type		typeI-SinglePanel
	Codebook Mode		1
	(CodebookConfig-N1,CodebookConfig-N2)		Not configured
	CodebookSubsetRestriction		000001
	RI Restriction		N/A
Physical channel for CSI report			PUCCH
CQI/RI/PMI delay		ms	8
Maximum number of HARQ transmission			1
Measurement channel			As specified in Table A.4-4, TBS.4-1

The normative reference for this requirement is TS 38.101-4 [5] clause 6.2.2.1.1.2.

6.2.2.1.1.2.4 Test Description

6.2.2.1.1.2.4.1 Initial Conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D.

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.2 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the NR cell are set up according to Table 6.1.2-1 and 6.2.2.1.1.2.3-1 as appropriate.

3. Downlink signals for the NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 , and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].

4. Propagation conditions for the NR cell are set according to Annex B.1.

5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR for SA with *Connected without release On, Test Mode On* or EN-DC, DC bearer *MCG* and *SCG, Connected without release On, Test Mode* On for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.2.2.1.1.2.4.3.

6.2.2.1.1.2.4.2 Test Procedure

1. Set the parameters of bandwidth, SCS, reference Channel, the propagation condition, antenna configuration and the SNR according to Table 6.2.2.1.1.2.3-1.

2. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to CQI value 2 and keep it regardless of the wideband CQI value sent by the UE. The SS sends downlink MAC padding bits on the DL RMC. Continue transmission of the PDSCH until 5000 wideband CQI reports have been gathered. In this process the SS collects wideband CQI reports every 5 ms and also cases where UE transmits nothing in its CQI timing are also counted as wideband CQI reports.

3. Set up a relative frequency distribution for the reported wideband CQI-values, Calculate the median value (wideband Median CQI is the wideband CQI that is at or crosses 50% distribution from the lower wideband CQI side). This CQI-value is declared as wideband Median CQI value.

4. If Median CQI is not equal to 1 or 15 and 4500 or more of the wideband CQI values are in the range (Median CQI - 1) ≤ Median CQI ≤ (Median CQI + 1) then continue with step 5, otherwise go to step 8.

5. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to the wideband median-CQI value and shall not react to the UE's wideband CQI reports. The SS sends downlink MAC padding bits on the DL RMC. For any PDSCH transmitted by the SS, record the associated ACK, NACK and statDTX responses. The responses are then filtered as follows: for the sequence of responses for each HARQ process, discard all the statDTX responses. Measure the BLER for a duration sufficient to achieve statistical significance according to Annex G.4.

   For the filtered ACK and NACK responses if the ratio (NACK / (ACK + NACK)) ≤ 10^{-5} then go to step 6, otherwise go to step 7.

6. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to the wideband median-CQI+1 value and shall not react to the UE's wideband CQI reports. The SS sends downlink MAC padding bits on the DL RMC. For any PDSCH, transmitted by the SS, record and filter the ACK, NACK and statDTX responses as in step 5, and measure the BLER for a duration sufficient to achieve statistical significance according to Annex G.4.

   If the ratio (NACK /(ACK + NACK)) > 10^{-5}

   then pass the UE for this test, otherwise go to step 8.

7. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to the wideband median-CQI-1 value and shall not react to the UE's wideband CQI reports. The SS sends downlink MAC padding bits on the DL RMC. For any PDSCH, transmitted by the SS, record and filter the ACK, NACK and statDTX responses as in step 5, and measure the BLER for a duration sufficient to achieve statistical significance according to Annex G.4.

   If the ratio (NACK /ACK + NACK) ≤10^{-5}

   then pass the UE for this test, otherwise go to step 8.

8. If both SNR points of the test have not been tested, then repeat the same procedure (steps 1 to 7) for the other SNR point as appropriate. Otherwise fail the UE.

6.2.2.1.1.2.4.3 Message contents

Message contents are according to TS 38.508 [6] clause 5.4.2 with the following exceptions:

6.2.2.1.1.2.4.3_1 Message exceptions for SA

Table 6.2.2.1.1.2.4.3_1-1: NZP CSI-RS-ResourceMapping

Derivation Path: TS 38.508-1 [6], Table 4.6.3-45			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
row1	0000	K0=0, row 1,	1Tx test cases
}			
nrofPorts	p1		
firstOFDMSymbolInTimeDomain	13		
CDM Type	noCDM		
density CHOICE {			
three	NULL		
}			
}			

Table 6.2.2.1.1.2.4.4_1-3: CSI-IM-Resource

Derivation Path: TS 38.508-1 [6], Table 5.4.2.4-6			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-IM-Resource ::= SEQUENCE {			
periodicityAndOffset SEQUENCE {			
slot5	0		
}			
}			

Table 6.2.2.1.1.2.4.3_1-2: *NZP-CSI-RS-Resource*

Derivation Path: TS 38.508-1 [6], Table 5.4.2.0-14			
Information Element	**Value/remark**	**Comment**	**Condition**
NZP-CSI-RS-Resource ::= SEQUENCE {			
periodicityAndOffset CHOICE {			
slot5	1		
}			
}			

Table 6.2.2.1.1.2.4.4_1-3: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], Table 5.4.2.4-12			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ReportConfig ::= SEQUENCE {			
cqi-Table	table3		
}			

Table 6.2.2.1.1.2.4.4_1-4: *CodebookConfig*

Derivation Path: TS38.508-1 [6], Table 5.4.2.4-15			
Information Element	**Value/remark**	**Comment**	**Condition**
CodebookConfig ::= SEQUENCE {			
codebookType CHOICE {			
type1 SEQUENCE {			
subType CHOICE {			
typeI-SinglePanel SEQUENCE {			
nrOfAntennaPorts CHOICE {			
Two SEQUENCE {			
twoTX-codebookSubsetRestriction	000001		
}			
}			
}			
}			
}			
}			
}			

Table 6.2.2.1.1.2.4.4_1-5: PDSCH-Config

Derivation Path: TS 38.508-1 [6], Table 4.6.3-100			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-Config ::= SEQUENCE {			
mcs-Table	**qam64LowSE**		
}			

6.2.2.1.1.2.4.3_2 Message exceptions for NSA

Same as specified in 6.2.2.1.1.2.4.3_1.

6.2.2.1.1.2.5 Test Requirements

The pass fail decision is as specified in the test procedure in clause 6.2.2.1.1.2.4.2.

There are no parameters in the test setup or measurement process whose variation impacts the results so there are no applicable test tolerances for this test.

6.2.2.1.2 CQI reporting under fading conditions

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.

6.2.2.1.2.1 2Rx FDD FR1 periodic wideband CQI reporting under fading conditions for both SA and NSA

6.2.2.1.2.1.1 Test purpose

To verify the variance of the wideband CQI reports is within the limits defined, that the ratio of the throughput is within the limits defined and that the average PDSCH BLER is greater than or equal to 2% for the indicated transport format.

6.2.2.1.2.1.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of E-UTRA UE release 15 and forward supporting EN-DC.

6.2.2.1.2.1.3 Minimum conformance requirements

For the parameters specified in Table 6.2.2.1.2.1.3-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

a) A CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least α% of the time where α% is specified in Table 6.2.2.1.2.1-2;

b) The ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be $\geq \gamma$, where γ is specified in Table 6.2.2.1.2.1.3-2;

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 6.2.2.1.2.1.3-1: Wideband CQI reporting test under frequency non-selective fading conditions

Parameter		Unit	Test 1		Test 2	
Bandwidth		MHz	10			
Subcarrier spacing		kHz	15			
Duplex Mode			FDD			
SNR		dB	6	7	12	13
Propagation channel			TDLA30-5			
Antenna configuration			2×2			
Correlation configuration			ULA high			
Beamforming Model			As specified in Annex B.4.1			
ZP CSI-RS configuration	CSI-RS resource Type		Periodic			
	Number of CSI-RS ports (*X*)		4			
	CDM Type		FD-CDM2			
	Density (ρ)		1			
	First subcarrier index in the PRB used for CSI-RS (k_0)		Row 5,4			
	First OFDM symbol in the PRB used for CSI-RS (l_0)		9			
	CSI-RS periodicity and offset	slot	5/1			
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Periodic			
	Number of CSI-RS ports (*X*)		2			
	CDM Type		FD-CDM2			
	Density (ρ)		1			
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 3,(6)			
	First OFDM symbol in the PRB used for CSI-RS (l_0)		13			
	NZP CSI-RS-timeConfig periodicity and offset	slot	5/1			
CSI-IM configuration	CSI-IM resource Type		Periodic			
	CSI-IM RE pattern		0			
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4, 9)			
	CSI-IM timeConfig periodicity and offset	slot	5/1			
ReportConfigType			Periodic			
CQI-table			Table 2			
reportQuantity			cri-RI-PMI-CQI			
timeRestrictionForChannelMeasurements			Not configured			
timeRestrictionForInterferenceMeasurements			Not configured			
cqi-FormatIndicator			Wideband			
pmi-FormatIndicator			Wideband			
Sub-band Size		RB	8			
Csi-ReportingBand			1111111			
CSI-Report periodicity and offset		slot	5/0			
aperiodicTriggeringOffset			Not configured			
Codebook configuration	Codebook Type		typeI-SinglePanel			
	Codebook Mode		1			
	(CodebookConfig-N1,CodebookConfig-N2)		Not configured			
	CodebookSubsetRestriction		000001			
	RI Restriction		N/A			
Physical channel for CSI report			PUCCH			
CQI/RI/PMI delay		ms	8			
Maximum number of HARQ transmission			1			
Measurement channel			As specified in Table A.4-2, TBS.2-1			

Table 6.2.2.1.2.1.3-2: Minimum requirements

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

The normative reference for this requirement is TS 38.101-4 [5] clause 6.2.2.1.2.1.

6.2.2.1.2.1.4 Test description

6.2.2.1.2.1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 and Table 5.3.6-1 of 38.521-1 [7].

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.1 for TE diagram and Figure A.3.2.3 for UE diagram.

2. The parameter settings for the cell are set up according to Table 6.2.2.1.2.1.3-1 as appropriate.

3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].

4. Propagation conditions are set according to Annex B.0.

5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR for SA with Connected without release On, Test Mode On or EN-DC, DC bearer MCG and SCG, Connected without release On, Test Mode On for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.2.2.1.2.1.4.3.

6.2.2.1.2.1.4.2 Test procedure

1. Set the parameters of bandwidth, reference Channel, the propagation condition, antenna configuration and the SNR according to Table 6.2.2.1.2.1.5-1.

2. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to CQI value 2 and keep it regardless of the wideband CQI value sent by the UE. The SS sends downlink MAC padding bits on the DL RMC. Continue transmission of the PDSCH until 6000 wideband CQI reports have been gathered. In this process the SS collects wideband CQI reports every 5 ms and also cases where UE transmits nothing in its CQI timing are also counted as wideband CQI reports.

3. Set up a relative frequency distribution for the reported wideband CQI-values, Calculate the median value (wideband Median CQI is the wideband CQI that is at or crosses 50% distribution from the lower wideband CQI side). This CQI-value is declared as Median CQI value.

4. If Median CQI value is not equal to 1 or 15 and 1200 (α%)or more of the wideband CQI values are outside the range (Median CQI - 1) ≤ Median CQI ≤ (Median CQI + 1) then continue with step 5, otherwise go to step 7.

5. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to the Median CQI value from step 3 and shall not react to the UE's wideband CQI reports. The SS sends downlink MAC padding bits on the DL RMC. Measure the average throughput according to Annex G.3.3 and G.3.4.

   Declare the throughput as t_{median}.

6. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to the UE's reported wideband CQI value. The SS sends downlink MAC padding bits on the DL RMC. For any PDSCH transmitted by the SS, record the associated ACK, NACK and statDTX responses. The responses are then filtered as follows: for the sequence of responses for each HARQ process, discard all the statDTX responses. Continue to gather data, record the BLER (NACK / ACK + NACK) and measure the average throughput according to Annex G.3.3 and G.3.4. Declare the throughput as t.

   If the recorded BLER ≥ 0.02 and t / t_{median} ≥ γ then pass the UE for this test and go to step 8.

7. If both SNR points of the test have not been tested, then repeat the same procedure (steps 1 to 6) for the other SNR point as appropriate. Otherwise fail the UE.

8. Repeat step 1 to 7, with test conditions according to the table 6.2.2.1.2.1.5 -1, for Test2 as appropriate.

6.2.2.1.2.1.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 5.4.2 with the following exceptions:

6.2.2.1.2.1.4.3_1 Message exceptions for SA

Table 6.2.2.1.2.1.4.3_1-1: CSI-RS-ResourceMapping for NZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-45			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	001000		
}			
nrofPorts	p2		
firstOFDMSymbolInTimeDomain	13		
}			

Table 6.2.2.1.2.1.4.3_1-2: CSI-RS-ResourceMapping for ZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-45			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	000100		
}			
nrofPorts	p4		
firstOFDMSymbolInTimeDomain	9		
}			

Table 6.2.2.1.2.1.4.3_1-3: CSI-IM-Resource

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-34			
Information Element	**Value/remark**	**Comment**	**Condition**
csi-IM-ResourceElementPattern			
pattern0 SEQUENCE {			
subcarrierLocation-p0	s4		
symbolLocation-p0	9		
}			
periodicityAndOffset	CSI-ResourcePeriodicityAndOffset		

Table 6.2.2.1.2.1.4.3_1-4: *CSI-ResourcePeriodicityAndOffset*

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-43			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourcePeriodicityAndOffset CHOICE {			
slots5	1		
}			

Table 6.2.2.1.2.1.4.3_1-5: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], clause 4.6.2, Table 4.6.3-25			
Information Element	**Value/remark**	**Comment**	**Condition**
nrOfAntennaPorts CHOICE {			
Two SEQUENCE {			
twoTX-CodebookSubsetRestriction	000001		
}			
}			
typeI-SinglePanel-ri-Restriction	11111111		

Table 6.2.2.1.2.1.4.3_1-6: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-39			
Information Element	**Value/remark**	**Comment**	**Condition**
reportConfigType CHOICE {			
periodic SEQUENCE {			
reportSlotConfig	CSI-ReportPeriodicityAndOffset		
pucch-CSI-ResourceList	PUCCH-CSI-Resource		
}			
reportFreqConfiguration SEQUENCE {			
csi-ReportingBand CHOICE {			
subbands7	1111111		
}			
}			
subbandSize	value2		
}			

6.2.2.1.2.1.4.3_2 Message exceptions for NSA

Same as in 6.2.2.1.2.1.4.3_1.

6.2.2.1.2.1.5 Test requirement

The pass/fail decision is as specified in the test procedure in clause 6.2.2.1.2.1.4.2.

Table 6.2.2.1.2.1.5-1: Wideband CQI reporting test under frequency non-selective fading conditions

Parameter		Unit	Test 1		Test 2	
Bandwidth		MHz	10			
Subcarrier spacing		kHz	15			
Duplex Mode			FDD			
SNR		dB	6	7	12	13
Propagation channel			TDLA30-5			
Antenna configuration			2×2			
Correlation configuration			ULA high			
Beamforming Model			As specified in Annex B.4.1			
ZP CSI-RS configuration	CSI-RS resource Type		Periodic			
	Number of CSI-RS ports (*X*)		4			
	CDM Type		FD-CDM2			
	Density (ρ)		1			
	First subcarrier index in the PRB used for CSI-RS (k_0)		Row 5,4			
	First OFDM symbol in the PRB used for CSI-RS (l_0)		9			
	CSI-RS periodicity and offset	slot	5/1			
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Periodic			
	Number of CSI-RS ports (*X*)		2			
	CDM Type		FD-CDM2			
	Density (ρ)		1			
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 3,(6)			
	First OFDM symbol in the PRB used for CSI-RS (l_0)		13			
	NZP CSI-RS-timeConfig periodicity and offset	slot	5/1			
CSI-IM configuration	CSI-IM resource Type		Periodic			
	CSI-IM RE pattern		0			
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4, 9)			
	CSI-IM timeConfig periodicity and offset	slot	5/1			
ReportConfigType			Periodic			
CQI-table			Table 2			
reportQuantity			cri-RI-PMI-CQI			
timeRestrictionForChannelMeasurements			Not configured			
timeRestrictionForInterferenceMeasurements			Not configured			
cqi-FormatIndicator			Wideband			
pmi-FormatIndicator			Wideband			
Sub-band Size		RB	8			
Csi-ReportingBand			1111111			
CSI-Report periodicity and offset		slot	5/0			
aperiodicTriggeringOffset			Not configured			
Codebook configuration	Codebook Type		typeI-SinglePanel			
	Codebook Mode		1			
	(CodebookConfig-N1,CodebookConfig-N2)		Not configured			
	CodebookSubsetRestriction		000001			
	RI Restriction		N/A			
Physical channel for CSI report			PUCCH			
CQI/RI/PMI delay		ms	8			
Maximum number of HARQ transmission			1			
Measurement channel			As specified in Table A.4-2, TBS.2-1			

Table 6.2.2.1.2.1.5-2: Test requirements

Parameters	Test 1	Test 2
α [%]	20	20
γ	1.05 -TT	1.05 -TT
Note1 : TT = 0.01		

6.2.2.1.2.2 2Rx FDD FR1 aperiodic subband CQI reporting under fading conditions for both SA and NSA

6.2.2.1.2.2.1 Test purpose

To verify the variance of the wideband CQI reports is within the limits defined, that the ratio of the throughput is within the limits defined and that the average PDSCH BLER is greater than or equal to 2% for the indicated transport format.

6.2.2.1.2.2.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of E-UTRA UE release 15 and forward supporting EN-DC.

6.2.2.1.2.2.3 Minimum conformance requirements

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 6.2.2.1.2.2.3-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

a) A sub-band differential CQI offset level of 0 shall be reported at least α% of the time but less than β% of the time for each sub-band, where α and β are specified in Table 6.2.2.1.2.2.3-2.

b) The ratio of the throughput obtained when transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level and that obtained when transmitting the transport format indicated by the reported wideband CQI median on a randomly selected sub-band among all the sub-bands shall be $\geq \gamma$, where γ is specified in Table 6.2.2.1.2.2.3-2.

c) When transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level, the average BLER for the indicated transport format shall be greater than or equal to 0.02.

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

Table 6.2.2.1.2.2.3-1: Sub-band CQI reporting test under frequency-selective fading conditions

Parameter		Unit	Test 1		Test 2	
Bandwidth		MHz	10			
Subcarrier spacing		kHz	15			
Duplex Mode			FDD			
SNR		dB	8	9	14	15
Propagation channel			Two tap model specified in Annex B.2.4 with a=1, f_D = 5Hz, and τ_d=0.45μs			
Antenna configuration			2×2			
Correlation configuration			As per Annex B.1			
Beamforming Model			As specified in Annex B.4.1			
ZP CSI-RS configuration	CSI-RS resource Type		Periodic			
	Number of CSI-RS ports (X)		4			
	CDM Type		FD-CDM2			
	Density (ρ)		1			
	First subcarrier index in the PRB used for CSI-RS (k_0)		Row 5,4			
	First OFDM symbol in the PRB used for CSI-RS (l_0)		9			
	CSI-RS periodicity and offset	slot	5/1			
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Periodic			
	Number of CSI-RS ports (X)		2			
	CDM Type		FD-CDM2			
	Density (ρ)		1			
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 3,(6,-)			
	First OFDM symbol in the PRB used for CSI-RS (l_0)		13			
	NZP CSI-RS-timeConfig periodicity and offset	slot	5/1			
CSI-IM configuration	CSI-IM resource Type		Periodic			
	CSI-IM RE pattern		0			
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4, 9)			
	CSI-IM timeConfig periodicity and offset	slot	5/1			
ReportConfigType			Aperiodic			
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-ReportingBand			1111111			
CSI-Report interval and offset		slot	Not configured			
Aperiodic Report Slot Offset			5			
CSI request			1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0			
reportTriggerSize			1			
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM			
aperiodicTriggeringOffset			Not configured			
Codebook configuration	Codebook Type		typeI-SinglePanel			
	Codebook Mode		1			
	(CodebookConfig-N1,CodebookConfig-N2)		Not configured			
	CodebookSubsetRestriction		000001			
	RI Restriction		N/A			
Physical channel for CSI report			PUSCH			

CQI/RI/PMI delay	ms	8
Maximum number of HARQ transmission		1
Measurement channel		As specified in Table A.4-2, TBS.2-5

Table 6.2.2.1.2.2.3-2: Minimum requirements

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

The normative reference for this requirement is TS 38.101-4 [5] clause 6.2.2.1.2.2.

6.2.2.1.2.2.4 Test description

6.2.2.1.2.2.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 and Table 5.3.6-1 of 38.521-1 [7].

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.6.1 for TE diagram and Figure A.3.2.3.1 for UE diagram.
2. The parameter settings for the cell are set up according to Table 6.2.2.1.2.2.3-1 as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].
4. Propagation conditions are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR for SA with Connected without release On, Test Mode On or EN-DC, DC bearer MCG and SCG, Connected without release On, Test Mode On for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.2.2.1.2.2.4.3.

6.2.2.1.2.2.4.2 Test procedure

1. Set the parameters of bandwidth, reference Channel, the propagation condition, antenna configuration and the SNR according to Table 6.2.2.1.2.2.3-1 as appropriate.
2. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to CQI value 2 and keep it regardless of the wideband and subband CQI value sent by the UE. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission with an UL RMC for CP-OFDM QPSK with 5 RBs at RB_{Start}=0 allocated according to A.2.2.6 of TS 38.521-1 [21] to carry the PUSCH CQI feedback via PDCCH DCI format 0_1 with aperiodic CSI request triggered. No transport block is sent in parallel to the CQI feedback. Continue transmission of the PDSCH until 2000 wideband CQI reports and full-size subband CQI reports for each full-size subband have been gathered. In this process the SS collects sub-band CQI reports every 5 ms and also cases where UE transmits nothing in its CQI timing are also counted as subband CQI reports.

3. Set up a relative frequency distribution for the reported wideband CQI-values, Calculate the median value (wideband Median CQI is the CQI that is at or crosses 50% distribution from the lower wideband CQI side). This CQI-value is declared as wideband Median CQI value.

4. For each subband, if subband differential CQI offset level of 0 is reported, at least α % but less than β % of 6000 full-size subband CQI report, then continue to step 5, otherwise, go to step 7.

5. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC in an each available downlink transmission instance randomly selected full-size subband using the transport format according to the wideband median CQI value regardless of UE wideband or subband CQI report. Note that each full-size subband shall be selected in the equal probability. The SS sends downlink MAC padding bits on the DL RMC. Measure the average throughput according to Annex G.3.3 and G.3.4. Declare the throughput as t_{median}.

6. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to the highest UE reported full-size subband CQI value in one full-size subband selected among the sub-bands in which UE report the highest full-size subband CQI. Subband differential CQI offset level is selected from {0, 1, 2, -1}. Note that the SS shall send PDSCH in the same full-size subband until next UE report is available. In case when same full-size subbands are reported subsequently as subbands with highest full-size subband CQI, the SS shall select for transmission a different subband with respect to the last selection. The SS sends downlink MAC padding bits on the DL RMC Measure the average throughput and (NACK /(ACK + NACK)) according to Annex G.3.3 and G.3.4. Declare the throughput as $t_{subband}$. If the ratio ($t_{subband}$ / t_{median}) $\geq \gamma$ and (NACK /(ACK + NACK)) ≥ 0.02, pass the UE and go to step 8. Otherwise, go to step 7.

7. If both SNR points of the test have not been tested, then repeat the same procedure (steps 1 to 6) for the other SNR point as appropriate. Otherwise fail the UE.

8. If both tests have not been done, then repeat the same procedure (steps 1 to 7) with test conditions according to the table 6.2.2.1.2.2.3-1 for the other test as appropriate.

6.2.2.1.2.2.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1.

6.2.2.1.2.2.4.3_1 Message exceptions for SA

Table 6.2.2.1.2.2.4.3_1-1: CSI-RS-ResourceMapping for NZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-45			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	001000		
}			
nrofPorts	p2		
firstOFDMSymbolInTimeDomain	13		
}			

Table 6.2.2.1.2.2.4.3_1-2: CSI-RS-ResourceMapping for ZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-45			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	000100		
}			
nrofPorts	p4		
firstOFDMSymbolInTimeDomain	9		
}			

Table 6.2.2.1.2.2.4.3_1-3: CSI-IM-Resource

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-34			
Information Element	**Value/remark**	**Comment**	**Condition**
csi-IM-ResourceElementPattern			
pattern0 SEQUENCE {			
subcarrierLocation-p0	s4		
symbolLocation-p0	9		
}			
periodicityAndOffset	CSI-ResourcePeriodicityAndOffset		

Table 6.2.2.1.2.2.4.3_1-4: *CSI-ResourcePeriodicityAndOffset*

Derivation Path: TS 38.508-1 [6], clause 4.6.2, Table 4.6.2-43			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourcePeriodicityAndOffset CHOICE {			
slots5	1		
}			

Table 6.2.2.1.2.2.4.3_1-5: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], clause 4.6.2, Table 4.6.3-25			
Information Element	**Value/remark**	**Comment**	**Condition**
nrOfAntennaPorts CHOICE {			
Two SEQUENCE {			
twoTX-CodebookSubsetRestriction	000001		
}			
}			
typeI-SinglePanel-ri-Restriction	11111111		

Table 6.2.2.1.2.2.4.3_1-6: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-39			
Information Element	**Value/remark**	**Comment**	**Condition**
reportFreqConfiguration SEQUENCE {			
cqi-FormatIndicator	subbandCQI		
csi-ReportingBand CHOICE {			
subbands7	1111111		
}			
}			

6.2.2.1.2.2.4.3_2 Message exceptions for NSA

Same as in 6.2.2.1.2.2.4.3_1.

6.2.2.1.2.2.5 Test requirement

The pass/fail decision is as specified in the test procedure in clause 6.2.2.1.2.2.4.2.

Table: 6.2.2.1.2.2.5-1: Test requirements

Parameters	Test 1	Test 2
α [%]	2	2
β [%]	55	55
γ	1.04	1.04

6.2.2.2 TDD

6.2.2.2.1 CQI Reporting definition under AWGN conditions

6.2.2.2.1.1 2Rx TDD FR1 periodic CQI reporting under AWGN conditions for both SA and NSA

6.2.2.2.1.1.1 Test Purpose

The purpose of this test is to verify the variance of the wideband CQI reports is within the limits defined and a PDSCH BLER of 10% falls between the transport format based median CQI-1 and median CQI or the transport format based median CQI and median CQI +1.

6.2.2.2.1.1.2 Test Applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

6.2.2.2.1.1.3 Minimum requirement for periodic CQI reporting

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

For the parameters specified in Table 6.2.2.2.1.1.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

a) The reported CQI value according to the reference channel shall be in the range of ±1 of the reported median more than 90% of the time.

b) If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 0.1.

Table 6.2.2.2.1.1.3-1: CQI reporting definition test

Parameter		Unit	Test 1	Test 2
Bandwidth		MHz	40	
Subcarrier spacing		kHz	30	
Duplex Mode			TDD	
TDD UL-DL pattern			FR1.30-1	
SNR		dB	8 / 9	14 / 15
Propagation channel			AWGN	
Antenna configuration			2×2 with static channel specified in Annex B.1	
Beamforming Model			As specified in Section Annex B.4.1	
ZP CSI-RS configuration	CSI-RS resource Type		Periodic	
	Number of CSI-RS ports (*X*)		4	
	CDM Type		FD-CDM2	
	Density (ρ)		1	
	First subcarrier index in the PRB used for CSI-RS (k_0)		Row 5,4	
	First OFDM symbol in the PRB used for CSI-RS (l_0)		9	
	CSI-RS periodicity and offset	slot	10/1	
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Periodic	
	Number of CSI-RS ports (*X*)		2	
	CDM Type		FD-CDM2	
	Density (ρ)		1	
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 3,(6,-)	
	First OFDM symbol in the PRB used for CSI-RS (l_0)		13	
	NZP CSI-RS-timeConfig periodicity and offset	slot	10/1	
CSI-IM configuration	CSI-IM resource Type		Periodic	
	CSI-IM RE pattern		0	
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4, 9)	
	CSI-IM timeConfig periodicity and offset	slot	10/1	
ReportConfigType			Periodic	
CQI-table			Table 2	
reportQuantity			cri-RI-PMI-CQI	
timeRestrictionForChannelMeasurements			Not configured	
timeRestrictionForInterferenceMeasurements			Not configured	
cqi-FormatIndicator			Wideband	
pmi-FormatIndicator			Wideband	
Sub-band Size		RB	16	
CSI-reportingBand			1111111	
CSI-Report periodicity and offset		slot	10/9	
aperiodicTriggeringOffset			Not configured	
Codebook configuration	Codebook Type		typeI-SinglePanel	
	Codebook Mode		1	
	(CodebookConfig-N1,CodebookConfig-N2)		Not configured	
	CodebookSubsetRestriction		010000	
	RI Restriction		N/A	
Physical channel for CSI report			PUCCH	
CQI/RI/PMI delay		ms	9.5	
Maximum number of HARQ transmission			1	
Measurement channel			As specified in Table A.4-2, TBS.2-4	

The normative reference for this requirement is TS 38.101-4 [5] clause 6.2.2.2.1.1.

6.2.2.2.1.1.4 Test Description

6.2.2.2.1.1.4.1 Initial Conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7 for TE diagram and section A.3.2.3 for UE diagram.

2. The parameter settings for the NR cell are set up according to Table 6.1.2-1 and 6.2.2.2.1.1.3-1 as appropriate.

3. Downlink signals for the NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 , and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].

4. Propagation conditions for the NR cell are set according to Annex B.1.

5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR for SA with *Connected without release On, Test Mode On* or EN-DC, DC bearer *MCG* and *SCG, Connected without release On, Test Mode On* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.2.2.2.1.1.4.3.

6.2.2.2.1.1.4.2 Test Procedure

1. Set the parameters of bandwidth, SCS, reference Channel, the propagation condition, antenna configuration and the SNR according to Table 6.2.2.2.1.1.3-1.

2. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to CQI value 2 and keep it regardless of the wideband CQI value sent by the UE. The SS sends downlink MAC padding bits on the DL RMC. Continue transmission of the PDSCH until 2000 wideband CQI reports have been gathered. In this process the SS collects wideband CQI reports every 5 ms and also cases where UE transmits nothing in its CQI timing are also counted as wideband CQI reports.

3. Set up a relative frequency distribution for the reported wideband CQI-values, Calculate the median value (wideband Median CQI is the wideband CQI that is at or crosses 50% distribution from the lower wideband CQI side). This CQI-value is declared as wideband Median CQI value.

4. If Median CQI is not equal to 1 or 15 and [1800] or more of the wideband CQI values are in the range (Median CQI - 1) ≤ Median CQI ≤ (Median CQI + 1) then continue with step 5, otherwise go to step 8.

5. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to the wideband median-CQI value and shall not react to the UE's wideband CQI reports. The SS sends downlink MAC padding bits on the DL RMC. For any PDSCH transmitted by the SS, record the associated ACK, NACK and statDTX responses. The responses are then filtered as follows: for the sequence of responses for each HARQ process, discard all the statDTX responses. Continue to gather data until the number of filtered ACK+NACK responses reaches 1000.

   For the filtered ACK and NACK responses if the ratio (NACK / ACK + NACK) ≤ 0.1 then go to step 6, otherwise go to step 7.

6. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to the wideband median-CQI+1 value and shall not react to the UE's wideband CQI reports. The SS sends

downlink MAC padding bits on the DL RMC. For any PDSCH, transmitted by the SS, record and filter the ACK, NACK and statDTX responses as in step 5 until 1000 filtered ACK+NACK responses are gathered.

If the ratio (NACK /ACK + NACK) > 0.1

then pass the UE for this test and go to step 9, otherwise go to step 8.

7. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to the wideband median-CQI-1 value and shall not react to the UE's wideband CQI reports. The SS sends downlink MAC padding bits on the DL RMC. For any PDSCH, transmitted by the SS, record and filter the ACK, NACK and statDTX responses as in step 5 until 1000 filtered ACK+NACK responses are gathered.

   If the ratio (NACK /ACK + NACK) ≤ 0.1

   then pass the UE for this test and go to step 9, otherwise go to step 8.

8. If both SNR points of the test have not been tested, then repeat the same procedure (steps 1 to 7) for the other SNR point as appropriate. Otherwise fail the UE.

9. Repeat step 1 to 8 for Test2.

6.2.2.2.1.1.4.4 Message contents

Message contents are according to TS 38.508 [6] clause 5.4.2 with the following exceptions:

6.2.2.2.1.1.4.4_1 Message exceptions for SA

Table 6.2.2.2.1.1.4.4_1-1: Void

Table 6.2.2.2.1.1.4.4_1-2: Void

6.2.2.2.1.1.4.4_2 Message exceptions for NSA

Same as specified in 6.2.2.2.1.1.4.4_1.

6.2.2.2.1.1.5 Test Requirements

The pass fail decision is as specified in the test procedure in clause 6.2.2.2.1.1.4.2.

There are no parameters in the test setup or measurement process whose variation impacts the results so there are no applicable test tolerances for this test.

6.2.2.2.1.2 2Rx TDD FR1 periodic CQI reporting with Table 3 under AWGN conditions for both SA and NSA

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

- Whether to adopt minimum sample for pass/fail verdict needs further study.

6.2.2.2.1.2.1 Test Purpose

The purpose of this test is to verify the variance of the wideband CQI reports is within the limits defined and a PDSCH BLER of 10^{-5} falls between the transport format based median CQI-1 and median CQI or the transport format based median CQI and median CQI +1.

6.2.2.2.1.2.2 Test Applicability

This test applies to all types of NR UE release 16 supporting *cqi-TableAlt*.

This test also applies to all types of EUTRA UE release 16 and forward supporting EN-DC and *cqi-TableAlt*.

6.2.2.2.1.2.3 Minimum requirement for periodic CQI reporting with Table 3

For the parameters specified in Table 6.2.2.2.1.2.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

a) The reported CQI value according to the reference channel shall be in the range of ±1 of the reported median more than 90% of the time.

b) If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 10^{-5}, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 10^{-5}. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 10^{-5}, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 10^{-5}.

c) The reported CQI value according to the reference channel shall be ≥ 1.

Table 6.2.2.2.1.2.3-1: CQI reporting test parameters

Parameter		Unit	Test 1	
Bandwidth		MHz	40	
Subcarrier spacing		kHz	30	
Duplex Mode			TDD	
TDD UL-DL pattern			FR1.30-1	
SNR		dB	1	2
Propagation channel			AWGN	
Antenna configuration			1×2 with static channel specified in Annex B.1	
Beamforming Model			As specified in Annex B.4.1	
ZP CSI-RS configuration	CSI-RS resource Type		Periodic	
	Number of CSI-RS ports (*X*)		4	
	CDM Type		FD-CDM2	
	Density (ρ)		1	
	First subcarrier index in the PRB used for CSI-RS (k_0)		Row 5,4	
	First OFDM symbol in the PRB used for CSI-RS (l_0)		9	
	CSI-RS periodicity and offset	slot	10/1	
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Periodic	
	Number of CSI-RS ports (*X*)		1	
	CDM Type		No CDM	
	Density (ρ)		3	
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 1,(0,-)	
	First OFDM symbol in the PRB used for CSI-RS (l_0)		1	
	NZP CSI-RS-timeConfig periodicity and offset	slot	10/1	
CSI-IM configuration	CSI-IM resource Type		Periodic	
	CSI-IM RE pattern		0	
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4, 9)	
	CSI-IM timeConfig periodicity and offset	slot	10/1	

ReportConfigType			Periodic
CQI-table			Table 3
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	16
Csi-ReportingBand			1111111
CSI-Report periodicity and offset		slot	10/9
aperiodicTriggeringOffset			Not configured
Codebook configuration	Codebook Type		typeI-SinglePanel
	Codebook Mode		1
	(CodebookConfig-N1,CodebookConfig-N2)		Not configured
	CodebookSubsetRestriction		000001
	RI Restriction		N/A
Physical channel for CSI report			PUCCH
CQI/RI/PMI delay		ms	9.5
Maximum number of HARQ transmission			1
Measurement channel			As specified in Table A.4-4, TBS.4-2

The normative reference for this requirement is TS 38.101-4 [5] clause 6.2.2.2.1.2.

6.2.2.2.1.2.4 Test Description

6.2.2.2.1.2.4.1 Initial Conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D.

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.2 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the NR cell are set up according to Table 6.1.2-1 and 6.2.2.2.1.2.3-1 as appropriate.

3. Downlink signals for the NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 , and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].

4. Propagation conditions for the NR cell are set according to Annex B.1.

5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR for SA with *Connected without release On, Test Mode On* or EN-DC, DC bearer *MCG* and *SCG, Connected without release On, Test Mode* On for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.2.2.2.1.2.4.3.

6.2.2.2.1.2.4.2 Test Procedure

1. Set the parameters of bandwidth, SCS, reference Channel, the propagation condition, antenna configuration and the SNR according to Table 6.2.2.2.1.2.3-1.

2. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to CQI value 2 and keep it regardless of the wideband CQI value sent by the UE. The SS sends downlink MAC padding bits on the DL RMC. Continue transmission of the PDSCH until 5000 wideband CQI reports have been gathered. In this process the SS collects wideband CQI reports every 10 ms and also cases where UE transmits nothing in its CQI timing are also counted as wideband CQI reports.

3. Set up a relative frequency distribution for the reported wideband CQI-values, Calculate the median value (wideband Median CQI is the wideband CQI that is at or crosses 50% distribution from the lower wideband CQI side). This CQI-value is declared as wideband Median CQI value.

4. If Median CQI is not equal to 1 or 15 and 4500 or more of the wideband CQI values are in the range (Median CQI - 1) ≤ Median CQI ≤ (Median CQI + 1) then continue with step 5, otherwise go to step 8.

5. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to the wideband median-CQI value and shall not react to the UE's wideband CQI reports. The SS sends downlink MAC padding bits on the DL RMC. For any PDSCH transmitted by the SS, record the associated ACK, NACK and statDTX responses. The responses are then filtered as follows: for the sequence of responses for each HARQ process, discard all the statDTX responses. Measure the BLER for a duration sufficient to achieve statistical significance according to Annex G.4.

   For the filtered ACK and NACK responses if the ratio (NACK / (ACK + NACK)) ≤ 10^{-5} then go to step 6, otherwise go to step 7.

6. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to the wideband median-CQI+1 value and shall not react to the UE's wideband CQI reports. The SS sends downlink MAC padding bits on the DL RMC. For any PDSCH, transmitted by the SS, record and filter the ACK, NACK and statDTX responses as in step 5, and measure the BLER for a duration sufficient to achieve statistical significance according to Annex G.4.

   If the ratio (NACK / (ACK + NACK)) > 10^{-5}

   then pass the UE for this test, otherwise go to step 8.

7. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to the wideband median-CQI-1 value and shall not react to the UE's wideband CQI reports. The SS sends downlink MAC padding bits on the DL RMC. For any PDSCH, transmitted by the SS, record and filter the ACK, NACK and statDTX responses as in step 5, and measure the BLER for a duration sufficient to achieve statistical significance according to Annex G.4.

   If the ratio (NACK / ACK + NACK) ≤10^{-5}

   then pass the UE for this test, otherwise go to step 8.

8. If both SNR points of the test have not been tested, then repeat the same procedure (steps 1 to 7) for the other SNR point as appropriate. Otherwise fail the UE.

6.2.2.2.1.2.4.3 Message contents

Message contents are according to TS 38.508 [6] clause 5.4.2 with the following exceptions:

6.2.2.2.1.2.4.3_1 Message exceptions for SA

Table 6.2.2.2.1.2.4.3_1-1: NZP CSI-RS-ResourceMapping

Derivation Path: TS 38.508-1 [6], Table 4.6.3-45			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
row1	0000	K0=0, row 1,	1Tx test cases
}			
nrofPorts	p1		
firstOFDMSymbolInTimeDomain	1		
CDM Type	noCDM		
density CHOICE {			
three	NULL		
}			
}			

Table 6.2.2.2.1.2.4.3_1-2: *NZP-CSI-RS-Resource*

Derivation Path: TS 38.508-1 [6], Table 5.4.2.0-14			
Information Element	**Value/remark**	**Comment**	**Condition**
NZP-CSI-RS-Resource ::= SEQUENCE {			
periodicityAndOffset CHOICE {			
slot10	1		
}			
}			

Table 6.2.2.2.1.2.4.4_1-3: CSI-IM-Resource

Derivation Path: TS 38.508-1 [6], Table 5.4.2.4-6			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-IM-Resource ::= SEQUENCE {			
periodicityAndOffset SEQUENCE {			
slot10	1		
}			
}			

Table 6.2.2.2.1.2.4.4_1-4: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], Table 5.4.2.4-12			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ReportConfig ::= SEQUENCE {			
cqi-Table	table3		
}			

Table 6.2.2.2.1.2.4.4_1-5: *CodebookConfig*

Derivation Path: TS38.508-1 [6], Table 5.4.2.4-15			
Information Element	**Value/remark**	**Comment**	**Condition**
CodebookConfig ::= SEQUENCE {			
codebookType CHOICE {			
type1 SEQUENCE {			
subType CHOICE {			
typeI-SinglePanel SEQUENCE {			
nrOfAntennaPorts CHOICE {			
Two SEQUENCE {			
twoTX-codebookSubsetRestriction	000001		
}			
}			
}			
}			
}			
}			
}			

Table 6.2.2.2.1.2.4.4_1-6: PDSCH-Config

Derivation Path: TS 38.508-1 [6], Table 4.6.3-100			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-Config ::= SEQUENCE {			
mcs-Table	**qam64LowSE**		
}			

6.2.2.2.1.2.4.3_2 Message exceptions for NSA

Same as specified in 6.2.2.2.1.2.4.3_1.

6.2.2.2.1.2.5 Test Requirements

The pass fail decision is as specified in the test procedure in clause 6.2.2.2.1.2.4.2.

There are no parameters in the test setup or measurement process whose variation impacts the results so there are no applicable test tolerances for this test.

6.2.2.2.2 CQI reporting under fading conditions

6.2.2.2.2.1 2Rx TDD FR1 periodic wideband CQI reporting under fading conditions for both SA and NSA

6.2.2.2.2.1.1 Test purpose

To verify the variance of the wideband CQI reports is within the limits defined, that the ratio of the throughput is within the limits defined and that the average PDSCH BLER is greater than or equal to 2% for the indicated transport format.

6.2.2.2.2.1.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of E-UTRA UE release 15 and forward supporting EN-DC.

6.2.2.2.2.1.3 Minimum conformance requirements

For the parameters specified in Table 6.2.2.2.2.1.3-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

a) A CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least α% of the time where α% is specified in Table 6.2.2.2.2.1.3-2;

b) The ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be $\geq \gamma$, where γ is specified in Table 6.2.2.2.2.1.3-2;

c) When transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater than or equal to 0.02.

Table 6.2.2.2.2.1.3-1: Wideband CQI reporting test under frequency non-selective fading conditions

Parameter		Unit	Test 1	Test 2
Bandwidth		MHz	40	
Subcarrier spacing		kHz	30	
Duplex Mode			TDD	
TDD UL-DL pattern			FR1.30-1	
SNR		dB	6	7	12	13
Propagation channel			TDLA30-5	
Antenna configuration			2×2	
Correlation configuration			ULA high	
Beamforming Model			As specified in AnnexB.4.1	
ZP CSI-RS configuration	CSI-RS resource Type		Periodic	
	Number of CSI-RS ports (*X*)		4	
	CDM Type		FD-CDM2	
	Density (ρ)		1	
	First subcarrier index in the PRB used for CSI-RS (k_0)		Row 5,4	
	First OFDM symbol in the PRB used for CSI-RS (l_0)		9	
	CSI-RS periodicity and offset	slot	10/1	
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Periodic	
	Number of CSI-RS ports (*X*)		2	
	CDM Type		FD-CDM2	
	Density (ρ)		1	
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 3,(6,-)	
	First OFDM symbol in the PRB used for CSI-RS (l_0)		13	
	NZP CSI-RS-timeConfig periodicity and offset	slot	10/1	
CSI-IM configuration	CSI-RS resource Type		Periodic	
	CSI-IM RE pattern		0	
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4, 9)	
	CSI-IM timeConfig periodicity and offset	slot	10/1	
ReportConfigType			Periodic	
CQI-table			Table 2	
reportQuantity			cri-RI-PMI-CQI	
timeRestrictionForChannelMeasurements			Not configured	
timeRestrictionForInterferenceMeasurements			Not configured	
cqi-FormatIndicator			Wideband	
pmi-FormatIndicator			Wideband	
Sub-band Size		RB	16	
Csi-ReportingBand			1111111	
CSI-Report periodicity and offset		slot	10/9	
aperiodicTriggeringOffset			Not configured	
Codebook configuration	Codebook Type		typeI-SinglePanel	
	Codebook Mode		1	
	(CodebookConfig-N1,CodebookConfig-N2)		Not configured	
	CodebookSubsetRestriction		000001	
	RI Restriction		N/A	
Physical channel for CSI report			PUCCH	
CQI/RI/PMI delay		ms	9.5	
Maximum number of HARQ transmission			1	
Measurement channel			As specified in Table A.4-1, TBS.2-3	

Table 6.2.2.2.2.1.3-2: Minimum requirements

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

The normative reference for this requirement is TS 38.101-4 [5] clause 6.2.2.2.2.1.

6.2.2.2.2.1.4 Test description

6.2.2.2.2.1.4.1 Initial conditions

Same initial conditions as specified in clause 6.2.2.1.2.1.4.1 with the following exceptions:

Instead of Table 6.2.2.1.2.1.3-1 → use Table 6.2.2.2.2.1.3-1.

6.2.2.2.2.1.4.2 Test procedure

Same test procedure as specified in clause 6.2.2.1.2.1.4.2 with the following exceptions:

Instead of Table 6.2.2.1.2.1.5-1 → use Table 6.2.2.2.2.1.3-1.

6.2.2.2.2.1.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 5.4.2 with the following exceptions:

6.2.2.2.2.1.4.3_1 Message exceptions for SA

Same as 6.2.2.1.2.1.4.3_1 with following exceptions:

Table 6.2.2.2.2.1.4.3_1-1: *CSI-ResourcePeriodicityAndOffset*

Derivation Path: TS 38.508-1 [6], clause 4.6.2, Table 4.6.2-43			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourcePeriodicityAndOffset CHOICE {			
slots10	1		
}			

6.2.2.2.2.1.4.3_2 Message exceptions for NSA

Same as 6.2.2.2.2.1.4.3_1.

6.2.2.2.2.1.5 Test requirement

The pass/fail decision is as specified in the test procedure in clause 6.2.2.2.2.1.4.2.

Table 6.2.2.2.2.1.5-1: Test requirements

Parameters	Test 1	Test 2
α [%]	20	20
γ	1.04	1.04

6.2.2.2.2.2 2Rx TDD FR1 aperiodic subband CQI reporting under fading conditions for both SA and NSA

6.2.2.2.2.2.1 Test purpose

To verify the variance of the subband CQI reports is within the limits defined, that the ratio of the throughput is within the limits defined and that the average PDSCH BLER is greater than or equal to 2 % for the indicated transport format.

6.2.2.2.2.2.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of E-UTRA UE release 15 and forward supporting EN-DC.

6.2.2.2.2.2.3 Minimum conformance requirements

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 6.2.2.2.2.2.3-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

a) A sub-band differential CQI offset level of 0 shall be reported at least α% of the time but less than β% of the time for each sub-band, where α and β are specified in Table 6.2.2.2.2.2.3-2;

b) The ratio of the throughput obtained when transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level and that obtained when transmitting the transport format indicated by the reported wideband CQI median on a randomly selected sub-band among all the sub-bands shall be $\geq \gamma$, where γ is specified in Table 6.2.2.2.2.2.3-2;

c) When transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level, the average BLER for the indicated transport format shall be greater than or equal to 0.02.

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

Table 6.2.2.2.2.2.3-1: Sub-band CQI reporting test under frequency-selective fading conditions

Parameter		Unit	Test 1	Test 2
Bandwidth		MHz	40	
Subcarrier spacing		kHz	30	
Duplex Mode			TDD	
TDD UL-DL pattern			FR1.30-1	
SNR		dB	8 / 9	14 / 15
Propagation channel			Two tap model specified in Annex B.2.4 with a=1, f_D = 5Hz, and τ_d=0.1125μs	
Antenna configuration			2×2	
Correlation configuration			As per Annex B.1	
Beamforming Model			As specified in Annex B.4.1	
ZP CSI-RS configuration	CSI-RS resource Type		Periodic	
	Number of CSI-RS ports (X)		4	
	CDM Type		FD-CDM2	
	Density (ρ)		1	
	First subcarrier index in the PRB used for CSI-RS (k_0)		Row 5,4	
	First OFDM symbol in the PRB used for CSI-RS (l_0)		9	
	CSI-RS periodicity and offset	slot	10/1	
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Periodic	
	Number of CSI-RS ports (X)		2	
	CDM Type		FD-CDM2	
	Density (ρ)		1	
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 3,(6,-)	
	First OFDM symbol in the PRB used for CSI-RS (l_0)		13	
	NZP CSI-RS-timeConfig periodicity and offset	slot	10/1	
CSI-IM configuration	CSI-IM resource Type		Periodic	
	CSI-IM RE pattern		0	
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4, 9)	
	CSI-IM timeConfig periodicity and offset	slot	10/1	
ReportConfigType			Aperiodic	
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-ReportingBand			1111111	
CSI-Report interval and offset		slot	Not configured	
Aperiodic Report Slot Offset			8	
CSI request			1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0	
reportTriggerSize			1	
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM	
aperiodicTriggeringOffset			Not configured	
Codebook configuration	Codebook Type		typeI-SinglePanel	
	Codebook Mode		1	
	(CodebookConfig-N1,CodebookConfig-N2)		Not configured	
	CodebookSubsetRestriction		000001	
	RI Restriction		N/A	

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

Table 6.2.2.2.2.2.3-2: Minimum requirements

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

The normative reference for this requirement is TS 38.101-4 [5] clause 6.2.2.2.2.2.

6.2.2.2.2.2.4 Test description

6.2.2.2.2.2.4.1 Initial conditions

Same initial conditions as specified in clause 6.2.2.1.2.2.4.1 with the following exceptions:

Instead of Table 6.2.2.1.2.2.3-1 → use Table 6.2.2.2.2.2.3 -1.

Instead of clause 6.2.2.1.2.2.4.3 → use clause 6.2.2.2.2.2.4.3.

6.2.2.2.2.2.4.2 Test procedure

Same test procedure as specified in clause 6.2.2.1.2.2.4.2 with the following exceptions:

Instead of Table 6.2.2.1.2.2.3-1 → use Table 6.2.2.2.2.2.3-1.

6.2.2.2.2.2.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 5.4.2 with the following exceptions:

6.2.2.2.2.2.4.3_1 Message exceptions for SA

Table 6.2.2.2.2.2.4.3_1-1: CSI-RS-ResourceMapping for NZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-45			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	001000		
}			
nrofPorts	p2		
firstOFDMSymbolInTimeDomain	13		
}			

Table 6.2.2.2.2.2.4.3_1-2: CSI-RS-ResourceMapping for ZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-45			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	000100		
}			
nrofPorts	p4		
firstOFDMSymbolInTimeDomain	9		
}			

Table 6.2.2.2.2.2.4.3_1-3: CSI-IM-Resource

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-34			
Information Element	**Value/remark**	**Comment**	**Condition**
csi-IM-ResourceElementPattern			
pattern0 SEQUENCE {			
subcarrierLocation-p0	s4		
symbolLocation-p0	9		
}			
periodicityAndOffset	CSI-ResourcePeriodicityAndOffset		

Table 6.2.2.2.2.2.4.3_1-4: *CSI-ResourcePeriodicityAndOffset*

Derivation Path: TS 38.508-1 [6], clause 4.6.2, Table 4.6.2-43			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourcePeriodicityAndOffset CHOICE {			
slots10	1		
}			

Table 6.2.2.2.2.2.4.3_1-5: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], clause 4.6.2, Table 4.6.3-25			
Information Element	**Value/remark**	**Comment**	**Condition**
nrOfAntennaPorts CHOICE {			
Two SEQUENCE {			
twoTX-CodebookSubsetRestriction	000001		
}			
}			
typeI-SinglePanel-ri-Restriction	11111111		

Table 6.2.2.2.2.2.4.3_1-6: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-39			
Information Element	**Value/remark**	**Comment**	**Condition**
reportFreqConfiguration SEQUENCE {			
cqi-FormatIndicator	subbandCQI		
csi-ReportingBand CHOICE {			
subbands7	1111111		
}			
}			

6.2.2.2.2.2.4.3_2 Message exceptions for NSA

Same as in 6.2.2.2.2.2.4.3_1.

6.2.2.2.2.2.5 Test requirement

The pass/fail decision is as specified in the test procedure in clause 6.2.2.2.2.2.4.2.

Table 6.2.2.2.2.2.5-1: Test requirements

Parameters	Test 1	Test 2
α [%]	2	2
β [%]	55	55
γ	1.04	1.04

6.2.3 4RX requirements

6.2.3.1 FDD

6.2.3.1.1 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

6.2.3.1.1.1 4Rx FDD FR1 periodic CQI reporting under AWGN conditions for both SA and NSA

6.2.3.1.1.1.1 Test Purpose

The purpose of this test is to verify the variance of the wideband CQI reports is within the limits defined and a PDSCH BLER of 10% falls between the transport format based median CQI-1 and median CQI or the transport format based median CQI and median CQI +1.

6.2.3.1.1.1.2 Test Applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

6.2.3.1.1.1.3 Minimum requirement for periodic CQI reporting

For the parameters specified in Table 6.2.3.1.1.1.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

a) The reported CQI value according to the reference channel shall be in the range of ±1 of the reported median more than 90% of the time.

b) If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 0.1.

Table 6.2.3.1.1.1.3-1: CQI reporting definition test

Parameter		Unit	Test 1		Test 2	
Bandwidth		MHz	10			
Subcarrier spacing		kHz	15			
Duplex Mode			FDD			
SNR		dB	5	6	11	12
Propagation channel			AWGN			
Antenna configuration			2×4 with static channel specified in Annex B.1			
Beamforming Model			As specified in Annex B.4.1			
ZP CSI-RS configuration	CSI-RS resource Type		Periodic			
	Number of CSI-RS ports (*X*)		4			
	CDM Type		FD-CDM2			
	Density (ρ)		1			
	First subcarrier index in the PRB used for CSI-RS (k_0)		Row 5,4			
	First OFDM symbol in the PRB used for CSI-RS (l_0)		9			
	CSI-RS periodicity and offset	slot	5/1			
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Periodic			
	Number of CSI-RS ports (*X*)		2			
	CDM Type		FD-CDM2			
	Density (ρ)		1			
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 3,(6,-)			
	First OFDM symbol in the PRB used for CSI-RS (l_0)		13			
	NZP CSI-RS-timeConfig periodicity and offset	slot	5/1			
CSI-IM configuration	CSI-IM resource Type		Periodic			
	CSI-IM RE pattern		0			
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4, 9)			
	CSI-IM timeConfig periodicity and offset	slot	5/1			
ReportConfigType			Periodic			
CQI-table			Table 2			
reportQuantity			cri-RI-PMI-CQI			
timeRestrictionForChannelMeasurements			Not configured			
timeRestrictionForInterferenceMeasurements			Not configured			
cqi-FormatIndicator			Wideband			
pmi-FormatIndicator			Wideband			
Sub-band Size		RB	8			
csi-ReportingBand			1111111			
CSI-Report periodicity and offset		slot	5/0			
aperiodicTriggeringOffset			Not configured			
Codebook configuration	Codebook Type		typeI-SinglePanel			
	Codebook Mode		1			
	(CodebookConfig-N1,CodebookConfig-N2)		Not configured			
	CodebookSubsetRestriction		010000			
	RI Restriction		N/A			
Physical channel for CSI report			PUCCH			
CQI/RI/PMI delay		ms	8			
Maximum number of HARQ transmission			1			
Measurement channel			As specified in Table A.4-2, TBS.2-2			

The normative reference for this requirement is TS 38.101-4 [5] clause 6.2.3.1.1.1.

6.2.3.1.1.1.4 Test Description

6.2.3.1.1.1.4.1 Initial Conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D.

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.5 for TE diagram and section A.3.2.5 for UE diagram.

2. The parameter settings for the NR cell are set up according to Table 6.1.2-1 and 6.2.3.1.1.1.3-1 as appropriate.

3. Downlink signals for the NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 , and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].

4. Propagation conditions for the NR cell are set according to Annex B.1.

5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR for SA with *Connected without release On, Test Mode On* or EN-DC, DC bearer *MCG* and *SCG, Connected without release On, Test Mode On* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.2.3.1.1.1.4.3.

6.2.3.1.1.1.4.2 Test Procedure

1. Set the parameters of bandwidth, SCS, reference Channel, the propagation condition, antenna configuration and the SNR according to Table 6.2.2.2.1.1.3-1.

2. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to CQI value 2 and keep it regardless of the wideband CQI value sent by the UE. The SS sends downlink MAC padding bits on the DL RMC. Continue transmission of the PDSCH until 2000 wideband CQI reports have been gathered. In this process the SS collects wideband CQI reports every 5 ms and also cases where UE transmits nothing in its CQI timing are also counted as wideband CQI reports.

3. Set up a relative frequency distribution for the reported wideband CQI-values, Calculate the median value (wideband Median CQI is the wideband CQI that is at or crosses 50% distribution from the lower wideband CQI side). This CQI-value is declared as wideband Median CQI value.

4. If Median CQI is not equal to 1 or 15 and [1800] or more of the wideband CQI values are in the range (Median CQI - 1) ≤ Median CQI ≤ (Median CQI + 1) then continue with step 5, otherwise go to step 8.

5. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to the wideband median-CQI value and shall not react to the UE's wideband CQI reports. The SS sends downlink MAC padding bits on the DL RMC. For any PDSCH transmitted by the SS, record the associated ACK, NACK and statDTX responses. The responses are then filtered as follows: for the sequence of responses for each HARQ process, discard all the statDTX responses. Continue to gather data until the number of filtered ACK+NACK responses reaches 1000.

   For the filtered ACK and NACK responses if the ratio (NACK / ACK + NACK) ≤ 0.1 then go to step 6, otherwise go to step 7.

6. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to the wideband median-CQI+1 value and shall not react to the UE's wideband CQI reports. The SS sends downlink MAC padding bits on the DL RMC. For any PDSCH, transmitted by the SS, record and filter the ACK, NACK and statDTX responses as in step 5 until 1000 filtered ACK+NACK responses are gathered.

If the ratio (NACK /ACK + NACK) > 0.1

then pass the UE for this test and go to step 9, otherwise go to step 8.

7. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to the wideband median-CQI-1 value and shall not react to the UE's wideband CQI reports. The SS sends downlink MAC padding bits on the DL RMC. For any PDSCH, transmitted by the SS, record and filter the ACK, NACK and statDTX responses as in step 5 until 1000 filtered ACK+NACK responses are gathered.

   If the ratio (NACK /ACK + NACK) ≤ 0.1

   then pass the UE for this test and go to step 9, otherwise go to step 8.

8. If both SNR points of the test have not been tested, then repeat the same procedure (steps 1 to 7) for the other SNR point as appropriate. Otherwise fail the UE.

9. Repeat step 1 to 8 for Test2.

6.2.3.1.1.1.4.4 Message contents

Message contents are according to TS 38.508-1 [6] clause 5.4.2 with the following exceptions:

6.2.3.1.1.1.4.4_1 Message exceptions for SA

Same as specified in clause 6.2.2.1.1.1.4.4_1

6.2.3.1.1.1.4.4_2 Message exceptions for NSA

Same as specified in clause 6.2.3.1.1.1.4.4_1.

6.2.3.1.1.5 Test Requirements

The pass fail decision is as specified in the test procedure in clause 6.2.3.1.1.1.4.2.

There are no parameters in the test setup or measurement process whose variation impacts the results so there are no applicable test tolerances for this test.

6.2.3.1.2 4Rx FDD FR1 periodic CQI reporting with Table 3 under AWGN conditions for both SA and NSA

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

- Whether to adopt minimum sample for pass/fail verdict needs further study.

6.2.3.1.2.1 Test Purpose

The purpose of this test is to verify the variance of the wideband CQI reports is within the limits defined and a PDSCH BLER of 10^{-5} falls between the transport format based median CQI-1 and median CQI or the transport format based median CQI and median CQI +1.

6.2.3.1.2.2 Test Applicability

This test applies to all types of NR UE release 16 supporting *cqi-TableAlt*.

This test also applies to all types of EUTRA UE release 16 and forward supporting EN-DC and *cqi-TableAlt*.

6.2.3.1.2.3 Minimum requirement for periodic CQI reporting with Table 3

For the parameters specified in Table 6.2.3.1.2.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

a) The reported CQI value according to the reference channel shall be in the range of ±1 of the reported median more than 90% of the time.

b) If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 10^{-5}, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 10^{-5}. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 10^{-5}, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 10^{-5}.

c) The reported CQI value according to the reference channel shall be ≥ 1.

Table 6.2.3.1.1.2.3-1: CQI reporting test parameters

Parameter		Unit	Test 1	
Bandwidth		MHz	10	
Subcarrier spacing		kHz	15	
Duplex Mode			FDD	
SNR		dB	-2	-1
Propagation channel			AWGN	
Antenna configuration			1×4 with static channel specified in Annex B.1	
Beamforming Model			As specified in Annex B.4.1	
ZP CSI-RS configuration	CSI-RS resource Type		Periodic	
	Number of CSI-RS ports (*X*)		4	
	CDM Type		FD-CDM2	
	Density (ρ)		1	
	First subcarrier index in the PRB used for CSI-RS (k_0)		Row 5,4	
	First OFDM symbol in the PRB used for CSI-RS (l_0)		9	
	CSI-RS periodicity and offset	slot	5/1	
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Periodic	
	Number of CSI-RS ports (*X*)		1	
	CDM Type		No CDM	
	Density (ρ)		3	
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 1,(0,-)	
	First OFDM symbol in the PRB used for CSI-RS (l_0)		1	
	NZP CSI-RS-timeConfig periodicity and offset	slot	5/1	
CSI-IM configuration	CSI-IM resource Type		Periodic	
	CSI-IM RE pattern		0	
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4, 9)	
	CSI-IM timeConfig periodicity and offset	slot	5/1	
ReportConfigType			Periodic	
CQI-table			Table 3	
reportQuantity			cri-RI-PMI-CQI	
timeRestrictionForChannelMeasurements			Not configured	
timeRestrictionForInterferenceMeasurements			Not configured	
cqi-FormatIndicator			Wideband	
pmi-FormatIndicator			Wideband	
Sub-band Size		RB	8	
Csi-ReportingBand			1111111	
CSI-Report periodicity and offset		slot	5/0	
aperiodicTriggeringOffset			Not configured	
Codebook configuration	Codebook Type		typeI-SinglePanel	
	Codebook Mode		1	
	(CodebookConfig-N1,CodebookConfig-N2)		Not configured	
	CodebookSubsetRestriction		000001	
	RI Restriction		N/A	
Physical channel for CSI report			PUCCH	
CQI/RI/PMI delay		ms	8	
Maximum number of HARQ transmission			1	
Measurement channel			As specified in Table A.4-4, TBS.4-1	

The normative reference for this requirement is TS 38.101-4 [5] clause 6.2.3.1.1.2.

6.2.3.1.1.2.4 Test Description

6.2.3.1.1.2.4.1 Initial Conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D.

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.3 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the NR cell are set up according to Table 6.1.2-1 and 6.2.3.1.1.2.3-1 as appropriate.

3. Downlink signals for the NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 , and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].

4. Propagation conditions for the NR cell are set according to Annex B.1.

5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR for SA with *Connected without release On, Test Mode On* or EN-DC, DC bearer *MCG* and *SCG, Connected without release On, Test Mode* On for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.2.3.1.1.2.4.3.

6.2.3.1.1.2.4.2 Test Procedure

1. Set the parameters of bandwidth, SCS, reference Channel, the propagation condition, antenna configuration and the SNR according to Table 6.2.3.1.1.2.3-1.

2. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to CQI value 2 and keep it regardless of the wideband CQI value sent by the UE. The SS sends downlink MAC padding bits on the DL RMC. Continue transmission of the PDSCH until 5000 wideband CQI reports have been gathered. In this process the SS collects wideband CQI reports every 5 ms and also cases where UE transmits nothing in its CQI timing are also counted as wideband CQI reports.

3. Set up a relative frequency distribution for the reported wideband CQI-values, Calculate the median value (wideband Median CQI is the wideband CQI that is at or crosses 50% distribution from the lower wideband CQI side). This CQI-value is declared as wideband Median CQI value.

4. If Median CQI is not equal to 1 or 15 and 4500 or more of the wideband CQI values are in the range (Median CQI - 1) ≤ Median CQI ≤ (Median CQI + 1) then continue with step 5, otherwise go to step 8.

5. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to the wideband median-CQI value and shall not react to the UE's wideband CQI reports. The SS sends downlink MAC padding bits on the DL RMC. For any PDSCH transmitted by the SS, record the associated ACK, NACK and statDTX responses. The responses are then filtered as follows: for the sequence of responses for each HARQ process, discard all the statDTX responses. Measure the BLER for a duration sufficient to achieve statistical significance according to Annex G.4.

   For the filtered ACK and NACK responses if the ratio (NACK / (ACK + NACK)) ≤ 10^{-5} then go to step 6, otherwise go to step 7.

6. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to the wideband median-CQI+1 value and shall not react to the UE's wideband CQI reports. The SS sends downlink MAC padding bits on the DL RMC. For any PDSCH, transmitted by the SS, record and filter the

ACK, NACK and statDTX responses as in step 5, and measure the BLER for a duration sufficient to achieve statistical significance according to Annex G.4.

If the ratio (NACK /(ACK + NACK)) > 10^{-5}

then pass the UE for this test, otherwise go to step 8.

7. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to the wideband median-CQI-1 value and shall not react to the UE's wideband CQI reports. The SS sends downlink MAC padding bits on the DL RMC. For any PDSCH, transmitted by the SS, record and filter the ACK, NACK and statDTX responses as in step 5, and measure the BLER for a duration sufficient to achieve statistical significance according to Annex G.4.

   If the ratio (NACK /ACK + NACK) ≤10^{-5}

   then pass the UE for this test, otherwise go to step 8.

8. If both SNR points of the test have not been tested, then repeat the same procedure (steps 1 to 7) for the other SNR point as appropriate. Otherwise fail the UE.

6.2.3.1.1.2.4.3 Message contents

Message contents are according to TS 38.508 [6] clause 5.4.2 with the following exceptions:

6.2.3.1.1.2.4.3_1 Message exceptions for SA

Same as specified in clause 6.2.2.1.1.2.4.3_1.

6.2.3.1.1.2.4.3_2 Message exceptions for NSA

Same as specified in 6.2.3.1.1.2.4.3_1.

6.2.3.1.1.2.5 Test Requirements

The pass fail decision is as specified in the test procedure in clause 6.2.3.1.1.2.4.2.

There are no parameters in the test setup or measurement process whose variation impacts the results so there are no applicable test tolerances for this test.

6.2.3.1.2 CQI reporting definition under fading conditions

6.2.3.1.2.1 4Rx FDD FR1 periodic wideband CQI reporting under fading conditions for both SA and NSA

6.2.3.1.2.1.1 Test purpose

To verify the variance of the wideband CQI reports is within the limits defined, that the ratio of the throughput is within the limits defined and that the average PDSCH BLER is greater than or equal to 2% for the indicated transport format.

6.2.3.1.2.1.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of E-UTRA UE release 15 and forward supporting EN-DC.

6.2.3.1.2.1.3 Minimum conformance requirements

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 6.2.3.1.2.1.3-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

a) A CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least α% of the time where α% is specified in Table 6.2.3.1.2.1.3-2;

b) The ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be $\geq \gamma$, where γ is specified in Table 6.2.3.1.2.1.3-2;

c) When transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater than or equal to 0.02.

Table 6.2.3.1.2.1.3-1: Wideband CQI reporting test under frequency non-selective fading conditions

Parameter		Unit	Test 1		Test 2	
Bandwidth		MHz	10			
Subcarrier spacing		kHz	15			
Duplex Mode			FDD			
SNR		dB	3	4	9	10
Propagation channel			TDLA30-5			
Antenna configuration			2×4			
Correlation configuration			XP High			
Beamforming Model			As specified in Annex B.4.1			
ZP CSI-RS configuration	CSI-RS resource Type		Periodic			
	Number of CSI-RS ports (*X*)		4			
	CDM Type		FD-CDM2			
	Density (ρ)		1			
	First subcarrier index in the PRB used for CSI-RS (k_0)		Row 5,4			
	First OFDM symbol in the PRB used for CSI-RS (l_0)		9			
	CSI-RS periodicity and offset	slot	5/1			
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Periodic			
	Number of CSI-RS ports (*X*)		2			
	CDM Type		FD-CDM2			
	Density (ρ)		1			
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 3,(6,-)			
	First OFDM symbol in the PRB used for CSI-RS (l_0)		13			
	NZP CSI-RS-timeConfig periodicity and offset	slot	5/1			
CSI-IM configuration	CSI-IM resource Type		Periodic			
	CSI-IM RE pattern		0			
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4, 9)			
	CSI-IM timeConfig periodicity and offset	slot	5/1			
ReportConfigType			Periodic			
CQI-table			Table 2			
reportQuantity			cri-RI-PMI-CQI			
timeRestrictionForChannelMeasurements			Not configured			
timeRestrictionForInterferenceMeasurements			Not configured			
cqi-FormatIndicator			Wideband			
pmi-FormatIndicator			Wideband			
Sub-band Size		RB	8			
csi-ReportingBand			1111111			
CSI-Report periodicity and offset		slot	5/0			
aperiodicTriggeringOffset			Not configured			
Codebook configuration	Codebook Type		typeI-SinglePanel			
	Codebook Mode		1			
	(CodebookConfig-N1,CodebookConfig-N2)		Not configured			
	CodebookSubsetRestriction		000001			
	RI Restriction		N/A			
Physical channel for CSI report			PUCCH			
CQI/RI/PMI delay		ms	8			
Maximum number of HARQ transmission			1			
Measurement channel			As specified in Table A.4-2, TBS.2-1			

Table 6.2.3.1.2.1.3-2: Minimum requirements

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

The normative reference for this requirement is TS 38.101-4 [5] clause 6.2.3.1.2.1.

6.2.3.1.2.1.4 Test description

6.2.3.1.2.1.4.1 Initial conditions

Same initial conditions as specified in clause 6.2.2.1.2.1.4.1 with the following exceptions:

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.4 for TE diagram and section A.3.2.5 for UE diagram.

Instead of Table 6.2.2.1.2.1.3-1→ use Table 6.2.3.1.2.1.3-1.

6.2.3.1.2.1.4.2 Test procedure

Same test procedure as specified in clause 6.2.2.1.2.1.4.2 with the following exceptions:

4. If Median CQI value is not equal to 1 or 15 and 300 (α%)or more of the wideband CQI values are outside the range (Median CQI - 1) ≤ Median CQI ≤ (Median CQI + 1) then continue with step 5, otherwise go to step 7.

Instead of Table 6.2.2.1.2.1.5-1 → use Table 6.2.3.1.2.1.3-1.

6.2.3.1.2.1.4.3 Message contents

Same message contests as specified in clause 6.2.2.1.2.1.4.3 with the following exceptions:

6.2.3.1.2.1.4.3_1 Message exceptions for SA

Table 6.2.3.1.2.1.4.3_1-1: *CSI-ResourcePeriodicityAndOffset*

Derivation Path: TS 38.508-1 [6], clause 4.6.2, Table 4.6.2-43			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourcePeriodicityAndOffset CHOICE {			
slots5	1		
}			

6.2.3.1.2.1.4.3_2 Message exceptions for NSA

Same as in 6.2.3.1.2.1.4.3_1.

6.2.3.1.2.1.5 Test requirement

The pass/fail decision is as specified in the test procedure in clause 6.2.3.1.2.1.4.2.

Table 6.2.3.1.2.1.3-1: Test requirements

Parameters	Test 1	Test 2
α [%]	5	5
γ	1.04	1.04

6.2.3.1.2.2 4Rx FDD FR1 aperiodic subband CQI reporting under fading conditions for both SA and NSA

6.2.3.1.2.2.1 Test purpose

To verify the variance of the wideband CQI reports is within the limits defined, that the ratio of the throughput is within the limits defined and that the average PDSCH BLER is greater than or equal to 2% for the indicated transport format.

6.2.3.1.2.2.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of E-UTRA UE release 15 and forward supporting EN-DC.

6.2.3.1.2.2.3 Minimum conformance requirements

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 6.2.3.1.2.2.3-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

a) A sub-band differential CQI offset level of 0 shall be reported at least α% of the time but less than β% of the time for each sub-band, where α and β are specified in Table 6.2.3.1.2.2.3-2;

b) The ratio of the throughput obtained when transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level and that obtained when transmitting the transport format indicated by the reported wideband CQI median on a randomly selected sub-band among all the sub-bands shall be $\geq \gamma$, where γ is specified in Table 6.2.3.1.2.2.3-2;

c) When transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level, the average BLER for the indicated transport format shall be greater than or equal to 0.02.

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

Table 6.2.3.1.2.2.3-1: Sub-band CQI reporting test under frequency-selective fading conditions

Parameter		Unit	Test 1		Test 2	
Bandwidth		MHz	10			
Subcarrier spacing		kHz	15			
Duplex Mode			FDD			
SNR		dB	5	6	11	12
Propagation channel			Two tap model specified in Annex B.2.4 with a=1, f_D = 5Hz, and τ_d=0.45μs			
Antenna configuration			2×4			
Correlation configuration			As per Annex B.1			
Beamforming Model			As specified in Annex B.4.1			
ZP CSI-RS configuration	CSI-RS resource Type		Periodic			
	Number of CSI-RS ports (X)		4			
	CDM Type		FD-CDM2			
	Density (ρ)		1			
	First subcarrier index in the PRB used for CSI-RS (k_0)		Row 5,4			
	First OFDM symbol in the PRB used for CSI-RS (l_0)		9			
	CSI-RS periodicity and offset	slot	5/1			
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Periodic			
	Number of CSI-RS ports (X)		2			
	CDM Type		FD-CDM2			
	Density (ρ)		1			
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 3,(6,-)			
	First OFDM symbol in the PRB used for CSI-RS (l_0)		13			
	NZP CSI-RS-timeConfig periodicity and offset	slot	5/1			
CSI-IM configuration	CSI-IM resource Type		Periodic			
	CSI-IM RE pattern		0			
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4, 9)			
	CSI-IM timeConfig periodicity and offset	slot	5/1			
ReportConfigType			Aperiodic			
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-ReportingBand			1111111			
CSI-Report interval and offset		slot	Not configured			
Aperiodic Report Slot Offset			5			
CSI request			1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0			
reportTriggerSize			1			
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM			
aperiodicTriggeringOffset			Not configured			
Codebook configuration	Codebook Type		typeI-SinglePanel			
	Codebook Mode		1			
	(CodebookConfig-N1,CodebookConfig-N2)		Not configured			
	CodebookSubsetRestriction		000001			
	RI Restriction		N/A			
Physical channel for CSI report			PUSCH			

CQI/RI/PMI delay	ms	8
Maximum number of HARQ transmission		1
Measurement channel		As specified in Table A.4-2, TBS.2-5

Table 6.2.3.1.2.2.3-2: Minimum requirements

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

The normative reference for this requirement is TS 38.101-4 [5] clause 6.2.3.1.2.2.

6.2.3.1.2.2.4 Test description

6.2.3.1.2.2.4.1 Initial conditions

Same initial conditions as specified in clause 6.2.2.1.2.2.4.1 with the following exceptions:

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.4 for TE diagram and section A.3.2.5 for UE diagram.

Instead of Table 6.2.2.1.2.2.3-1→ use Table 6.2.3.1.2.2.3-1.

6.2.3.1.2.2.4.2 Test procedure

Same test procedure as specified in clause 6.2.2.1.2.2.4.2 with the following exceptions:

Instead of Table 6.2.2.1.2.2.5-1 → use Table 6.2.3.1.2.2.3-1.

6.2.3.1.2.2.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 5.4.2 with the following exceptions:

6.2.3.1.2.2.4.3_1 Message exceptions for SA

Same message exceptions as in 6.2.2.1.2.2.4.3_1.

6.2.3.1.2.2.4.3_2 Message exceptions for NSA

Same as in 6.2.3.1.2.2.4.3_1.

6.2.3.1.2.2.5 Test requirement

The pass/fail decision is as specified in the test procedure in clause 6.2.3.1.2.2.4.2.

Table 6.2.3.1.2.2.5-1: Test requirements

Parameters	Test 1	Test 2
α [%]	2	2
β [%]	55	55
γ	1.04	1.04

6.2.3.2 TDD

6.2.3.2.1 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

6.2.3.2.1.1 4Rx TDD FR1 periodic CQI reporting under AWGN conditions for both SA and NSA

6.2.3.2.1.1.1 Test Purpose

The purpose of this test is to verify the variance of the wideband CQI reports is within the limits defined and a PDSCH BLER of 10% falls between the transport format based median CQI-1 and median CQI or the transport format based median CQI and median CQI +1.

6.2.3.2.1.1.2 Test Applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

6.2.3.2.1.1.3 Minimum requirement for periodic CQI reporting

For the parameters specified in Table 6.2.3.2.1.1.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

a) The reported CQI value according to the reference channel shall be in the range of ±1 of the reported median more than 90% of the time.

b) If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 0.1.

Table 6.2.3.2.1.1.3-1: CQI reporting definition test

Parameter		Unit	Test 1		Test 2	
Bandwidth		MHz	40			
Subcarrier spacing		kHz	30			
Duplex Mode			TDD			
TDD UL-DL pattern			FR1.30-1			
SNR		dB	5	6	11	12
Propagation channel			AWGN			
Antenna configuration			2×4 with static channel specified in Annex B.1			
Beamforming Model			As specified in Annex B.4.1			
ZP CSI-RS configuration	CSI-RS resource Type		Periodic			
	Number of CSI-RS ports (*X*)		4			
	CDM Type		FD-CDM2			
	Density (ρ)		1			
	First subcarrier index in the PRB used for CSI-RS (k_0)		Row 5,4			
	First OFDM symbol in the PRB used for CSI-RS (l_0)		9			
	CSI-RS periodicity and offset	slot	10/1			
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Periodic			
	Number of CSI-RS ports (*X*)		2			
	CDM Type		FD-CDM2			
	Density (ρ)		1			

	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 3,(6,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0)		13
	NZP CSI-RS-timeConfig periodicity and offset	slot	10/1
CSI-IM configuration	CSI-IM resource Type		Periodic
	CSI-IM RE pattern		0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4, 9)
	CSI-IM timeConfig periodicity and offset	slot	10/1
ReportConfigType			Periodic
CQI-table			Table 2
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	16
csi-ReportingBand			1111111
CSI-Report periodicity and offset		slot	10/9
aperiodicTriggeringOffset			Not configured
Codebook configuration	Codebook Type		typeI-SinglePanel
	Codebook Mode		1
	(CodebookConfig-N1,CodebookConfig-N2)		Not configured
	CodebookSubsetRestriction		010000
	RI Restriction		N/A
Physical channel for CSI report			PUCCH
CQI/RI/PMI delay		ms	9.5
Maximum number of HARQ transmission			1
Measurement channel			As specified in Table A.4-2, TBS.2-4

The normative reference for this requirement is TS 38.101-4 [5] clause 6.2.3.2.1.1.

6.2.3.2.1.1.4 Test Description

6.2.3.2.1.1.4.1 Initial Conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.5 for TE diagram and section A.3.2.5 for UE diagram.

2. The parameter settings for the NR cell are set up according to Table 6.1.2-1 and 6.2.3.2.1.1.3-1 as appropriate.

3. Downlink signals for the NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 , and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].

4. Propagation conditions for the NR cell are set according to Annex B.1.

5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR for SA with *Connected without release On, Test Mode On* or EN-DC, DC bearer *MCG* and *SCG, Connected without release On, Test Mode On* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.2.3.2.1.1.4.3.

6.2.3.2.1.1.4.2 Test Procedure

1. Set the parameters of bandwidth, SCS, reference Channel, the propagation condition, antenna configuration and the SNR according to Table 6.2.2.2.1.1.3-1.

2. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to CQI value 2 and keep it regardless of the wideband CQI value sent by the UE. The SS sends downlink MAC padding bits on the DL RMC. Continue transmission of the PDSCH until 2000 wideband CQI reports have been gathered. In this process the SS collects wideband CQI reports every 5 ms and also cases where UE transmits nothing in its CQI timing are also counted as wideband CQI reports.

3. Set up a relative frequency distribution for the reported wideband CQI-values, Calculate the median value (wideband Median CQI is the wideband CQI that is at or crosses 50% distribution from the lower wideband CQI side). This CQI-value is declared as wideband Median CQI value.

4. If Median CQI is not equal to 1 or 15 and [1800] or more of the wideband CQI values are in the range (Median CQI - 1) ≤ Median CQI ≤ (Median CQI + 1) then continue with step 5, otherwise go to step 8.

5. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to the wideband median-CQI value and shall not react to the UE's wideband CQI reports. The SS sends downlink MAC padding bits on the DL RMC. For any PDSCH transmitted by the SS, record the associated ACK, NACK and statDTX responses. The responses are then filtered as follows: for the sequence of responses for each HARQ process, discard all the statDTX responses. Continue to gather data until the number of filtered ACK+NACK responses reaches 1000.

   For the filtered ACK and NACK responses if the ratio (NACK / ACK + NACK) ≤ 0.1 then go to step 6, otherwise go to step 7.

6. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to the wideband median-CQI+1 value and shall not react to the UE's wideband CQI reports. The SS sends downlink MAC padding bits on the DL RMC. For any PDSCH, transmitted by the SS, record and filter the ACK, NACK and statDTX responses as in step 5 until 1000 filtered ACK+NACK responses are gathered.

   If the ratio (NACK /ACK + NACK) > 0.1

   then pass the UE for this test and go to step 9, otherwise go to step 8.

7. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to the wideband median-CQI-1 value and shall not react to the UE's wideband CQI reports. The SS sends downlink MAC padding bits on the DL RMC. For any PDSCH, transmitted by the SS, record and filter the ACK, NACK and statDTX responses as in step 5 until 1000 filtered ACK+NACK responses are gathered.

   If the ratio (NACK /ACK + NACK) ≤ 0.1

   then pass the UE for this test and go to step 9, otherwise go to step 8.

8. If both SNR points of the test have not been tested, then repeat the same procedure (steps 1 to 7) for the other SNR point as appropriate. Otherwise fail the UE.

9. Repeat step 1 to 8 for Test2.

6.2.3.2.1.1.4.4 Message contents

Message contents are according to TS 38.508-1 [6] clause 5.4.2 with the following exceptions:

6.2.3.2.1.1.4.4_1 Message exceptions for SA

Same as specified in 6.2.2.2.1.1.4.4_1.

6.2.3.2.1.1.4.4_2 Message exceptions for NSA

Same as specified in 6.2.3.2.1.1.4.4_1.

6.2.3.2.1.1.5 Test Requirements

The pass fail decision is as specified in the test procedure in clause 6.2.3.2.1.1.4.2.

There are no parameters in the test setup or measurement process whose variation impacts the results so there are no applicable test tolerances for this test.

6.2.3.2.1.2 4Rx TDD FR1 periodic CQI reporting with Table 3 under AWGN conditions for both SA and NSA

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

- Whether to adopt minimum sample for pass/fail verdict needs further study.

6.2.3.2.1.2.1 Test Purpose

The purpose of this test is to verify the variance of the wideband CQI reports is within the limits defined and a PDSCH BLER of 10^{-5} falls between the transport format based median CQI-1 and median CQI or the transport format based median CQI and median CQI +1.

6.2.3.2.1.2.2 Test Applicability

This test applies to all types of NR UE release 16 supporting *cqi-TableAlt*.

This test also applies to all types of EUTRA UE release 16 and forward supporting EN-DC and *cqi-TableAlt*.

6.2.3.2.1.2.3 Minimum requirement for periodic CQI reporting with Table 3

For the parameters specified in Table 6.2.3.2.1.2.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

a) The reported CQI value according to the reference channel shall be in the range of ±1 of the reported median more than 90% of the time.

b) If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 10^{-5}, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 10^{-5}. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 10^{-5}, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 10^{-5}.

c) The reported CQI value according to the reference channel shall be ≥ 1.

Table 6.2.3.2.1.2.3-1: CQI reporting test parameters

Parameter		Unit	Test 1	
Bandwidth		MHz	40	
Subcarrier spacing		kHz	30	
Duplex Mode			TDD	
TDD UL-DL pattern			FR1.30-1	
SNR		dB	-2	-1
Propagation channel			AWGN	
Antenna configuration			1×4 with static channel specified in Annex B.1	
Beamforming Model			As specified in Annex B.4.1	
ZP CSI-RS configuration	CSI-RS resource Type		Periodic	
	Number of CSI-RS ports (*X*)		4	
	CDM Type		FD-CDM2	
	Density (ρ)		1	
	First subcarrier index in the PRB used for CSI-RS (k_0)		Row 5,4	
	First OFDM symbol in the PRB used		9	

	for CSI-RS (l_0)		
	CSI-RS periodicity and offset	slot	10/1
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (*X*)		1
	CDM Type		No CDM
	Density (ρ)		3
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 1,(0,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0)		1
	NZP CSI-RS-timeConfig periodicity and offset	slot	10/1
CSI-IM configuration	CSI-IM resource Type		Periodic
	CSI-IM RE pattern		0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4, 9)
	CSI-IM timeConfig periodicity and offset	slot	10/1
ReportConfigType			Periodic
CQI-table			Table 3
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	16
Csi-ReportingBand			1111111
CSI-Report periodicity and offset		slot	10/9
aperiodicTriggeringOffset			Not configured
Codebook configuration	Codebook Type		typeI-SinglePanel
	Codebook Mode		1
	(CodebookConfig-N1,CodebookConfig-N2)		Not configured
	CodebookSubsetRestriction		000001
	RI Restriction		N/A
Physical channel for CSI report			PUCCH
CQI/RI/PMI delay		ms	9.5
Maximum number of HARQ transmission			1
Measurement channel			As specified in Table A.4-4, TBS.4-2

The normative reference for this requirement is TS 38.101-4 [5] clause 6.2.3.2.1.2.

6.2.3.2.1.2.4 Test Description

6.2.3.2.1.2.4.1 Initial Conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D.

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.3 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the NR cell are set up according to Table 6.1.2-1 and 6.2.3.2.1.2.3-1 as appropriate.

3. Downlink signals for the NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 , and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].

4. Propagation conditions for the NR cell are set according to Annex B.1.

5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR for SA with *Connected without release On, Test Mode On* or EN-DC, DC bearer *MCG* and *SCG, Connected without release On, Test Mode* On for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.2.3.2.1.2.4.3.

6.2.3.2.1.2.4.2 Test Procedure

1. Set the parameters of bandwidth, SCS, reference Channel, the propagation condition, antenna configuration and the SNR according to Table 6.2.3.2.1.2.3-1.

2. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to CQI value 2 and keep it regardless of the wideband CQI value sent by the UE. The SS sends downlink MAC padding bits on the DL RMC. Continue transmission of the PDSCH until 5000 wideband CQI reports have been gathered. In this process the SS collects wideband CQI reports every 10 ms and also cases where UE transmits nothing in its CQI timing are also counted as wideband CQI reports.

3. Set up a relative frequency distribution for the reported wideband CQI-values, Calculate the median value (wideband Median CQI is the wideband CQI that is at or crosses 50% distribution from the lower wideband CQI side). This CQI-value is declared as wideband Median CQI value.

4. If Median CQI is not equal to 1 or 15 and 4500 or more of the wideband CQI values are in the range (Median CQI - 1) ≤ Median CQI ≤ (Median CQI + 1) then continue with step 5, otherwise go to step 8.

5. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to the wideband median-CQI value and shall not react to the UE's wideband CQI reports. The SS sends downlink MAC padding bits on the DL RMC. For any PDSCH transmitted by the SS, record the associated ACK, NACK and statDTX responses. The responses are then filtered as follows: for the sequence of responses for each HARQ process, discard all the statDTX responses. Measure the BLER for a duration sufficient to achieve statistical significance according to Annex G.4.

   For the filtered ACK and NACK responses if the ratio (NACK / (ACK + NACK)) ≤ 10^{-5} then go to step 6, otherwise go to step 7.

6. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to the wideband median-CQI+1 value and shall not react to the UE's wideband CQI reports. The SS sends downlink MAC padding bits on the DL RMC. For any PDSCH, transmitted by the SS, record and filter the ACK, NACK and statDTX responses as in step 5, and measure the BLER for a duration sufficient to achieve statistical significance according to Annex G.4.

   If the ratio (NACK / (ACK + NACK)) > 10^{-5}

   then pass the UE for this test, otherwise go to step 8.

7. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to the wideband median-CQI-1 value and shall not react to the UE's wideband CQI reports. The SS sends downlink MAC padding bits on the DL RMC. For any PDSCH, transmitted by the SS, record and filter the ACK, NACK and statDTX responses as in step 5, and measure the BLER for a duration sufficient to achieve statistical significance according to Annex G.4.

   If the ratio (NACK / ACK + NACK) ≤10^{-5}

   then pass the UE for this test, otherwise go to step 8.

8. If both SNR points of the test have not been tested, then repeat the same procedure (steps 1 to 7) for the other SNR point as appropriate. Otherwise fail the UE.

6.2.3.2.1.2.4.3 Message contents

Message contents are according to TS 38.508 [6] clause 5.4.2 with the following exceptions:

6.2.3.2.1.2.4.3_1 Message exceptions for SA

Same as specified in clause 6.2.2.2.1.2.4.3_1.

6.2.3.2.1.2.4.3_2 Message exceptions for NSA

Same as specified in 6.2.3.2.1.2.4.3_1.

6.2.3.2.1.2.5 Test Requirements

The pass fail decision is as specified in the test procedure in clause 6.2.3.2.1.2.4.2.

There are no parameters in the test setup or measurement process whose variation impacts the results so there are no applicable test tolerances for this test.

6.2.3.2.2 CQI reporting under fading conditions

6.2.3.2.2.1 4Rx TDD FR1 periodic wideband CQI reporting under fading conditions for both SA and NSA

6.2.3.2.2.1.1 Test purpose

To verify the variance of the wideband CQI reports is within the limits defined, that the ratio of the throughput is within the limits defined and that the average PDSCH BLER is greater than or equal to 2% for the indicated transport format.

6.2.3.2.2.1.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of E-UTRA UE release 15 and forward supporting EN-DC.

6.2.3.2.2.1.3 Minimum conformance requirements

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 6.2.3.2.2.1.3-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

a) A CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least α% of the time where α% is specified in Table 6.2.3.2.2.1.3-2;

b) The ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be $\geq \gamma$, where γ is specified in Table 6.2.3.2.2.1.3-2;

c) When transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater than or equal to 0.02.

Table 6.2.3.2.2.1.3-1: Wideband CQI reporting test under frequency non-selective fading conditions

Parameter		Unit	Test 1		Test 2	
Bandwidth		MHz	40			
Subcarrier spacing		kHz	30			
Duplex Mode			TDD			
TDD UL-DL pattern			FR1.30-1			
SNR		dB	3	4	9	10
Propagation channel			TDLA30-5			
Antenna configuration			2×4			
Correlation configuration			XP High			
Beamforming Model			As specified in Annex B.4.1			
ZP CSI-RS configuration	CSI-RS resource Type		Periodic			
	Number of CSI-RS ports (*X*)		4			
	CDM Type		FD-CDM2			
	Density (ρ)		1			
	First subcarrier index in the PRB used for CSI-RS (k_0)		Row 5,4			
	First OFDM symbol in the PRB used for CSI-RS (l_0)		9			
	CSI-RS periodicity and offset	slot	10/1			
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Periodic			
	Number of CSI-RS ports (*X*)		2			
	CDM Type		FD-CDM2			
	Density (ρ)		1			
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 3,(6,-)			
	First OFDM symbol in the PRB used for CSI-RS (l_0)		13			
	NZP CSI-RS-timeConfig periodicity and offset	slot	10/1			
CSI-IM configuration	CSI-IM resource Type		Periodic			
	CSI-IM RE pattern		0			
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4, 9)			
	CSI-IM timeConfig periodicity and offset	slot	10/1			
ReportConfigType			Periodic			
CQI-table			Table 2			
reportQuantity			cri-RI-PMI-CQI			
timeRestrictionForChannelMeasurements			Not configured			
timeRestrictionForInterferenceMeasurements			Not configured			
cqi-FormatIndicator			Wideband			
pmi-FormatIndicator			Wideband			
Sub-band Size		RB	16			
csi-ReportingBand			1111111			
CSI-Report periodicity and offset		slot	10/9			
aperiodicTriggeringOffset			Not configured			
Codebook configuration	Codebook Type		typeI-SinglePanel			
	Codebook Mode		1			
	(CodebookConfig-N1,CodebookConfig-N2)		Not configured			
	CodebookSubsetRestriction		000001			
	RI Restriction		N/A			
Physical channel for CSI report			PUCCH			
CQI/RI/PMI delay		ms	9.5			
Maximum number of HARQ transmission			1			
Measurement channel			As specified in Table A.4-2, TBS.2-3			

Table 6.2.3.2.2.1.3-2: Minimum requirements

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

The normative reference for this requirement is TS 38.101-4 [5] clause 6.2.3.2.2.1.

6.2.3.2.2.1.4 Test description

6.2.3.2.2.1.4.1 Initial conditions

Same initial conditions as specified in clause 6.2.2.1.2.1.4.1 with the following exceptions:

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.4 for TE diagram and section A.3.2.5 for UE diagram.

Instead of Table 6.2.2.1.2.1.3-1 → use Table 6.2.3.2.2.1.3-1.

6.2.3.2.2.1.4.2 Test procedure

Same test procedure as specified in clause 6.2.2.1.2.1.4.2 with the following exceptions:

4. If Median CQI value is not equal to 1 or 15 and 300 (α%)or more of the wideband CQI values are outside the range (Median CQI - 1) ≤ Median CQI ≤ (Median CQI + 1) then continue with step 5, otherwise go to step 7.

Instead of Table 6.2.2.1.2.1.5-1 → use Table 6.2.3.2.2.1.3-1.

6.2.3.2.2.1.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 5.4.2 with the following exceptions:

6.2.3.2.2.1.4.3_1 Message exceptions for SA

Same as 6.2.2.1.2.1.4.3_1 with following exceptions:

Table 6.2.3.2.2.1.4.3_1-1: *CSI-ResourcePeriodicityAndOffset*

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-43			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourcePeriodicityAndOffset CHOICE {			
slots10	1		
}			

6.2.3.2.2.1.4.3_2 Message exceptions for NSA

Same as 6.2.3.2.2.1.4.3_1.

6.2.3.2.2.1.5 Test requirement

The pass/fail decision is as specified in the test procedure in clause 6.2.3.2.2.1.4.2.

Table 6.2.3.2.2.1.5-1: Test requirements

Parameters	Test 1	Test 2
α [%]	5	5
γ	1.04	1.04

6.2.3.2.2.2 4Rx TDD FR1 aperiodic subband CQI reporting under fading conditions for both SA and NSA

6.2.3.2.2.2.1 Test purpose

To verify the variance of the wideband CQI reports is within the limits defined, that the ratio of the throughput is within the limits defined and that the average PDSCH BLER is greater than or equal to 2% for the indicated transport format.

6.2.3.2.2.2.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of E-UTRA UE release 15 and forward supporting EN-DC.

6.2.3.2.2.2.3 Minimum conformance requirements

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 6.2.3.2.2.2.3-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

a) A sub-band differential CQI offset level of 0 shall be reported at least α% of the time but less than β% of the time for each sub-band, where α and β are specified in Table 6.2.3.2.2.2.3-2;

b) The ratio of the throughput obtained when transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level and that obtained when transmitting the transport format indicated by the reported wideband CQI median on a randomly selected sub-band among all the sub-bands shall be $\geq \gamma$, where γ is specified in Table 6.2.3.2.2.2.3-2;

c) When transmitting the corresponding transport format on a randomly selected sub-band among the sub-bands with the highest differential CQI offset level, the average BLER for the indicated transport format shall be greater than or equal to 0.02.

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

Table 6.2.3.2.2.2.3-1: Sub-band CQI reporting test under frequency-selective fading conditions

Parameter		Unit	Test 1	Test 2
Bandwidth		MHz	40	
Subcarrier spacing		kHz	30	
Duplex Mode			TDD	
TDD UL-DL pattern			FR1.30-1	
SNR		dB	5	6	11	12
Propagation channel			Two tap model specified in Annex B.2.4 with a=1, f_D = 5Hz, and τ_d=0.1125μs	
Antenna configuration			2×4	
Correlation configuration			As per Annex B.1	
Beamforming Model			As specified in Annex B.4.1	
ZP CSI-RS configuration	CSI-RS resource Type		Periodic	
	Number of CSI-RS ports (X)		4	
	CDM Type		FD-CDM2	
	Density (ρ)		1	
	First subcarrier index in the PRB used for CSI-RS (k_0)		Row 5,4	
	First OFDM symbol in the PRB used for CSI-RS (l_0)		9	
	CSI-RS periodicity and offset	slot	10/1	
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Periodic	
	Number of CSI-RS ports (X)		2	
	CDM Type		FD-CDM2	
	Density (ρ)		1	
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 3,(6,-)	
	First OFDM symbol in the PRB used for CSI-RS (l_0)		13	
	NZP CSI-RS-timeConfig periodicity and offset	slot	10/1	
CSI-IM configuration	CSI-IM resource Type		Periodic	
	CSI-IM RE pattern		0	
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4, 9)	
	CSI-IM timeConfig periodicity and offset	slot	10/1	
ReportConfigType			Aperiodic	
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-ReportingBand			1111111	
CSI-Report interval and offset		slot	Not configured	
Aperiodic Report Slot Offset			8	
CSI request			1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0	
reportTriggerSize			1	
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM	
aperiodicTriggeringOffset			Not Configured	
Codebook configuration	Codebook Type		typeI-SinglePanel	
	Codebook Mode		1	
	(CodebookConfig-N1,CodebookConfig-N2)		Not configured	
	CodebookSubsetRestriction		000001	
	RI Restriction		N/A	

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

Table 6.2.3.2.2.2.3-2: Minimum requirements

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

The normative reference for this requirement is TS 38.101-4 [5] clause 6.2.3.2.2.2.

6.2.3.2.2.2.4 Test description

6.2.3.2.2.2.4.1 Initial conditions

Same initial conditions as specified in clause 6.2.2.1.2.2.4.1 with the following exceptions:

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.4 for TE diagram and section A.3.2.5 for UE diagram.

Instead of Table 6.2.2.1.2.2.3-1 → use Table 6.2.3.2.2.2.3-1.

Instead of clause 6.2.2.1.2.2.4.3 → use clause 6.2.3.2.2.2.4.3.

6.2.3.2.2.2.4.2 Test procedure

Same test procedure as specified in clause 6.2.2.1.2.2.4.2 with the following exceptions:

Instead of Table 6.2.2.1.2.2.3-1 → use Table 6.2.3.2.2.2.3-1.

6.2.3.2.2.2.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 5.4.2 with the following exceptions:

6.2.3.2.2.2.4.3_1 Message exceptions for SA

Same as 6.2.2.1.2.2.4.3_1 with following exceptions:

Table 6.2.3.2.2.2.4.3_1-1: *CSI-ResourcePeriodicityAndOffset*

Derivation Path: TS 38.508-1 [6], clause 4.6.2, Table 4.6.2-43			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourcePeriodicityAndOffset CHOICE {			
Slots10	1		
}			

6.2.3.2.2.2.4.3_2 Message exceptions for NSA

Same as 6.2.3.2.2.2.4.3_1.

6.2.3.2.2.2.5 Test requirement

The pass/fail decision is as specified in the test procedure in clause 6.2.3.2.2.2.4.2.

Table 6.2.3.2.2.2.5-1: Minimum requirements

Parameters	Test 1	Test 2
α [%]	2	2
β [%]	55	55
γ	1.04	1.04
Note 1: TT = 0.01		

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

6.2A.1 General

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

6.2A.2 1RX requirements

(Void)

6.2A.3 2RX requirements

6.2A.3.1 CQI reporting definition under AWGN conditions

6.2A.3.1.0 Minimum requirement for periodic CQI reporting

For each CA CQI reporting test defined in Table 6.2A.3.1.0-6, the test requirements and the test parameters are defined as below.

For each CC, the test parameters are specified in Table 6.2A.3.1.0-1. The additional parameters specified in Table 6.2A.3.1.0-2 are applicable for tests on FDD CC. The additional parameters specified in Table 6.2A.3.1.0-3 are applicable for tests on TDD CC.

For CA with 2 DL CC, for the SNR configuration specified in Table 6.2A.3.1.0-4, and using the downlink physical channels specified in Annex C.3.1 on each CC, the difference between the wideband CQI indices of PCell and SCell reported shall be such that

$$\text{wideband CQI}_{\text{PCell}} - \text{wideband CQI}_{\text{SCell}} \geq 2$$

for more than 90% of the time.

For CA with 3 or more DL CC, for the SNR configuration specified in Table 6.2A.3.1.0-5, and using the downlink physical channels specified in Annex C.3.1 on each cell, the difference between the wideband CQI indices of PCell and SCell1 reported, and the difference between the wideband CQI indices of SCell1 and SCell2, 3… reported shall be such that

$$\text{wideband CQI}_{\text{PCell}} - \text{wideband CQI}_{\text{SCell1}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell2, 3...}} \geq 2$$

for more than 90% of the time.

Table 6.2A.3.1.0-1: CA CQI reporting test parameters for FDD and TDD CC

Parameter		Unit	Value
Propagation channel			AWGN
Antenna configuration			1×2 with static channel specified in Annex B.1
ZP CSI-RS configuration	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (*X*)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0)		Row 5, 4
	First OFDM symbol in the PRB used for CSI-RS (l_0)		9
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (*X*)		1
	CDM Type		No CDM
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0)		Row 2, 6
	First OFDM symbol in the PRB used for CSI-RS (l_0)		13
CSI-IM configuration	CSI-IM resource Type		Periodic
	CSI-IM RE pattern		0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4, 9)
ReportConfigType			Periodic
CQI-table			Table 2
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Csi-ReportingBand			1111111
aperiodicTriggeringOffset			Not configured
Physical channel for CSI report			PUCCH
Maximum number of HARQ transmission			1
Measurement channel			Derived as per section 5.1.3.2 of TS 38.214 [12]

Table 6.2A.3.1.0-2: Additional test parameters for FDD CC

Parameter		Unit	Value
Duplex Mode			FDD
Subcarrier spacing		kHz	15
ZP CSI-RS configuration	CSI-RS periodicity and offset	slot	5/1
NZP CSI-RS for CSI acquisition	NZP CSI-RS-timeConfig periodicity and offset	slot	5/1
			10/1 if configured as SCell with TDD PCell (Test1)
CSI-IM configuration	CSI-IM timeConfig periodicity and offset	slot	5/1
CSI-Report periodicity and offset		slot	5/0 if configured as PCell
			5/1 if configured as SCell with FDD PCell (Test2)
			20/18 if configured as SCell with TDD PCell (Test1)
CQI/RI/PMI delay		ms	8 if configured as PCell
			12 if configured as SCell
Sub-band Size		RB	8 for 5MHz and 10MHz, 16 for 15MHz, 20MHz and 25MHz, 32 for 30MHz, 35MHz, 40MHz, 45MHz and 50MHz
Note 1: NZP CSI-RS periodicity/offset slots are based on the carrier SCS and CSI reporting periodicity/offset slots are based on the PCell SCS.			

Table 6.2A.3.1.0-3: Additional test parameters for TDD CC

Parameter		Unit	Value
Duplex Mode			TDD
Subcarrier spacing		kHz	30
TDD UL-DL pattern			FR1.30-1
ZP CSI-RS configuration	CSI-RS periodicity and offset	slot	10/1
NZP CSI-RS for CSI acquisition	NZP CSI-RS-timeConfig periodicity and offset	slot	10/1 if configured as SCell with FDD PCell (Test1)
			20/1
CSI-IM configuration	CSI-IM timeConfig periodicity and offset	slot	10/1
CSI-Report periodicity and offset		slot	20/19 if configured as PCell
			20/18 if configured as SCell with TDD PCell (Test3)
			5/1 if configured as SCell with FDD PCell (Test1)
CQI/RI/PMI delay		ms	14.5 if configured as PCell
			12.5 if configured as SCell with TDD PCell (Test3)
			9.5 if configured as SCell with FDD PCell (Test1)
Sub-band Size		RB	8 for 10MHz, 15MHz, 20MHz and 25MHz, 16 for 30MHz, 40MHz and 50MHz, 32 for 60MHz, 80MHz, 90MHz and 100MHz
Note 1: NZP CSI-RS periodicity/offset slots are based on the carrier SCS and CSI reporting periodicity/offset slots are based on the PCell SCS.			

Table 6.2A.3.1.0-4: SNR configurations for 2 DL CA

Parameter	PCell	SCell
SNR (dB)	10.0	4.0

Table 6.2A.3.1.0-5: SNR configurations for 3 or more DL CA

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

Table 6.2A.3.1.0-6: List of CA CQI reporting test

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

The normative reference for this requirement is TS 38.101-4 [5], clause 6.2A.3.1.1.

6.2A.3.1.1 2Rx CQI reporting accuracy under AWGN conditions for CA (2DL CA)

Editor's note: EN-DC applicability of this test case is FFS in TS 38.522.

6.2A.3.1.1.1 Test Purpose

To verify that the CQI is correctly reported in accordance with the CQI definition given in TS 38.214 [12] for each CC with multiple cells configured for periodic reporting.

6.2A.3.1.1.2 Test applicability

This test applies to all types of NR UE release 15 and forward that supports 2DL CA.

6.2A.3.1.1.3 Test description

6.2A.3.1.1.3.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 and Table 5.3.6-1 of 38.521-1 [7].

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

CA capability to be tested: test any one of the supported CA capabilities with largest aggregated CA bandwidth combination, as specified in 6.1.1.5.2.

CA configuration to be tested: For the selected CA capability, test any one of the supported CA configurations with largest aggregated CA bandwidth combination, as specified in 6.1.1.5.2.

Table 6.2A.3.1.1.3.1-1: Test point selection table

Test number	CA duplex mode	Configuration	PCell CC configuration
1	FDD 15 kHz + TDD 30 kHz	As defined in Table 6.2A.3.1.0-1 to Table 6.2A.3.1.0-3	TDD CC if supported, otherwise FDD CC
2 (Note 2)	FDD 15 kHz + FDD 15 kHz	As defined in Table 6.2A.3.1.0-1 to Table 6.2A.3.1.0-2	Any of CCs
3	TDD 30 kHz + TDD 30 kHz	As defined in Table 6.2A.3.1.0-1 and Table 6.2A.3.1.0-3	Any of CCs
NOTE 1: The test coverage can be considered fulfilled if UE passes one of the CC as PCell in Test 1. NOTE 2: These scenarios are only tested for UEs which are not verified with Test 1.			

1. Connect the SS and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A Figure A.3.1.7.2A for TE diagram, Figure A.3.2.3 for UE supporting only 2Rx RF bands on all CC. Annex A, Figure A.3.2.5 for UE supporting 4Rx on some or all the CCs.

2. The parameter settings for the cell are set up according to Table 6.1.2-1, and Table 6.2A.3.1.0-1 to Table 6.2A.3.1.0-3 as appropriate.

3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].

4. Propagation conditions are set according to Annex B.1.

5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR for SA with *Connected without release On, Test Mode On* or EN-DC, DC bearer *MCG* and *SCG, Connected without release On, Test Mode On* for NSA according to TS 38.508-1 [6] clause 4.5. Message contents are defined in clause 6.2A.3.1.1.3.3.

6.2A.3.1.1.3.2 Test Procedure

1. Configure SCC according to Annex C.0, C.1 and C.2 for all downlink physical channels.

2. The SS shall configure SCC as per TS 38.508-1 [6] clause 5.5.1. Message contents are defined in clause 6.2A.3.1.1.3.3.

3. SS activates SCC by sending the activation MAC-CE (Refer TS 38.321 [24], clauses 5.9, 6.1.3.10). Wait for at least 1 second (Refer TS 38.133[25], clause9.3).

4. Set the parameters of bandwidth, reference channel, propagation condition and antenna configuration according to Table 6.2A.3.1.0-1 to Table 6.2A.3.1.0-3 as appropriate. Set the SNR according to Table 6.2A.3.1.0-4 as appropriate for PCC and SCC (For UE supporting 4Rx antenna ports on a given CC, the SNR is reduced by 3dB for that CC).

5. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC on both PCC and SCC. The SS sends downlink MAC padding bits on the DL RMC.

6. The SS shall start gathering CQI reports, and will continue gathering CQI reports until 2000 wideband CQI reports have been gathered for each PCC and SCC. For each CSI report calculate the respective difference CQI_{P-S} = wideband CQI_{PCell} − wideband CQI_{SCell}.

7. If more than 1800 values of CQI_{P-S} are ≥ 2 pass the UE. Otherwise fail the UE.

8. Repeat steps from 1 to 7 for each test point in Table 6.2A.3.1.1.3.1-1 as appropriate.

6.2A.3.1.1.3.3 Message contents

Message contents are according to TS 38.508 [6] clause 5.4.2 with the following exceptions:

6.2A.3.1.1.3.3_1 Message exceptions for SA

Table 6.2A.3.1.1.3.3_1-1: CSI-RS-ResourceMapping

Derivation Path: TS 38.508-1 [6], Table 5.4.2.4-2			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
row2	0000 1000 0000	k0= 4, row2	
}			
density CHOICE {			
one	NULL		
}			
}			

Table 6.2A.3.1.1.3.3_1-2: NZP CSI-ResourcePeriodicityAndOffset

Derivation Path: TS 38.508-1 [6], Table 5.4.2.4-2a			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourcePeriodicityAndOffset ::= CHOICE {			
slots5	1		For FDD CC
slot10	1		(For TDD CC if configured as SCell with FDD PCell (Test1)) OR (For FDD CC if configured as SCell with TDD PCell (Test1))
Slot20	1		For TDD CC
}			

Table 6.2A.3.1.1.3.3_1-3: CSI-IM-Resource

Derivation Path: TS 38.508-1 [6], Table 5.4.2.4-6			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-IM-Resource ::= SEQUENCE {			
periodicityAndOffset SEQUENCE {			
slots5	1		For FDD CC
slots10	1		For TDD CC
}			
}			

Table 6.2A.3.1.1.3.3_1-4: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], Table 5.4.2.4-12		
Information Element	**Value/remark**	**Condition**
CSI-ReportConfig ::= SEQUENCE {		
subbandSize	8	For the CC with FDD 15kHz SCS 5MHz and 10MHz CHBW; For the CC with TDD 30kHz SCS 10MHz, 15MHz, 20MHz and 25MHz CHBW.
	16	For the CC with FDD 15kHz SCS 15MHz, 20MHz and 25MHz CHBW; For the CC with TDD 30kHz SCS 30MHz, 40MHz and 50MHz CHBW.
	32	For the CC with FDD 15kHz SCS 30MHz, 35MHz, 40MHz, 45MHz and 50MHz CHBW; For the CC with TDD 30kHz SCS 60MHz, 80MHz, 90MHz and 100MHz CHBW.
}		

6.2A.3.1.1.3.3_2 Message exceptions for NSA

Same as specified in 6.2A.3.1.1.3.3_2.

6.2A.3.1.1.4 Test Requirements

The pass fail decision is as specified in the test procedure in clause 6.2A.3.1.1.3.2.

There are no parameters in the test setup or measurement process whose variation impacts the results so there are no applicable test tolerances for this test.

6.2A.3.1.2 2Rx CQI reporting accuracy under AWGN conditions for CA (3DL CA)

Editor's note: EN-DC applicability of this test case is FFS in TS 38.522.

6.2A.3.1.2.1 Test Purpose

Same with 6.2A.3.1.1.1.

6.2A.3.1.2.2 Test applicability

This test applies to all types of NR UE release 15 and forward that supports 3DL CA.

6.2A.3.1.2.3 Test description

6.2A.3.1.2.3.1 Initial conditions

Same with 6.2A.3.1.1.3.1.

6.2A.3.1.2.3.2 Test Procedure

1. Configure SCCs according to Annex C.0, C.1 and C.2 for all downlink physical channels.
2. The SS shall configure SCCs as per TS 38.508-1 [6] clause 5.5.1. Message contents are defined in clause 6.2A.3.1.2.3.3.
3. SS activates SCCs by sending the activation MAC-CE (Refer TS 38.321 [24], clauses 5.9, 6.1.3.10). Wait for at least 1 second (Refer TS 38.133[25], clause9.3).

4. Set the parameters of bandwidth, reference channel, propagation condition and antenna configuration according to Table 6.2A.3.1.0-1 to Table 6.2A.3.1.0-3 as appropriate. Set the SNR according to Table 6.2A.3.1.0-5 as appropriate for PCC and SCCs (For a UE supporting 4Rx antenna ports on a given CC, the SNR is reduced by 3dB for that CC).

5. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC on both PCC and SCCs. The SS sends downlink MAC padding bits on the DL RMC.

6. The SS shall start gathering CQI reports, and will continue gathering CQI reports until 2000 wideband CQI reports have been gathered for each PCC and SCCs. For each CSI report calculate the respective difference $CQI_{P\text{-}S1}$ = wideband CQI_{PCell} – wideband CQI_{SCell1} and the respective difference $CQI_{S1\text{-}S2}$ = wideband CQI_{SCell1} – wideband CQI_{SCell2}.

7. If more than 1800 values of $CQI_{P\text{-}S1}$ are ≥ 2 and more than 1800 values of $CQI_{S1\text{-}S2}$ are ≥ 2, pass the UE. Otherwise fail the UE.

8. Repeat steps from 1 to 7 for each test point in Table 6.2A.3.1.0-6 as appropriate.

6.2A.3.1.2.3.3 Message contents

Same with 6.2A.3.1.1.3.3.

6.2A.3.1.2.4 Test Requirements

The pass fail decision is as specified in the test procedure in clause 6.2A.3.1.2.3.2.

There are no parameters in the test setup or measurement process whose variation impacts the results so there are no applicable test tolerances for this test.

6.2A.3.1.3 2Rx CQI reporting accuracy under AWGN conditions for CA (4DL CA)

Editor's note: EN-DC applicability of this test case is FFS in TS 38.522.

6.2A.3.1.3.1 Test Purpose

Same with 6.2A.3.1.1.1.

6.2A.3.1.3.2 Test applicability

This test applies to all types of NR UE release 15 and forward that supports 4DL CA.

6.2A.3.1.3.3 Test description

6.2A.3.1.3.3.1 Initial conditions

Same with 6.2A.3.1.1.3.1.

6.2A.3.1.3.3.2 Test Procedure

1. Configure SCCs according to Annex C.0, C.1 and C.2 for all downlink physical channels.

2. The SS shall configure SCCs as per TS 38.508-1 [6] clause 5.5.1. Message contents are defined in clause 6.2A.3.1.3.3.3.

3. SS activates SCCs by sending the activation MAC-CE (Refer TS 38.321 [24], clauses 5.9, 6.1.3.10). Wait for at least 1 second (Refer TS 38.133[25], clause9.3).

4. Set the parameters of bandwidth, reference channel, propagation condition and antenna configuration according to Table 6.2A.3.1.0-1 to Table 6.2A.3.1.0-3 as appropriate. Set the SNR according to Table 6.2A.3.1.0-5 as appropriate for PCC and SCCs (For a UE supporting 4Rx antenna ports on a given CC, the SNR is reduced by 3dB for that CC).

5. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC on both PCC and SCCs. The SS sends downlink MAC padding bits on the DL RMC.

6. The SS shall start gathering CQI reports, and will continue gathering CQI reports until 2000 wideband CQI reports have been gathered for each PCC and SCCs. For each CSI report calculate the respective difference $CQI_{P\text{-}S1}$ = wideband CQI_{PCell} – wideband $CQI_{SCell1,}$ the respective difference $CQI_{S1\text{-}S2}$ = wideband CQI_{SCell1} – wideband CQI_{SCell2} and the respective difference $CQI_{S1\text{-}S3}$ = wideband CQI_{SCell1} – wideband CQI_{SCell3}.

7. If more than 1800 values of $CQI_{P\text{-}S1}$ are ≥ 2, more than 1800 values of $CQI_{S1\text{-}S2}$ are ≥ 2 and more than 1800 values of $CQI_{S1\text{-}S3}$ are ≥ 2, pass the UE. Otherwise fail the UE.

8. Repeat steps from 1 to 7 for each test point defined in Table 6.2A.3.1.0-6 as appropriate.

6.2A.3.1.3.3.3 Message contents

Same with 6.2A.3.1.1.3.3.

6.2A.3.1.3.4 Test Requirements

The pass fail decision is as specified in the test procedure in clause 6.2A.3.1.3.3.2.

There are no parameters in the test setup or measurement process whose variation impacts the results so there are no applicable test tolerances for this test.

6.3 Reporting of Precoding Matrix Indicator (PMI)

6.3.0 General

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

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

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

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

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

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

In the definition of γ, for 16TX PMI requirements, $t_{ue,\,follow1,\,follow2}$ is 90 % of the maximum throughput obtained at $SNR_{follow1,\,follow2}$ using the precoders configured according to the UE reports, and $t_{rnd1,\,rnd2}$ is the throughput measured at $SNR_{follow1,\,follow2}$ with random precoding.

6.3.1 1RX requirements (Void)

6.3.2 2RX requirements

6.3.2.1 FDD

6.3.2.1.1 2Rx FDD FR1 Single PMI with 4TX TypeI-SinglePanel codebook for both SA and NSA

6.3.2.1.1.1 Test purpose

The purpose of this test is to test the accuracy of the Precoding Matrix Indicator (PMI) reporting such that the system throughput is maximized based on the precoders configured according to the UE reports.

6.3.2.1.1.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

6.3.2.1.1.3 Minimum conformance requirements

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 6.3.2.1.1.3-1: Test parameters (single layer)

Parameter		Unit	Test 1
Bandwidth		MHz	10
Subcarrier spacing		kHz	15
Duplex Mode			FDD
Propagation channel			TDLA30-5
Antenna configuration			High XP 4 x 2 (N1,N2) = (2,1)
Beamforming Model			As specified in Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (*X*)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(9,-)
	CSI-RS interval and offset	slot	5/1
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 4, (0,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(13,-)
	CSI-RS interval and offset		Not configured
	aperiodicTriggeringOffset		0
CSI-IM configuration	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Patten 0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	8
csi-ReportingBand			1111111
CSI-Report interval and offset		slot	Not configured
Aperiodic Report Slot Offset			4
CSI request			1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0

reportTriggerSize			1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
Codebook configuration	Codebook Type		typeI-SinglePanel
	Codebook Mode		1
	(CodebookConfig-N1,CodebookConfig-N2)		(2,1)
	(CodebookConfig-O1,CodebookConfig-O2)		(4,1)
	CodebookSubset Restriction		11111111
	RI Restriction		00000001
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	6
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.1-6.1 FDD
PDSCH & PDSCH DMRS Precoding configuration for random Precoding			Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i_1, i_2 combination, and with Wideband granularity
Note 1: For random precoder selection, the precoder shall be updated in each slot (1 ms granularity). Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-3), this reported PMI cannot be applied at the eNB downlink before slot#(n+3). Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.			

Table 6.3.2.1.1-2: Minimum requirement

Parameter	Test 1
γ	1.3

6.3.2.1.1.4 Test description

6.3.2.1.1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 and Table 5.3.6-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.1 for TE diagram and section A.3.2.2 for UE diagram.

2. The parameter settings for the cell are set up according to Table 6.1.2-1 and Table 6.3.2.1.1.3_1 and as appropriate.

3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].

4. Propagation conditions are set according to Annex B.0.

5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR, Connected without release *On* for SA or (EN-DC, DC bearer *MCG* and *SCG, Connected without Release On)* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause6.3.2.1.1.4.3.

6.3.2.1.1.4.2 Test procedure

1. Set the parameters of bandwidth, the propagation condition, antenna configuration and measurement channel according to Table 6.3.2.2.1.3-1 as appropriate.

2. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC with precoding matrix according to PMI report from the UE. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission with an UL RMC for CP-OFDM QPSK with 5 RBs allocated according to A.2.2.6 of TS 38.521-1 [21] to carry the PUSCH CQI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. No transport block is sent in parallel to the CQI feedback. Establish $t_{ue,\,follow1,\,follow2}$ and $SNR_{follow1,\,follow2}$ according to Annex G.3.2.

3. Set SNR to $SNR_{follow1,\,follow2}$. The SS shall transmit PDSCH with randomly selected precoding matrix from codebook (Table 5.2.2.2.1-5 in TS 38.214 [12]) every slot regardless of PMI reports from the UE. Note that each precoding matrix shall be selected in equal probabilities. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission to carry the PUSCH CSI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. Measure $t_{rnd1,\,rnd2}$ according to Annex G.3.3.

4. Calculate $\gamma = \frac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. If the ratio ≥ γ which is specified in table 6.3.2.1.1.5-1, then the test is pass. Otherwise, the test is fail.

6.3.2.1.1.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1.

6.3.2.1.1.4.3.1 Message exceptions for SA

Table 6.3.2.1.1.4.3.1-1: CSI-ResourceConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-41			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourceConfig ::= SEQUENCE {			
resourceType	Aperiodic		
}			

Table 6.3.2.1.1.4.3.1-2: CSI-RS-ResourceMapping for NZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-45			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
Row4	001		
}			
nrofPorts	p4		
firstOFDMSymbolInTimeDomain	13		
}			

Table 6.3.2.1.1.4.3.1-3: CSI-RS-ResourceMapping for ZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-45			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
Row5	000100		
}			
nrofPorts	p4		
firstOFDMSymbolInTimeDomain	9		
}			

Table 6.3.2.1.1.4.3.1-4: CSI-IM-Resource

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-34			
Information Element	**Value/remark**	**Comment**	**Condition**
csi-IM-ResourceElementPattern			
pattern0 SEQUENCE {			
subcarrierLocation-p0	s4		
symbolLocation-p0	9		
}			
periodicityAndOffset	CSI-ResourcePeriodicityAndOffset		

Table 6.3.2.1.1.4.3.1-5: *CSI-ResourcePeriodicityAndOffset*

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.2-43			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourcePeriodicityAndOffset CHOICE {			
Slots5	1		
}			

Table 6.3.2.1.1.4.3.1-6: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], clause 4.6.2, Table 4.6.3-25			
Information Element	**Value/remark**	**Comment**	**Condition**
nrOfAntennaPorts CHOICE {			
moreThanTwo SEQUENCE {			
n1-n2 CHOICE {			
two-one-TypeI-SinglePanel-Restriction	11111111		
}			
}			
}			
typeI-SinglePanel-ri-Restriction	00000001		

Table 6.3.2.1.1.4.3.1-7: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-39			
Information Element	**Value/remark**	**Comment**	**Condition**
reportConfigType CHOICE {			
aperiodic SEQUENCE {			
reportSlotOffsetList	0		
}			
reportFreqConfiguration SEQUENCE {			
csi-ReportingBand CHOICE {			
subbands7	[1111111]		
}			
}			
subbandSize	8		
}			

6.3.2.1.1.4.3.2 Message exceptions for NSA

Same as in clause 6.3.2.1.1.4.3.1.

6.3.2.1.1.5 Test requirement

Table 6.3.2.1.1.5-1: Test requirement

Parameter	Test 1
γ	1.29

6.3.2.1.2 2Rx FDD FR1 Single PMI with 8TX TypeI-SinglePanel codebook for both SA and NSA

6.3.2.1.2.1 Test purpose

The purpose of this test is to test the accuracy of the Precoding Matrix Indicator (PMI) reporting such that the system throughput is maximized based on the precoders configured according to the UE reports.

6.3.2.1.2.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

6.3.2.1.2.3 Minimum conformance requirements

For the parameters specified in Table 6.3.2.1.2.3-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.1.2.3-2.

Table 6.3.2.1.2.3-1: Test parameters (dual-layer)

Parameter		Unit	Test 1
Bandwidth		MHz	10
Subcarrier spacing		kHz	15
Duplex Mode			FDD
Propagation channel			TDLA30-5
Antenna configuration			High XP 8 x 2 (N1,N2) = (4,1)
Beamforming Model			As specified in Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (*X*)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(9,-)
	CSI-RS interval and offset	slot	5/1
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		8
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 8, (4,6)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(5,-)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggeringOffset		0
CSI-IM configuration	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	8
csi-ReportingBand			1111111
CSI-Report interval and offset		slot	Not configured
Aperiodic Report Slot Offset			5
CSI request			1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0

reportTriggerSize			1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
Codebook configuration	Codebook Type		typeI-SinglePanel
	Codebook Mode		1
	(CodebookConfig-N1,CodebookConfig-N2)		(4,1)
	(CodebookConfig-O1,CodebookConfig-O2)		(4,1)
	CodebookSubset Restriction		0x FFFF
	RI Restriction		00000010
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	8
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.1-6.2
PDSCH & PDSCH DMRS Precoding configuration for random Precoding			Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i_1, i_2 combination, and with Wideband granularity
Note 1: For random precoder selection, the precoder shall be updated in each slot (1 ms granularity). Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-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 Annex B.2.3.2.3.			

Table 6.3.2.1.2.3-2: Minimum requirement

Parameter	Test 1
γ	1.5

6.3.2.1.2.4 Test description

6.3.2.1.2.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 and Table 5.3.6-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.1 for TE diagram and section A.3.2.2 for UE diagram.

2. The parameter settings for the cell are set up according to Table 6.1.2-1 and Table 6.3.2.1.2.3-1 and as appropriate.

3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].

4. Propagation conditions are set according to Annex B.0.

5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR, Connected without release *On* for SA or (EN-DC, DC bearer *MCG* and *SCG, Connected without Release On)* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.3.2.1.2.4.3.

6.3.2.1.2.4.2 Test procedure

1. Set the parameters of bandwidth, the propagation condition, antenna configuration and measurement channel according to Table 6.3.2.1.2.3-1 as appropriate.

2. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC with precoding matrix according to PMI report from the UE. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission with an UL RMC for CP-OFDM QPSK with 5 RBs allocated according to A.2.2.6 of TS 38.521-1 [21] to carry the PUSCH CSI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. No transport block is sent in parallel to the CQI feedback. Establish $t_{ue,\,follow1,\,follow2}$ and $SNR_{follow1,\,follow2}$ according to Annex G.3.2.

3. Set SNR to $SNR_{follow1,\,follow2}$. The SS shall transmit PDSCH with randomly selected precoding matrix from codebook (Table 5.2.2.2.1-6 in TS 38.214 [12]) every slot regardless of PMI reports from the UE. Note that each precoding matrix shall be selected in equal probabilities. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission to carry the PUSCH CSI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. Measure $t_{rnd1,\,rnd2}$ according to Annex G.3.3.

4. Calculate $\gamma = \frac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. If the ratio ≥ γ which is specified in table 6.3.2.1.2.5-1, then the test is pass. Otherwise, the test is fail.

6.3.2.1.2.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1.

6.3.2.1.2.4.3.1 Message exceptions for SA

Table 6.3.2.1.2.4.3.1-1: CSI-ResourceConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-41			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourceConfig ::= SEQUENCE {			
resourceType	aperiodic		
}			

Table 6.3.2.1.2.4.3.1-2: CSI-RS-ResourceMapping for NZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 5.4.2, Table5.4.2.0-15			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	001100		
}			
nrofPorts	p8		
firstOFDMSymbolInTimeDomain	5		
cdm-Type	cdm4-FD2-TD2		
}			

Table 6.3.2.1.2.4.3.1-3: CSI-RS-ResourceMapping for ZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 5.4.2, Table5.4.2.0-21			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	000100		
}			
nrofPorts	p4		
firstOFDMSymbolInTimeDomain	9		
}			

Table 6.3.2.1.2.4.3.1-4: CSI-IM-Resource

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-34			
Information Element	**Value/remark**	**Comment**	**Condition**
csi-IM-ResourceElementPattern			
pattern0 SEQUENCE {			
subcarrierLocation-p0	s4		
symbolLocation-p0	9		
}			

Table 6.3.2.1.2.4.3.1-5: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-25			
Information Element	**Value/remark**	**Comment**	**Condition**
nrOfAntennaPorts CHOICE {			
moreThanTwo SEQUENCE {			
n1-n2 CHOICE {			
four-one-TypeI-SinglePanel-Restriction	FFFF		
}			
}			
}			
typeI-SinglePanel-ri-Restriction	00000010		

Table 6.3.2.1.2.4.3.1-6: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-39			
Information Element	**Value/remark**	**Comment**	**Condition**
reportConfigType CHOICE {			
aperiodic SEQUENCE {			
reportSlotOffsetList	5		
}			
reportFreqConfiguration SEQUENCE {			
csi-ReportingBand CHOICE {			
subbands7	1111111		
}			
}			
}			

6.3.2.1.2.4.3.2 Message exceptions for NSA

Same as in clause 6.3.2.1.2.4.3.1.6.3.2.1.2.5Test requirement

Table 6.3.2.1.2.5-1: Test requirement

Parameter	Test 1
γ	1.49

6.3.2.1.3 2Rx FDD FR1 Multiple PMI with 16Tx Type I – SinglePanel Codebook for both SA and NSA

6.3.2.1.3.1 Test purpose

To test the accuracy of the Precoding Matrix Indicator (PMI) reporting such that the system throughput is maximized based on the precoders configured according to the UE reports.

6.3.2.1.3.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

6.3.2.1.3.3 Minimum conformance requirements

For the parameters specified in Table 6.3.2.1.3.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.1.3.3-2.

Table 6.3.2.1.3.3-1: Test parameters (dual-layer)

Parameter		**Unit**	**Test 1**
Bandwidth		MHz	10
Subcarrier spacing		kHz	15
Duplex Mode			FDD
Propagation channel			TDLC300-5
Antenna configuration			High XP 16 x 2 (N1,N2) = (4,2)
Beamforming Model			As specified in Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier		Row 5, (4,-)

	index in the PRB used for CSI-RS (k_0, k_1)		
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(9,-)
	CSI-RS interval and offset	slot	Not configured
	ZP CSI-RS trigger		1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		16
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1, k_2, k_3)		Row 12, (2, 4, 6, 8)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(5, -)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggeringOffset		0
CSI-IM configuration	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Subband
Sub-band Size		RB	8
csi-ReportingBand			1111111
CSI-Report interval and offset		slot	Not configured
Aperiodic Report Slot Offset			5
CSI request			1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
reportTriggerSize			1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
Codebook configuration	Codebook Type		typeI-SinglePanel
	Codebook Mode		1
	(CodebookConfig-N1,CodebookConfig-N2)		(4,2)
	(CodebookConfig-O1,CodebookConfig-O2)		(4,4)
	CodebookSubset		0x FFFF

	Restriction		
	RI Restriction		00000010
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	8
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.1-6.3 FDD
Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable i_1, i_2 combination. Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-4), this reported PMI cannot be applied at the gNB downlink before slot#(n+4). Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.			

Table 6.3.2.1.3.3-2: Minimum requirement

Parameter	Test 1
γ	2.5

The normative reference for this requirement is TS 38.101-4 [5] clause 6.3.2.1.3.

6.3.2.1.3.4 Test description

6.3.2.1.3.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 and Table 5.3.6-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.10 for TE diagram and section A.3.2.2 for UE diagram.
2. The parameter settings for the cell are set up according to Table 6.1.2-1 and Table 6.3.2.1.3.3-1 and as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].
4. Propagation conditions are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR, Connected without release *On* for SA or (EN-DC, DC bearer *MCG* and *SCG, Connected without Release On)* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.3.2.1.3.4.3.

6.3.2.1.3.4.2 Test procedure

1. Set the parameters of bandwidth, the propagation condition, antenna configuration and measurement channel according to Table 6.3.2.1.3.3-1 as appropriate.

2. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC with precoding matrix according to PMI report from the UE. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission with an UL RMC for CP-OFDM QPSK with 5 RBs allocated according to A.2.2.6 of TS 38.521-1 [21] to carry the PUSCH CQI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. No transport block is sent in parallel to the CQI feedback. Establish $t_{ue,\,follow1,\,follow2}$ and $SNR_{follow1,\,follow2}$ according to Annex G.3.2.

3. Set SNR to $SNR_{follow1,\,follow2}$. The SS shall transmit PDSCH with randomly selected precoding matrix from codebook (Table 5.2.2.2.1-6 in TS 38.214 [12]) every slot regardless of PMI reports from the UE. Note that each precoding matrix shall be selected in equal probabilities. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission to carry the PUSCH CSI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. Measure $t_{rnd1,\,rnd2}$ according to Annex G.3.3.

4. Calculate $\gamma = \frac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. If the ratio ≥ γ which is specified in table 6.3.2.1.3.5-1, then the test is pass. Otherwise, the test is fail.

6.3.2.1.3.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1.

6.3.2.1.3.4.3.1 Message exceptions for SA

Table 6.3.2.1.3.4.3.1-1: CSI-RS-ResourceMapping for NZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 5.4.2.5, Table 5.4.2.5-2			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	011110		
}			
nrofPorts	P16		
firstOFDMSymbolInTimeDomain	5		
cdm-Type	cdm4-FD2-TD2		
}			

Table 6.3.2.1.3.4.3.1-2: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], clause 5.4.2.5, Table 5.4.2.5-14			
Information Element	**Value/remark**	**Comment**	**Condition**
nrOfAntennaPorts CHOICE {			
moreThanTwo SEQUENCE {			
n1-n2 CHOICE {			
four-two-TypeI-SinglePanel-Restriction	FFFF FFFF FFFF FFFF		
}			
}			
}			
typeI-SinglePanel-ri-Restriction	00000010		

Table 6.3.2.1.3.4.3.1-3: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 5.4.2.5, Table 5.4.2.5-13			
Information Element	**Value/remark**	**Comment**	**Condition**
reportConfigType CHOICE {			
aperiodic SEQUENCE {			
reportSlotOffsetList	5		
}			
reportFreqConfiguration SEQUENCE {			
pmi-FormatIndicator	subbandPMI		
}			
}			

6.3.2.1.3.4.3.2 Message exceptions for NSA

Same as in clause 6.3.2.1.3.4.3.1.

6.3.2.1.3.5 Test requirement

Table 6.3.2.1.3.5-1: Test requirement

Parameter	Test 1
γ	2.49

6.3.2.1.4 2Rx FDD FR1 Single PMI with 32Tx Type1 - SinglePanel codebook for both SA and NSA

6.3.2.1.4.1 Test purpose

To test the accuracy of the Precoding Matrix Indicator (PMI) reporting such that the system throughput is maximized based on the precoders configured according to the UE reports.

6.3.2.1.4.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

6.3.2.1.4.3 Minimum conformance requirements

For the parameters specified in Table 6.3.2.1.4.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.1.4.3-2.

Table 6.3.2.1.4.3-1: Test parameters (dual-layer)

Parameter		Unit	Test 1
Bandwidth		MHz	10
Subcarrier spacing		kHz	15
Duplex Mode			FDD
Propagation channel			TDLA30-5
Antenna configuration			High XP 32 x 2 (N1,N2) = (4,4)
Beamforming Model			As specified in Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		4
	CDM Type		FD-CDM2
	Density (ρ)		1

	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(9,-)
	CSI-RS interval and offset	slot	Not configured
	ZP CSI-RS trigger		1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		32
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1, k_2, k_3)		Row 17, (2, 4, 6, 8)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(5, 12)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggeringOffset		0
CSI-IM configuration	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	8
csi-ReportingBand			1111111
CSI-Report interval and offset		slot	Not configured
Aperiodic Report Slot Offset			5
CSI request			1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
reportTriggerSize			1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
Codebook configuration	Codebook Type		typeI-SinglePanel
	Codebook Mode		1
	(CodebookConfig-N1,CodebookConfig-N2)		(4,4)
	(CodebookConfig-O1,CodebookConfig-O2)		(4,4)

	CodebookSubset Restriction		0x FFFF
	RI Restriction		00000010
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	8
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.1-6.3 FDD
PDSCH & PDSCH DMRS Precoding configuration for random Precoding			Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i_1, i_2 combination, and with Wideband granularity
Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable i_1, i_2 combination. Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-4), this reported PMI cannot be applied at the gNB downlink before slot#(n+4). Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.			

Table 6.3.2.1.4.3-2: Minimum requirement

Parameter	Test 1
γ	5.0

The normative reference for this requirement is TS 38.101-4 [5] clause 6.3.2.1.4.

6.3.2.1.4.4 Test description

6.3.2.1.4.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 and Table 5.3.6-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.10 for TE diagram and section A.3.2.2 for UE diagram.

2. The parameter settings for the cell are set up according to Table 6.1.2-1 and Table 6.3.2.1.4.3-1 and as appropriate.

3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].

4. Propagation conditions are set according to Annex B.0.

5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR, Connected without release *On* for SA or (EN-DC, DC bearer *MCG* and *SCG, Connected without Release On)* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.3.2.1.4.4.3.

6.3.2.1.4.4.2 Test procedure

1. Set the parameters of bandwidth, the propagation condition, antenna configuration and measurement channel according to Table 6.3.2.1.4.3-1 as appropriate.

2. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC with precoding matrix according to PMI report from the UE. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission with an UL RMC for CP-OFDM QPSK with 5 RBs allocated according to A.2.2.6 of TS 38.521-1 [21] to carry the PUSCH CQI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. No transport block is sent in parallel to the CQI feedback. Establish $t_{ue,\,follow1,\,follow2}$ and $SNR_{follow1,\,follow2}$ according to Annex G.3.2.

3. Set SNR to $SNR_{follow1,\,follow2}$. The SS shall transmit PDSCH with randomly selected precoding matrix from codebook (Table 5.2.2.2.1-6 in TS 38.214 [12]) every slot regardless of PMI reports from the UE. Note that each precoding matrix shall be selected in equal probabilities. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission to carry the PUSCH CSI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. Measure $t_{rnd1,\,rnd2}$ according to Annex G.3.3.

4. Calculate $\gamma = \frac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. If the ratio ≥ γ which is specified in table 6.3.2.1.4.5-1, then the test is pass. Otherwise, the test is fail.

6.3.2.1.4.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1.

6.3.2.1.4.4.3.1 Message exceptions for SA

Table 6.3.2.1.4.4.3.1-1: CSI-RS-ResourceMapping for NZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 5.4.2.5, Table 5.4.2.5-2			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	011110		
}			
nrofPorts	P32		
firstOFDMSymbolInTimeDomain	5		
cdm-Type	cdm4-FD2-TD2		
}			

Table 6.3.2.1.4.4.3.1-2: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], clause 5.4.2.5, Table 5.4.2.5-14			
Information Element	**Value/remark**	**Comment**	**Condition**
nrOfAntennaPorts CHOICE {			
moreThanTwo SEQUENCE {			
n1-n2 CHOICE {			
four-four-TypeI-SinglePanel-Restriction	FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF		
}			
}			
}			
typeI-SinglePanel-ri-Restriction	00000010		

Table 6.3.2.1.4.4.3.1-3: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 5.4.2.5, Table 5.4.2.5-13			
Information Element	**Value/remark**	**Comment**	**Condition**
reportConfigType CHOICE {			
aperiodic SEQUENCE {			
reportSlotOffsetList	5		
}			
}			

6.3.2.1.4.4.3.2 Message exceptions for NSA

Same as in clause 6.3.2.1.4.4.3.1.

6.3.2.1.4.5 Test requirement

Table 6.3.2.1.4.5-1: Test requirement

Parameter	Test 1
γ	4.99

6.3.2.1.5 2Rx FDD FR1 Multiple PMI with 16Tx TypeII codebook for both SA and NSA

6.3.2.1.5.1 Test purpose

To test the accuracy of the Precoding Matrix Indicator (PMI) reporting such that the system throughput is maximized based on the precoders configured according to the UE reports.

6.3.2.1.5.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

6.3.2.1.5.3 Minimum conformance requirements

For the parameters specified in Table 6.3.2.1.5.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.1.5.3-2.

Table 6.3.2.1.5.3-1: Test parameters (dual-layer)

Parameter		Unit	Test 1
Bandwidth		MHz	10
Subcarrier spacing		kHz	15
Duplex Mode			FDD
Propagation channel			TDLA30-5
Antenna configuration			XP Medium 16 x 2 (N1,N2) = (4,2)
Beamforming Model			As specified in Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(9,-)

	CSI-RS interval and offset	slot	Not configured
	ZP CSI-RS trigger		1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		16
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1, k_2, k_3)		Row 12, (2, 4, 6, 8)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(5, -)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggeringOffset		0
CSI-IM configuration	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Subband
Sub-band Size		RB	8
csi-ReportingBand			1111111
CSI-Report interval and offset		slot	Not configured
Aperiodic Report Slot Offset			5
CSI request			1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
reportTriggerSize			1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
Codebook configuration	Codebook Type		typeII
	L (*numberOfBeams*)		2
	N_{PSK} (*phaseAlphabetSize*)		8
	subbandAmplitude		True
	(CodebookConfig-N1,CodebookConfig-N2)		(4,2)
	(CodebookConfig-O1,CodebookConfig-O2)		(4,4)
	CodebookSubsetRestriction		0x 7FF FFFF FFFF FFFF FFFF
	RI Restriction (typeII-RI-Restriction)		10

Physical channel for CSI report		PUSCH
CQI/RI/PMI delay	ms	8
Maximum number of HARQ transmission		4
Measurement channel		R.PDSCH.1-6.3 FDD
Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable i_1, i_2 combination. The random precoder generation shall follow 'typeI-SinglePanel' codebook configuration as specified in table 6.3.2.1.3-1.		
Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-4), this reported PMI cannot be applied at the gNB downlink before slot#(n+4).		
Note 3: Randomization of the dual-cluster beam directions shall be used as specified in Annex B.2.3.2.3A. The value of relative power ratio (p) shall be fixed as 1 during the test.		

Table 6.3.2.1.5.3-2: Minimum requirement

Parameter	Test 1
γ	1.9

The normative reference for this requirement is TS 38.101-4 [5] clause 6.3.2.1.5.

6.3.2.1.5.4 Test description

6.3.2.1.5.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 and Table 5.3.6-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.10 for TE diagram and section A.3.2.2 for UE diagram.
2. The parameter settings for the cell are set up according to Table 6.1.2-1 and Table 6.3.2.1.5.3-1 and as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].
4. Propagation conditions are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR, Connected without release *On* for SA or (EN-DC, DC bearer *MCG* and *SCG, Connected without Release On)* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.3.2.1.4.4.3.

6.3.2.1.5.4.2 Test procedure

1. Set the parameters of bandwidth, the propagation condition, antenna configuration and measurement channel according to Table 6.3.2.1.5.3-1 as appropriate.

2. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC with precoding matrix according to PMI report from the UE. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission with an UL RMC for CP-OFDM QPSK with 5 RBs allocated according to A.2.2.6 of TS 38.521-1 [21] to carry the PUSCH CQI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. No transport block is sent in parallel to the CQI feedback. Establish $t_{ue,\,follow1,\,follow2}$ and $SNR_{follow1,\,follow2}$ according to Annex G.3.2.

3. Set SNR to $SNR_{follow1,\,follow2}$. The SS shall transmit PDSCH with randomly selected precoding matrix from codebook (Table 5.2.2.2.1-6 in TS 38.214 [12]) every slot regardless of PMI reports from the UE. Note that each precoding matrix shall be selected in equal probabilities, and the random precoder generation shall follow the codebook configuration as specified in Table 6.3.2.1.3.3-1. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission to carry the PUSCH CSI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. Measure $t_{rnd1,\,rnd2}$ according to Annex G.3.3.

4. Calculate $\gamma = \frac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. If the ratio ≥ γ which is specified in table 6.3.2.1.5.5-1, then the test is pass. Otherwise, the test is fail.

6.3.2.1.5.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1.

6.3.2.1.5.4.3.1 Message exceptions for SA

Table 6.3.2.1.5.4.3.1-1: CSI-RS-ResourceMapping for NZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 5.4.2.5, Table 5.4.2.5-2			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	'011110'B		
}			
nrofPorts	P16		
firstOFDMSymbolInTimeDomain	5		
cdm-Type	cdm4-FD2-TD2		
}			

Table 6.3.2.1.5.4.3.1-2: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], clause 5.4.2.5, Table 5.4.2.5-14			
Information Element	**Value/remark**	**Comment**	**Condition**
CodebookConfig ::= SEQUENCE {			
codebookType CHOICE {			
type2 SEQUENCE {			
subType CHOICE {			
typeII SEQUENCE {			
n1-n2-codebookSubsetRestriction CHOICE {			
four-two	0x 7FF FFFF FFFF FFFF FFFF		
}			
typeII-RI-Restriction	'10'B		
}			
}			
phaseAlphabetSize	8		
subbandAmplitude	TRUE		
numberOfBeams	2		
}			
}			
}			

Table 6.3.2.1.5.4.3.1-3: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 5.4.2.5, Table 5.4.2.5-13			
Information Element	**Value/remark**	**Comment**	**Condition**
reportConfigType CHOICE {			
aperiodic SEQUENCE {			
reportSlotOffsetList	5		
}			
reportFreqConfiguration SEQUENCE {			
pmi-FormatIndicator	subbandPMI		
}			
}			

6.3.2.1.5.4.3.2 Message exceptions for NSA

Same as in clause 6.3.2.1.5.4.3.1.

6.3.2.1.5.5 Test requirement

Table 6.3.2.1.5.5-1: Test requirement

Parameter	Test 1
γ	1.89

6.3.2.1.6 2Rx FDD FR1 Multiple PMI with 16Tx Enhanced TypeII codebook for both SA and NSA

6.3.2.1.6.1 Test purpose

To test the accuracy of the Precoding Matrix Indicator (PMI) reporting such that the system throughput is maximized based on the precoders configured according to the UE reports.

6.3.2.1.6.2 Test applicability

This test applies to all types of NR UE release 16 and forward supporting Enhanced Type II codebook with at least 16 ports per CSI-RS resource.

This test also applies to all types of EUTRA UE release 16 and forward supporting EN-DC and Enhanced Type II codebook with at least 16 ports per CSI-RS resource.

6.3.2.1.6.3 Minimum conformance requirements

For the parameters specified in Table 6.3.2.1.6.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.1.6.3-2.

Table 6.3.2.1.6.3-1: Test parameters (dual-layer)

Parameter		Unit	Test 1
Bandwidth		MHz	10
Subcarrier spacing		kHz	15
Duplex Mode			FDD
Propagation channel			TDLA30-5
Antenna configuration			XP Medium 16 x 2 (N1,N2) = (4,2)
Beamforming Model			As specified in Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(9,-)
	CSI-RS interval and offset	slot	Not configured
	ZP CSI-RS trigger		1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		16
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1, k_2, k_3)		Row 12, (2, 4, 6, 8)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(5, -)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggeringOffset		0
CSI-IM configuration	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured

ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Not configured
Sub-band Size		RB	4
csi-ReportingBand			1111111
CSI-Report interval and offset		slot	Not configured
Aperiodic Report Slot Offset			5
CSI request			1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
reportTriggerSize			1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
Codebook configuration	Codebook Type		typeII-r16
	paramCombination-r16		6 (L =4, p_v =1/2, β=1/2)
	R*(numberOfPMISubbandsPerCQISubband-r16)*		1
	(CodebookConfig-N1,CodebookConfig-N2)		(4,2)
	(CodebookConfig-O1,CodebookConfig-O2)		(4,4)
	CodebookSubsetRestriction		0x 7FF FFFF FFFF FFFF FFFF
	RI Restriction (typeII-RI-Restriction-r16)		0010
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	8
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.1-6.3
Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable i_1, i_2 combination. The random precoder generation shall follow 'typeI-SinglePanel' codebook configuration as specified in table 6.3.2.1.3-1. Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-4), this reported PMI cannot be applied at the gNB downlink before slot#(n+4). Note 3: Randomization of the dual-cluster beam directions shall be used as specified in AnnexB.2.3.2.3A. The value of relative power ratio (p) shall be fixed as 1 during the test.			

Table 6.3.2.1.6.3-2: Minimum requirement

Parameter	Test 1
γ	2.2

The normative reference for this requirement is TS 38.101-4 [5], clause 6.3.2.1.6.

6.3.2.1.6.4 Test description

6.3.2.1.6.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 and Table 5.3.6-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.10 for TE diagram and section A.3.2.2 for UE diagram.
2. The parameter settings for the cell are set up according to Table 6.1.2-1 and Table 6.3.2.1.6.3-1 as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].
4. Propagation conditions are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR, Connected without release *On* for SA or (EN-DC, DC bearer *MCG* and *SCG*, *Connected without Release On)* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.3.2.1.6.4.3.

6.3.2.1.6.4.2 Test procedure

1. Set the parameters of bandwidth, the propagation condition, antenna configuration and measurement channel according to Table 6.3.2.1.6.3-1 as appropriate.
2. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC with precoding matrix according to PMI report from the UE. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission with an UL RMC for CP-OFDM QPSK with 5 RBs allocated according to A.2.2.6 of TS 38.521-1 [21] to carry the PUSCH CQI feedback via PDCCH DCI format 0_1 with aperiodic CSI request triggered. No transport block is sent in parallel to the CQI feedback. Establish $t_{ue,\,follow1,\,follow2}$ and $SNR_{follow1,\,follow2}$ according to Annex G.3.2.
3. Set SNR to $SNR_{follow1,\,follow2}$. The SS shall transmit PDSCH with randomly selected precoding matrix from codebook (Table 5.2.2.2.1-6 in TS 38.214 [12]) every slot regardless of PMI reports from the UE. Note that each precoding matrix shall be selected in equal probabilities. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission to carry the PUSCH CSI feedback via PDCCH DCI format 0_1 with aperiodic CSI request triggered. Measure $t_{rnd1,\,rnd2}$ according to Annex G.3.3.
4. Calculate $\gamma = \frac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. If the ratio $\geq \gamma$ which is specified in table 6.3.2.1.6.5-1, then the test is pass. Otherwise, the test is fail.

6.3.2.1.6.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 5.4.2.

6.3.2.1.6.4.3.1 Message exceptions for SA

Table 6.3.2.1.6.4.3.1-1: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 5.4.2.5, Table 5.4.2.5-13			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ReportConfig ::= SEQUENCE {			
reportFreqConfiguration SEQUENCE {			
pmi-FormatIndicator	Not present		
}			
codebookConfig	Not present		
subbandSize	Value1		
codebookConfig-r16	CodebookConfig-r16		
}			

Table 6.3.2.1.6.4.3.1-2: *CodebookConfig-r16* (Table 6.3.2.1.6.4.3.1-1)

Derivation Path: TS 38.331 [6], clause 6.3.2			
Information Element	**Value/remark**	**Comment**	**Condition**
CodebookConfig-r16 ::= SEQUENCE {			
codebookType CHOICE {			
type2 SEQUENCE {			
subType CHOICE {			
typeII-r16 SEQUENCE {			
N1-n2-codebookSubsetRestriction-r16			
Four-two	0x 7FF FFFF FFFF FFFF FFFF		
}			
typeII-RI-Restriction-r16	0010		
}			
}			
numberOfPMI-SubbandsPerCQI-Subband-r16	1		
paramCombinatin-r16	6	(L =4, p_v =1/2, β=1/2)	
}			
}			
}			

6.3.2.1.6.4.3.2 Message exceptions for NSA

Same as in clause 6.3.2.1.6.4.3.1.

6.3.2.1.6.5 Test requirement

Table 6.3.2.1.6.5-1: Test requirement

Parameter	Test 1
γ	2.19

6.3.2.2 TDD

6.3.2.2.1 2Rx TDD FR1 Single PMI with 4TX TypeI-SinglePanel codebook for both SA and NSA

6.3.2.2.1.1 Test Purpose

The purpose of this test is to test the accuracy of the Precoding Matrix Indicator (PMI) reporting such that the system throughput is maximized based on the precoders configured according to the UE reports.

6.3.2.2.1.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

6.3.2.2.1.3 Minimum Conformance Requirements

For the parameters specified in Table 6.3.2.2.1.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.2.1.3-2.

Table 6.3.2.2.1.3-1: Test parameters (single layer)

Parameter		Unit	Test 1
Bandwidth		MHz	40
Subcarrier spacing		kHz	30
Duplex Mode			TDD
TDD DL-UL configuration			FR1.30-1 as specified in Annex A
DL BWP configuration #1	First PRB		0
	Number of contiguous PRB		106
	Subcarrier spacing	kHz	30
Propagation channel			TDLA30-5
Antenna configuration			High XP 4 x 2 (N1,N2) = (2,1)
Beamforming Model			As specified in Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (*X*)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(9,-)
	CSI-RS interval and offset	slot	10/1
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 4, (0,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(13,-)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggering Offset		0
CSI-IM configuration	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Patten 0
	CSI-IM Resource Mapping		(4,9)

Parameter		Unit	Test 1
	(k_{CSI-IM}, l_{CSI-IM})		
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	16
csi-ReportingBand			1111111
CSI-Report interval and offset		slot	Not configured
Aperiodic Report Slot Offset			8
CSI request			1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
reportTriggerSize			1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
Codebook configuration	Codebook Type		typeI-SinglePanel
	Codebook Mode		1
	(CodebookConfig-N1,CodebookConfig-N2)		(2,1)
	(CodebookConfig-O1,CodebookConfig-O2)		(4,1)
	CodebookSubsetRestriction		11111111
	RI Restriction		00000001
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	5.5
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.2-8.1 TDD
PDSCH & PDSCH DMRS Precoding configuration for random Precoding			Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i_1, i_2 combination, and with Wideband granularity
NOTE 1: For random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity). NOTE 2: If the UE reports in an available uplink reporting instance at slot #n based on PMI estimation at a downlink slot not later than slot#[(n-4)], this reported PMI cannot be applied at the eNB downlink before slot#[(n+4)]. NOTE 3: Randomization of the principle beam direction shall be used as specified inAnnex B.2.3.2.3.			

Table 6.3.2.2.1.3-2: Minimum requirement

Parameter	Test 1
γ	1.3

6.3.2.2.1.4 Test Description

6.3.2.2.1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 and Table 5.3.6-1 of TS 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.1 for TE diagram and section A.3.2.2 for UE diagram.
2. The parameter settings for the cell are set up according to Table 6.1.2-1 and Table 6.3.2.2.1.3-1 as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].
4. Propagation conditions are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR, connected without release *On* for SA or (EN-DC, DC bearer *MCG* and *SCG*, *Connected without Release On)* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.3.2.2.1.4.3.

6.3.2.2.1.4.2 Test procedure

1. Set the parameters of bandwidth, the propagation condition, antenna configuration and measurement channel according to Table 6.3.2.2.1.3-1 as appropriate.
2. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC with precoding matrix according to PMI report from the UE. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission with an UL RMC for CP-OFDM QPSK with 5 RBs allocated according to A.2.2.6 of TS 38.521-1 [21] to carry the PUSCH CQI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. No transport block is sent in parallel to the CQI feedback. Establish $t_{ue,\,follow1,\,follow2}$ and $SNR_{follow1,\,follow2}$ according to Annex G.3.2.
3. Set SNR to $SNR_{follow1,\,follow2}$. The SS shall transmit PDSCH with randomly selected precoding matrix from codebook (Table 5.2.2.2.1-5 in TS 38.214 [12]) every slot regardless of PMI reports from the UE. Note that each precoding matrix shall be selected in equal probabilities. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission to carry the PUSCH CSI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. Measure $t_{rnd1,\,rnd2}$ according to Annex G.3.3.
4. Calculate $\gamma = \frac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. If the ratio ≥ γ which is specified in table 6.3.2.2.1.5-1, then the test is pass. Otherwise, the test is fail.

6.3.2.2.1.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1.

6.3.2.2.1.4.3_1 Message exceptions for SA

Table 6.3.2.2.1.4.3_1-1: CSI-ResourceConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-41			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourceConfig ::= SEQUENCE {			
resourceType	aperiodic		
}			

Table 6.3.2.2.1.4.3_1-2: CSI-RS-ResourceMapping for NZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause5.4.2, Table **5.4.2.0-15**			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
Row4	001		
}			
nrofPorts	p4		
firstOFDMSymbolInTimeDomain	13		
}			

Table 6.3.2.2.1.4.3_1-3: CSI-RS-ResourceMapping for ZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause5.4.2, Table5.4.2.0-21			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	000100		
}			
nrofPorts	p4		
firstOFDMSymbolInTimeDomain	9		
}			

Table 6.3.2.2.1.4.3_1-4: CSI-IM-Resource

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-34			
Information Element	**Value/remark**	**Comment**	**Condition**
csi-IM-ResourceElementPattern			
pattern0 SEQUENCE {			
subcarrierLocation-p0	s4		
symbolLocation-p0	9		
}			

Table 6.3.2.2.1.4.3_1-5: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], clause 4.6.2, Table 4.6.3-25			
Information Element	**Value/remark**	**Comment**	**Condition**
nrOfAntennaPorts CHOICE {			
moreThanTwo SEQUENCE {			
n1-n2 CHOICE {			
two-one-TypeI-SinglePanel-Restriction	11111111		
}			
}			
}			
typeI-SinglePanel-ri-Restriction	00000001		

Table 6.3.2.2.1.4.3_1-6: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-39			
Information Element	**Value/remark**	**Comment**	**Condition**
reportConfigType CHOICE {			
aperiodic SEQUENCE {			
reportSlotOffsetList	0		
}			
reportFreqConfiguration SEQUENCE {			
csi-ReportingBand CHOICE {			
subbands7	1111111		
}			
}			
subbandSize	value2		
}			

6.3.2.2.1.4.3_2 Message exceptions for NSA

Same as in clause 6.2.2.1.2.1.4.3_1.

6.3.2.2.1.5 Test Requirements

Table 6.3.2.2.1.5-1: Test requirement (TDD)

Parameter	Test 1
γ	1.29

6.3.2.2.2 2Rx TDD FR1 Single PMI with 8TX TypeI-SinglePanel codebook for both SA and NSA

6.3.2.2.2.1 Test purpose

The purpose of this test is to test the accuracy of the Precoding Matrix Indicator (PMI) reporting such that the system throughput is maximized based on the precoders configured according to the UE reports.

6.3.2.2.2.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

6.3.2.2.2.3 Minimum conformance requirements

For the parameters specified in Table 6.3.2.2.2.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.2.2.3-2.

Table 6.3.2.2.2.3-1: Test parameters (dual-layer)

Parameter		Unit	Test 1
Bandwidth		MHz	40
Subcarrier spacing		kHz	30
Duplex Mode			TDD
TDD DL-UL configurations			FR1.30-1 as specified in Annex A
DL BWP configuration #1	First PRB		0
	Number of contiguous PRB		106
	Subcarrier spacing	kHz	30
Propagation channel			TDLA30-5
Antenna configuration			High XP 8 x 2 (N1,N2) = (4,1)
Beamforming Model			As specified in Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (*X*)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(9,-)
	CSI-RS interval and offset	slot	10/1
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		8
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 8, (4,6)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(5,-)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggeringOffset		0
CSI-IM configuration	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Patten 0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForIChannelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband

pmi-FormatIndicator			Wideband
Sub-band Size		RB	16
csi-ReportingBand			1111111
CSI-Report interval and offset		slot	Not configured
Aperiodic Report Slot Offset			8
CSI request			1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
reportTriggerSize			1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
Codebook configuration	Codebook Type		typeI-SinglePanel
	Codebook Mode		1
	(CodebookConfig-N1,CodebookConfig-N2)		(4,1)
	(CodebookConfig-O1,CodebookConfig-O2)		(4,1)
	CodebookSubset Restriction		0x FFFF
	RI Restriction		00000010
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	6.5
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.2-8.2 TDD
PDSCH & PDSCH DMRS Precoding configuration for random Precoding			Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i_1, i_2 combination, and with Wideband granularity
Note 1: For random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity). Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#[(n-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 inAnnex B.2.3.2.3.			

Table 6.3.2.2.2.3-2: Minimum requirement

Parameter	Test 1
γ	1.5

6.3.2.2.2.4 Test description

6.3.2.2.2.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 and Table 5.3.6-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.1 for TE diagram and section A.3.2.2 for UE diagram.
2. The parameter settings for the cell are set up according to Table 6.1.2-1 and Table 6.3.2.2.2.3-1 as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].
4. Propagation conditions are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR, connected without release *On* for SA or (EN-DC, DC bearer *MCG* and *SCG, Connected without Release On)* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.3.2.2.2.4.3.

6.3.2.2.2.4.2 Test procedure

1. Set the parameters of bandwidth, the propagation condition, antenna configuration and measurement channel according to Table 6.3.2.2.2.3-1 as appropriate.
2. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC with precoding matrix according to PMI report from the UE. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission with an UL RMC for CP-OFDM QPSK with 5 RBs allocated according to A.2.2.6 of TS 38.521-1 [21] to carry the PUSCH CSI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. No transport block is sent in parallel to the CQI feedback. Establish $t_{ue,\,follow1,\,follow2}$ and $SNR_{follow1,\,follow2}$ according to Annex G.3.2.
3. Set SNR to $SNR_{follow1,\,follow2}$. The SS shall transmit PDSCH with randomly selected precoding matrix from codebook (Table 5.2.2.2.1-6 in TS 38.214 [12]) every slot regardless of PMI reports from the UE. Note that each precoding matrix shall be selected in equal probabilities. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission to carry the PUSCH CSI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. Measure $t_{rnd1,\,rnd2}$ according to Annex G.3.3.
4. Calculate $\gamma = \frac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. If the ratio ≥ γ which is specified in table 6.3.2.2.2.5-1, then the test is pass. Otherwise, the test is fail.

6.3.2.2.2.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1.

6.3.2.2.2.4.3_1 Message exceptions for SA

Table 6.3.2.2.2.4.3_1-1: CSI-ResourceConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-41			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourceConfig ::= SEQUENCE {			
resourceType	aperiodic		
}			

Table 6.3.2.2.2.4.3_1-2: CSI-RS-ResourceMapping for NZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 5.4.2, Table5.4.2.0-15			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	001100		
}			
nrofPorts	p8		
firstOFDMSymbolInTimeDomain	5		
cdm-Type	cdm4-FD2-TD2		
}			

Table 6.3.2.2.2.4.3_1-3: CSI-RS-ResourceMapping for ZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 5.4.2, Table5.4.2.0-21			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	000100		
}			
nrofPorts	p4		
firstOFDMSymbolInTimeDomain	9		
}			

Table 6.3.2.2.2.4.3_1-4: CSI-IM-Resource

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-34			
Information Element	**Value/remark**	**Comment**	**Condition**
csi-IM-ResourceElementPattern			
pattern0 SEQUENCE {			
subcarrierLocation-p0	s4		
symbolLocation-p0	9		
}			

Table 6.3.2.2.2.4.3_1-5: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], clause 4.6.2, Table 4.6.3-25			
Information Element	**Value/remark**	**Comment**	**Condition**
nrOfAntennaPorts CHOICE {			
moreThanTwo SEQUENCE {			
n1-n2 CHOICE {			
four-one-TypeI-SinglePanel-Restriction	FFFF		
}			
}			
}			
typeI-SinglePanel-ri-Restriction	00000010		

Table 6.3.2.2.2.4.3_1-6: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-39			
Information Element	**Value/remark**	**Comment**	**Condition**
reportConfigType CHOICE {			
aperiodic SEQUENCE {			
reportSlotOffsetList	8		
}			
reportFreqConfiguration SEQUENCE {			
csi-ReportingBand CHOICE {			
subbands7	1111111		
}			
}			
}			

6.3.2.2.2.4.3_2 Message exceptions for NSA

Same as in clause 6.3.2.2.2.4.3_1.

6.3.2.2.2.5 Test requirement

Table 6.3.2.2.2.5-1: Test requirement (TDD)

Parameter	Test 1
γ	1.49

6.3.2.2.3 2Rx TDD FR1 Multiple PMI with 16Tx Type1 - SinglePanel codebook for both SA and NSA

6.3.2.2.3.1 Test purpose

The purpose of this test is to test the accuracy of the Precoding Matrix Indicator (PMI) reporting such that the system throughput is maximized based on the precoders configured according to the UE reports.

6.3.2.2.3.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

6.3.2.2.3.3 Minimum conformance requirements

For the parameters specified in Table 6.3.2.2.3.3-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.2.3.3-2.

Table 6.3.2.2.3.3-1: Test parameters (dual-layer)

Parameter		Unit	Test 1
Bandwidth		MHz	40
Subcarrier spacing		kHz	30
Duplex Mode			TDD
TDD DL-UL configurations			FR1.30-1 as specified in Annex A
Propagation channel			TDLC300-5
Antenna configuration			High XP 16 x 2 (N1,N2) = (4,2)
Beamforming Model			As specified in Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(9,-)
	CSI-RS interval and offset	slot	Not configured
	ZP CSI-RS trigger		1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		16
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1, k_2, k_3)		Row 12, (2, 4, 6, 8)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(5, -)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggeringOffset		0
CSI-IM configuration	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForIChannelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Subband
Sub-band Size		RB	16
csi-ReportingBand			1111111

CSI-Report interval and offset		slot	Not configured
Aperiodic Report Slot Offset			8
CSI request			1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
reportTriggerSize			1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
Codebook configuration	Codebook Type		typeI-SinglePanel
	Codebook Mode		1
	(CodebookConfig-N1,CodebookConfig-N2)		(4,2)
	(CodebookConfig-O1,CodebookConfig-O2)		(4,4)
	CodebookSubset Restriction		0x FFFF
	RI Restriction		00000010
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	6.5
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.2-8.3 TDD
Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable i_1, i_2 combination. Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-6), this reported PMI cannot be applied at the gNB downlink before slot#(n+6). Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.			

Table 6.3.2.2.3.3-2: Minimum requirement

Parameter	Test 1
γ	2.5

The normative reference for this requirement is TS 38.101-4 [5], clause 6.3.2.2.3.

6.3.2.2.3.4 Test description

6.3.2.2.3.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 and Table 5.3.6-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.10 for TE diagram and section A.3.2.3 for UE diagram.

2. The parameter settings for the cell are set up according to Table 6.1.2-1 and Table 6.3.2.2.3.3-1 as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].
4. Propagation conditions are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR, connected without release *On* for SA or (EN-DC, DC bearer *MCG* and *SCG, Connected without Release On)* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.3.2.2.3.4.3.

6.3.2.2.3.4.2 Test procedure

1. Set the parameters of bandwidth, the propagation condition, antenna configuration and measurement channel according to Table 6.3.2.2.3.3-1 as appropriate.
2. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC with precoding matrix according to PMI report from the UE. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission with an UL RMC for CP-OFDM QPSK with 5 RBs allocated according to A.2.2.6 of TS 38.521-1 [21] to carry the PUSCH CSI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. No transport block is sent in parallel to the CQI feedback. Establish $t_{ue,\,follow1,\,follow2}$ and $SNR_{follow1,\,follow2}$ according to Annex G.3.2.
3. Set SNR to $SNR_{follow1,\,follow2}$. The SS shall transmit PDSCH with randomly selected precoding matrix from codebook (Table 5.2.2.2.1-6 in TS 38.214 [12]) every slot regardless of PMI reports from the UE. Note that each precoding matrix shall be selected in equal probabilities. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission to carry the PUSCH CSI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. Measure $t_{rnd1,\,rnd2}$ according to Annex G.3.3.
4. Calculate $\gamma = \frac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. If the ratio ≥ γ which is specified in table 6.3.2.2.3.5-1, then the test is pass.
   Otherwise, the test is fail.

6.3.2.2.3.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1.

6.3.2.2.3.4.3_1 Message exceptions for SA

Table 6.3.2.2.3.4.3_1-1: CSI-ResourceConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-41			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourceConfig ::= SEQUENCE {			
resourceType	aperiodic		
}			

Table 6.3.2.2.3.4.3_1-2: CSI-RS-ResourceMapping for NZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 5.4.2, Table 5.4.2.0-15			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	011110		
}			
nrofPorts	p16		
firstOFDMSymbolInTimeDomain	5		
cdm-Type	cdm4-FD2-TD2		
}			

Table 6.3.2.2.3.4.3_1-3: CSI-RS-ResourceMapping for ZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 5.4.2, Table 5.4.2.0-21			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	000100		
}			
nrofPorts	p4		
firstOFDMSymbolInTimeDomain	9		
}			

Table 6.3.2.2.3.4.3_1-4: CSI-IM-Resource

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-34			
Information Element	**Value/remark**	**Comment**	**Condition**
csi-IM-ResourceElementPattern			
pattern0 SEQUENCE {			
subcarrierLocation-p0	s4		
symbolLocation-p0	9		
}			

Table 6.3.2.2.3.4.3_1-5: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], clause 4.6.2, Table 4.6.3-25			
Information Element	**Value/remark**	**Comment**	**Condition**
nrOfAntennaPorts CHOICE {			
moreThanTwo SEQUENCE {			
n1-n2 CHOICE {			
four-one-TypeI-SinglePanel-Restriction	FFFF		
}			
}			
}			
typeI-SinglePanel-ri-Restriction	00000010		

Table 6.3.2.2.3.4.3_1-6: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-39			
Information Element	**Value/remark**	**Comment**	**Condition**
reportConfigType CHOICE {			
aperiodic SEQUENCE {			
reportSlotOffsetList	8		
}			
reportFreqConfiguration SEQUENCE {			
csi-ReportingBand CHOICE {			
subbands7	1111111		
}			
}			
}			

6.3.2.2.3.4.3_2 Message exceptions for NSA

Same as in clause 6.3.2.2.3.4.3_1.

6.3.2.2.3.5 Test requirement

Table 6.3.2.2.3.5-1: Test requirement (TDD)

Parameter	Test 1
γ	2.49

6.3.2.2.4 2Rx TDD FR1 Single PMI with 32Tx Type1 - SinglePanel codebook for both SA and NSA

6.3.2.2.4.1 Test purpose

The purpose of this test is to test the accuracy of the Precoding Matrix Indicator (PMI) reporting such that the system throughput is maximized based on the precoders configured according to the UE reports.

6.3.2.2.4.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

6.3.2.2.4.3 Minimum conformance requirements

For the parameters specified in Table 6.3.2.2.4.3-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.2.4.3-2.

Table 6.3.2.2.4.3-1: Test parameters (dual-layer)

Parameter		Unit	Test 1
Bandwidth		MHz	40
Subcarrier spacing		kHz	30
Duplex Mode			TDD
TDD DL-UL configurations			FR1.30-1 as specified in Annex A
Propagation channel			TDLA30-5
Antenna configuration			High XP 32 x 2 (N1,N2) = (4,4)
Beamforming Model			As specified in Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(9,-)
	CSI-RS interval and offset	slot	Not configured
	ZP CSI-RS trigger		1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		32
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1, k_2, k_3)		Row 17, (2, 4, 6, 8)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(5, 12)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggeringOffset		0
CSI-IM configuration	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForIChannelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	16
csi-ReportingBand			1111111

CSI-Report interval and offset		slot	Not configured
Aperiodic Report Slot Offset			8
CSI request			1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
reportTriggerSize			1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
Codebook configuration	Codebook Type		typeI-SinglePanel
	Codebook Mode		1
	(CodebookConfig-N1,CodebookConfig-N2)		(4,4)
	(CodebookConfig-O1,CodebookConfig-O2)		(4,4)
	CodebookSubset Restriction		0x FFFF
	RI Restriction		00000010
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	6.5
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.2-8.3 TDD
PDSCH & PDSCH DMRS Precoding configuration for random Precoding			Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i_1, i_2 combination, and with Wideband granularity

Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable i_1, i_2 combination.

Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-6), this reported PMI cannot be applied at the gNB downlink before slot#(n+6).

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

Table 6.3.2.2.4.3-2: Minimum requirement

Parameter	Test 1
γ	5.0

The normative reference for this requirement is TS 38.101-4 [5], clause 6.3.2.2.4.

6.3.2.2.4.4 Test description

6.3.2.2.4.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 and Table 5.3.6-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.10TBD for TE diagram and section A.3.2.3 for UE diagram.
2. The parameter settings for the cell are set up according to Table 6.1.2-1 and Table 6.3.2.2.4.3-1 as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].
4. Propagation conditions are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR, connected without release *On* for SA or (EN-DC, DC bearer *MCG* and *SCG, Connected without Release On)* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.3.2.2.4.4.3.

6.3.2.2.4.4.2 Test procedure

1. Set the parameters of bandwidth, the propagation condition, antenna configuration and measurement channel according to Table 6.3.2.2.4.3-1 as appropriate.
2. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC with precoding matrix according to PMI report from the UE. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission with an UL RMC for CP-OFDM QPSK with 5 RBs allocated according to A.2.2.6 of TS 38.521-1 [21] to carry the PUSCH CSI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. No transport block is sent in parallel to the CQI feedback. Establish $t_{ue,\,follow1,\,follow2}$ and $SNR_{follow1,\,follow2}$ according to Annex G.3.2.
3. Set SNR to $SNR_{follow1,\,follow2}$. The SS shall transmit PDSCH with randomly selected precoding matrix from codebook (Table 5.2.2.2.1-6 in TS 38.214 [12]) every slot regardless of PMI reports from the UE. Note that each precoding matrix shall be selected in equal probabilities. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission to carry the PUSCH CSI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. Measure $t_{rnd1,\,rnd2}$ according to Annex G.3.3.
4. Calculate $\gamma = \frac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. If the ratio ≥ γ which is specified in table 6.3.2.2.4.5-1, then the test is pass. Otherwise, the test is fail.

6.3.2.2.4.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1.

6.3.2.2.4.4.3_1 Message exceptions for SA

Table 6.3.2.2.4.4.3_1-1: CSI-ResourceConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-41			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourceConfig ::= SEQUENCE {			
resourceType	aperiodic		
}			

Table 6.3.2.2.4.4.3_1-2: CSI-RS-ResourceMapping for NZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 5.4.2, Table 5.4.2.0-15			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	011110		
}			
nrofPorts	p32		
firstOFDMSymbolInTimeDomain	5		
cdm-Type	cdm4-FD2-TD2		
}			

Table 6.3.2.2.4.4.3_1-3: CSI-RS-ResourceMapping for ZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 5.4.2, Table 5.4.2.0-21			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	000100		
}			
nrofPorts	p4		
firstOFDMSymbolInTimeDomain	9		
}			

Table 6.3.2.2.4.4.3_1-4: CSI-IM-Resource

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-34			
Information Element	**Value/remark**	**Comment**	**Condition**
csi-IM-ResourceElementPattern			
pattern0 SEQUENCE {			
subcarrierLocation-p0	s4		
symbolLocation-p0	9		
}			

Table 6.3.2.2.4.4.3_1-5: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], clause 4.6.2, Table 4.6.3-25			
Information Element	**Value/remark**	**Comment**	**Condition**
nrOfAntennaPorts CHOICE {			
moreThanTwo SEQUENCE {			
n1-n2 CHOICE {			
four-one-TypeI-SinglePanel-Restriction	FFFF		
}			
}			
}			
typeI-SinglePanel-ri-Restriction	00000010		

Table 6.3.2.2.4.4.3_1-6: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-39			
Information Element	**Value/remark**	**Comment**	**Condition**
reportConfigType CHOICE {			
aperiodic SEQUENCE {			
reportSlotOffsetList	8		
}			
reportFreqConfiguration SEQUENCE {			
csi-ReportingBand CHOICE {			
subbands7	1111111		
}			
}			
}			

6.3.2.2.4.4.3_2 Message exceptions for NSA

Same as in clause 6.3.2.2.4.4.3_1.

6.3.2.2.4.5 Test requirement

Table 6.3.2.2.4.5-1: Test requirement (TDD)

Parameter	Test 1
γ	4.99

6.3.2.2.5 2Rx TDD FR1 Multiple PMI with 16Tx TypeII codebook for both SA and NSA

6.3.2.2.5.1 Test purpose

To test the accuracy of the Precoding Matrix Indicator (PMI) reporting such that the system throughput is maximized based on the precoders configured according to the UE reports.

6.3.2.2.5.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

6.3.2.2.5.3 Minimum conformance requirements

For the parameters specified in Table 6.3.2.2.5.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.2.5.3-2.

Table 6.3.2.2.5.3-1: Test parameters (dual-layer)

Parameter		Unit	Test 1
Bandwidth		MHz	40
Subcarrier spacing		kHz	30
Duplex Mode			TDD
TDD DL-UL configurations			FR1.30-1 as specified in Annex A
Propagation channel			TDLA30-5
Antenna configuration			XP Medium 16 x 2 (N1,N2) = (4,2)
Beamforming Model			As specified in Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		4
	CDM Type		FD-CDM2

	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(9,-)
	CSI-RS interval and offset	slot	Not configured
	ZP CSI-RS trigger		1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		16
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1, k_2, k_3)		Row 12, (2, 4, 6, 8)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(5, -)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggeringOffset		0
CSI-IM configuration	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForIChannelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Subband
Sub-band Size		RB	16
csi-ReportingBand			1111111
CSI-Report interval and offset		slot	Not configured
Aperiodic Report Slot Offset			8
CSI request			1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
reportTriggerSize			1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
Codebook configuration	Codebook Type		typeII
	L (*numberOfBeams*)		2
	N_{PSK} (*phaseAlphabetSize*)		8
	subbandAmplitude		True
	(CodebookConfig-N1,CodebookConfig-N2)		(4,2)
	(CodebookConfig-O1,CodebookConfig-O2)		(4,4)
	CodebookSubsetRestriction		0x 7FF FFFF FFFF FFFF FFFF

	RI Restriction (typeII-RI-Restriction)		10
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	6.5
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.2-8.3 TDD
Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable i_1, i_2 combination. The random precoder generation shall follow 'typeI-SinglePanel' codebook configuration as specified in table 6.3.2.2.3-1. Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-6), this reported PMI cannot be applied at the gNB downlink before slot#(n+6). Note 3: Randomization of the dual-cluster beam directions shall be used as specified in Annex B.2.3.2.3A. The value of relative power ratio (p) shall be fixed as 1 during the test.			

Table 6.3.2.2.5.3-2: Minimum requirement

Parameter	Test 1
γ	1.9

The normative reference for this requirement is TS 38.101-4 [5] clause 6.3.2.2.5.

6.3.2.2.5.4 Test description

6.3.2.2.5.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 and Table 5.3.6-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.10 for TE diagram and section A.3.2.2 for UE diagram.
2. The parameter settings for the cell are set up according to Table 6.1.2-1 and Table 6.3.2.2.5.3-1 and as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].
4. Propagation conditions are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR, Connected without release *On* for SA or (EN-DC, DC bearer *MCG* and *SCG, Connected without Release On)* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.3.2.1.4.4.3.

6.3.2.2.5.4.2 Test procedure

1. Set the parameters of bandwidth, the propagation condition, antenna configuration and measurement channel according to Table 6.3.2.2.5.3-1 as appropriate.

2. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC with precoding matrix according to PMI report from the UE. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission with an UL RMC for CP-OFDM QPSK with 5 RBs allocated according to A.2.2.6 of TS 38.521-1 [21] to carry the PUSCH CQI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. No transport block is sent in parallel to the CQI feedback. Establish $t_{ue,\,follow1,\,follow2}$ and $SNR_{follow1,\,follow2}$ according to Annex G.3.2.

3. Set SNR to $SNR_{follow1,\,follow2}$. The SS shall transmit PDSCH with randomly selected precoding matrix from codebook (Table 5.2.2.2.1-6 in TS 38.214 [12]) every slot regardless of PMI reports from the UE. Note that each precoding matrix shall be selected in equal probabilities, and the random precoder generation shall follow the codebook configuration as specified in Table 6.3.2.2.3.3-1. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission to carry the PUSCH CSI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. Measure $t_{rnd1,\,rnd2}$ according to Annex G.3.3.

4. Calculate $\gamma = \frac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. If the ratio ≥ γ which is specified in table 6.3.2.2.5.5-1, then the test is pass. Otherwise, the test is fail.

6.3.2.2.5.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1.

6.3.2.2.5.4.3.1 Message exceptions for SA

Table 6.3.2.2.5.4.3.1-1: CSI-RS-ResourceMapping for NZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 5.4.2.5, Table 5.4.2.5-2			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	'011110'B		
}			
nrofPorts	P16		
firstOFDMSymbolInTimeDomain	5		
cdm-Type	cdm4-FD2-TD2		
}			

Table 6.3.2.2.5.4.3.1-2: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], clause 5.4.2.5, Table 5.4.2.5-14			
Information Element	**Value/remark**	**Comment**	**Condition**
CodebookConfig ::= SEQUENCE {			
codebookType CHOICE {			
type2 SEQUENCE {			
subType CHOICE {			
typeII SEQUENCE {			
n1-n2-codebookSubsetRestriction CHOICE {			
four-two	0x 7FF FFFF FFFF FFFF FFFF		
}			
typeII-RI-Restriction	'10'B		
}			
}			
phaseAlphabetSize	8		
subbandAmplitude	TRUE		
numberOfBeams	2		
}			
}			
}			

Table 6.3.2.2.5.4.3.1-3: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 5.4.2.5, Table 5.4.2.5-13			
Information Element	**Value/remark**	**Comment**	**Condition**
reportConfigType CHOICE {			
aperiodic SEQUENCE {			
reportSlotOffsetList	5		
}			
reportFreqConfiguration SEQUENCE {			
pmi-FormatIndicator	subbandPMI		
}			
}			

6.3.2.2.5.4.3.2 Message exceptions for NSA

Same as in clause 6.3.2.2.5.4.3.1.

6.3.2.2.5.5 Test requirement

Table 6.3.2.2.5.5-1: Test requirement

Parameter	Test 1
γ	1.89

6.3.2.2.6 2Rx TDD FR1 Multiple PMI with 16Tx Enhanced TypeII codebook for both SA and NSA

6.3.2.2.6.1 Test purpose

To test the accuracy of the Precoding Matrix Indicator (PMI) reporting such that the system throughput is maximized based on the precoders configured according to the UE reports.

6.3.2.2.6.2 Test applicability

This test applies to all types of NR UE release 16 and forward supporting Enhanced Type II codebook with at least 16 ports per CSI-RS resource.

This test also applies to all types of EUTRA UE release 16 and forward supporting EN-DC and Enhanced Type II codebook with at least 16 ports per CSI-RS resource.

6.3.2.2.6.3 Minimum conformance requirements

For the parameters specified in Table 6.3.2.2.6.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.2.6.3-2.

Table 6.3.2.2.6.3-1: Test parameters (dual-layer)

Parameter		Unit	Test 1
Bandwidth		MHz	40
Subcarrier spacing		kHz	30
Duplex Mode			TDD
TDD DL-UL configurations			FR1.30-1 as specified in Annex A
Propagation channel			TDLA30-5
Antenna configuration			XP Medium 16 x 2 (N1,N2) = (4,2)
Beamforming Model			As specified in Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(9,-)
	CSI-RS interval and offset	slot	Not configured
	ZP CSI-RS trigger		1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		16
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1, k_2, k_3)		Row 12, (2, 4, 6, 8)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(5, -)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggeringOffset		0
CSI-IM configuration	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured

ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForIChannelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Not configured
Sub-band Size		RB	8
csi-ReportingBand			1111111
CSI-Report interval and offset		slot	Not configured
Aperiodic Report Slot Offset			8
CSI request			1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
reportTriggerSize			1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
Codebook configuration	Codebook Type		typeII-r16
	paramCombination-r16		6 (L =4, p_v =1/2, β=1/2)
	R*(numberOfPMISubbandsPerCQISubband-r16)*		1
	(CodebookConfig-N1,CodebookConfig-N2)		(4,2)
	(CodebookConfig-O1,CodebookConfig-O2)		(4,4)
	CodebookSubsetRestriction		0x 7FF FFFF FFFF FFFF FFFF
	RI Restriction (typeII-RI-Restriction-r16)		0010
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	6.5
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.2-8.3 TDD
Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable i_1, i_2 combination. The random precoder generation shall follow 'typeI-SinglePanel' codebook configuration as specified in table 6.3.2.2.3-1. Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-6), this reported PMI cannot be applied at the gNB downlink before slot#(n+6). Note 3: Randomization of the dual-cluster beam directions shall be used as specified in Annex B.2.3.2.3A. The value of relative power ratio (p) shall be fixed as 1 during the test.			

Table 6.3.2.2.6.3-2: Minimum requirement

Parameter	Test 1
γ	2.2

The normative reference for this requirement is TS 38.101-4 [5], clause 6.3.2.2.6.

6.3.2.2.6.4 Test description

6.3.2.2.6.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 and Table 5.3.6-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.10 for TE diagram and section A.3.2.2 for UE diagram.
2. The parameter settings for the cell are set up according to Table 6.1.2-1 and Table 6.3.2.2.6.3-1 as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].
4. Propagation conditions are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR, Connected without release *On* for SA or (EN-DC, DC bearer *MCG* and *SCG*, *Connected without Release On)* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.3.2.2.6.4.3.

6.3.2.2.6.4.2 Test procedure

1. Set the parameters of bandwidth, the propagation condition, antenna configuration and measurement channel according to Table 6.3.2.2.6.3-1 as appropriate.
2. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC with precoding matrix according to PMI report from the UE. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission with an UL RMC for CP-OFDM QPSK with 5 RBs allocated according to A.2.2.6 of TS 38.521-1 [21] to carry the PUSCH CQI feedback via PDCCH DCI format 0_1 with aperiodic CSI request triggered. No transport block is sent in parallel to the CQI feedback. Establish $t_{ue,\,follow1,\,follow2}$ and $SNR_{follow1,\,follow2}$ according to Annex G.3.2.
3. Set SNR to $SNR_{follow1,\,follow2}$. The SS shall transmit PDSCH with randomly selected precoding matrix from codebook (Table 5.2.2.2.1-6 in TS 38.214 [12]) every slot regardless of PMI reports from the UE. Note that each precoding matrix shall be selected in equal probabilities. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission to carry the PUSCH CSI feedback via PDCCH DCI format 0_1 with aperiodic CSI request triggered. Measure $t_{rnd1,\,rnd2}$ according to Annex G.3.3.
4. Calculate $\gamma = \dfrac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. If the ratio $\geq \gamma$ which is specified in table 6.3.2.2.6.5-1, then the test is pass. Otherwise, the test is fail.

6.3.2.2.6.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 5.4.2.

6.3.2.2.6.4.3.1 Message exceptions for SA

Table 6.3.2.2.6.4.3.1-1: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 5.4.2.5, Table 5.4.2.5-13			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ReportConfig ::= SEQUENCE {			
reportFreqConfiguration SEQUENCE {			
pmi-FormatIndicator	Not present		
}			
codebookConfig	Not present		
subbandSize	Value1		
codebookConfig-r16	CodebookConfig-r16		
}			

Table 6.3.2.2.6.4.3.1-2: *CodebookConfig-r16* (Table 6.3.2.2.6.4.3.1-1)

Derivation Path: TS 38.331 [6], clause 6.3.2			
Information Element	**Value/remark**	**Comment**	**Condition**
CodebookConfig-r16 ::= SEQUENCE {			
codebookType CHOICE {			
type2 SEQUENCE {			
subType CHOICE {			
typeII-r16 SEQUENCE {			
N1-n2-codebookSubsetRestriction-r16			
Four-two	0x 7FF FFFF FFFF FFFF FFFF		
}			
typeII-RI-Restriction-r16	0010		
}			
}			
numberOfPMI-SubbandsPerCQI-Subband-r16	1		
paramCombinatin-r16	6	(L =4, p_v =1/2, β=1/2)	
}			
}			
}			

6.3.2.2.6.4.3.2 Message exceptions for NSA

Same as in clause 6.3.2.2.6.4.3.1.

6.3.2.2.6.5 Test requirement

Table 6.3.2.2.6.5-1: Test requirement

Parameter	Test 1
γ	2.19

6.3.3 4RX requirements

6.3.3.1 FDD

6.3.3.1.1 4Rx FDD FR1 Single PMI with 4TX TypeI-SinglePanel codebook for both SA and NSA

6.3.3.1.1.1 Test purpose

To test the accuracy of the Precoding Matrix Indicator (PMI) reporting such that the system throughput is maximized based on the precoders configured according to the UE reports.

6.3.3.1.1.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

6.3.3.1.1.3 Minimum conformance requirements

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 6.3.3.1.1.3-1: Test parameters (single layer)

Parameter		Unit	Test 1
Bandwidth		MHz	10
Subcarrier spacing		kHz	15
Duplex Mode			FDD
Propagation channel			TDLA30-5
Antenna configuration			High XP 4 x 4 (N1,N2) = (2,1)
Beamforming Model			As specified in Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (*X*)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(9,-)
	CSI-RS interval and offset	slot	5/1
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 4, (0,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(13,-)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggeringOffset		0
CSI-IM configuration	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	8
csi-ReportingBand			1111111
CSI-Report interval and offset		slot	Not configured
Aperiodic Report Slot Offset			4
CSI request			1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0

reportTriggerSize			1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
Codebook configuration	Codebook Type		typeI-SinglePanel
	Codebook Mode		1
	(CodebookConfig-N1,CodebookConfig-N2)		(2,1)
	(CodebookConfig-O1,CodebookConfig-O2)		(4,1)
	CodebookSubsetRestriction		11111111
	RI Restriction		00000001
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	6
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.1-6.1 FDD
PDSCH & PDSCH DMRS Precoding configuration for random Precoding			Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i_1, i_2 combination, and with Wideband granularity
Note 1: For random precoder selection, the precoder shall be updated in each slot (1 ms granularity). Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-3), this reported PMI cannot be applied at the eNB downlink before slot#(n+3). Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.			

Table 6.3.3.1.1.3-2: Minimum requirement

Parameter	Test 1
γ	1.3

The normative reference for this requirement is TS 38.101-4 [5] clause 6.3.3.1.1.

6.3.3.1.1.4 Test description

6.3.3.1.1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 and Table 5.3.6-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.1 for TE diagram and section A.3.2.2 for UE diagram.

2. The parameter settings for the cell are set up according to Table 6.1.2-1 and Table 6.3.3.1.1_1 and as appropriate.

3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].

4. Propagation conditions are set according to Annex B.0.

5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR, Connected without release *On* for SA or (EN-DC, DC bearer *MCG* and *SCG, Connected without Release On)* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.3.3.1.1.4.3.

6.3.3.1.1.4.2 Test procedure

1. Set the parameters of bandwidth, the propagation condition, antenna configuration and measurement channel according to Table 6.3.2.2.1.3-1 as appropriate.

2. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC with precoding matrix according to PMI report from the UE. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission with an UL RMC for CP-OFDM QPSK with 5 RBs allocated according to A.2.2.6 of TS 38.521-1 [21] to carry the PUSCH CQI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. No transport block is sent in parallel to the CQI feedback. Establish $t_{ue,\,follow1,\,follow2}$ and $SNR_{follow1,\,follow2}$ according to Annex G.3.2.

3. Set SNR to $SNR_{follow1,\,follow2}$. The SS shall transmit PDSCH with randomly selected precoding matrix from codebook (Table 5.2.2.2.1-5 in TS 38.214 [12]) every slot regardless of PMI reports from the UE. Note that each precoding matrix shall be selected in equal probabilities. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission to carry the PUSCH CSI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. Measure $t_{rnd1,\,rnd2}$ according to Annex G.3.3.

4. Calculate $\gamma = \frac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. If the ratio ≥ γ which is specified in table 6.3.2.1.1.5-1, then the test is pass.
   Otherwise, the test is fail.

6.3.3.1.1.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1.

6.3.3.1.1.4.3.1 Message exceptions for SA

Table 6.3.3.1.1.4.3.1-1: CSI-ResourceConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-41			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourceConfig ::= SEQUENCE {			
resourceType	Aperiodic		
}			

Table 6.3.3.1.1.4.3.1-2: CSI-RS-ResourceMapping for NZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-45			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
Row4	001		
}			
nrofPorts	p4		
firstOFDMSymbolInTimeDomain	13		
}			

Table 6.3.3.1.1.4.3.1-3: CSI-RS-ResourceMapping for ZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-45			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
Row5	000100		
}			
nrofPorts	p4		
firstOFDMSymbolInTimeDomain	9		
}			

Table 6.3.3.1.1.4.3.1-4: CSI-IM-Resource

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-34			
Information Element	**Value/remark**	**Comment**	**Condition**
csi-IM-ResourceElementPattern			
pattern0 SEQUENCE {			
subcarrierLocation-p0	s4		
symbolLocation-p0	9		
}			
periodicityAndOffset	CSI-ResourcePeriodicityAndOffset		

Table 6.3.3.1.1.4.3.1-5: *CSI-ResourcePeriodicityAndOffset*

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.2-43			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourcePeriodicityAndOffset CHOICE {			
Slots5	1		
}			

Table 6.3.3.1.1.4.3.1-6: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-25			
Information Element	**Value/remark**	**Comment**	**Condition**
nrOfAntennaPorts CHOICE {			
moreThanTwo SEQUENCE {			
n1-n2 CHOICE {			
two-one-TypeI-SinglePanel-Restriction	11111111		
}			
}			
}			
typeI-SinglePanel-ri-Restriction	00000001		

Table 6.3.3.1.1.4.3.1-7: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-39			
Information Element	**Value/remark**	**Comment**	**Condition**
reportConfigType CHOICE {			
aperiodic SEQUENCE {			
reportSlotOffsetList	0		
}			
reportFreqConfiguration SEQUENCE {			
csi-ReportingBand CHOICE {			
subbands7	[1111111]		
}			
}			
subbandSize	8		
}			

6.3.3.1.1.4.3.2 Message exceptions for NSA

Same as in clause 6.3.3.1.1.4.3.1.

6.3.3.1.1.5 Test requirement

Table 6.3.3.1.1.5-1: Test requirement

Parameter	Test 1
γ	1.29

6.3.3.1.2 4Rx FDD FR1 Single PMI with 8TX TypeI-SinglePanel codebook for both SA and NSA

6.3.3.1.2.1 Test purpose

To test the accuracy of the Precoding Matrix Indicator (PMI) reporting such that the system throughput is maximized based on the precoders configured according to the UE reports.

6.3.3.1.2.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

6.3.3.1.2.3 Minimum conformance requirements

For the parameters specified in Table 6.3.3.1.2.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.1.2.3-2.

Table 6.3.3.1.2.3-1: Test parameters (dual-layer)

Parameter		Unit	Test 1
Bandwidth		MHz	10
Subcarrier spacing		kHz	15
Duplex Mode			FDD
Propagation channel			TDLA30-5
Antenna configuration			High XP 8 x 4 (N1,N2) = (4,1)
Beamforming Model			As specified in Section Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (*X*)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(9,-)
	CSI-RS interval and offset	slot	5/1
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		8
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 8, (4,6)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(5,-)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggeringOffset		0
CSI-IM configuration	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Patten 0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	8
csi-ReportingBand			1111111
CSI-Report interval and offset		slot	Not configured
Aperiodic Report Slot Offset			5
CSI request			1 in slots i, where mod(i, 5) = 1,

			otherwise it is equal to 0
reportTriggerSize			1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
Codebook configuration	Codebook Type		typeI-SinglePanel
	Codebook Mode		1
	(CodebookConfig-N1,CodebookConfig-N2)		(4,1)
	(CodebookConfig-O1,CodebookConfig-O2)		(4,1)
	CodebookSubset Restriction		0x FFFF
	RI Restriction		00000010
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	8
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.1-6.2 FDD
PDSCH & PDSCH DMRS Precoding configuration for random Precoding			Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i_1, i_2 combination, and with Wideband granularity
Note 1: For random precoder selection, the precoder shall be updated in each slot (1 ms granularity). Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#[(n-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 Annex B.2.3.2.3			

Table 6.3.3.1.2.3-2: Minimum requirement

Parameter	Test 1
γ	1.5

The normative reference for this requirement is TS 38.101-4 [5] clause 6.3.3.1.2.

6.3.3.1.2.4 Test description

6.3.3.1.2.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 and Table 5.3.6-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.1 for TE diagram and section A.3.2.2 for UE diagram.
2. The parameter settings for the cell are set up according to Table 6.1.2-1 and Table 6.3.3.1.2.3-1and as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].
4. Propagation conditions are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR, Connected without release *On* for SA or (EN-DC, DC bearer *MCG* and *SCG, Connected without Release On)* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.3.3.1.2.4.3.

6.3.3.1.2.4.2 Test procedure

1. Set the parameters of bandwidth, the propagation condition, antenna configuration and measurement channel according to Table 6.3.3.1.2.3-1 as appropriate.
2. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC with precoding matrix according to PMI report from the UE. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission with an UL RMC for CP-OFDM QPSK with 5 RBs allocated according to A.2.2.6 of TS 38.521-1 [21] to carry the PUSCH CQI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. No transport block is sent in parallel to the CQI feedback. Establish $t_{ue,\,follow1,\,follow2}$ and $SNR_{follow1,\,follow2}$ according to Annex G.3.2.
3. Set SNR to $SNR_{follow1,\,follow2}$. The SS shall transmit PDSCH with randomly selected precoding matrix from codebook (Table 5.2.2.2.1-5 in TS 38.214 [12]) every slot regardless of PMI reports from the UE. Note that each precoding matrix shall be selected in equal probabilities. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission to carry the PUSCH CSI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. Measure $t_{rnd1,\,rnd2}$ according to Annex G.3.3.
4. Calculate $\gamma = \frac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. If the ratio $\geq \gamma$ which is specified in table 6.3.3.1.2.5-1, then the test is pass.
   Otherwise, the test is fail.

6.3.3.1.2.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1.

6.3.3.1.2.4.3.1 Message exceptions for SA

Table 6.3.3.1.2.4.3.1-1: CSI-ResourceConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-41			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourceConfig ::= SEQUENCE {			
resourceType	aperiodic		
}			

Table 6.3.3.1.2.4.3.1-2: CSI-RS-ResourceMapping for NZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 5.4.2, Table5.4.2.0-15			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	001100		
}			
nrofPorts	p8		
firstOFDMSymbolInTimeDomain	5		
cdm-Type	cdm4-FD2-TD2		
}			

Table 6.3.3.1.2.4.3.1-3: CSI-RS-ResourceMapping for ZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 5.4.2, Table5.4.2.0-21			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	000100		
}			
nrofPorts	p4		
firstOFDMSymbolInTimeDomain	9		
}			

Table 6.3.3.1.2.4.3.1-4: CSI-IM-Resource

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-34			
Information Element	**Value/remark**	**Comment**	**Condition**
csi-IM-ResourceElementPattern			
pattern0 SEQUENCE {			
subcarrierLocation-p0	s4		
symbolLocation-p0	9		
}			

Table 6.3.3.1.2.4.3.1-5: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-25			
Information Element	**Value/remark**	**Comment**	**Condition**
nrOfAntennaPorts CHOICE {			
moreThanTwo SEQUENCE {			
n1-n2 CHOICE {			
four-one-TypeI-SinglePanel-Restriction	FFFF		
}			
}			
}			
typeI-SinglePanel-ri-Restriction	00000010		

Table 6.3.3.1.2.4.3.1-6: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-39			
Information Element	**Value/remark**	**Comment**	**Condition**
reportConfigType CHOICE {			
aperiodic SEQUENCE {			
reportSlotOffsetList	5		
}			
reportFreqConfiguration SEQUENCE {			
csi-ReportingBand CHOICE {			
subbands7	1111111		
}			
}			
}			

6.3.3.1.2.4.3.2 Message exceptions for NSA

Same as in clause 6.3.3.1.2.4.3.

6.3.3.1.2.5 Test requirement

Table 6.3.3.1.2.5-1: Test requirement

Parameter	Test 1
γ	1.49

6.3.3.1.3 4Rx FDD FR1 Multiple PMI with 16Tx Type I – SinglePanel Codebook for both SA and NSA

6.3.3.1.3.1 Test purpose

To test the accuracy of the Precoding Matrix Indicator (PMI) reporting such that the system throughput is maximized based on the precoders configured according to the UE reports.

6.3.3.1.3.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

6.3.3.1.3.3 Minimum conformance requirements

For the parameters specified in Table 6.3.3.1.3.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.1.3.3-2.

Table 6.3.3.1.3.3-1: Test parameters (dual-layer)

Parameter		Unit	Test 1
Bandwidth		MHz	10
Subcarrier spacing		kHz	15
Duplex Mode			FDD
Propagation channel			TDLC300-5
Antenna configuration			High XP 16 x 4 (N1,N2) = (4,2)
Beamforming Model			As specified in Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		4

	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(9,-)
	CSI-RS interval and offset	slot	Not configured
	ZP CSI-RS trigger		1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		16
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1, k_2, k_3)		Row 12, (2, 4, 6, 8)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(5, -)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggeringOffset		0
CSI-IM configuration	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Subband
Sub-band Size		RB	8
csi-ReportingBand			1111111
CSI-Report interval and offset		slot	Not configured
Aperiodic Report Slot Offset			5
CSI request			1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
reportTriggerSize			1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
Codebook configuration	Codebook Type		typeI-SinglePanel
	Codebook Mode		1
	(CodebookConfig-N1,CodebookConfig-N2)		(4,2)
	(CodebookConfig-		(4,4)

	O1,CodebookConfig-O2)		
	CodebookSubsetRestriction		0x FFFF
	RI Restriction		00000010
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	8
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.1-6.3 FDD
Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable i_1, i_2 combination. Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-4), this reported PMI cannot be applied at the gNB downlink before slot#(n+4). Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.			

Table 6.3.3.1.3.3-2: Minimum requirement

Parameter	Test 1
γ	3.0

The normative reference for this requirement is TS 38.101-4 [5] clause 6.3.3.1.3.

6.3.3.1.3.4 Test description

6.3.3.1.3.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 and Table 5.3.6-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.10 for TE diagram and section A.3.2.2 for UE diagram.

2. The parameter settings for the cell are set up according to Table 6.1.2-1 and Table 6.3.3.1.3.3-1 and as appropriate.

3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].

4. Propagation conditions are set according to Annex B.0.

5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR, Connected without release *On* for SA or (EN-DC, DC bearer *MCG* and *SCG, Connected without Release On)* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.3.3.1.3.4.3.

6.3.3.1.3.4.2 Test procedure

1. Set the parameters of bandwidth, the propagation condition, antenna configuration and measurement channel according to Table 6.3.3.1.3.3-1 as appropriate.

2. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC with precoding matrix according to PMI report from the UE. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission with an UL RMC for CP-OFDM QPSK with 5 RBs allocated according to A.2.2.6 of TS 38.521-1 [21] to carry the PUSCH CQI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. No transport block is sent in parallel to the CQI feedback. Establish $t_{ue,\,follow1,\,follow2}$ and $SNR_{follow1,\,follow2}$ according to Annex G.3.2.

3. Set SNR to $SNR_{follow1,\,follow2}$. The SS shall transmit PDSCH with randomly selected precoding matrix from codebook (Table 5.2.2.2.1-6 in TS 38.214 [12]) every slot regardless of PMI reports from the UE. Note that each precoding matrix shall be selected in equal probabilities. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission to carry the PUSCH CSI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. Measure $t_{rnd1,\,rnd2}$ according to Annex G.3.3.

4. Calculate $\gamma = \frac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. If the ratio $\geq \gamma$ which is specified in table 6.3.3.1.3.5-1, then the test is pass.
   Otherwise, the test is fail.

6.3.3.1.3.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1.

6.3.3.1.3.4.3.1 Message exceptions for SA

Table 6.3.3.1.3.4.3.1-1: CSI-RS-ResourceMapping for NZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 5.4.2.5, Table 5.4.2.5-2			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	011110		
}			
nrofPorts	P16		
firstOFDMSymbolInTimeDomain	5		
cdm-Type	cdm4-FD2-TD2		
}			

Table 6.3.3.1.3.4.3.1-2: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], clause 5.4.2.5, Table 5.4.2.5-14			
Information Element	**Value/remark**	**Comment**	**Condition**
nrOfAntennaPorts CHOICE {			
moreThanTwo SEQUENCE {			
n1-n2 CHOICE {			
four-two-TypeI-SinglePanel-Restriction	FFFF FFFF FFFF FFFF		
}			
}			
}			
typeI-SinglePanel-ri-Restriction	00000010		

Table 6.3.3.1.3.4.3.1-3: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 5.4.2.5, Table 5.4.2.5-13			
Information Element	**Value/remark**	**Comment**	**Condition**
reportConfigType CHOICE {			
aperiodic SEQUENCE {			
reportSlotOffsetList	5		
}			
reportFreqConfiguration SEQUENCE {			
pmi-FormatIndicator	subbandPMI		
}			
}			

6.3.3.1.3.4.3.2 Message exceptions for NSA

Same as in clause 6.3.3.1.3.4.3.1.

6.3.3.1.3.5 Test requirement

Table 6.3.3.1.3.5-1: Test requirement

Parameter	Test 1
γ	2.99

6.3.3.1.4 4Rx FDD FR1 Single PMI with 32Tx Type1 - SinglePanel codebook for both SA and NSA

6.3.3.1.4.1 Test purpose

To test the accuracy of the Precoding Matrix Indicator (PMI) reporting such that the system throughput is maximized based on the precoders configured according to the UE reports.

6.3.3.1.4.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

6.3.3.1.4.3 Minimum conformance requirements

For the parameters specified in Table 6.3.3.1.4.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.1.4.3-2.

Table 6.3.3.1.4.3-1: Test parameters (dual-layer)

Parameter		Unit	Test 1
Bandwidth		MHz	10
Subcarrier spacing		kHz	15
Duplex Mode			FDD
Propagation channel			TDLA30-5
Antenna configuration			High XP 32 x 4 (N1,N2) = (4,4)
Beamforming Model			As specified in Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index in the PRB		Row 5, (4,-)

	used for CSI-RS (k_0, k_1)		
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(9,-)
	CSI-RS interval and offset	slot	Not configured
	ZP CSI-RS trigger		1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		32
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1, k_2, k_3)		Row 17, (2, 4, 6, 8)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(5, 12)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggeringOffset		0
CSI-IM configuration	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	8
csi-ReportingBand			1111111
CSI-Report interval and offset		slot	Not configured
Aperiodic Report Slot Offset			5
CSI request			1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
reportTriggerSize			1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
Codebook configuration	Codebook Type		typeI-SinglePanel
	Codebook Mode		1
	(CodebookConfig-N1,CodebookConfig-N2)		(4,4)
	(CodebookConfig-O1,CodebookConfig-O2)		(4,4)
	CodebookSubset Restriction		0x FFFF

	RI Restriction		00000010
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	8
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.1-6.3 FDD
PDSCH & PDSCH DMRS Precoding configuration for random Precoding			Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i_1, i_2 combination, and with Wideband granularity
Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable i_1, i_2 combination. Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-4), this reported PMI cannot be applied at the gNB downlink before slot#(n+4). Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.			

Table 6.3.3.1.4.3-2: Minimum requirement

Parameter	Test 1
γ	7.0

The normative reference for this requirement is TS 38.101-4 [5] clause 6.3.3.1.4.

6.3.3.1.4.4 Test description

6.3.3.1.4.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 and Table 5.3.6-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.10 for TE diagram and section A.3.2.2 for UE diagram.
2. The parameter settings for the cell are set up according to Table 6.1.2-1 and Table 6.3.3.1.4.3-1 and as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].
4. Propagation conditions are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR, Connected without release *On* for SA or (EN-DC, DC bearer *MCG* and *SCG, Connected without Release On)* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.3.3.1.4.4.3.

6.3.3.1.4.4.2 Test procedure

1. Set the parameters of bandwidth, the propagation condition, antenna configuration and measurement channel according to Table 6.3.3.1.4.3-1 as appropriate.

2. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC with precoding matrix according to PMI report from the UE. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission with an UL RMC for CP-OFDM QPSK with 5 RBs allocated according to A.2.2.6 of TS 38.521-1 [21] to carry the PUSCH CQI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. No transport block is sent in parallel to the CQI feedback. Establish $t_{ue,\,follow1,\,follow2}$ and $SNR_{follow1,\,follow2}$ according to Annex G.3.2.

3. Set SNR to $SNR_{follow1,\,follow2}$. The SS shall transmit PDSCH with randomly selected precoding matrix from codebook (Table 5.2.2.2.1-6 in TS 38.214 [12]) every slot regardless of PMI reports from the UE. Note that each precoding matrix shall be selected in equal probabilities. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission to carry the PUSCH CSI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. Measure $t_{rnd1,\,rnd2}$ according to Annex G.3.3.

4. Calculate $\gamma = \frac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. If the ratio $\geq \gamma$ which is specified in table 6.3.3.1.4.5-1, then the test is pass.
   Otherwise, the test is fail.

6.3.3.1.4.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1.

6.3.3.1.4.4.3.1 Message exceptions for SA

Table 6.3.3.1.4.4.3.1-1: CSI-RS-ResourceMapping for NZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 5.4.2.5, Table 5.4.2.5-2			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping:: = SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	011110		
}			
nrofPorts	P32		
firstOFDMSymbolInTimeDomain	5		
cdm-Type	cdm4-FD2-TD2		
}			

Table 6.3.3.1.4.4.3.1-2: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], clause 5.4.2.5, Table 5.4.2.5-14			
Information Element	**Value/remark**	**Comment**	**Condition**
nrOfAntennaPorts CHOICE {			
moreThanTwo SEQUENCE {			
n1-n2 CHOICE {			
four-four-TypeI-SinglePanel-Restriction	FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF		
}			
}			
}			
typeI-SinglePanel-ri-Restriction	00000010		

Table 6.3.3.1.4.4.3.1-3: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 5.4.2.5, Table 5.4.2.5-13			
Information Element	**Value/remark**	**Comment**	**Condition**
reportConfigType CHOICE {			
aperiodic SEQUENCE {			
reportSlotOffsetList	5		
}			
}			

6.3.3.1.4.4.3.2 Message exceptions for NSA

Same as in clause 6.3.3.1.4.4.3.1.

6.3.3.1.4.5 Test requirement

Table 6.3.3.1.4.5-1: Test requirement

Parameter	Test 1
γ	6.99

6.3.3.1.5 4Rx FDD FR1 Multiple PMI with 16Tx TypeII codebook for both SA and NSA

6.3.3.1.5.1 Test purpose

To test the accuracy of the Precoding Matrix Indicator (PMI) reporting such that the system throughput is maximized based on the precoders configured according to the UE reports.

6.3.3.1.5.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

6.3.3.1.5.3 Minimum conformance requirements

For the parameters specified in Table 6.3.3.1.5.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.1.5.3-2.

Table 6.3.3.1.5.3-1: Test parameters (dual-layer)

Parameter		Unit	Test 1
Bandwidth		MHz	10
Subcarrier spacing		kHz	15
Duplex Mode			FDD
Propagation channel			TDLA30-5
Antenna configuration			XP Medium 16 x 4 (N1,N2) = (4,2)
Beamforming Model			As specified in Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(9,-)

	CSI-RS interval and offset	slot	Not configured
	ZP CSI-RS trigger		1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		16
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1, k_2, k_3)		Row 12, (2, 4, 6, 8)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(5, -)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggeringOffset		0
CSI-IM configuration	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Subband
Sub-band Size		RB	8
csi-ReportingBand			1111111
CSI-Report interval and offset		slot	Not configured
Aperiodic Report Slot Offset			5
CSI request			1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
reportTriggerSize			1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
Codebook configuration	Codebook Type		typeII
	L (*numberOfBeams*)		2
	N_{PSK} (*phaseAlphabetSize*)		8
	subbandAmplitude		True
	(CodebookConfig-N1,CodebookConfig-N2)		(4,2)
	(CodebookConfig-O1,CodebookConfig-O2)		(4,4)
	CodebookSubsetRestriction		0x 7FF FFFF FFFF FFFF FFFF
	RI Restriction (typeII-RI-Restriction)		10

Physical channel for CSI report		PUSCH
CQI/RI/PMI delay	ms	8
Maximum number of HARQ transmission		4
Measurement channel		R.PDSCH.1-6.3 FDD
Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable i_1, i_2 combination. The random precoder generation shall follow 'typeI-SinglePanel' codebook configuration as specified in table 6.3.3.1.3-1.		
Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-4), this reported PMI cannot be applied at the gNB downlink before slot#(n+4).		
Note 3: Randomization of the dual-cluster beam directions shall be used as specified in Annex B.2.3.2.3A. The value of relative power ratio (p) shall be fixed as 1 during the test.		

Table 6.3.3.1.5.3-2: Minimum requirement

Parameter	Test 1
γ	1.9

The normative reference for this requirement is TS 38.101-4 [5] clause 6.3.3.1.5.

6.3.3.1.5.4 Test description

6.3.3.1.5.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 and Table 5.3.6-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.10 for TE diagram and section A.3.2.2 for UE diagram.
2. The parameter settings for the cell are set up according to Table 6.1.2-1 and Table 6.3.3.1.5.3-1 and as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].
4. Propagation conditions are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR, Connected without release *On* for SA or (EN-DC, DC bearer *MCG* and *SCG, Connected without Release On)* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.3.2.1.4.4.3.

6.3.3.1.5.4.2 Test procedure

1. Set the parameters of bandwidth, the propagation condition, antenna configuration and measurement channel according to Table 6.3.3.1.5.3-1 as appropriate.

2. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC with precoding matrix according to PMI report from the UE. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission to carry the PUSCH CQI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. Establish $t_{ue,\,follow1,\,follow2}$ and $SNR_{follow1,\,follow2}$ according to Annex G.3.2.

3. Set SNR to $SNR_{follow1,\,follow2}$. The SS shall transmit PDSCH with randomly selected precoding matrix from codebook (Table 5.2.2.2.1-6 in TS 38.214 [12]) every slot regardless of PMI reports from the UE. Note that each precoding matrix shall be selected in equal probabilities, and the random precoder generation shall follow the codebook configuration as specified in Table 6.3.3.1.3.3-1. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission with an UL RMC for CP-OFDM QPSK with 5 RBs allocated according to A.2.2.6 of TS 38.521-1 [21] to carry the PUSCH CSI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. No transport block is sent in parallel to the CQI feedback. Measure $t_{rnd1,\,rnd2}$ according to Annex G.3.3.

4. Calculate $\gamma = \frac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. If the ratio $\geq \gamma$ which is specified in table 6.3.3.1.5.5-1, then the test is pass. Otherwise, the test is fail.

6.3.3.1.5.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1.

6.3.3.1.5.4.3.1 Message exceptions for SA

Table 6.3.3.1.5.4.3.1-1: CSI-RS-ResourceMapping for NZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 5.4.2.5, Table 5.4.2.5-2			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	'011110'B		
}			
nrofPorts	P16		
firstOFDMSymbolInTimeDomain	5		
cdm-Type	cdm4-FD2-TD2		
}			

Table 6.3.3.1.5.4.3.1-2: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], clause 5.4.2.5, Table 5.4.2.5-14			
Information Element	**Value/remark**	**Comment**	**Condition**
CodebookConfig ::= SEQUENCE {			
codebookType CHOICE {			
type2 SEQUENCE {			
subType CHOICE {			
typeII SEQUENCE {			
n1-n2-codebookSubsetRestriction CHOICE {			
four-two	0x 7FF FFFF FFFF FFFF FFFF		
}			
typeII-RI-Restriction	'10'B		
}			
}			
phaseAlphabetSize	8		
subbandAmplitude	TRUE		
numberOfBeams	2		
}			
}			
}			

Table 6.3.3.1.5.4.3.1-3: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 5.4.2.5, Table 5.4.2.5-13			
Information Element	**Value/remark**	**Comment**	**Condition**
reportConfigType CHOICE {			
aperiodic SEQUENCE {			
reportSlotOffsetList	5		
}			
reportFreqConfiguration SEQUENCE {			
pmi-FormatIndicator	subbandPMI		
}			
}			

6.3.3.1.5.4.3.2 Message exceptions for NSA

Same as in clause 6.3.3.1.5.4.3.1.

6.3.3.1.5.5 Test requirement

Table 6.3.3.1.5.5-1: Test requirement

Parameter	Test 1
γ	1.89

6.3.3.1.6 4Rx FDD FR1 Multiple PMI with 16Tx Enhanced TypeII codebook for both SA and NSA

6.3.3.1.6.1 Test purpose

To test the accuracy of the Precoding Matrix Indicator (PMI) reporting such that the system throughput is maximized based on the precoders configured according to the UE reports.

6.3.3.1.6.2 Test applicability

This test applies to all types of NR UE release 16 and forward supporting Enhanced Type II codebook with at least 16 ports per CSI-RS resource.

This test also applies to all types of EUTRA UE release 16 and forward supporting EN-DC and Enhanced Type II codebook with at least 16 ports per CSI-RS resource.

6.3.3.1.6.3 Minimum conformance requirements

For the parameters specified in Table 6.3.3.1.6.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.1.6.3-2.

Table 6.3.3.1.6.3-1: Test parameters (dual-layer)

Parameter		Unit	Test 1
Bandwidth		MHz	10
Subcarrier spacing		kHz	15
Duplex Mode			FDD
Propagation channel			TDLA30-5
Antenna configuration			XP Medium 16 x 2 (N1,N2) = (4,2)
Beamforming Model			As specified in Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(9,-)
	CSI-RS interval and offset	slot	Not configured
	ZP CSI-RS trigger		1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		16
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1, k_2, k_3)		Row 12, (2, 4, 6, 8)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(5, -)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggeringOffset		0
CSI-IM configuration	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured

ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Not configured
Sub-band Size		RB	4
csi-ReportingBand			1111111
CSI-Report interval and offset		slot	Not configured
Aperiodic Report Slot Offset			5
CSI request			1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
reportTriggerSize			1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
Codebook configuration	Codebook Type		typeII-r16
	paramCombination-r16		6 (L =4, p_v =1/2, β=1/2)
	R*(numberOfPMISubbandsPerCQISubband-r16)*		1
	(CodebookConfig-N1,CodebookConfig-N2)		(4,2)
	(CodebookConfig-O1,CodebookConfig-O2)		(4,4)
	CodebookSubsetRestriction		0x 7FF FFFF FFFF FFFF FFFF
	RI Restriction (typeII-RI-Restriction-r16)		0010
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	8
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.1-6.3
Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable i_1, i_2 combination. The random precoder generation shall follow 'typeI-SinglePanel' codebook configuration as specified in table 6.3.3.1.3-1. Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-4), this reported PMI cannot be applied at the gNB downlink before slot#(n+4). Note 3: Randomization of the dual-cluster beam directions shall be used as specified in AnnexB.2.3.2.3A. The value of relative power ratio (p) shall be fixed as 1 during the test.			

Table 6.3.3.1.6.3-2: Minimum requirement

Parameter	Test 1
γ	2.2

The normative reference for this requirement is TS 38.101-4 [5], clause 6.3.3.1.6.

6.3.3.1.6.4 Test description

6.3.3.1.6.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 and Table 5.3.6-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.10 for TE diagram and section A.3.2.2 for UE diagram.
2. The parameter settings for the cell are set up according to Table 6.1.2-1 and Table 6.3.3.1.6.3-1 and as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].
4. Propagation conditions are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR, Connected without release *On* for SA or (EN-DC, DC bearer *MCG* and *SCG*, *Connected without Release On)* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.3.3.1.6.4.3.

6.3.3.1.6.4.2 Test procedure

1. Set the parameters of bandwidth, the propagation condition, antenna configuration and measurement channel according to Table 6.3.3.1.6.3-1 as appropriate.
2. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC with precoding matrix according to PMI report from the UE. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission with an UL RMC for CP-OFDM QPSK with 5 RBs allocated according to A.2.2.6 of TS 38.521-1 [21] to carry the PUSCH CQI feedback via PDCCH DCI format 0_1 with aperiodic CSI request triggered. No transport block is sent in parallel to the CQI feedback. Establish $t_{ue,\,follow1,\,follow2}$ and $SNR_{follow1,\,follow2}$ according to Annex G.3.2.
3. Set SNR to $SNR_{follow1,\,follow2}$. The SS shall transmit PDSCH with randomly selected precoding matrix from codebook (Table 5.2.2.2.1-6 in TS 38.214 [12]) every slot regardless of PMI reports from the UE. Note that each precoding matrix shall be selected in equal probabilities. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission to carry the PUSCH CSI feedback via PDCCH DCI format 0_1 with aperiodic CSI request triggered. Measure $t_{rnd1,\,rnd2}$ according to Annex G.3.3.
4. Calculate $\gamma = \frac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. If the ratio $\geq \gamma$ which is specified in table 6.3.3.1.6.5-1, then the test is pass. Otherwise, the test is fail.

6.3.3.1.6.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1.

6.3.3.1.6.4.3.1 Message exceptions for SA

Table 6.3.3.1.6.4.3.1-1: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 5.4.2.5, Table 5.4.2.5-13			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ReportConfig ::= SEQUENCE {			
reportFreqConfiguration SEQUENCE {			
pmi-FormatIndicator	subbandPMI		
}			
codebookConfig	Not present		
subbandSize	Value1		
codebookConfig-r16	CodebookConfig-r16		
}			

Table 6.3.3.1.6.4.3.1-2: *CodebookConfig-r16* (Table 6.3.3.1.6.4.3.1-1)

Derivation Path: TS 38.331 [6], clause 6.3.2			
Information Element	**Value/remark**	**Comment**	**Condition**
CodebookConfig-r16 ::= SEQUENCE {			
codebookType CHOICE {			
type2 SEQUENCE {			
subType CHOICE {			
typeII-r16 SEQUENCE {			
N1-n2-codebookSubsetRestriction-r16			
Four-two	0x 7FF FFFF FFFF FFFF FFFF		
}			
typeII-RI-Restriction-r16	0010		
}			
}			
numberOfPMI-SubbandsPerCQI-Subband-r16	1		
paramCombinatin-r16	6	(L =4, p_v =1/2, β=1/2)	
}			
}			
}			

6.3.3.1.6.4.3.2 Message exceptions for NSA

Same as in clause 6.3.3.1.6.4.3.1.

6.3.3.1.6.5 Test requirement

Table 6.3.3.1.6.5-1: Test requirement

Parameter	Test 1
γ	2.19

6.3.3.2 TDD

6.3.3.2.1 4Rx TDD FR1 Single PMI with 4TX TypeI-SinglePanel codebook for both SA and NSA

6.3.3.2.1.1 Test purpose

To test the accuracy of the Precoding Matrix Indicator (PMI) reporting such that the system throughput is maximized based on the precoders configured according to the UE reports.

6.3.3.2.1.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

6.3.3.2.1.3 Minimum conformance requirements

For the parameters specified in Table 6.3.3.2.1.3-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.2.1.3-2.

Table 6.3.3.2.1.3-1: Test parameters (single layer)

Parameter		Unit	Test 1
Bandwidth		MHz	40
Subcarrier spacing		kHz	30
Duplex Mode			TDD
TDD DL-UL configuration			FR1.30-1 as specified in Annex A
Propagation channel			TDLA30-5
Antenna configuration			High XP 4 x 4 (N1,N2) = (2,1)
Beamforming Model			As specified in Section Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (*X*)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(9,-)
	CSI-RS interval and offset	slot	10/1
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 4, (0,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(13,-)
	CSI-RS interval and offset		Not configured
	aperiodicTriggeringOffset		0
CSI-IM configuration	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Patten 0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	16
csi-ReportingBand			1111111
CSI-Report interval and offset		slot	Not configured

Aperiodic Report Slot Offset			8
CSI request			1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
reportTriggerSize			1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
Codebook configuration	Codebook Type		typeI-SinglePanel
	Codebook Mode		1
	(CodebookConfig-N1,CodebookConfig-N2)		(2,1)
	(CodebookConfig-O1,CodebookConfig-O2)		(4,1)
	CodebookSubset Restriction		11111111
	RI Restriction		00000001
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	5.5
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.2-8.1 TDD
PDSCH & PDSCH DMRS Precoding configuration for random Precoding			Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i_1, i_2 combination, and with Wideband granularity
Note 1: For random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity). Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#[(n-4)], this reported PMI cannot be applied at the eNB downlink before slot#[(n+4)]. Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3			

Table 6.3.3.2.1.3-2: Minimum requirement

Parameter	Test 1
γ	1.3

6.3.3.2.1.4 Test description

6.3.3.2.1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 and Table 5.3.6-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.1 for TE diagram and section A.3.2.2 for UE diagram.
2. The parameter settings for the cell are set up according to Table 6.1.2-1 and Table 6.3.3.2.1.3-1 and as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].
4. Propagation conditions are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR, Connected without release On for SA or (EN-DC, DC bearer MCG and SCG, Connected without Release On) for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.3.3.2.1.4.3.

6.3.3.2.1.4.2 Test procedure

1. Set the parameters of bandwidth, the propagation condition, antenna configuration and measurement channel according to Table 6.3.3.2.1.3-1 as appropriate.
2. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC with precoding matrix according to PMI report from the UE. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission with an UL RMC for CP-OFDM QPSK with 5 RBs allocated according to A.2.2.6 of TS 38.521-1 [21] to carry the PUSCH CQI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. No transport block is sent in parallel to the CQI feedback. Establish $t_{ue,\,follow1,\,follow2}$ and $SNR_{follow1,\,follow2}$ according to Annex G.3.2.
3. Set SNR to $SNR_{follow1,\,follow2}$. The SS shall transmit PDSCH with randomly selected precoding matrix from codebook (Table 5.2.2.2.1-5 in TS 38.214 [12]) every slot regardless of PMI reports from the UE. Note that each precoding matrix shall be selected in equal probabilities. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission to carry the PUSCH CSI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. Measure $t_{rnd1,\,rnd2}$ according to Annex G.3.3.
4. Calculate $\gamma = \frac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. If the ratio ≥ γ which is specified in table 6.3.3.1.1.5-1, then the test is pass. Otherwise, the test is fail.

6.3.3.2.1.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1.

6.3.3.2.1.4.3.1 Message exceptions for SA

Table 6.3.3.2.1.4.3.1-1: CSI-ResourceConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-41			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourceConfig ::= SEQUENCE {			
resourceType	Aperiodic		
}			

Table 6.3.3.2.1.4.3.1-2: CSI-RS-ResourceMapping for NZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause5.4.2, Table5.4.2.0-15			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
Row4	001		
}			
nrofPorts	p4		
firstOFDMSymbolInTimeDomain	13		
}			

Table 6.3.3.2.1.4.3.1-3: CSI-RS-ResourceMapping for ZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 5.4.2, Table5.4.2.0-21			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
Row5	000100		
}			
nrofPorts	p4		
firstOFDMSymbolInTimeDomain	9		
}			

Table 6.3.3.2.1.4.3.1-4: CSI-IM-Resource

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-34			
Information Element	**Value/remark**	**Comment**	**Condition**
csi-IM-ResourceElementPattern			
pattern0 SEQUENCE {			
subcarrierLocation-p0	s4		
symbolLocation-p0	9		
}			

Table 6.3.3.2.1.4.3.1-5: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-25			
Information Element	**Value/remark**	**Comment**	**Condition**
nrOfAntennaPorts CHOICE {			
moreThanTwo SEQUENCE {			
n1-n2 CHOICE {			
two-one-TypeI-SinglePanel-Restriction	11111111		
}			
}			
}			
typeI-SinglePanel-ri-Restriction	00000001		

Table 6.3.3.2.1.4.3.1-6: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-39			
Information Element	**Value/remark**	**Comment**	**Condition**
reportConfigType CHOICE {			
aperiodic SEQUENCE {			
reportSlotOffsetList	0		
}			
reportFreqConfiguration SEQUENCE {			
csi-ReportingBand CHOICE {			
subbands7	[1111111]		
}			
}			
subbandSize	value2		
}			

6.3.3.2.1.4.3.2 Message exception for NSA

Same as in 6.3.3.2.1.4.3.1.

6.3.3.2.1.5 Test requirement

Table 6.3.3.2.1.5-1: Test requirement

Parameter	Test 1
γ	1.29

6.3.3.2.2 4Rx TDD FR1 Single PMI with 8TX TypeI-SinglePanel codebook for both SA and NSA

6.3.3.2.2.1 Test purpose

To test the accuracy of the Precoding Matrix Indicator (PMI) reporting such that the system throughput is maximized based on the precoders configured according to the UE reports.

6.3.3.2.2.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

6.3.3.2.2.3 Minimum conformance requirements

For the parameters specified in Table 6.3.3.2.2.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.2.2.3-2.

Table 6.3.3.2.2.3-1: Test parameters (dual-layer)

Parameter		Unit	Test 1
Bandwidth		MHz	40
Subcarrier spacing		kHz	30
Duplex Mode			TDD
TDD DL-UL configurations			FR1.30-1 as specified in Annex A
Propagation channel			TDLA30-5
Antenna configuration			High XP 8 x 4 (N1,N2) = (4,1)
Beamforming Model			As specified in Section Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (*X*)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(9,-)
	CSI-RS interval and offset	slot	10/1
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		8
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 8, (4,6)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(5,-)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggeringOffset		0
CSI-IM configuration	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Patten 0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannnelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	16
csi-ReportingBand			1111111
CSI-Report interval and offset		slot	Not configured

Aperiodic Report Slot Offset			8
CSI request			1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
reportTriggerSize			1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
Codebook configuration	Codebook Type		typeI-SinglePanel
	Codebook Mode		1
	(CodebookConfig-N1,CodebookConfig-N2)		(4,1)
	(CodebookConfig-O1,CodebookConfig-O2)		(4,1)
	CodebookSubset Restriction		0x FFFF
	RI Restriction		00000010
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	6.5
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.2-8.2 TDD
PDSCH & PDSCH DMRS Precoding configuration for random Precoding			Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i_1, i_2 combination, and with Wideband granularity
Note 1: For random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity). Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#[(n-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 Annex B.2.3.2.3			

Table 6.3.3.2.2.3-2: Minimum requirement

Parameter	Test 1
γ	1.5

6.3.3.2.2.4 Test description

6.3.3.2.2.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 and Table 5.3.6-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7 for TE diagram and section A.3.2.2 for UE diagram.
2. The parameter settings for the cell are set up according to Table 6.2.1-2 and Table 6.3.3.2.2.3-1and as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].
4. Propagation conditions are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR, Connected without release *On* for SA or (EN-DC, DC bearer *MCG* and *SCG, Connected without Release On)* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.3.3.2.2.4.3.

6.3.3.2.2.4.2 Test procedure

1. Set the parameters of bandwidth, the propagation condition, antenna configuration and measurement channel according to Table 6.3.3.2.2.3-1 as appropriate.
2. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC with precoding matrix according to PMI report from the UE. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission with an UL RMC for CP-OFDM QPSK with 5 RBs allocated according to A.2.2.6 of TS 38.521-1 [21] to carry the PUSCH CQI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. No transport block is sent in parallel to the CQI feedback. Establish $t_{ue,\,follow1,\,follow2}$ and $SNR_{follow1,\,follow2}$ according to Annex G.3.2.
3. Set SNR to $SNR_{follow1,\,follow2}$. The SS shall transmit PDSCH with randomly selected precoding matrix from codebook (Table 5.2.2.2.1-5 in TS 38.214 [12]) every slot regardless of PMI reports from the UE. Note that each precoding matrix shall be selected in equal probabilities. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission to carry the PUSCH CSI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. Measure $t_{rnd1,\,rnd2}$ according to Annex G.3.3.
4. Calculate $\gamma = \frac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. If the ratio ≥ γ which is specified in table 6.3.3.2.2.5-1, then the test is pass. Otherwise, the test is fail.

6.3.3.2.2.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1.

6.3.3.2.2.4.3.1 Message contents for SA

Table 6.3.3.2.2.4.3.1-1: CSI-ResourceConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-41			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourceConfig ::= SEQUENCE {			
resourceType	Aperiodic		
}			

Table 6.3.3.2.2.4.3.1-2: CSI-RS-ResourceMapping for NZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause5.4.2, Table5.4.2.0-15			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	001100		
}			
nrofPorts	p8		
firstOFDMSymbolInTimeDomain	5		
cdm-Type	cdm4-FD2-TD2		
}			

Table 6.3.3.2.2.4.3.1-3: CSI-RS-ResourceMapping for ZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 5.4.2, Table5.4.2.0-21			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	000100		
}			
nrofPorts	p4		
firstOFDMSymbolInTimeDomain	9		
}			

Table 6.3.3.2.2.4.3.1-4: CSI-IM-Resource

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-34			
Information Element	**Value/remark**	**Comment**	**Condition**
csi-IM-ResourceElementPattern			
pattern0 SEQUENCE {			
subcarrierLocation-p0	s4		
symbolLocation-p0	9		
}			

Table 6.3.3.2.2.4.3.1-5: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-25			
Information Element	**Value/remark**	**Comment**	**Condition**
nrOfAntennaPorts CHOICE {			
moreThanTwo SEQUENCE {			
n1-n2 CHOICE {			
four-one-TypeI-SinglePanel-Restriction	FFFF		
}			
}			
}			
typeI-SinglePanel-ri-Restriction	00000010		

Table 6.3.3.2.2.4.3.1-6: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-39			
Information Element	**Value/remark**	**Comment**	**Condition**
reportConfigType CHOICE {			
aperiodic SEQUENCE {			
reportSlotOffsetList	8		
}			
reportFreqConfiguration SEQUENCE {			
csi-ReportingBand CHOICE {			
subbands7	1111111		
}			
}			
}			

6.3.3.2.2.4.3.2 Message contents for NSA

Same as in clause 6.3.3.2.2.4.3.1.

6.3.3.2.2.5 Test requirement

Table 6.3.3.2.2.5-1: Test requirement

Parameter	Test 1
γ	1.49

6.3.3.2.3 4Rx TDD FR1 Multiple PMI with 16Tx Type1 - SinglePanel codebook for both SA and NSA

6.3.3.2.3.1 Test purpose

To test the accuracy of the Precoding Matrix Indicator (PMI) reporting such that the system throughput is maximized based on the precoders configured according to the UE reports.

6.3.3.2.3.2 Test applicability

This test applies to all types of NR UE release 15 and forward supporting 4 Rx antenna ports.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC and 4 Rx antenna ports.

6.3.3.2.3.3 Minimum conformance requirements

For the parameters specified in Table 6.3.3.2.3.3-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.2.3.3-2.

Table 6.3.3.2.3.3-1: Test parameters (dual-layer)

Parameter		Unit	Test 1
Bandwidth		MHz	40
Subcarrier spacing		kHz	30
Duplex Mode			TDD
TDD DL-UL configurations			FR1.30-1 as specified in Annex A
Propagation channel			TDLC300-5
Antenna configuration			High XP 16 x 4 (N1,N2) = (4,2)
Beamforming Model			As specified in Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(9,-)
	CSI-RS interval and offset	slot	Not configured
	ZP CSI-RS trigger		1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		16
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1, k_2, k_3)		Row 12, (2, 4, 6, 8)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(5, -)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggeringOffset		0
CSI-IM configuration	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannnelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Subband
Sub-band Size		RB	16
csi-ReportingBand			1111111

CSI-Report interval and offset		slot	Not configured
Aperiodic Report Slot Offset			8
CSI request			1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
reportTriggerSize			1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
Codebook configuration	Codebook Type		typeI-SinglePanel
	Codebook Mode		1
	(CodebookConfig-N1,CodebookConfig-N2)		(4,2)
	(CodebookConfig-O1,CodebookConfig-O2)		(4,4)
	CodebookSubset Restriction		0x FFFF
	RI Restriction		00000010
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	6.5
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.2-8.3 TDD
Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable i_1, i_2 combination. Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-6), this reported PMI cannot be applied at the gNB downlink before slot#(n+6). Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.			

Table 6.3.3.2.3.3-2: Minimum requirement

Parameter	Test 1
γ	3.0

The normative reference for this requirement is TS 38.101-4 [5], clause 6.3.3.2.3.

6.3.3.2.3.4 Test description

6.3.3.2.3.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 and Table 5.3.6-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.10 for TE diagram and section A.3.2.5 for UE diagram.

2. The parameter settings for the cell are set up according to Table 6.2.1-2 and Table 6.3.3.2.3.3-1and as appropriate.

3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].

4. Propagation conditions are set according to Annex B.0.

5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR, Connected without release *On* for SA or (EN-DC, DC bearer *MCG* and *SCG, Connected without Release On)* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.3.3.2.3.4.3.

6.3.3.2.3.4.2 Test procedure

1. Set the parameters of bandwidth, the propagation condition, antenna configuration and measurement channel according to Table 6.3.3.2.3.3-1 as appropriate.

2. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC with precoding matrix according to PMI report from the UE. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission with an UL RMC for CP-OFDM QPSK with 5 RBs allocated according to A.2.2.6 of TS 38.521-1 [21] to carry the PUSCH CQI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. No transport block is sent in parallel to the CQI feedback. Establish $t_{ue,\,follow1,\,follow2}$ and $SNR_{follow1,\,follow2}$ according to Annex G.3.2.

3. Set SNR to $SNR_{follow1,\,follow2}$. The SS shall transmit PDSCH with randomly selected precoding matrix from codebook (Table 5.2.2.2.1-6 in TS 38.214 [12]) every slot regardless of PMI reports from the UE. Note that each precoding matrix shall be selected in equal probabilities. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission to carry the PUSCH CSI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. Measure $t_{rnd1,\,rnd2}$ according to Annex G.3.3.

4. Calculate $\gamma = \frac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. If the ratio ≥ γ which is specified in table 6.3.3.2.3.5-1, then the test is pass. Otherwise, the test is fail.

6.3.3.2.3.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1.

6.3.3.2.3.4.3.1 Message contents for SA

Table 6.3.3.2.3.4.3.1-1: CSI-ResourceConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-41			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourceConfig ::= SEQUENCE {			
resourceType	Aperiodic		
}			

Table 6.3.3.2.3.4.3.1-2: CSI-RS-ResourceMapping for NZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause5.4.2, Table 5.4.2.0-15			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	011110		
}			
nrofPorts	p16		
firstOFDMSymbolInTimeDomain	5		
cdm-Type	cdm4-FD2-TD2		
}			

Table 6.3.3.2.3.4.3.1-3: CSI-RS-ResourceMapping for ZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 5.4.2, Table 5.4.2.0-21			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	000100		
}			
nrofPorts	p4		
firstOFDMSymbolInTimeDomain	9		
}			

Table 6.3.3.2.3.4.3.1-4: CSI-IM-Resource

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-34			
Information Element	**Value/remark**	**Comment**	**Condition**
csi-IM-ResourceElementPattern			
pattern0 SEQUENCE {			
subcarrierLocation-p0	s4		
symbolLocation-p0	9		
}			

Table 6.3.3.2.3.4.3.1-5: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-25			
Information Element	**Value/remark**	**Comment**	**Condition**
nrOfAntennaPorts CHOICE {			
moreThanTwo SEQUENCE {			
n1-n2 CHOICE {			
four-two-TypeI-SinglePanel-Restriction	FFFF FFFF FFFF FFFF		
}			
}			
}			
typeI-SinglePanel-ri-Restriction	00000010		

Table 6.3.3.2.3.4.3.1-6: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-39			
Information Element	**Value/remark**	**Comment**	**Condition**
reportConfigType CHOICE {			
aperiodic SEQUENCE {			
reportSlotOffsetList	8		
}			
reportFreqConfiguration SEQUENCE {			
pmi-FormatIndicator	subbandPMI		
csi-ReportingBand CHOICE {			
subbands7	1111111		
}			
}			
}			

6.3.3.2.3.4.3.2 Message contents for NSA

Same as in clause 6.3.3.2.3.4.3.1.

6.3.3.2.3.5 Test requirement

Table 6.3.3.2.3.5-1: Test requirement

Parameter	Test 1
γ	2.99

6.3.3.2.4 4Rx TDD FR1 Single PMI with 32Tx Type1 - SinglePanel codebook for both SA and NSA

6.3.3.2.4.1 Test purpose

To test the accuracy of the Precoding Matrix Indicator (PMI) reporting such that the system throughput is maximized based on the precoders configured according to the UE reports.

6.3.3.2.4.2 Test applicability

This test applies to all types of NR UE release 15 and forward supporting 4 Rx antenna ports.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC and 4 Rx antenna ports.

6.3.3.2.4.3 Minimum conformance requirements

For the parameters specified in Table 6.3.3.2.4.3-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.2.4.3-2.

Table 6.3.3.2.4.3-1: Test parameters (dual-layer)

Parameter		Unit	Test 1
Bandwidth		MHz	40
Subcarrier spacing		kHz	30
Duplex Mode			TDD
TDD DL-UL configurations			FR1.30-1 as specified in Annex A
Propagation channel			TDLA30-5
Antenna configuration			High XP 32 x 4 (N1,N2) = (4,4)
Beamforming Model			As specified in Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(9,-)
	CSI-RS interval and offset	slot	Not configured
	ZP CSI-RS trigger		1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		32
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1, k_2, k_3)		Row 17, (2, 4, 6, 8)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(5, 12)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggeringOffset		0
CSI-IM configuration	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured

ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannnelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	16
csi-ReportingBand			1111111
CSI-Report interval and offset		slot	Not configured
Aperiodic Report Slot Offset			8
CSI request			1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
reportTriggerSize			1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
Codebook configuration	Codebook Type		typeI-SinglePanel
	Codebook Mode		1
	(CodebookConfig-N1,CodebookConfig-N2)		(4,4)
	(CodebookConfig-O1,CodebookConfig-O2)		(4,4)
	CodebookSubset Restriction		0x FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF
	RI Restriction		00000010
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	6.5
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.2-8.3 TDD
PDSCH & PDSCH DMRS Precoding configuration for random Precoding			Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i_1, i_2 combination, and with Wideband granularity

Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable i_1, i_2 combination.

Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-6), this reported PMI cannot be applied at the gNB downlink before slot#(n+6).

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

Table 6.3.3.2.4.3-2: Minimum requirement

Parameter	Test 1
γ	7.0

The normative reference for this requirement is TS 38.101-4 [5], clause 6.3.3.2.4.

6.3.3.2.4.4 Test description

6.3.3.2.4.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 and Table 5.3.6-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 4.3.1.1.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.10 for TE diagram and section A.3.2.5 for UE diagram.
2. The parameter settings for the cell are set up according to Table 6.2.1-2 and Table 6.3.3.2.4.3-1and as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].
4. Propagation conditions are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR, Connected without release *On* for SA or (EN-DC, DC bearer *MCG* and *SCG, Connected without Release On)* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.3.3.2.4.4.3.

6.3.3.2.4.4.2 Test procedure

1. Set the parameters of bandwidth, the propagation condition, antenna configuration and measurement channel according to Table 6.3.3.2.4.3-1 as appropriate.
2. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC with precoding matrix according to PMI report from the UE. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission to carry the PUSCH CQI feedback via PDCCH DCI format 0_1 with aperiodic CSI request triggered. Establish $t_{ue,\,follow1,\,follow2}$ and $SNR_{follow1,\,follow2}$ according to Annex G.3.2.
3. Set SNR to $SNR_{follow1,\,follow2}$. The SS shall transmit PDSCH with randomly selected precoding matrix from codebook (Table 5.2.2.2.1-6 in TS 38.214 [12]) every slot regardless of PMI reports from the UE. Note that each precoding matrix shall be selected in equal probabilities. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission to carry the PUSCH CSI feedback via PDCCH DCI format 0_1 with aperiodic CSI request triggered. Measure $t_{rnd1,\,rnd2}$ according to Annex G.3.3.
4. Calculate $\gamma = \frac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. If the ratio ≥ γ which is specified in table 6.3.3.2.4.5-1, then the test is pass. Otherwise, the test is fail.

6.3.3.2.4.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1.

6.3.3.2.4.4.3.1 Message contents for SA

Table 6.3.3.2.4.4.3.1-1: CSI-ResourceConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-41			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourceConfig ::= SEQUENCE {			
resourceType	Aperiodic		
}			

Table 6.3.3.2.4.4.3.1-2: CSI-RS-ResourceMapping for NZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause5.4.2, Table 5.4.2.0-15			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	011110		
}			
nrofPorts	p32		
firstOFDMSymbolInTimeDomain	5		
cdm-Type	cdm4-FD2-TD2		
}			

Table 6.3.3.2.4.4.3.1-3: CSI-RS-ResourceMapping for ZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 5.4.2, Table 5.4.2.0-21			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	000100		
}			
nrofPorts	p4		
firstOFDMSymbolInTimeDomain	9		
}			

Table 6.3.3.2.4.4.3.1-4: CSI-IM-Resource

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-34			
Information Element	**Value/remark**	**Comment**	**Condition**
csi-IM-ResourceElementPattern			
pattern0 SEQUENCE {			
subcarrierLocation-p0	s4		
symbolLocation-p0	9		
}			

Table 6.3.3.2.4.4.3.1-5: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-25			
Information Element	**Value/remark**	**Comment**	**Condition**
nrOfAntennaPorts CHOICE {			
moreThanTwo SEQUENCE {			
n1-n2 CHOICE {			
four-four-TypeI-SinglePanel-Restriction	FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF		
}			
}			
}			
typeI-SinglePanel-ri-Restriction	00000010		

Table 6.3.3.2.4.4.3.1-6: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-39			
Information Element	**Value/remark**	**Comment**	**Condition**
reportConfigType CHOICE {			
aperiodic SEQUENCE {			
reportSlotOffsetList	8		
}			
reportFreqConfiguration SEQUENCE {			
pmi-FormatIndicator	subbandPMI		
csi-ReportingBand CHOICE {			
subbands7	1111111		
}			
}			
}			

6.3.3.2.4.4.3.2 Message contents for NSA

Same as in clause 6.3.3.2.4.4.3.1.

6.3.3.2.4.5 Test requirement

Table 6.3.3.2.4.5-1: Test requirement

Parameter	Test 1
γ	6.99

6.3.3.2.5 4Rx TDD FR1 Multiple PMI with 16Tx TypeII codebook for both SA and NSA

6.3.3.2.5.1 Test purpose

To test the accuracy of the Precoding Matrix Indicator (PMI) reporting such that the system throughput is maximized based on the precoders configured according to the UE reports.

6.3.3.2.5.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

6.3.3.2.5.3 Minimum conformance requirements

For the parameters specified in Table 6.3.3.2.5.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.2.5.3-2.

Table 6.3.3.2.5.3-1: Test parameters (dual-layer)

Parameter		Unit	Test 1
Bandwidth		MHz	40
Subcarrier spacing		kHz	30
Duplex Mode			TDD
TDD DL-UL configurations			FR1.30-1 as specified in Annex A
Propagation channel			TDLA30-5
Antenna configuration			XP Medium 16 x 4 (N1,N2) = (4,2)
Beamforming Model			As specified in Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		4

	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(9,-)
	CSI-RS interval and offset	slot	Not configured
	ZP CSI-RS trigger		1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		16
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1, k_2, k_3)		Row 12, (2, 4, 6, 8)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(5, -)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggeringOffset		0
CSI-IM configuration	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured
ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForIChannelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Subband
Sub-band Size		RB	16
csi-ReportingBand			1111111
CSI-Report interval and offset		slot	Not configured
Aperiodic Report Slot Offset			8
CSI request			1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
reportTriggerSize			1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
Codebook configuration	Codebook Type		typeII
	L (*numberOfBeams*)		2
	N_{PSK} (*phaseAlphabetSize*)		8
	subbandAmplitude		True
	(CodebookConfig-N1,CodebookConfig-N2)		(4,2)
	(CodebookConfig-O1,CodebookConfig-O2)		(4,4)
	CodebookSubsetRestri		0x 7FF

	ction		FFFF FFFF FFFF FFFF
	RI Restriction (typeII-RI-Restriction)		10
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	6.5
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.2-8.3 TDD
Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable i_1, i_2 combination. The random precoder generation shall follow 'typeI-SinglePanel' codebook configuration as specified in table 6.3.3.2.3-1. Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-6), this reported PMI cannot be applied at the gNB downlink before slot#(n+6). Note 3: Randomization of the dual-cluster beam directions shall be used as specified in Annex B.2.3.2.3A. The value of relative power ratio (p) shall be fixed as 1 during the test.			

Table 6.3.3.2.5.3-2: Minimum requirement

Parameter	Test 1
γ	1.8

The normative reference for this requirement is TS 38.101-4 [5] clause 6.3.3.2.5.

6.3.3.2.5.4 Test description

6.3.3.2.5.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 and Table 5.3.6-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.10 for TE diagram and section A.3.2.2 for UE diagram.
2. The parameter settings for the cell are set up according to Table 6.1.2-1 and Table 6.3.3.2.5.3-1 and as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].
4. Propagation conditions are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR, Connected without release *On* for SA or (EN-DC, DC bearer *MCG* and *SCG, Connected without Release On)* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.3.2.1.4.4.3.

6.3.3.2.5.4.2 Test procedure

1. Set the parameters of bandwidth, the propagation condition, antenna configuration and measurement channel according to Table 6.3.3.2.5.3-1 as appropriate.

2. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC with precoding matrix according to PMI report from the UE. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission with an UL RMC for CP-OFDM QPSK with 5 RBs allocated according to A.2.2.6 of TS 38.521-1 [21] to carry the PUSCH CQI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. No transport block is sent in parallel to the CQI feedback. Establish $t_{ue,\,follow1,\,follow2}$ and $SNR_{follow1,\,follow2}$ according to Annex G.3.2.

3. Set SNR to $SNR_{follow1,\,follow2}$. The SS shall transmit PDSCH with randomly selected precoding matrix from codebook (Table 5.2.2.2.1-6 in TS 38.214 [12]) every slot regardless of PMI reports from the UE. Note that each precoding matrix shall be selected in equal probabilities, and the random precoder generation shall follow the codebook configuration as specified in Table 6.3.3.2.3.3-1. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission to carry the PUSCH CSI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. Measure $t_{rnd1,\,rnd2}$ according to Annex G.3.3.

4. Calculate $\gamma = \frac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. If the ratio $\geq \gamma$ which is specified in table 6.3.3.2.5.5-1, then the test is pass. Otherwise, the test is fail.

6.3.3.2.5.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1.

6.3.3.2.5.4.3.1 Message exceptions for SA

Table 6.3.3.2.5.4.3.1-1: CSI-RS-ResourceMapping for NZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 5.4.2.5, Table 5.4.2.5-2			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	'011110'B		
}			
nrofPorts	P16		
firstOFDMSymbolInTimeDomain	5		
cdm-Type	cdm4-FD2-TD2		
}			

Table 6.3.3.2.5.4.3.1-2: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], clause 5.4.2.5, Table 5.4.2.5-14			
Information Element	**Value/remark**	**Comment**	**Condition**
CodebookConfig ::= SEQUENCE {			
codebookType CHOICE {			
type2 SEQUENCE {			
subType CHOICE {			
typeII SEQUENCE {			
n1-n2-codebookSubsetRestriction CHOICE {			
four-two	0x 7FF FFFF FFFF FFFF FFFF		
}			
typeII-RI-Restriction	'10'B		
}			
}			
phaseAlphabetSize	8		
subbandAmplitude	TRUE		
numberOfBeams	2		
}			
}			
}			

Table 6.3.3.2.5.4.3.1-3: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 5.4.2.5, Table 5.4.2.5-13			
Information Element	**Value/remark**	**Comment**	**Condition**
reportConfigType CHOICE {			
aperiodic SEQUENCE {			
reportSlotOffsetList	5		
}			
reportFreqConfiguration SEQUENCE {			
pmi-FormatIndicator	subbandPMI		
}			
}			

6.3.3.2.5.4.3.2 Message exceptions for NSA

Same as in clause 6.3.3.2.5.4.3.1.

6.3.3.2.5.5 Test requirement

Table 6.3.3.2.5.5-1: Test requirement

Parameter	Test 1
γ	1.79

6.3.3.2.6 4Rx TDD FR1 Multiple PMI with 16Tx Enhanced TypeII codebook for both SA and NSA

6.3.3.2.6.1 Test purpose

To test the accuracy of the Precoding Matrix Indicator (PMI) reporting such that the system throughput is maximized based on the precoders configured according to the UE reports.

6.3.3.2.6.2 Test applicability

This test applies to all types of NR UE release 16 and forward supporting Enhanced Type II codebook with at least 16 ports per CSI-RS resource.

This test also applies to all types of EUTRA UE release 16 and forward supporting EN-DC and Enhanced Type II codebook with at least 16 ports per CSI-RS resource.

6.3.3.2.6.3 Minimum conformance requirements

For the parameters specified in Table 6.3.3.2.6.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.2.6.3-2.

Table 6.3.3.2.6.3-1: Test parameters (dual-layer)

Parameter		Unit	Test 1
Bandwidth		MHz	40
Subcarrier spacing		kHz	30
Duplex Mode			TDD
TDD DL-UL configurations			FR1.30-1 as specified in Annex A
Propagation channel			TDLA30-5
Antenna configuration			XP Medium 16 x 2 (N1,N2) = (4,2)
Beamforming Model			As specified in Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(9,-)
	CSI-RS interval and offset	slot	Not configured
	ZP CSI-RS trigger		1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Aperiodic
	Number of CSI-RS ports (*X*)		16
	CDM Type		CDM4 (FD2, TD2)
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1, k_2, k_3)		Row 12, (2, 4, 6, 8)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(5, -)
	CSI-RS interval and offset	slot	Not configured
	aperiodicTriggeringOffset		0
CSI-IM configuration	CSI-IM resource Type		Aperiodic
	CSI-IM RE pattern		Pattern 0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4,9)
	CSI-IM timeConfig interval and offset	slot	Not configured

ReportConfigType			Aperiodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForIChannelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Not configured
Sub-band Size		RB	8
csi-ReportingBand			1111111
CSI-Report interval and offset		slot	Not configured
Aperiodic Report Slot Offset			8
CSI request			1 in slots i, where mod(i, 10) = 1, otherwise it is equal to 0
reportTriggerSize			1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
Codebook configuration	Codebook Type		typeII-r16
	paramCombination-r16		6 (L =4, p_v =1/2, β=1/2)
	R*(numberOfPMISubbandsPerCQISubband-r16)*		1
	(CodebookConfig-N1,CodebookConfig-N2)		(4,2)
	(CodebookConfig-O1,CodebookConfig-O2)		(4,4)
	CodebookSubsetRestriction		0x 7FF FFFF FFFF FFFF FFFF
	RI Restriction (typeII-RI-Restriction-r16)		0010
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	6.5
Maximum number of HARQ transmission			4
Measurement channel			R.PDSCH.2-8.3 TDD
Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable i_1, i_2 combination. The random precoder generation shall follow 'typeI-SinglePanel' codebook configuration as specified in table 6.3.3.2.3-1. Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-6), this reported PMI cannot be applied at the gNB downlink before slot#(n+6). Note 3: Randomization of the dual-cluster beam directions shall be used as specified in Annex B.2.3.2.3A. The value of relative power ratio (p) shall be fixed as 1 during the test.			

Table 6.3.3.2.6.3-2: Minimum requirement

Parameter	Test 1
γ	2.2

The normative reference for this requirement is TS 38.101-4 [5], clause 6.3.3.2.6.

6.3.3.2.6.4 Test description

6.3.3.2.6.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 and Table 5.3.6-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.10 for TE diagram and section A.3.2.2 for UE diagram.
2. The parameter settings for the cell are set up according to Table 6.1.2-1 and Table 6.3.3.2.6.3-1 as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].
4. Propagation conditions are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR, Connected without release *On* for SA or (EN-DC, DC bearer *MCG* and *SCG*, *Connected without Release On)* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 6.3.3.2.6.4.3.

6.3.3.2.6.4.2 Test procedure

1. Set the parameters of bandwidth, the propagation condition, antenna configuration and measurement channel according to Table 6.3.3.2.6.3-1 as appropriate.
2. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC with precoding matrix according to PMI report from the UE. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission with an UL RMC for CP-OFDM QPSK with 5 RBs allocated according to A.2.2.6 of TS 38.521-1 [21] to carry the PUSCH CQI feedback via PDCCH DCI format 0_1 with aperiodic CSI request triggered. No transport block is sent in parallel to the CQI feedback. Establish $t_{ue,\,follow1,\,follow2}$ and $SNR_{follow1,\,follow2}$ according to Annex G.3.2.
3. Set SNR to $SNR_{follow1,\,follow2}$. The SS shall transmit PDSCH with randomly selected precoding matrix from codebook (Table 5.2.2.2.1-6 in TS 38.214 [12]) every slot regardless of PMI reports from the UE. Note that each precoding matrix shall be selected in equal probabilities. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission to carry the PUSCH CSI feedback via PDCCH DCI format 0_1 with aperiodic CSI request triggered. Measure $t_{rnd1,\,rnd2}$ according to Annex G.3.3.
4. Calculate $\gamma = \frac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. If the ratio $\geq \gamma$ which is specified in table 6.3.3.2.6.5-1, then the test is pass.
   Otherwise, the test is fail.

6.3.3.2.6.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 5.4.2.

6.3.3.2.6.4.3.1 Message exceptions for SA

Table 6.3.3.2.6.4.3.1-1: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 5.4.2.5, Table 5.4.2.5-13			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ReportConfig ::= SEQUENCE {			
reportFreqConfiguration SEQUENCE {			
pmi-FormatIndicator	Not present		
}			
codebookConfig	Not present		
subbandSize	Value1		
codebookConfig-r16	CodebookConfig-r16		
}			

Table 6.3.3.2.6.4.3.1-2: *CodebookConfig-r16* (Table 6.3.3.2.6.4.3.1-1)

Derivation Path: TS 38.331 [6], clause 6.3.2			
Information Element	**Value/remark**	**Comment**	**Condition**
CodebookConfig-r16 ::= SEQUENCE {			
codebookType CHOICE {			
type2 SEQUENCE {			
subType CHOICE {			
typeII-r16 SEQUENCE {			
N1-n2-codebookSubsetRestriction-r16			
Four-two	0x 7FF FFFF FFFF FFFF FFFF		
}			
typeII-RI-Restriction-r16	0010		
}			
}			
numberOfPMI-SubbandsPerCQI-Subband-r16	1		
paramCombinatin-r16	6	(L =4, p_v =1/2, β=1/2)	
}			
}			
}			

6.3.3.2.6.4.3.2 Message exceptions for NSA

Same as in clause 6.3.3.2.6.4.3.1.

6.3.3.2.6.5 Test requirement

Table 6.3.3.2.6.5-1: Test requirement

Parameter	Test 1
γ	2.19

6.4 Reporting of Rank Indicator (RI)

6.4.1 1RX requirements (Void)

6.4.2 2RX requirements

6.4.2.1 FDD

6.4.2.1_1 2Rx FDD FR1 RI reporting for both SA and NSA

6.4.2.1_1.1 Test Purpose

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.

6.4.2.1_1.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

6.4.2.1_1.3 Minimum Conformance Requirements

The minimum performance requirement in Table 6.4.2.1_1.3-2 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_1.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.4.2.1_1.3-2.

Table 6.4.2.1_1.3-1: RI Test (FDD)

Parameter		Unit	Test 1	Test 2	Test 3
Bandwidth		MHz	10	10	10
Subcarrier spacing		kHz	15	15	15
Duplex Mode			FDD	FDD	FDD
SNR		dB	0	20	20
Propagation channel			TDLA30-5	TDLA30-5	TDLA30-5
Antenna configuration			ULA Low 2x2	ULA Low 2x2	ULA High 2x2
Beamforming Model			As defined in Annex B.4.1	As defined in Annex B.4.1	As defined in Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Periodic	Periodic	Periodic
	Number of CSI-RS ports (*X*)		4	4	4
	CDM Type		FD-CDM2	FD-CDM2	FD-CDM2
	Density (ρ)		1	1	1
	First subcarrier index in the PRB used for CSI-RS (k_0)		Row 5,(4)	Row (5,4)	Row 5,(4)
	First OFDM symbol in the PRB used for CSI-RS (l_0)		(9)	(9)	(9)
	CSI-RS periodicity and offset	slot	5/1	5/1	5/1
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Periodic	Periodic	Periodic
	Number of CSI-RS ports (*X*)		2	2	2
	CDM Type		FD-CDM2	FD-CDM2	FD-CDM2
	Density (ρ)		1	1	1
	First subcarrier index in the		Row 3 (6)	Row 3 (6)	Row 3 (6)

	PRB used for CSI-RS (k_0)				
	First OFDM symbol in the PRB used for CSI-RS (l_0)		(13)	(13)	(13)
	NZP CSI-RS-timeConfig periodicity and offset	slot	5/1	5/1	5/1
CSI-IM configuration	CSI-IM resource Type		Periodic	Periodic	Periodic
	CSI-IM RE pattern		Pattern 0	Pattern 0	Pattern 0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4,9)	(4,9)	(4,9)
	CSI-IM timeConfig periodicity and offset	slot	5/1	5/1	5/1
ReportConfigType			Periodic	Periodic	Periodic
CQI-table			Table 2	Table 2	Table 2
reportQuantity			cri-RI-PMI-CQI	cri-RI-PMI-CQI	cri-RI-PMI-CQI
timeRestrictionForChannelMeasurements			not configured	not configured	not configured
timeRestrictionForInterferenceMeasurements			not configured	not configured	not configured
cqi-FormatIndicator			Wideband	Wideband	Wideband
pmi-FormatIndicator			Wideband	Wideband	Wideband
Sub-band Size		RB	8	8	8
csi-ReportingBand			1111111	1111111	1111111
CSI-Report periodicity and offset		slot	5/0	5/0	5/0
Codebook configuration	Codebook Type		typeI-SinglePanel	typeI-SinglePanel	typeI-SinglePanel
	Codebook Mode		1	1	1
	(CodebookConfig-N1,CodebookConfig-N2)		N/A	N/A	N/A
	CodebookSubsetRestriction		010000 for fixed rank 2, 010011 for following rank	000011 for fixed rank 1, 010011 for following rank	000011 for fixed rank 1, 010011 for following rank
	RI Restriction		N/A	N/A	N/A
Physical channel for CSI report			PUCCH	PUCCH	PUCCH
CQI/RI/PMI delay		ms	8	8	8
Maximum number of HARQ transmission			1	1	1
RI Configuration			Fixed RI = 2 and follow RI	Fixed RI = 1 and follow RI	Fixed RI = 1 and follow RI
Note 1: Measurements channels are specified in Table A.4-2. TBS.2-1 is used for Rank 1 case. TBS.2-2 is used for Rank 2 case.					

Table 6.4.2.1_1.3-2: Minimum requirement (FDD)

	Test 1	Test 2	Test 3
γ_1	N/A	1.05	0.9
γ_2	1.0	N/A	N/A

The normative reference for this requirement is TS 38.101-4 [2] clause 6.4.2.1.

6.4.2.1_1.4 Test Description

6.4.2.1_1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state. The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex D.

Test Environment: Normal as defined in TS 38.508 [6] clause 4.1.

Frequencies to be tested: Mid Range as defined in TS 38.508 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.1 for TE diagram and section A.3.2.3 for UE diagram.
2. The parameter settings for the cell are set up according to Table 6.1.2-1 and Table 6.4.2.1_1.3-1 as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].
4. Propagation conditions for the NR cell are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR, *Connected without release On* and Test Mode ON for SA or EN-DC, DC bearer *MCG* and *SCG*, *Connected without release On* and Test Mode ON for NSA according to TS 38.508-1 [6] clause 4.5. Message contents are defined in clause 6.4.2.1_1.4.3.

6.4.2.1_1.4.2 Test procedure

1. Set the parameters of bandwidth, reference channel, the propagation condition, antenna configuration, antenna correlation, Codebook configuration, Beamforming Model, RI configuration and SNR according to Table 6.4.2.1_1.3-1 as appropriate.
2. The SS shall send PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to the UE reported CQI (wideband CQI), PMI and fixed RI as defined in Table 6.4.2.1_1.3-1. The SS sends downlink MAC padding bits on the DL RMC. Measure the t_{fix} according to Annex G.3. 3.
3. Propagation conditions are set according to Annex B.2.
4. The SS shall transmit an RRC Connection Reconfiguration message to set codebookSubsetRestriction as for UE reported RI according to Table 6.4.2.1_1.3-1.
5. The UE shall transmit RRC Connection Reconfiguration Complete message.
6. Propagation conditions are set according to Table 6.4.2.1_1.3-1.
7. The SS shall send PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to the UE reported CQI (wideband CQI), PMI and RI. The SS sends downlink MAC padding bits on the DL RMC. Measure $t_{reported}$ according to Annex G.3.3.

   If the ratio ($t_{reported}$ / t_{fix}) satisfies the requirement in Table 6.4.2.1_1.5-1, then pass the UE for this test and go to step 8. Otherwise, declare a FAIL verdict.
8. If all tests have not been done, then repeat the same procedure (steps 1 to 7) with test conditions according to the Table 6. 4.2. 1_1.3-2 for the other Tests as appropriate. Otherwise, declare a PASS verdict.

6.4.2.1_1.4.3 Message Contents

6.4.2.1_1.4.3.1 Message exceptions for SA

Table 6.4.2.1_1.4.3.1-1: CSI-ResourceConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-41			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourceConfig ::= SEQUENCE {			
resourceType	periodic		
}			

Table 6.4.2.1_1.4.3.1-2: CSI-RS-ResourceMapping for NZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-45			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	001000	row3, k_0=6	
}			
nrofPorts	p2		
firstOFDMSymbolInTimeDomain	13		
}			

Table 6.4.2.1_1.4.3.1-3: CSI-RS-ResourceMapping for ZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-45			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	000100	row5, k_0=4	
}			
nrofPorts	p4		
firstOFDMSymbolInTimeDomain	9		
}			

Table 6.4.2.1_1.4.3.1-4: CSI-IM-Resource

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-34			
Information Element	**Value/remark**	**Comment**	**Condition**
csi-IM-ResourceElementPattern			
pattern0 SEQUENCE {			
subcarrierLocation-p0	s4		
symbolLocation-p0	9		
}			
periodicityAndOffset	CSI-ResourcePeriodicityAndOffset		

Table 6.4.2.1_1.4.3.1-5: *CSI-ResourcePeriodicityAndOffset*

Derivation Path: TS 38.508-1 [6], clause 4.6.2, Table 4.6.3-43			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourcePeriodicityAndOffset CHOICE {			
Slots5	1		
}			

Table 6.4.2.1_1.4.3.1-6: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], clause 4.6.2, Table 4.6.3-25			
Information Element	**Value/remark**	**Comment**	**Condition**
nrOfAntennaPorts CHOICE {			
Two SEQUENCE {			
twoTX-CodebookSubsetRestriction	010000	Fixed rank 2	
	000011	Fixed rank 1	
	010011	Following rank	
}			
}			
}			
typeI-SinglePanel-ri-Restriction	11111111	Non restriction	

Table 6.4.2.1_1.4.3.1-7: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-39			
Information Element	**Value/remark**	**Comment**	**Condition**
reportConfigType CHOICE {			
periodic SEQUENCE {			
reportSlotConfig CHOICE {	slots5		
slots5	0		
}			
pucch-CSI-ResourceList	9	PUCCH format Id=9	
}			
reportFreqConfiguration SEQUENCE {			
csi-ReportingBand CHOICE {			
subbands7	1111111		
}			
}			
}			

6.4.2.1_1.4.3.2 Message exceptions for NSA

Same as in clause 6.4.2.1_1.4.3.1.

6.4.2.1_1.5 Test Requirements

Table 6.4.2.1_1.5-1: Test Requirement (FDD)

	Test 1	**Test 2**	**Test 3**
γ_1	N/A	1.04	0.89
γ_2	0.99	N/A	N/A

6.4.2.2 TDD

6.4.2.2_1 2Rx TDD FR1 RI reporting for both SA and NSA

6.4.2.2_1.1 Test Purpose

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.

6.4.2.2_1.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

6.4.2.2_1.3 Minimum Conformance Requirements

The minimum performance requirement in Table 6.4.2.2_1.3-2 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_1.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.4.2.2_1.3-2.

Table 6.4.2.2_1.3-1: RI Test (TDD)

Parameter		Unit	Test 1	Test 2	Test 3
Bandwidth		MHz	40	40	40
Subcarrier spacing		kHz	30	30	30
Duplex Mode			TDD	TDD	TDD
TDD Slot Configuration			FR1.30-1	FR1.30-1	FR1.30-1
SNR		dB	0	20	20
Propagation channel			TDLA30-5	TDLA30-5	TDLA30-5
Antenna configuration			ULA Low 2x2	ULA Low 2x2	ULA High 2x2
Beamforming Model			As defined in Annex B.4.1	As defined in Annex B.4.1	As defined in Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Periodic	Periodic	Periodic
	Number of CSI-RS ports (*X*)		4	4	4
	CDM Type		FD-CDM2	FD-CDM2	FD-CDM2
	Density (ρ)		1	1	1
	First subcarrier index in the PRB used for CSI-RS (k_0)		Row 5, (4)	Row 5, (4)	Row 5, (4)
	First OFDM symbol in the PRB used for CSI-RS (l_0)		(9)	(9)	(9)
	CSI-RS periodicity and offset	slot	10/1	10/1	10/1
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Periodic	Periodic	Periodic
	Number of CSI-RS ports (*X*)		2	2	2
	CDM Type		FD-CDM2	FD-CDM2	FD-CDM2
	Density (ρ)		1	1	1
	First subcarrier index in the PRB used for CSI-RS (k_0)		Row 3 (6)	Row 3 (6)	Row 3 (6)
	First OFDM symbol in the PRB used for CSI-RS (l_0)		(13)	(13)	(13)
	NZP CSI-RS-timeConfig periodicity and offset	slot	10/1	10/1	10/1
CSI-IM configuration	CSI-IM resource Type		Periodic	Periodic	Periodic
	CSI-IM RE pattern		Pattern 0	Pattern 0	Pattern 0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4,9)	(4,9)	(4,9)
	CSI-IM timeConfig periodicity and offset	slot	10/1	10/1	10/1
ReportConfigType			Periodic	Periodic	Periodic
CQI-table			Table 2	Table 2	Table 2
reportQuantity			cri-RI-PMI-CQI	cri-RI-PMI-CQI	cri-RI-PMI-CQI
timeRestrictionForChannelMeasurements			not configured	not configured	not configured
timeRestrictionForInterferenceMeasurements			not configured	not configured	not configured
cqi-FormatIndicator			Wideband	Wideband	Wideband
pmi-FormatIndicator			Wideband	Wideband	Wideband
Sub-band Size		RB	16	16	16
csi-ReportingBand			1111111	1111111	1111111
CSI-Report periodicity and offset		slot	10/9	10/9	10/9
Codebook configuration	Codebook Type		typeI-SinglePanel	typeI-SinglePanel	typeI-SinglePanel
	Codebook Mode		1	1	1
	(CodebookConfig-N1,CodebookConfig-N2)		N/A	N/A	N/A
	CodebookSubsetRestriction		010000 for fixed rank 2, 010011 for following rank	000011 for fixed rank 1, 010011 for following rank	000011 for fixed rank 1, 010011 for following rank
	RI Restriction		N/A	N/A	N/A
Physical channel for CSI report			PUCCH	PUCCH	PUCCH
CQI/RI/PMI delay		ms	9.5	9.5	9.5
Maximum number of HARQ transmission			1	1	1

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

Table 6.4.2.2_1.3-2: Minimum requirement (TDD)

	Test 1	Test 2	Test 3
γ_1	N/A	1.05	0.9
γ_2	1.0	N/A	N/A

The normative reference for this requirement is TS 38.101-4 [2] clause 6.4.2.2.

6.4.2.2_1.4 Test Description

6.4.2.2_1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state. The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex D.

Test Environment: Normal as defined in TS 38.508 [6] clause 4.1.

Frequencies to be tested: Mid Range as defined in TS 38.508 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7 for TE diagram and section A.3.2.3 for UE diagram.
2. The parameter settings for the cell are set up according to Table 6.1.2-1 and Table 6.4.2.2_1.3-1 as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].
4. Propagation conditions for the NR cell are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR, *Connected without release On* and Test Mode ON for SA or EN-DC, DC bearer *MCG* and *SCG, Connected without release On* and Test Mode ON for NSA according to TS 38.508-1 [6] clause 4.5. Message contents are defined in clause 6.4.2.2_1.4.3.

6.4.2.2_1.4.2 Test procedure

1. Set the parameters of bandwidth, reference channel, the propagation condition, antenna configuration, antenna correlation, Codebook configuration, Beamforming Model, RI configuration and SNR according to Table 6.4.2.2_1.3-1 as appropriate.
2. The SS shall send PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to the UE reported CQI (wideband CQI), PMI and fixed RI as defined in Table 6.4.2.2_1.3-1. The SS sends downlink MAC padding bits on the DL RMC. Measure the t_{fix} according to Annex G.3. 3.
3. Propagation conditions are set according to Annex B.2.
4. The SS shall transmit an RRC Connection Reconfiguration message to set codebookSubsetRestriction as for UE reported RI according to Table 6.4.2.2_1.3-1.
5. The UE shall transmit RRC Connection Reconfiguration Complete message.

6. Propagation conditions are set according to Table 6.4.2.2_1.3-1.

7. The SS shall send PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to the UE reported CQI (wideband CQI), PMI and RI. The SS sends downlink MAC padding bits on the DL RMC. Measure $t_{reported}$ according to Annex G.3.3.

   If the ratio ($t_{reported}$ / t_{fix}) satisfies the requirement in Table 6.4.2.2_1.5-1, then pass the UE for this test and go to step 8. Otherwise, declare a FAIL verdict.

8. If all tests have not been done, then repeat the same procedure (steps 1 to 7) with test conditions according to the Table 6.4.2.2_1.3-2 for the other Tests as appropriate. Otherwise, declare a PASS verdict.

6.4.2.2_1.4.3 Message Contents

6.4.2.2_1.4.3.1 Message Contents for SA

Table 6.4.2.2_1.4.3.1-1: CSI-ResourceConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-41			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourceConfig ::= SEQUENCE {			
resourceType	periodic		
}			

Table 6.4.2.2_1.4.3.1-2: CSI-RS-ResourceMapping for NZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-45			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	001000	row3, k_0=6	
}			
nrofPorts	p2		
firstOFDMSymbolInTimeDomain	13		
}			

Table 6.4.2.2_1.4.3.1-3: CSI-RS-ResourceMapping for ZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-45			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	000100	row5, k_0=4	
}			
nrofPorts	p4		
firstOFDMSymbolInTimeDomain	9		
}			

Table 6.4.2.2_1.4.3.1-4: CSI-IM-Resource

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-34			
Information Element	**Value/remark**	**Comment**	**Condition**
csi-IM-ResourceElementPattern			
pattern0 SEQUENCE {			
subcarrierLocation-p0	s4		
symbolLocation-p0	9		
}			
periodicityAndOffset	CSI-ResourcePeriodicityAndOffset		

Table 6.4.2.2_1.4.3.1-5: *CSI-ResourcePeriodicityAndOffset*

Derivation Path: TS 38.508-1 [6], clause 4.6.2, Table 4.6.2-43			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourcePeriodicityAndOffset CHOICE {			
Slots10	1		
}			

Table 6.4.2.2_1.4.3.1-6: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], clause 4.6.2, Table 4.6.3-25			
Information Element	**Value/remark**	**Comment**	**Condition**
nrOfAntennaPorts CHOICE {			
Two SEQUENCE {			
twoTX-CodebookSubsetRestriction	010000	Fixed rank 2	
	000011	Fixed rank 1	
	010011	Following rank	
}			
}			
}			
typeI-SinglePanel-ri-Restriction	11111111	Non restriction	

Table 6.4.2.2_1.4.3.1-7: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-39			
Information Element	**Value/remark**	**Comment**	**Condition**
reportConfigType CHOICE {			
periodic SEQUENCE {			
reportSlotConfig CHOICE {	slots10		
slots10	9		
}			
pucch-CSI-ResourceList	9	PUCCH format Id=9	
}			
reportFreqConfiguration SEQUENCE {			
csi-ReportingBand CHOICE {			
subbands7	1111111		
}			
}			
}			

6.4.2.2_1.4.3.2 Message exceptions for NSA

Same as in clause 6.4.2.1.2.1.4.3_1.

6.4.2.2_1.5 Test Requirements

Table 6.4.2.2_1.5-1: Test Requirement (TDD)

	Test 1	**Test 2**	**Test 3**
γ_1	N/A	1.04	0.89
γ_2	0.99	N/A	N/A

6.4.3 4RX requirements

6.4.3.1 FDD

6.4.3.1_1 4Rx FDD FR1 RI reporting for both SA and NSA

6.4.3.1_1.1 Test Purpose

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.

6.4.3.1_1.2 Test applicability

This test applies to all types of NR UE release 15 and forward supporting 4 Rx antenna ports.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC and 4 Rx antenna ports.

6.4.3.1_1.3 Minimum Conformance Requirements

The minimum performance requirement in Table 6.4.3.1_1.3-2 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_1.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.4.3.1_1.3-2.

Table 6.4.3.1_1.3-1: RI Test (FDD)

Parameter		Unit	Test 1	Test 2	Test 3	Test 4
Bandwidth		MHz	10	10	10	10
Subcarrier spacing		kHz	15	15	15	15
Duplex Mode			FDD	FDD	FDD	FDD
SNR		dB	-2	16	16	22
Propagation channel			TDLA30-5	TDLA30-5	TDLA30-5	TDLA30-5
Antenna configuration			ULA Low 2x4	ULA Low 2x4	ULA High 2x4	ULA Low 4x4
Beamforming Model			As defined in Annex B.4.1	As defined in Annex B.4.1	As defined in Annex B.4.1	As defined in Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Periodic	Periodic	Periodic	Periodic
	Number of CSI-RS ports (*X*)		4	4	4	4
	CDM Type		FD-CDM2	FD-CDM2	FD-CDM2	FD-CDM2
	Density (ρ)		1	1	1	1
	First subcarrier index in the PRB used for CSI-RS (k_0)		Row 5, (4)	Row 5, (4)	Row 5, (4)	Row 5, (4)
	First OFDM symbol in the PRB used for CSI-RS (l_0)		(9)	(9)	(9)	(9)
	CSI-RS periodicity and offset	slot	5/1	5/1	5/1	5/1
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Periodic	Periodic	Periodic	Periodic
	Number of CSI-RS ports (*X*)		2	2	2	4
	CDM Type		FD-CDM2	FD-CDM2	FD-CDM2	FD-CDM2
	Density (ρ)		1	1	1	1
	First subcarrier index in the PRB used for CSI-RS (k_0)		Row 3 (6)	Row 3 (6)	Row 3 (6)	Row 4 (0)
	First OFDM symbol in the PRB used for CSI-RS (l_0)		(13)	(13)	(13)	(13)
	NZP CSI-RS-timeConfig periodicity and offset	slot	5/1	5/1	5/1	5/1
CSI-IM configuration	CSI-IM resource Type		Periodic	Periodic	Periodic	Periodic
	CSI-IM RE pattern		Pattern 0	Pattern 0	Pattern 0	Pattern 0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4,9)	(4,9)	(4,9)	(4,9)
	CSI-IM timeConfig periodicity and offset	slot	5/1	5/1	5/1	5/1
ReportConfigType			Periodic	Periodic	Periodic	Periodic
CQI-table			Table 2	Table 2	Table 2	Table 2
reportQuantity			cri-RI-PMI-CQI	cri-RI-PMI-CQI	cri-RI-PMI-CQI	cri-RI-PMI-CQI
timeRestrictionForChannelMeasurements			not configured	not configured	not configured	not configured
timeRestrictionForInterferenceMeasurements			not configured	not configured	not configured	not configured
cqi-FormatIndicator			Wideband	Wideband	Wideband	Wideband
pmi-FormatIndicator			Wideband	Wideband	Wideband	Wideband
Sub-band Size		RB	8	8	8	8
csi-ReportingBand			1111111	1111111	1111111	1111111
CSI-Report periodicity and offset		slot	5/0	5/0	5/0	5/0
Codebook configuration	Codebook Type		typeI-SinglePanel	typeI-SinglePanel	typeI-SinglePanel	typeI-SinglePanel
	Codebook Mode		1	1	1	1
	(CodebookConfig-N1,CodebookConfig-N2)		N/A	N/A	N/A	(2,1)
	CodebookSubsetRestriction		010000 for fixed rank 2, 010011 for following rank	000011 for fixed rank 1, 010011 for following rank	000011 for fixed rank 1, 010011 for following rank	11111111
	RI Restriction		N/A	N/A	N/A	00000010 for fixed Rank 2 and 00001111 for follow RI
Physical channel for CSI report			PUCCH	PUCCH	PUCCH	PUCCH
CQI/RI/PMI delay		ms	8	8	8	8

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

Table 6.4.3.1_1.3-2: Minimum requirement (FDD)

	Test 1	Test 2	Test 3	Test 4
γ_1	N/A	1.05	0.9	N/A
γ_2	0.9	N/A	N/A	0.9

The normative reference for this requirement is TS 38.101-4 [2] clause 6.4.3.1.

6.4.3.1_1.4 Test Description

6.4.3.1_1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal as defined in TS 38.508 [6] clause 4.1.

Frequencies to be tested: Mid Range as defined in TS 38.508 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.4 or A.3.1.7.5 for TE diagram and section A.3.2.5 for UE diagram.
2. The parameter settings for the cell are set up according to Table 6.1.2-1, Table 6.4.3.1_1.3-1 as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].
4. Propagation conditions for the NR cell are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR, *Connected without release On* and Test Mode ON for SA or (EN-DC, DC bearer *MCG* and *SCG, Connected without release On* for NSA according to TS 38.508-1 [6] clause 4.5. Message contents are defined in clause 6.4.3.1_1.4.3.

6.4.3.1_1.4.2 Test procedure

1. Set the parameters of bandwidth, reference channel, the propagation condition, antenna configuration, antenna correlation, Codebook configuration, Beamforming Model, RI configuration and SNR according to Table 6.4.3.1_1.3-1 as appropriate.
2. The SS shall send PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to the UE reported CQI (wideband CQI), PMI and fixed RI as defined in Table 6.4.3.1_1.3-1. The SS sends downlink MAC padding bits on the DL RMC. Measure the t_{fix} according to Annex G.3. 3.
3. Propagation conditions are set according to Annex B.2. 4
4. The SS shall transmit an RRC Connection Reconfiguration message to set codebookSubsetRestriction as for UE reported RI according to Table 6.4.3.1_1.3-1.
5. The UE shall transmit RRC Connection Reconfiguration Complete message.

6. Propagation conditions are set according to Table 6.4.3.1_1.3-1.

7. The SS shall send PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to the UE reported CQI (wideband CQI), PMI and RI. The SS sends downlink MAC padding bits on the DL RMC. Measure $t_{reported}$ according to Annex G.3.3.

   If the ratio ($t_{reported}$ / t_{fix}) satisfies the requirement in Table 6.4.3.1_1.5-1, then pass the UE for this test and go to step 8. Otherwise, declare a FAIL verdict.

8. If all tests have not been done, then repeat the same procedure (steps 1 to 7) with test conditions according to the Table 6.4.3.1_1.3-2 for the other Tests as appropriate. Otherwise, declare a PASS verdict.

6.4.3.1_1.4.3 Message Contents

6.4.3.1_1.4.3.1 Message exceptions for SA

Table 6.4.3.1_1.4.3.1-1: CSI-ResourceConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-41			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourceConfig ::= SEQUENCE {			
resourceType	periodic		
}			

Table 6.4.3.1_1.4.3.1-2: CSI-RS-ResourceMapping for NZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-45			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	001000	row3, k_0=6 for test 1,2,3	
row 4	001	row4, k_0=0 for test 4	
}			
nrofPorts	p2	Test 1,2,3	
	p4	Test 4	
firstOFDMSymbolInTimeDomain	13		
}			

Table 6.4.3.1_1.4.3.1-3: CSI-RS-ResourceMapping for ZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-45			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	000100	row5, k_0=4	
}			
nrofPorts	p4		
firstOFDMSymbolInTimeDomain	9		
}			

Table 6.4.3.1_1.4.3.1-4: CSI-IM-Resource

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-34			
Information Element	**Value/remark**	**Comment**	**Condition**
csi-IM-ResourceElementPattern			
pattern0 SEQUENCE {			
subcarrierLocation-p0	s4		
symbolLocation-p0	9		
}			
periodicityAndOffset	CSI-ResourcePeriodicityAndOffset		

Table 6.4.3.1_1.4.3.1-5: *CSI-ResourcePeriodicityAndOffset*

Derivation Path: TS 38.508-1 [6], clause 4.6.2, Table 4.6.3-43			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourcePeriodicityAndOffset CHOICE {			
Slots5	1		
}			

Table 6.4.3.1_1.4.3.1-6: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], clause 4.6.2, Table 4.6.3-25			
Information Element	**Value/remark**	**Comment**	**Condition**
nrOfAntennaPorts CHOICE {			
Two SEQUENCE {			
twoTX-CodebookSubsetRestriction	010000	Fixed rank 2	
	000011	Fixed rank 1	
	010011	Following rank for test 1,2,3	
	11111111	Test 4	
}			
}			
}			
typeI-SinglePanel-ri-Restriction	11111111	Non restriction for test 1,2,3	
	00000010	For fixed Rank2 for test 4	
	00001111	For follow RI for test 4	

Table 6.4.3.1_1.4.3.1-7: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-39			
Information Element	**Value/remark**	**Comment**	**Condition**
reportConfigType CHOICE {			
periodic SEQUENCE {			
reportSlotConfig CHOICE {	slots5		
slots5	0		
}			
pucch-CSI-ResourceList	8	PUCCH format Id=8	
}			
reportFreqConfiguration SEQUENCE {			
csi-ReportingBand CHOICE {			
subbands7	1111111		
}			
}			
}			

6.4.3.1_1.4.3.2 Message exceptions for NSA

Same as in clause 6.4.3.1_1.4.3.1.

6.4.3.1_1.5 Test Requirements

Table 6.4.3.1_1.5-1: Minimum requirement (FDD)

	Test 1	**Test 2**	**Test 3**	**Test 4**
γ_1	N/A	1.04	0.89	N/A
γ_2	0.89	N/A	N/A	0.89

6.4.3.2 TDD

6.4.3.2_1 4Rx TDD FR1 RI reporting for both SA and NSA

6.4.3.2_1.1 Test Purpose

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.

6.4.3.2_1.2 Test applicability

This test applies to all types of NR UE release 15 and forward supporting 4 Rx antenna ports.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC and 4 Rx antenna ports.

6.4.3.2_1.3 Minimum Conformance Requirements

The minimum performance requirement in Table 6.4.3.2_1.3-2 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_1.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.4.3.2_1.3-2.

Table 6.4.3.2_1.3-1: RI Test (TDD)

Parameter		Unit	Test 1	Test 2	Test 3	Test 4
Bandwidth		MHz	40	40	40	40
Subcarrier spacing		kHz	30	30	30	30
Duplex Mode			TDD	TDD	TDD	TDD
TDD Slot Configuration			FR1.30-1	FR1.30-1	FR1.30-1	FR1.30-1
SNR		dB	-2	16	16	22
Propagation channel			TDLA30-5	TDLA30-5	TDLA30-5	TDLA30-5
Antenna configuration			ULA Low 2x4	ULA Low 2x4	ULA High 2x4	ULA Low 4x4
Beamforming Model			As defined in Annex B.4.1	As defined in Annex B.4.1	As defined in Annex B.4.1	As defined in Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Periodic	Periodic	Periodic	Periodic
	Number of CSI-RS ports (*X*)		4	4	4	4
	CDM Type		FD-CDM2	FD-CDM2	FD-CDM2	FD-CDM2
	Density (ρ)		1	1	1	1
	First subcarrier index in the PRB used for CSI-RS (k_0)		Row 5, (4)	Row 5, (4)	Row 5, (4)	Row 5, (4)
	First OFDM symbol in the PRB used for CSI-RS (l_0)		(9)	(9)	(9)	(9)
	CSI-RS periodicity and offset	slot	10/1	10/1	10/1	10/1
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Periodic	Periodic	Periodic	Periodic
	Number of CSI-RS ports (*X*)		2	2	2	4
	CDM Type		FD-CDM2	FD-CDM2	FD-CDM2	FD-CDM2
	Density (ρ)		1	1	1	1
	First subcarrier index in the PRB used for CSI-RS (k_0)		Row 3 (6)	Row 3 (6)	Row 3 (6)	Row 4 (0)
	First OFDM symbol in the PRB used for CSI-RS (l_0)		(13)	(13)	(13)	(13)
	NZP CSI-RS-timeConfig periodicity and offset	slot	10/1	10/1	10/1	10/1
CSI-IM configuration	CSI-IM resource Type		Periodic	Periodic	Periodic	Periodic
	CSI-IM RE pattern		Pattern 0	Pattern 0	Pattern 0	Pattern 0
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(4,9)	(4,9)	(4,9)	(4,9)
	CSI-IM timeConfig periodicity and offset	slot	10/1	10/1	10/1	10/1
ReportConfigType			Periodic	Periodic	Periodic	Periodic
CQI-table			Table 2	Table 2	Table 2	Table 2
reportQuantity			cri-RI-PMI-CQI	cri-RI-PMI-CQI	cri-RI-PMI-CQI	cri-RI-PMI-CQI
timeRestrictionForChannelMeasurements			not configured	not configured	not configured	not configured
timeRestrictionForInterferenceMeasurements			not configured	not configured	not configured	not configured
cqi-FormatIndicator			Wideband	Wideband	Wideband	Wideband
pmi-FormatIndicator			Wideband	Wideband	Wideband	Wideband
Sub-band Size		RB	16	16	16	16
csi-ReportingBand			1111111	1111111	1111111	1111111
CSI-Report periodicity and offset		slot	10/9	10/9	10/9	10/9
Codebook configuration	Codebook Type		typeI-SinglePanel	typeI-SinglePanel	typeI-SinglePanel	typeI-SinglePanel
	Codebook Mode		1	1	1	1
	(CodebookConfig-N1,CodebookConfig-N2)		N/A	N/A	N/A	(2,1)
	CodebookSubsetRestriction		010000 for fixed rank 2, 010011 for following rank	000011 for fixed rank 1, 010011 for following rank	000011 for fixed rank 1, 010011 for following rank	11111111
	RI Restriction		N/A	N/A	N/A	00000010 for fixed Rank 2 and 00001111 for follow RI
Physical channel for CSI report			PUCCH	PUCCH	PUCCH	PUCCH

CQI/RI/PMI delay	ms	9.5	9.5	9.5	9.5
Maximum number of HARQ transmission		1	1	1	1
RI Configuration		Fixed RI = 2 and follow RI	Fixed RI = 1 and follow RI	Fixed RI = 1 and follow RI	Fixed RI = 2 and follow RI
Note 1: Measurements channels are specified in Table A.4-2 and Table A.4-3. TBS.2-3 is used for Rank 1 case. TBS.2-4 is used for Rank 2 case. TBS.3-3 is used for Rank 3 case. TBS.3-4 is used for Rank 4 case.					

Table 6.4.3.2_1.3-2: Minimum requirement (TDD)

	Test 1	Test 2	Test 3	Test 4
γ_1	N/A	1.05	0.9	N/A
γ_2	0.9	N/A	N/A	0.9

The normative reference for this requirement is TS 38.101-4 [2] clause 6.4.3.2.

6.4.3.2_1.4 Test Description

6.4.3.2_1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 of 38.521-1[7].

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7 for TE diagram and section A.3.2.5 for UE diagram.
2. The parameter settings for the cell are set up according to Table 6.1.2-1 and Table 6.4.3.2_1.3-1 as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].
4. Propagation conditions are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR, *Connected without release On* and Test Mode ON for SA or EN-DC, DC bearer *MCG* and *SCG*, *Connected without release On* and Test Mode ON for NSA according to TS 38.508-1 [6] clause 4.5. Message contents are defined in clause 6.4.3.2_1.4.3.

6.4.3.2_1.4.2 Test procedure

1. Set the parameters of bandwidth, reference channel, the propagation condition, antenna configuration, antenna correlation, Codebook configuration, Beamforming Model, RI configuration and SNR according to Table 6.4.3.2_1.3-1 as appropriate.
2. The SS shall send PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to the UE reported CQI (wideband CQI), PMI and fixed RI as defined in Table 6.4.3.2_1.3-1. The SS sends downlink MAC padding bits on the DL RMC. Measure the t_{fix} according to Annex G.3.3.
3. Propagation conditions are set according to Annex B.2.
4. The SS shall transmit an RRC Connection Reconfiguration message to set codebookSubsetRestriction as for UE reported RI according to Table 6.4.3.2_1.3-1.

5. The UE shall transmit RRC Connection Reconfiguration Complete message.
6. Propagation conditions are set according to Table 6.4.3.2_1.3-1.
7. The SS shall send PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to the UE reported CQI (wideband CQI), PMI and RI. The SS sends downlink MAC padding bits on the DL RMC. Measure $t_{reported}$ according to Annex G.3.3.

   If the ratio ($t_{reported}$ / t_{fix}) satisfies the requirement in Table 6.4.3.2_1.5-1, then pass the UE for this test and go to step 8. Otherwise, declare a FAIL verdict.
8. If all tests have not been done, then repeat the same procedure (steps 1 to 7) with test conditions according to the Table 6.4.3.2_1.3-2 for the other Tests as appropriate. Otherwise, declare a PASS verdict.

6.4.3.2_1.4.3 Message Contents

Message contents are according to TS 38.508-1 [6] clause 4.6 with the following exceptions:

Table 6.4.3.2_1.4.3-1: CSI-RS-ResourceMapping for NZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-45			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	001000		Test1, 2, 3
row4	001		Test4
}			
nrofPorts	p2		Test1, 2, 3
	p4		Test4
firstOFDMSymbolInTimeDomain	13		
}			

Table 6.4.3.2_1.4.3-2: CSI-RS-ResourceMapping for ZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-45			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	000100		
}			
nrofPorts	p4		
firstOFDMSymbolInTimeDomain	9		
}			

Table 6.4.3.2_1.4.3-3: CSI-IM-Resource

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-34			
Information Element	**Value/remark**	**Comment**	**Condition**
csi-IM-ResourceElementPattern			
pattern0 SEQUENCE {			
subcarrierLocation-p0	s4		
symbolLocation-p0	9		
}			
periodicityAndOffset	CSI-ResourcePeriodicityAndOffset		

Table 6.4.3.2_1.4.3-4: *CSI-ResourcePeriodicityAndOffset*

Derivation Path: TS 38.508-1 [6], clause 4.6.2, Table 4.6.3-43			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourcePeriodicityAndOffset CHOICE {			
slots10	1		
}			

Table 6.4.3.2_1.4.3-5: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], clause 4.6.2, Table 4.6.3-25			
Information Element	**Value/remark**	**Comment**	**Condition**
nrOfAntennaPorts CHOICE {			
two SEQUENCE {			
twoTX-CodebookSubsetRestriction	010000		Fixed rank 2
	000011		Fixed rank 1
	010011		Following rank
}			
}			
typeI-SinglePanel-ri-Restriction	11111111		

Table 6.4.3.2_1.4.3-6: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-39			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ReportConfig ::= SEQUENCE {			
reportConfigType CHOICE {			
periodic SEQUENCE {			
reportSlotConfig CHOICE {	slot10		
slot10	9		
}			
}			
}			
reportFreqConfiguration SEQUENCE {			
csi-ReportingBand CHOICE {			
subbands7	1111111		
}			
}			
}			

6.4.3.2_1.5 Test Requirements

Table 6.4.3.2_1.5-1: Test Requirement (TDD)

	Test 1	**Test 2**	**Test 3**	**Test 4**
γ_1	N/A	1.04	0.89	N/A
γ_2	0.89	N/A	N/A	0.89

7 Demodulation performance requirements (Radiated requirements)

7.1 General

For conformance testing involving FR2 test cases in this specification, the UE under test shall be pre-configured with UL Tx diversity schemes disabled to account for single polarization System Simulator (SS) in the test environment. The UE under test may transmit with dual polarization.

7.1.1 Applicability of requirements

7.1.1.1 General

The minimum performance requirements are applicable to the FR2 operating bands defined in TS 38.101-2 [3] with F_{DL_high} not exceeding 40000 MHz.

The minimum performance requirements in Clause 7 are mandatary for UE supporting NR operation, except test cases listed in Clause 7.1.1.3, 7.1.1.4.

7.1.1.2 Applicability of requirements for different number of RX antenna ports

UE shall support 2 RX ports for different RF operating bands. The UE requirements applicability is defined in Table 7.1.1.2-1.

Table 7.1.1.2-1: Requirements applicability

Supported RX antenna ports	Test type	Test list
UE supports 2RX antenna ports	PDSCH	All tests in Clause 7.2.2
	PDCCH	All tests in Clause 7.3.2
	PBCH	All tests in Clause 7.4.2

7.1.1.3 Applicability of requirements for optional UE features

The performance requirements in Table 7.1.1.3-1 shall apply for UEs which support optional UE features only.

Table 7.1.1.3-1: Requirements applicability for optional UE features

UE feature/capability [14]	Test type		Test list	Applicability notes
SU-MIMO Interference Mitigation advanced receiver	FR2 TDD	PDSCH	Clause 7.2.2.2.1 (Test 3-1)	
Basic DL NR-NR CA operation (*supportedBandCombinationList*)	NR CA	SDR	Clause 7.5A.1	1)Up to 16 DL carriers 2)Same numerology across carrier for data/control channel at a given time
PDSCH repetitions over multiple slots *(pdsch-RepetitionMultiSlots)*	FR2 TDD	PDSCH	Clause 7.2.2.2.2	
256QAM for PDSCH (*pdsch-256QAM-FR2*)	FR2 TDD	PDSCH	Clause 7.2.2.2.1 (Test 1-4)	
256QAM for PDSCH (*pdsch-256QAM-FR2*)	FR2 TDD	SDR	Clause 7.5A.1	For UE capable of *pdsch-256QAM-FR2* for certain band(s), *mcs-Table* is configured to '64QAM' for SDR test.

7.1.1.4 Applicability of requirements for mandatory UE features with capability signaling

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

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

UE feature/capability [14]	Test type		Test list	Applicability notes
Supported maximum number of PDSCH MIMO layers (*maxNumberMIMO-LayersPDSCH)*	FR2 TDD	PDSCH	Clause 7.2.2.2.1 (Tests from 2-1 to 2-6)	The requirements apply only in case the PDSCH MIMO rank in the test case does not exceed UE PDSCH MIMO layers capability
Support of PT-RS with one antenna port for DL reception (*onePortsPTRS*)	FR2 TDD	PDSCH	Clause 7.2	
		SDR	Clause 7.5.1 Clause 7.5A.1	
PCell operation on FR2 (*pCell-FR2*)	FR2 TDD	SDR	Clause 7.5A.1	
PDSCH mapping type B (*pdsch-MappingTypeB*)	FR2 TDD	PDSCH	Clause 7.2.2.2.3	

7.1.1.5 Applicability of CA requirements

7.1.1.5.1 Definition of CA capability

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

Table 7.1.1.5.1-1: Definition of CA capability

CA Capability	CA Capability Description
CA_C	Intra-band contiguous CA
CA_N	Intra-band non-contiguous CA
CA_AX	Inter-band CA (X bands)
NOTE 1: CA_C corresponds to NR CA configurations and bandwidth combination sets defined in Section 5.5A.1 of TS 38.101-2 [3]. CA_N corresponds to NR CA configurations and bandwidth combination sets defined in Section 5.5A.2 of TS 38.101-2 [3]. CA_AX corresponds to NR CA configurations and bandwidth combination sets defined in Clause 5.5A.3 of TS 38.101-2 [3].	

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

The performance requirement for CA UE demodulation tests in Clause 7.2A are defined independent of CA configurations and bandwidth combination sets specified in Section 5.5A of TS 38.101-2 [3]. For UEs supporting different CA configurations and bandwidth combination sets, the applicability and test rules are defined in Table 7.1.1.5.2-1 and Table 7.1.1.5.2-2. For simplicity, CA configuration below refers to combination of CA configuration and bandwidth combination set.

Table 7.1.1.5.2-1: Applicability and test rules for CA UE demodulation tests

Tests	CA capability where the tests apply	CA configuration from the selected CA capability where the tests apply	CA Bandwidth combination to be tested in priority order	PCell CC configuration
Test 1 in Section 7.2A.2.1	CA_C, CA_N, CA_AX	Table 7.1.1.5.2-2	Largest aggregated CA bandwidth combination	Any of CCs

Table 7.1.1.5.2-2: Selection of CA configurations

CA capability	Step 1	Step 2	Step 3
CA_C or CA_N or CA_AX	Select CA configuration(s), which contain all CA bandwidth combinations requiring SNR below test equipment maximum achievable SNR	Select the CA configurations with the maximum number of CCs, for which the supported maximum number of MIMO layers is not lower than 2, among all the selected CA configurations from Step 1.	Select any one of CA configurations, which contain CA bandwidth combination with the largest aggregated channel bandwidth and supported maximum data rate is not lower than the tested date rate, among all the selected CA configurations from Step 2.
NOTE 1: Maximum supported data rate for Step 3 is calculated based clause 4.1.2 of TS 38.306 [14]			
NOTE 2: Tested data rate for Step 3 is calculated based on the equation $DataRate = 10^{-3}\sum_{j=1}^{J} TBS_j 2^{\mu_j}$ and FRCs used in the test.			

7.1.1_1 Applicability of test requirements due to maximum achievable SNR

Table 7.1.1_1-1 and Table 7.1.1_1.1-1a specify the current assumption of maximum testable SNR_{BB} for indirect farfield (IFF), PC3, Max device size ≤ 30 cm under fading conditions.

Table 7.1.1_1-1: maximum testable SNR_{BB} under fading conditions for modulations up to 64 QAM

Operating Band / Frequency	Maximum testable SNR_{BB} (dB)		
	CHBW 50 MHz	CHBW 100 MHz	CHBW 200 MHz
n257 mid	30.6	27.5	24.4
n258 mid	30.6	27.5	24.4
n259 mid	20.4	17.2	14.1
n260 mid	24.4	21.2	18.2
n261 mid	30.6	27.5	24.4

Table 7.1.1_1-1a: maximum testable SNR_{BB} under fading conditions for 256QAM modulation for DEMOD scenarios

Operating Band / Frequency	Maximum testable SNR_{BB} (dB)		
	CHBW 50 MHz	CHBW 100 MHz	CHBW 200 MHz
n257 mid	29.1	25.9	22.9
n258 mid	29.1	25.9	22.9
n259 mid	18.8	15.6	12.5
n260 mid	22.9	19.7	16.6
n261 mid	29.1	25.9	22.9

Based on the current assumption of maximum testable SNR_{BB}, the applicability of test points is defined in Table 7.1.1_1-2 for indirect farfield (IFF), PC3, Max device size size ≤ 30 cm under fading conditions.

Table 7.1.1_1-2: Testability of test requirements due to maximum achievable SNR per band

Test Case	Test point	CHBW / MHz	Fading	SNR test requirement	Test Point Applicability				
					n257	n258	n259	n260	n261
7.2.2.2.1_1	1-1	100	Yes	1.4	x	x	x	x	x
	1-2	100	Yes	3.6	x	x	x	x	x
	1-3	100	Yes	14.2	x	x	x	x	x
	2-1	100	Yes	5.8	x	x	x	x	x
	2-2	100	Yes	16.0	x	x	x	x	x
	2-3	50	Yes	15.7	x	x	x	x	x
	2-4	200	Yes	15.8	x	x	-	x	x
	2-5	50	Yes	16	x	x	x	x	x
	2-6	100	Yes	20.3	x	x	-	x	x
7.2.2.2.1_2	3-1	100	Yes	20.7	x	x	-	x	x
7.2.2.2.1_3	1-4	50	Yes	22.0	x	x		x	x
7.2.2.2.2_1	1-1	100	Yes	TBD	TBD	TBD	TBD	TBD	TBD
7.2.2.2.3_1	1-1	100	Yes	3.1	x	x	x	x	X
7.2A.2.1	1,2	BW_{agg} ≤ 200	Yes	12.0	x	x	x	x	x
	3,4	BW_{agg} ≥ 200	Yes	12.0	TBD	TBD	TBD	TBD	TBD
7.2A.2.2	1,2	BW_{agg} ≤ 200	Yes	12.0	x	x	x	x	x
	3,4	BW_{agg} ≥ 200	Yes	12.0	TBD	TBD	TBD	TBD	TBD
7.3.2.2.1	1-1	100	Yes	7.7	x	x	x	x	x
	1-2	100	Yes	4.3	x	x	x	x	x
7.3.2.2.2	2-1	100	Yes	3.2	x	x	x	x	x
	2-2	100	Yes	0.2	x	x	x	x	x
7.3.2.2.3	1-1	100	Yes	4.7	x	x	x	x	x
7.5.1	-	100	No	NA	x	x	x	x	x
	-	200	No	NA	x	x	x	x	x
	-	400	No	NA	TBD	TBD	TBD	TBD	TBD
7.5A.1	-	BWagg ≤ 200	No	NA	x	x	x	x	x
	-	BWagg ≤ 200	No	NA	TBD	TBD	TBD	TBD	TBD

7.2 PDSCH demodulation requirements

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

Table 7.2-1: Common Test Parameters

Parameter		Unit	Value
PDSCH transmission scheme			Transmission scheme 1
PTRS *epre-Ratio*			0
Actual carrier configuration	Offset between Point A and the lowest usable subcarrier on this carrier (Note 2)	RBs	0
	Subcarrier spacing	kHz	60 or 120
DL BWP configuration #1	Cyclic prefix		Normal
	RB offset	RBs	0
	Number of contiguous PRB	PRBs	Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-2 [3] for tested channel bandwidth and subcarrier spacing
Common serving cell parameters	Physical Cell ID		0
	SSB position in burst		1
	SSB periodicity	ms	20
PDCCH configuration	Slots for PDCCH monitoring		Each slot
	Symbols with PDCCH		0
	Number of PRBs in CORESET		Table 7.2-2 for tested channel bandwidth and subcarrier spacing
	Number of PDCCH candidates and aggregation levels		1/AL8
	CCE-to-REG mapping type		Non-interleaved
	DCI format		1_1
	TCI state		TCI state #1
	PDCCH & PDCCH DMRS Precoding configuration		Single Panel Type I, Random per slot with equal probability of each applicable i_1, i_2 combination, and with REG bundling granularity for number of Tx larger than 1
Cross carrier scheduling			Not configured
CSI-RS for tracking	First subcarrier index in the PRB used for CSI-RS (k_0)		0 for CSI-RS resource 1,2,3,4
	First OFDM symbol in the PRB used for CSI-RS (l_0)		6 for CSI-RS resource 1 and 3 10 for CSI-RS resource 2 and 4
	Number of CSI-RS ports (X)		1 for CSI-RS resource 1,2,3,4
	CDM Type		'No CDM' for CSI-RS resource 1,2,3,4
	Density (ρ)		3 for CSI-RS resource 1,2,3,4
	CSI-RS periodicity	Slots	60 kHz SCS: 80 for CSI-RS resource 1,2,3,4 120 kHz SCS: 160 for CSI-RS resource 1,2,3,4
	CSI-RS offset	Slots	60 kHz SCS: 40 for CSI-RS resource 1 and 2 41 for CSI-RS resource 3 and 4 120 kHz SCS: 80 for CSI-RS resource 1 and 2 81 for CSI-RS resource 3 and 4

	Frequency Occupation			Start PRB 0 Number of PRB = BWP size
	QCL info			TCI state #0
NZP CSI-RS for CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k_0)			0
	First OFDM symbol in the PRB used for CSI-RS (l_0)			12
	Number of CSI-RS ports (X)			2
	CDM Type			FD-CDM2
	Density (ρ)			1
	CSI-RS periodicity		Slots	60 kHz SCS: 80 120 kHz SCS: 160
	CSI-RS offset			0
	Frequency Occupation			Start PRB 0 Number of PRB = BWP size
	QCL info			TCI state #1
ZP CSI-RS for CSI acquisition	First subcarrier index in the PRB used for CSI-RS (k_0)			4
	First OFDM symbol in the PRB used for CSI-RS (l_0)			12
	Number of CSI-RS ports (X)			4
	CDM Type			FD-CDM2
	Density (ρ)			1
	CSI-RS periodicity		Slots	60 kHz SCS: 80 120 kHz SCS: 160
	CSI-RS offset			0
	Frequency Occupation			Start PRB 0 Number of PRB = BWP size
CSI-RS for beam refinement	First subcarrier index in the PRB used for CSI-RS			k_0=0 for CSI-RS resource 1,2
	First OFDM symbol in the PRB used for CSI-RS			l_0 = 8 for CSI-RS resource 1 l_0 = 9 for CSI-RS resource 2
	Number of CSI-RS ports (X)			1 for CSI-RS resource 1,2
	CDM Type			'No CDM' for CSI-RS resource 1,2
	Density (ρ)			3 for CSI-RS resource 1,2
	CSI-RS periodicity		Slots	60 kHz SCS: 80 for CSI-RS resource 1,2 120 kHz SCS: 160 for CSI-RS resource 1,2
	CSI-RS offset		Slots	0 for CSI-RS resource 1,2
	Repetition			ON
	QCL info			TCI state #1
PDSCH DMRS configuration	Antenna ports indexes			{1000} for Rank 1 tests {1000, 1001} for Rank 2 tests
	Position of the first DMRS for PDSCH mapping type A			2
	Number of PDSCH DMRS CDM group(s) without data			1
TCI state #0	Type 1 QCL information	SSB index		SSB #0
		QCL Type		Type C
	Type 2 QCL information	SSB index		SSB #0
		QCL Type		Type D
TCI state #1	Type 1 QCL information	CSI-RS resource		CSI-RS resource 1 from 'CSI-RS for tracking' configuration

		QCL Type		Type A
	Type 2 QCL information	CSI-RS resource		CSI-RS resource 1 from 'CSI-RS for tracking' configuration
		QCL Type		Type D
PTRS configuration	Frequency density (K_{PT-RS})			2
	Time density (L_{PT-RS})			1
	Resource Element Offset			2
Maximum 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}
PDSCH & PDSCH DMRS Precoding configuration				Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i_1, i_2 combination, and with Wideband granularity
Symbols for all unused REs				OCNG in Annex A.5
Physical signals, channels mapping and precoding				As specified in Annex B.4.1
Note 1: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH transmission. Note 2: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-2 [3] for tested channel bandwidth and subcarrier spacing.				

Table 7.2-2: Number of PRBs in CORESET

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

7.2.1 1RX requirements (Void)

7.2.2 2RX requirements

7.2.2.1 FDD (Void)

7.2.2.2 TDD

7.2.2.2.1 2Rx TDD FR2 PDSCH mapping Type A performance

7.2.2.2.1_0 Minimum conformance requirements

For PDSCH Type-A scheduling, the requirements are specified in Table 7.2.2.2.1_0-3, 7.2.2.2.1_0-4 and 7.2.2.2.1_0-5, with the addition of the parameters in Table 7.2.2.2.1_0-2 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 7.2.2.2.1_0-1.

Table 7.2.2.2.1_0-1: 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, 1-3, 1-4, 2-1, 2-2, 2-3, 2-4, 2-5, 2-6
Verify the PDSCH mapping Type A HARQ soft combining performance under 2 receive antenna conditions.	1-2
Verify the PDSCH mapping Type A enhanced performance requirement Type 1 under 2 receive antenna conditions and with 2 MIMO layers.	3-1

Table 7.2.2.2.1_0-2: Test Parameters

Parameter		Unit	Value
Duplex mode			TDD
Active DL BWP index			1
CSI-RS for tracking	First OFDM symbol in the PRB used for CSI-RS (l_0)		For Test 1-1 and 1-2: 3 for CSI-RS resource 1 and 3 7 for CSI-RS resource 2 and 4
	CSI-RS offset	Slots	For Test 1-2: 82 for CSI-RS resource 1 and 2 83 for CSI-RS resource 3 and 4
PDCCH configuration	Number of PDCCH candidates and aggregation levels		1/AL4 for Test 1-4 and 2-3 1/AL8 for other tests
PDSCH configuration	Mapping type		Type A
	k0		0
	Starting symbol (S)		1
	Length (L)		Specific to each Reference channel as defined in A.3.2.2
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		WB for 1-1, 2 for other tests
	Resource allocation type		Test 2-1: Type 1 with start RB = 30, L_{RBs} = 6 Other tests: Type 0
	RBG size		Test 2-1: N/A Other tests: Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS configuration	DMRS Type		Type 1
	Number of additional DMRS		1
	Maximum number of OFDM symbols for DL front loaded DMRS		1
Number of HARQ Processes			8 for Test 1-1, 1-3, 1-4, 2-2, 2-4 10 for Test 2-1, 2-3, 2-5, 2-6, 3-1 16 for Test 1-2
K1 value (PDSCH-to-HARQ-timing-indicator)			As defined in Annex A.1.3

Table 7.2.2.2.1_0-3: Minimum performance for Rank 1 (FRC)

Test num.	Reference channel	Bandwidth (MHz)/Subcarrier spacing (kHz)	Modulation and code rate	TDD UL-DL pattern	Propagation condition	Correlation matrix and antenna configuration	Reference value	
							Fraction of maximum throughput (%)	SNR_{BB} (dB)
1-1	R.PDSCH.5-1.1TDD	100/120	QPSK, 0.30	FR2.120-1. A	TDLC60-300	2x2 ULA Low	70	-0.4
1-2	R.PDSCH.5-2.1 TDD	100/120	16QAM, 0.48	FR2.120-1	TDLA30-300	2x2 ULA Low	30	1.7
1-3	R.PDSCH.5-3.1TDD	100/120	64QAM, 0.46	FR2.120-1	TDLA30-300	2x2 XPL Med	70	12.4
1-4	R.PDSCH.5-10.1 TDD	50/120	256QAM 0.67	FR2.120-1	TDLD30-75	2x2 ULA Low	70	20.2

Table 7.2.2.2.1_0-4: Minimum performance for Rank 2 (FRC)

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

Table 7.2.2.2.1_0-5: Minimum performance for Rank 2 (FRC) for Enhanced Type X Receiver

Test num.	Reference channel	Bandwidth (MHz)/Subcarrier spacing (kHz)	Modulation and code rate	TDD UL-DL pattern	Propagation condition	Correlation matrix and antenna configuration	Reference value	
							Fraction of maximum throughput (%)	SNR_{BB} (dB)
3-1	R.PDSCH.5-5.1TDD	100/120	16QAM, 0.48	FR2.120-2	TDLA30-75	2x2 ULA Medium	70	19.0

The normative reference for this requirement is TS 38.101-4 [5] clause 7.2.2.2.1.

7.2.2.2.1_1 2Rx TDD FR2 PDSCH mapping Type A performance - 2x2 MIMO with baseline receiver for SA and NSA

7.2.2.2.1_1.1 Test Purpose

Verify the PDSCH mapping Type A normal performance with different channel models, MCSs and number of MIMO layers.

7.2.2.2.1_1.2 Test Applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

7.2.2.2.1_1.3 Test Description

7.2.2.2.1_1.3.1 Initial Conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.2-1 of TS 38.521-2 [8].

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

Only sub tests shall be tested which are testable according to Table 7.1.1_1-2.

For EN-DC within FR2 operation, setup the LTE radiated link according to Annex D:

1. Connection between SS, the faders, AWGN noise source and the UE is shown in TS 38.508-1 [6] Annex A, Figure A.3.3.2 for TE diagram and Figure A.3.4.2 for UE diagram.
2. The parameter settings for the NR cell are set up according to Table 7.2-1 and Table 7.2.2.2.1.0-2 and as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-2 [8].
4. Propagation conditions for NR cell are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR for SA with *Connected without release On, Test Mode On* or EN-DC, DC bearer *MCG* and *SCG, Connected without release On, Test Mode On for NSA* according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 7.2.2.2.1_1.3.3.

7.2.2.2.1_1.3.2 Test Procedure

1. Set the UE in a direction that satisfies the 3 normative criteria specified in Annex H.0.If no direction found, mark the test as inconclusive.
2. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Tables 7.2.2.2.1_1.4-1 and 7.2.2.2.1_1.4-2.. The SS sends downlink MAC padding bits on the DL RMC.
3. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix and the SNR according to Tables 7.2.2.2.1_1.4-1 and 7.2.2.2.1_1.4-2 as appropriate.
4. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex G.1.5. Count the number of NACKs, ACKs and statDTXs on the UL during each subtest and decide pass or fail according to Tables G.1.5-1 in Annex G.
5. Repeat steps from 1 to 4 for each subtest in Tables 7.2.2.2.1_1.4-1 and 7.2.2.2.1_1.4-2 as appropriate.

7.2.2.2.1_1.3.3 Message Contents

Message contents are according to TS 38.508-1 [6] subclause 4.6.1 and 5.4.2 with the following exceptions:

7.2.2.2.1_1.3.3_1 Message exceptions for SA

Table 7.2.2.2.1_1.3.3_1-1: SchedulingRequestResourceConfig

Derivation Path: TS 38.508-1 [6], Table 4.6.3-157			
Information Element	**Value/remark**	**Comment**	**Condition**
SchedulingRequestResourceConfig ::= SEQUENCE {			
periodicityAndOffset CHOICE {			
sl80	7	Test point 2-1, 2-3, 2-6	
}			
}			

Table 7.2.2.2.1_1.3.3_1-2: CSI-RS-ResourceMapping for TRS

Derivation Path: TS 38.508-1 [6] Table 4.6.3-45			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
firstOFDMSymbolInTimeDomain	3	l_0 = 3 for CSI-RS resource 1 and 3	TRS, Test 1-1, 1-2
	7	l_0 = 7 for CSI-RS resource 2 and 4	TRS, Test 1-1, 1-2
nrofPorts	p1	1 for CSI-RS resource 1,2,3,4	TRS
}			

Table 7.2.2.2.1_1.3.3_1-3: CSI-ResourcePeriodicityAndOffset for TRS

Derivation Path: TS 38.508-1 [6] Table 4.6.3-43			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourcePeriodicityAndOffset ::= CHOICE {			
Slots160	82	Periodicity 20 slots and offset 10 for CSI-RS resource 1 and 2	
Slots160	83	Periodicity 20 slots and offset 11 for CSI-RS resource 3 and 4	
}			

Table 7.2.2.2.1_1.3.3_1-4: PDCCH *Search Space*

Derivation Path: TS 38.508-1 [6] Table 4.6.3-162			
Information Element	**Value/remark**	**Comment**	**Condition**
SearchSpace ::= SEQUENCE {			
nrofCandidates SEQUENCE {			
aggregationLevel1	n0		
aggregationLevel2	n0		
aggregationLevel4	n1		Test 2-3
aggregationLevel8	n1	AL8	Other than test 2-3
aggregationLevel16	n0		
}			
}			

Table 7.2.2.2.1_1.3.3_1-5: DMRS-DownlinkConfig

Derivation Path: TS 38.508-1 [6] Table 4.6.3-50			
Information Element	**Value/remark**	**Comment**	**Condition**
DMRS-DownlinkConfig ::= SEQUENCE {			
dmrs-Type	Type 1		
dmrs-AdditionalPosition	pos1		
maxLength	len1		
}			

Table 7.2.2.2.1_1.3.3_1-6: *PDSCH-Config*

Derivation Path: TS 38.508-1 [6] Table 4.6.3-100			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-Config ::= SEQUENCE {			
vrb-ToPRB-Interleaver	Not present		
resourceAllocation	resourceAllocationType0		
pdsch-AggregationFactor	Not present		
prb-BundlingType CHOICE {			
staticBundling SEQUENCE {			
bundleSize	Not present	PRB Bundling size of 2	Other than test 1-1
	Wideband		Test 1-1
}			
}			
}			

Table 7.2.2.2.1_1.3.3_1-7: PDSCH-ServingCellConfig

Derivation Path: TS 38.508-1 [6] Table 4.6.3-102			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-ServingCellConfig ::= SEQUENCE {			
nrofHARQ-ProcessesForPDSCH	Set according to the test id		8 for Test 1-1, 1-3, 2-2, 2-4 10 for Test 2-1, 2-3, 2-5, 2-6, 3-1 16 for Test 1-2
}			

7.2.2.2.1_1.3.3_2 Message exceptions for NSA

Same as 7.2.2.2.1_1.3.3_1.

7.2.2.2.1_1.4 Test Requirements

Tables 7.2.2.2.1_1.4-1 and 7.2.2.2.1_1.4-2 defines the primary level settings.

The fraction of maximum throughput percentage for the downlink reference measurement channels specified in Annex A.3.2 for each throughput test shall meet or exceed the specified value in Tables 7.2.2.2.1_1.4-1 and 7.2.2.2.1_1.4-2 for the specified SNR including test tolerances for all throughput tests.

Table 7.2.2.2.1_1.4-1: Test Requirement for Rank 1 (FRC)

Test num.	Reference channel	Bandwidth (MHz)/Subcarrier spacing (kHz)	Modulation and code rate	TDD UL-DL pattern	Propagation condition	Correlation matrix and antenna configuration	Reference value	
							Fraction of maximum throughput (%)	SNR_{BB} (dB)
1-1	R.PDSCH.5-1.1TDD	100/120	QPSK, 0.30	FR2.120-1 A	TDLC60-300	2x2 ULA Low	70	1.4
1-2	R.PDSCH.5-2.1TDD	100/120	16QAM, 0.48	FR2.120-1	TDLA30-300	2x2 ULA Low	30	3.6
1-3	R.PDSCH.5-3.1TDD	100/120	64QAM, 0.46	FR2.120-1	TDLA30-300	2x2 XPL Medium	70	14.2

Table 7.2.2.2.1_1.4-2: Test Requirement for Rank 2 (FRC)

Test num.	Reference channel	Bandwidth (MHz)/Subcarrier spacing (kHz)	Modulation and code rate	TDD UL-DL pattern	Propagation condition	Correlation matrix and antenna configuration	Reference value	
							Fraction of maximum throughput (%)	SNR_{BB} (dB)
2-1	R.PDSCH.5-4.1TDD	100/120	QPSK, 0.30	FR2.120-2	TDLA30-75	2x2 ULA Low	70	5.8
2-2	R.PDSCH.5-2.2TDD	100/120	16QAM, 0.48	FR2.120-1	TDLA30-300	2x2 ULA Low	70	16.0
2-3	R.PDSCH.5-5.2TDD	50/120	16QAM,0.48	FR2.120-2	TDLA30-75	2x2 ULA Low	70	15.7
2-4	R.PDSCH.5-2.3TDD	200/120	16QAM, 0.48	FR2.120-1	TDLA30-300	2x2 ULA Low	70	15.8
2-5	R.PDSCH.4-1.1TDD	50/60	16QAM, 0.48	FR2.60-1	TDLA30-75	2x2 ULA Low	70	16
2-6	R.PDSCH.5-6.1TDD	100/120	64QAM, 0.43	FR2.120-2	TDLA30-75	2x2 ULA Low	70	20.3

7.2.2.2.1_2 2Rx TDD FR2 PDSCH mapping Type A performance - 2x2 MIMO with enhanced type 1 receiver for SA and NSA

7.2.2.2.1_2.1 Test Purpose

Verify the PDSCH mapping Type A normal performance with different channel models, MCSs and number of MIMO layers.

7.2.2.2.1_2.2 Test Applicability

This test applies to all types of NR UE release 15 and forward supporting NR enhanced receiver type 1.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC and NR enhanced receiver type 1.

7.2.2.2.1_2.3 Test Description

Same test description as in clause 7.2.2.2.1_1.3 with following exception:

- Table 7.2.2.2.1_2.4-1 instead of Tables 7.2.2.2.1_1.4-1 and 7.2.2.2.1_1.4-2

7.2.2.2.1_2.3.1 Message contents

Message contents are according to TS 38.508-1 [6] subclause 4.6.1 and 5.4.2 with the following exceptions:

7.2.2.2.1_2.3.1_1 Message exceptions for SA

Same as 7.2.2.2.1_1.3.3_1 with following exceptions:

Table 7.2.2.2.1_2.3.1_1-1: SchedulingRequestResourceConfig

Derivation Path: TS 38.508-1 [6], Table 4.6.3-157			
Information Element	**Value/remark**	**Comment**	**Condition**
SchedulingRequestResourceConfig ::= SEQUENCE {			
periodicityAndOffset CHOICE {			
sl80	7		Test 3-1
}			
}			

7.2.2.2.1_2.3.1_2 Message exceptions for NSA

Same as 7.2.2.2.1_2.3.1_1.

7.2.2.2.1_2.4 Test Requirements

Table 7.2.2.2.1_2.4-1 defines the primary level settings.

The fraction of maximum throughput percentage for the downlink reference measurement channels specified in Annex A.3.2 for each throughput test shall meet or exceed the specified value in Table 7.2.2.2.1_2.4-1 for the specified SNR including test tolerances for all throughput tests.

Table 7.2.2.2.1_2.4-1: Test Requirement for Rank 2 (FRC) for Enhanced Type 1 Receiver

Test num.	Reference channel	Bandwidth (MHz)/Subcarrier spacing (kHz)	Modulation and code rate	TDD UL-DL pattern	Propagation condition	Correlation matrix and antenna configuration	Reference value	
							Fraction of maximum throughput (%)	SNR_{BB} (dB)
3-1	R.PDSCH.5-5.1TDD	100/120	16QAM, 0.48	FR2.120-2	TDLA30-75	2x2 ULA Med	70	20.7

7.2.2.2.1_3 2Rx TDD FR2 PDSCH mapping Type A performance - 2x2 MIMO with 256QAM for SA and NSA (Rel-16 and forward)

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

- Test point applicability is TBD for all bands in Table 7.1.1_1-2.

7.2.2.2.1_3.1 Test Purpose

Verify the PDSCH mapping Type A normal performance with different channel models, MCSs and number of MIMO layers.

7.2.2.2.1_3.2 Test Applicability

This test applies to all types of NR UE release 16 and forward supporting 256QAM for PDSCH.

This test also applies to all types of EUTRA UE release 16 and forward supporting EN-DC and NR 256QAM for PDSCH.

7.2.2.2.1_3.3 Test Description

Same test description as in clause 7.2.2.2.1_1.3 with following exception:

- Table 7.2.2.2.1_3.4-1 instead of Table 7.2.2.2.1_1.4-1

7.2.2.2.1_3.3.1 Message contents

Message contents are according to TS 38.508-1 [6] clause 5.4.2 with the following exceptions:

7.2.2.2.1_3.3.1_1 Message exceptions for SA

Same as 7.2.2.2.1_1.3.3_1 with following exceptions:

Table 7.2.2.2.1_3.3.1_1-1: SchedulingRequestResourceConfig

Derivation Path: TS 38.508-1 [6], Table 4.6.3-157			
Information Element	**Value/remark**	**Comment**	**Condition**
SchedulingRequestResourceConfig ::= SEQUENCE {			
periodicityAndOffset CHOICE {			
sl80	7		Test 1-4
}			
}			

Table 7.2.2.2.1_3.3.1_1-2: *SearchSpace*

Derivation Path: TS 38.508-1 Table 4.6.3-162			
Information Element	**Value/remark**	**Comment**	**Condition**
SearchSpace ::= SEQUENCE {			
nrofCandidates SEQUENCE {			
aggregationLevel1	n0		
aggregationLevel2	n0		
aggregationLevel4	n1	AL4	Test 1-4
aggregationLevel8	n0		
aggregationLevel16	n0		
}			
}			

Table 7.2.2.2.1_3.3.1_1-3: PDSCH-Config

Derivation Path: TS 38.508-1 Table 5.4.2.0-26 with condition DEMOD_FR2			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-Config ::= SEQUENCE {			
mcs-Table	qam256		Test 1-4
}			

Table 7.2.2.2.1_3.3.1_1-4: PDSCH-ServingCellConfig

Derivation Path: TS 38.508-1 Table 5.4.2.0-25 with condition DEMOD_FR2			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-ServingCellConfig ::= SEQUENCE {			
nrofHARQ-ProcessesForPDSCH	8		Test 1-4
}			

7.2.2.2.1_3.3.1_2 Message exceptions for NSA

Same as 7.2.2.2.1_3.3.1_1.

7.2.2.2.1_3.4 Test Requirements

Table 7.2.2.2.1.0-2 defines the primary level settings.

The fraction of maximum throughput percentage for the downlink reference measurement channels specified in Annex A.3.2 for each throughput test shall meet or exceed the specified value in Table 7.2.2.2.1_3.4-1 for the specified SNR including test tolerances for all throughput tests.

Table 7.2.2.2.1_3.4-1: Test Requirement for Rank 1 (FRC) for 256QAM

Test num.	Reference channel	Bandwidth (MHz)/Subcarrier spacing (kHz)	Modulation and code rate	TDD UL-DL pattern	Propagation condition	Correlation matrix and antenna configuration	Reference value	
							Fraction of maximum throughput (%)	SNR_{BB} (dB)
1-4	R.PDSCH.5-10.1 TDD	50/120	256QAM 0.67	FR2.120-1	TDLD30-75	2x2 ULA Low	70	22.0

7.2.2.2.2 2Rx TDD FR2 PDSCH repetitions over multiple slots

7.2.2.2.2_0 Minimum conformance requirements

For PDSCH with slot aggregation, the requirements are specified in Table 7.2.2.2.2_0-3, additional parameters in Table 7.2.2.2.2_0-2 and the downlink physical channel setup according to Annex C.5.1.

The test purpose is specified in Table 7.2.2.2.2_0-1.

Table 7.2.2.2.2_0-1: Test purpose

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

Table 7.2.2.2.2_0-2: Test Parameters

Parameter		Unit	Value
Duplex mode			TDD
Active DL BWP index			1
PDSCH configuration	Mapping type		Type A
	k0		0
	Starting symbol (S)		1
	Length (L)		13
	PDSCH aggregation factor		2
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS configuration	DMRS Type		Type 1
	Number of additional DMRS		1
	Maximum number of OFDM symbols for DL front loaded DMRS		1
Number of HARQ Processes			2
The number of slots between final repetition of PDSCH and corresponding HARQ-ACK information			As defined in Annex A.1.3 (Note 1)
Note 1: ACK/NACK feedback is generated for PDSCH on slot i, where mod(i,4) = 1, where i is the slot index per frame; i = {0,...,79}			

Table 7.2.2.2.2_0-3: Minimum performance for Rank 1 (FRC)

Test num	Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Modulation and code rate	TDD UL-DL pattern	Propagation condition	Correlation matrix and antenna configuration	Reference value	
							Target BLER	SNR (dB)
1-1	R.PDSCH.5-11.1 TDD	100 / 120	16QAM, 0.37	FR2.120-2	TDLA30-75	2x2 ULA Low	1% (Note 1)	-1.1
Note 1: BLER is defined as residual BLER; i.e. ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block.								

The normative reference for this requirement is TS 38.101-4 [5] clause 7.2.2.2.2.

7.2.2.2.2_1 2Rx TDD FR2 PDSCH repetitions over multiple slots - 2x2 MIMO with baseline receiver for SA and NSA

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

- MU factor due to finite test time needs further study

- Test point applicability is TBD for all bands in Table 7.1.1_1-2.

7.2.2.2.2_1.1 Test Purpose

Verify the PDSCH repetitions over multiple slots performance under 2 receive antenna conditions.

7.2.2.2.2_1.2 Test Applicability

This test applies to all types of NR UE release 16 and forward supporting capability IE *pdsch-RepetitionMultiSlots-r16*.

This test also applies to all types of EUTRA UE release 16 and forward supporting EN-DC supporting capability IE *pdsch-RepetitionMultiSlots-r16*.

7.2.2.2.2_1.3 Test Description

7.2.2.2.2_1.3.1 Initial Conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.2-1 of TS 38.521-2 [8].

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

Only sub tests shall be tested which are testable according to Table 7.1.1_1-2.

For EN-DC within FR2 operation, setup the LTE radiated link according to Annex D:

1. Connection between SS, the faders, AWGN noise source and the UE is shown in TS 38.508-1 [6] Annex A, Figure A.3.3.2 for TE diagram and Figure A.3.4.2 for UE diagram.

2. The parameter settings for the NR cell are set up according to Table 7.2-1 and Table 7.2.2.2.2.0-2 and as appropriate.

3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-2 [8].

4. Propagation conditions for NR cell are set according to Annex B.0.

5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR for SA with *Connected without release On, Test Mode On* or EN-DC, DC bearer *MCG* and *SCG, Connected without release On, Test Mode On for NSA* according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 7.2.2.2.2_1.3.3.

7.2.2.2.2_1.3.2 Test Procedure

1. Set the UE in a direction that satisfies the 3 normative criteria specified in Annex H.0.If no direction found, mark the test as inconclusive.

2. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Tables 7.2.2.2.2_1.4-1. The SS sends downlink MAC padding bits on the DL RMC. The UE may expect that the TB is repeated with same symbol allocation among each of the *pdsch-AggregationFactor* consecutive slots.

3. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix and the SNR according to Tables 7.2.2.2.2_1.4-1 as appropriate.

4. Measure the BLER for a duration sufficient to achieve statistical significance according to Annex G clause G.1.5. Count the number of correctly and incorrectly received transport blocks based on ACK/NACK feedback on the UL during each subtest and decide pass or fail according to Tables G.1.5-1a in Annex G.

7.2.2.2.2_1.3.3 Message Contents

Message contents are according to TS 38.508-1 [6] subclause 4.6.1 and 5.4.2 with the following exceptions:

7.2.2.2.2_1.3.3_1 Message exceptions for SA

Table 7.2.2.2.2_1.3.3_1-1: SchedulingRequestResourceConfig

Derivation Path: TS 38.508-1 [6], Table 4.6.3-157			
Information Element	**Value/remark**	**Comment**	**Condition**
SchedulingRequestResourceConfig ::= SEQUENCE {			
periodicityAndOffset CHOICE {			
sl80	7		
}			
}			

Table 7.2.2.2.2_1.3.3_1-2: *PDSCH-Config*

Derivation Path: TS 38.508-1 [6] Table 4.6.3-100			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-Config ::= SEQUENCE {			
pdsch-AggregationFactor	2		
}			

Table 7.2.2.2.2_1.3.3_1-3: PDSCH-ServingCellConfig

Derivation Path: TS 38.508-1 [6] Table 4.6.3-102			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-ServingCellConfig ::= SEQUENCE {			
nrofHARQ-ProcessesForPDSCH	4		
}			

7.2.2.2.2_1.3.3_2 Message exceptions for NSA

Same as 7.2.2.2.2_1.3.3_1.

7.2.2.2.2_1.4 Test Requirements

Table 7.2.2.2.2_1.4-1 defines the primary level settings.

The target BLER percentage for the downlink reference measurement channels specified in Annex A.3.2.2 for each BLER test shall meet or exceed the specified value in Table 7.2.2.2.2_1.4-1 for the specified SNR including test tolerances for all BLER tests.

Table 7.2.2.2.2_1.4-1: Test Requirement for Rank 1

Test num	Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Modulation and code rate	TDD UL-DL pattern	Propagation condition	Correlation matrix and antenna configuration	Reference value	
							Target BLER	SNR (dB)
1-1	R.PDSCH.5-11.1 TDD	100 / 120	16QAM, 0.37	FR2.120-2	TDLA30-75	2x2 ULA Low	1% (Note 1)	-1.1+TT
Note 1: BLER is defined as residual BLER; i.e. ratio of incorrectly received transport blocks / sent transport blocks, independently of the number HARQ transmission(s) for each transport block.								

7.2.2.2.3 2Rx TDD FR2 PDSCH Mapping Type B

7.2.2.2.3_0 Minimum conformance requirements

The performance requirements are specified in Table 7.2.2.2.3.0-3, with the addition of test parameters in Table 7.2.2.2.3.0-2 and the downlink physical channel setup according to Annex C.5.1. The purpose is to verify the performance of PDSCH Type B scheduling.

The test purposes are specified in Table 7.2.2.2.3.0-1.

Table 7.2.2.2.3.0-1: Test purpose

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

Table 7.2.2.2.3.0-2: Test parameters

Parameter		Unit	Value
Duplex mode			TDD
Active DL BWP index			1
PDCCH configuration	Number of PDCCH candidates and aggregation levels		1/AL8
PDSCH configuration	Mapping type		Type B
	k0		0
	Starting symbol (S)		1
	Length (L)		2
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS configuration	DMRS Type		Type 1
	Number of additional DMRS		0
	Maximum number of OFDM symbols for DL front loaded DMRS		1
Number of HARQ Processes			8
The number of slots between PDSCH and corresponding HARQ-ACK information			Specific to each TDD UL-DL pattern and as defined in Annex A.1.3

Table 7.2.2.2.3.0-3: Minimum performance for Rank 1

Test num.	Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	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.5-1.2 TDD	100 / 120	QPSK, 0.30	FR2.120-1	TDLA30-75	2x2, ULA Low	70	1.3

The normative reference for this requirement is TS 38.101-4 [5] clause 7.2.2.2.3.

7.2.2.2.3_1 2Rx TDD FR2 PDSCH mapping Type B performance - 2x2 MIMO with baseline receiver for SA and NSA

7.2.2.2.3_1.1 Test Purpose

Verify the PDSCH mapping Type B performance under 2 receive antenna conditions.

7.2.2.2.3_1.2 Test Applicability

This test applies to all types of NR UE release 16 and forward supporting PDSCH mapping type B.

This test also applies to all types of EUTRA UE release 16 and forward supporting EN-DC and PDSCH mapping type B.

7.2.2.2.3_1.3 Test Description

7.2.2.2.3_1.3.1 Initial Conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.2-1 of TS 38.521-2 [8].

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

Only sub tests shall be tested which are testable according to Table 7.1.1_1-2.

For EN-DC within FR2 operation, setup the LTE radiated link according to Annex D:

1. Connection between SS, the faders, AWGN noise source and the UE is shown in TS 38.508-1 [6] Annex A, Figure A.3.3.2 for TE diagram and Figure A.3.4.2 for UE diagram.
2. The parameter settings for the NR cell are set up according to Table 7.2-1 and Table 7.2.2.2.3.0-2 and as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-2 [8].
4. Propagation conditions for NR cell are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR for SA with *Connected without release On, Test Mode On* or EN-DC, DC bearer *MCG* and *SCG, Connected without release On, Test Mode On for NSA* according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 7.2.2.2.3_1.3.3.

7.2.2.2.3_1.3.2 Test Procedure

1. Set the UE in a direction that satisfies the 3 normative criteria specified in Annex H.0.If no direction found, mark the test as inconclusive.
2. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Tables 7.2.2.2.3_1.4-1. The SS sends downlink MAC padding bits on the DL RMC.
3. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix and the SNR according to Tables 7.2.2.2.3_1.4-1 as appropriate.
4. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex G.1.5. Count the number of NACKs, ACKs and statDTXs on the UL during each subtest and decide pass or fail according to Tables G.1.5-1 in Annex G.

7.2.2.2.3_1.3.3 Message Contents

Message contents are according to TS 38.508-1 [6] subclause 4.6.1 and 5.4.2 with the following exceptions:

7.2.2.2.3_1.3.3_1 Message exceptions for SA

Table 7.2.2.2.3_1.3.3_1-3: PDSCH-ServingCellConfig

Derivation Path: TS 38.508-1 [6] Table 4.6.3-102			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-ServingCellConfig ::= SEQUENCE {			
nrofHARQ-ProcessesForPDSCH	8		
}			

Table 7.2.2.2.3_1.3.3_1-4: PDSCH-TimeDomainResourceAllocationList

Derivation Path: TS 38.508-1 [6], Table 4.6.3-103			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-TimeDomainResourceAllocationList::= SEQUENCE(SIZE(1..maxNrofDL-Allocations)) OF {	2 entry		
PDSCH-TimeDomainResourceAllocation[1] SEQUENCE {			
K0	Not present		
mappingType	typeB		
startSymbolAndLength	15	Start symbol(S)=1, Length(L)=2	
}			
}			

7.2.2.2.3_1.3.3_2 Message exceptions for NSA

Same as 7.2.2.2.3_1.3.3_1.

7.2.2.2.3_1.4 Test Requirements

Table 7.2.2.2.3_1.4-1 defines the primary level settings.

The fraction of maximum throughput percentage for the downlink reference measurement channels specified in Annex A.3.2 for each throughput test shall meet or exceed the specified value in Table 7.2.2.2.3_1.4-1 for the specified SNR including test tolerances for all throughput tests.

Table 7.2.2.2.3_1.4-1: Test Requirement for Rank 1

Test num.	Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	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.5-1.2 TDD	100 / 120	QPSK, 0.30	FR2.120-1	TDLA30-75	2x2, ULA Low	70	3.1

7.2A PDSCH demodulation requirements for CA

The parameters specified in Table 7.2-1 for PDSCH single carrier tests are reused for PDSCH CA test unless otherwise stated.

7.2A.1 1RX requirements (Void)

7.2A.2 2RX requirements

7.2A.2.0 Minimum conformance requirements

For CA with different numbers of DL component carriers, the requirements are defined in Table 7.2A.2.0-3-3 based on the single carrier requirements for different bandwidth specified in Table 7.2A.2.0-2, with the parameters in Table 7.2A.2.0-1 and the downlink physical channel setup according to Annex C.2.2. The performance requirements specified in this sub-clause do not apply for UE single carrier test.

Table 7.2A.2.0-1: Test parameters for CA

Parameter		Unit	Value
Duplex mode			TDD
Active DL BWP index			1
PDSCH configuration	Mapping type		Type A
	k0		0
	Starting symbol (S)		1
	Length (L)		Specific to each Reference channel
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS configuration	DMRS Type		Type 1
	Number of additional DMRS		1
	Maximum number of OFDM symbols for DL front loaded DMRS		1
Number of HARQ Processes			8
TDD UL-DL pattern			120kHz SCS: FR2.120-1
The number of slots between PDSCH and corresponding HARQ-ACK information			As defined in Annex A.1.3

Table 7.2A.2.0-2: Single carrier performance for TDD 120 kHz SCS for CA configurations

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

Table 7.2A.2.0-3: Minimum performance for multiple CA configurations

Test number	CA duplex mode	Minimum performance requirements
1	TDD 120 kHz + TDD 120 kHz	As defined in Table 7.2A.2.1_0-2
Note 1: The applicability of requirements for different CA duplex modes, SCSs, CA configurations and bandwidth combination sets is defined in 7.1.1.5.		

The normative reference for this requirement is TS 38.101-4 [5] clause 7.2A.2.1

7.2A.2.1 2Rx TDD FR2 CA requirements for normal PDSCH Demodulation Performance for both SA and NSA (2DLCA)

7.2A.2.1.1 Test Purpose

Verify the PDSCH mapping Type A normal performance with different channel models, MCSs and number of MIMO layers.

7.2A.2.1.2 Test Applicability

This test applies to all types of NR UE release 15 and forward that support NR 2DL CA.

7.2A.2.1.3 Test Description

7.2A.2.1.3.1 Initial Conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 of 38.521-2.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

CA capability to be tested: Any one of the supported CA capability as per the selection criteria specified in Table 7.1.1.5.2-2.

For EN-DC within FR2 operation, setup the LTE radiated link according to Annex D:

1. Connection between SS, the faders, AWGN noise source and the UE is shown in TS 38.508-1 [6] Annex A, Figure A.3.3.2 for TE diagram and Figure A.3.4.2 for UE diagram.

2. The parameter settings for the NR cell are set up according to Table 7.2-1, 7.2A.2.0-1 and Table 7.2A.2.0-2 as appropriate.

3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-2 [8].

4. Propagation conditions for NR cell are set according to Annex B.0.

6. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR for SA with *Connected without release On, Test Mode On* or EN-DC, DC bearer *MCG* and *SCG, Connected without release On, Test Mode On for NSA* according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 7.2A.2.1.3.3.

7.2A.2.1.3.2 Test Procedure

1. Set the UE in a direction that satisfies the 3 normative criteria specified in Annex H.0. If no direction found, mark the test as inconclusive.

2. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Table 7.2A.2.1.4-1. The SS sends downlink MAC padding bits on the DL RMC.

3. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix and the SNR according to Table 7.2A.2.1.4-1

4. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex G.1.5. Count the number of NACKs, ACKs and statDTXs on the UL during each subtest and decide pass or fail according to Tables G.1.5-1 in Annex G.

5. Repeat steps from 1 to 4 for each subtest in Table 7.2A.2.1.4-1.

7.2A.2.1.3.3 Message Contents

Message contents are according to TS 38.508-1 [6] subclause 4.6.1 and 5.4.2

7.2A.2.1.4 Test Requirements

Table 7.2A.2.1.4-1: Single carrier performance for TDD 120 kHz SCS for CA configurations

Bandwidth (MHz)	Reference channel	Modulation format and code rate	Propagation condition	Correlation matrix and antenna configuration	Reference value	
					Fraction of maximum throughput (%)	SNR (dB)
50	R.PDSCH.5-9.1 TDD	16QAM, 0.33	TDLA30-75	2x2, ULA Low	70	12.1
100	R.PDSCH.5-9.2 TDD	16QAM, 0.33	TDLA30-75	2x2, ULA Low	70	11.9
200	R.PDSCH.5-9.3 TDD	16QAM, 0.33	TDLA30-75	2x2, ULA Low	70	12.0
400	R.PDSCH.5-9.4 TDD	16QAM, 0.33	TDLA30-75	2x2, ULA Low	70	12.0

7.2A.2.2 2Rx TDD FR2 CA requirements for normal PDSCH Demodulation Performance for both SA and NSA (3DLCA)

7.2A.2.2.1 Test Purpose

Same as 7.2A.2.1.1

7.2A.2.2.2 Test Applicability

This test applies to all types of NR UE release 15 and forward that support NR 3DL CA.

7.2A.2.2.3 Test Description

7.2A.2.2.3.1 Initial Conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 of 38.521-2.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 4.3.1.1.

CA capability to be tested: Any one of the supported CA capability as per the selection criteria specified in Table 7.1.1.5.2-2.

For EN-DC within FR2 operation, setup the LTE radiated link according to Annex D:

1. Connection between SS, the faders, AWGN noise source and the UE is shown in TS 38.508-1 [6] Annex A, Figure A.3.3.2 for TE diagram and Figure A.3.4.2 for UE diagram.
2. The parameter settings for the NR cell are set up according to Table 7.2-1, 7.2A.2.0-1 and Table 7.2A.2.0-2 as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-2 [8].

4. Propagation conditions for NR cell are set according to Annex B.0.

6. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR for SA with *Connected without release On, Test Mode On* or EN-DC, DC bearer *MCG* and *SCG, Connected without release On, Test Mode On for NSA* according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 7.2A.2.1.3.3.

7.2A.2.2.3.2 Test Procedure

1. Set the UE in a direction that satisfies the 3 normative criteria specified in Annex H.0. If no direction found, mark the test as inconclusive.

2. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Table 7.2A.2.2.4-1 on each CC. The SS sends downlink MAC padding bits on the DL RMC.

3. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix and the SNR according to Table 7.2A.2.2.4-1.

4. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex G.1.5. Count the number of NACKs, ACKs and statDTXs on the UL during each subtest and decide pass or fail according to Tables G.1.5-1 in Annex G.

5. Repeat steps from 1 to 4 for each subtest in Table 7.2A.2.2.4-1.

7.2A.2.2.3.3 Message Contents

Same as 7.2A.2.1.3.3

7.2A.2.2.4 Test Requirements

Table 7.2A.2.2.4-1: Single carrier performance for TDD 120 kHz SCS for CA configurations

Bandwidth (MHz)	Reference channel	Modulation format and code rate	Propagation condition	Correlation matrix and antenna configuration	Reference value	
					Fraction of maximum throughput (%)	SNR (dB)
50	R.PDSCH.5-9.1 TDD	16QAM, 0.33	TDLA30-75	2x2, ULA Low	70	12.1
100	R.PDSCH.5-9.2 TDD	16QAM, 0.33	TDLA30-75	2x2, ULA Low	70	11.9
200	R.PDSCH.5-9.3 TDD	16QAM, 0.33	TDLA30-75	2x2, ULA Low	70	12.0
400	R.PDSCH.5-9.4 TDD	16QAM, 0.33	TDLA30-75	2x2, ULA Low	70	12.0

7.3 PDCCH demodulation requirements

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

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

Table 7.3-1: Common test Parameters

Parameter	Unit		Value	Parameter
Carrier configuration	Offset between Point A and the lowest usable subcarrier on this carrier (Note 1)			0
DL BWP configuration #1	Cyclic prefix			Normal
Common serving cell parameters	Physical Cell ID			0
	SSB position in burst			1
	SSB periodicity		ms	20
PDCCH configuration	Slots for PDCCH monitoring			Each slot
	Number of PDCCH candidates			1
	Frequency domain resource allocation for CORESET			Start from RB = 0 with contiguous RB allocation
	TCI state			TCI state #1
CSI-RS for tracking	First subcarrier index in the PRB used for CSI-RS (k0)			0
	First OFDM symbol in the PRB used for CSI-RS (l0)			CSI-RS resource 1: 4 CSI-RS resource 2: 8 CSI-RS resource 3: 4 CSI-RS resource 4: 8
	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
	Frequency Occupation			Start PRB 0 Number of PRB = BWP size
	QCL info			TCI state #0
NZP CSI-RS for beam management	First subcarrier index in the PRB used for CSI-RS (k0)			0
	First OFDM symbol in the PRB used for CSI-RS (l0)			CSI-RS resource 1: 8 CSI-RS resource 2: 9
	Number of CSI-RS ports (X)			1
	CDM Type			No CDM
	Density (ρ)			3
	CSI-RS periodicity		Slots	120 kHz SCS: 160 for CSI-RS resource 1,2
	CSI-RS offset		Slots	0 for CSI-RS resource 1,2
	Repetition			ON
	QCL info			TCI state #1
PDCCH & PDCCH DMRS Precoding configuration				Single Panel Type I, Random per slot with equal probability of each applicable i_1, i_2 combination, and with REG bundling granularity for number of Tx larger than 1
TCI state #0	Type 1 QCL information	SSB index		SSB #0
		QCL Type		Type C
	Type 2 QCL information	SSB index		SSB #0
		QCL Type		Type D
TCI state #1	Type 1 QCL information	CSI-RS resource		CSI-RS resource 1 from 'CSI-RS for tracking' configuration
		QCL Type		Type A
	Type 2 QCL information	CSI-RS resource		CSI-RS resource 1 from 'CSI-RS for

				tracking' configuration
		QCL Type		Type D
Physical signals, channels mapping and precoding				As specified in Annex B.4.1
Symbols for all unused REs				OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1
The number of slots between PDSCH and corresponding HARQ-ACK information				Specific to each TDD UL-DL pattern and as defined in Annex A.1.3.
Note 1: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-2 [3] for tested channel bandwidth and subcarrier spacing.				

7.3.1 1RX requirements

(Void)

7.3.2 2RX requirements

7.3.2.1 FDD

(Void)

7.3.2.2 TDD

7.3.2.2.1 2Rx TDD FR2 PDCCH 1 Tx antenna performance for both SA and NSA

7.3.2.2.1.1 Test Purpose

This test verifies the demodulation performance of PDCCH for a single-antenna port with a given SNR for which the average probability of miss-detection of the Downlink Scheduling Grant (Pm-dsg), shall be below the specified value in Table 7.3.2.2.1.3-1.

7.3.2.2.1.2 Test Applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

7.3.2.2.1.3 Minimum conformance requirements

For the parameters specified in Table 7.3.2.2.1.3-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 7.3.2.2.1.3-2. The downlink physical setup is in accordance with Annex C.2.2.

Table 7.3.2.2.1.3-1: Test Parameters

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

Table 7.3.2.2.1.3-2: Minimum performance requirements with 120 kHz SCS for 1Tx antenna

Test number	Bandwidth	CORESET RB	CORESET duration	Aggregation level	Reference Channel	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
								Pm-dsg (%)	SNR_{BB} (dB)
1-1	100 MHz	60	1	2 CCE	R.PDCCH.5-1.1 TDD	TDLA30-75	1x2 Low	1	6.0
1-2	100 MHz	60	1	4 CCE	R.PDCCH.5-1.2 TDD	TDLA30-300	1x2 Low	1	2.6

The normative reference for this requirement is TS 38.101-4 [5] clause 7.3.2.2.1.

7.3.2.2.1.4 Test Description

7.3.2.2.1.4.1 Initial Conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.2-1 of TS 38.521-2 [8].

Configurations of PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

Only sub tests shall be tested which are testable according to Table 7.1.1_1-2.

For EN-DC within FR2 operation, setup the LTE link according to Annex D:

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.3.2 for TE diagram and Figure A.3.4.2 for UE diagram.
2. The parameter settings for the cell are set up according to Table 7.3-1 and Table 7.3.2.2.1.3-1 as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-2 [8].
4. Propagation conditions are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR for SA with *Connected without release On, Test Mode On* or EN-DC, DC bearer *MCG* and *SCG, Connected without Release On, Test Mode On* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 7.3.2.2.1.4.3.

7.3.2.2.1.4.2 Test procedure

1. Set the UE in a direction found using one of the test procedures defined in Annex H. If no direction found, mark the test as inconclusive.
2. SS transmits PDCCH with DCI format as specified in PDCCH Reference Channel for C_RNTI to transmit the DL RMC according to Table 7.3.2.2.1.4.4-1. The details of PDCCH are specified in Table 7.3.2.2.1.3-1 and Table 7.3.2.2.1.3-2. The details of PDSCH are specified in Table A.3.3.2.5-3. The SS sends downlink MAC padding bits on the DL RMC.
3. Set the parameters of the propagation condition, antenna configuration, the correlation matrix and the SNR according to Table 7.3.2.2.1.4.4-1 as appropriate.
4. Measure the Pm-dsg for a duration sufficient to achieve statistical significance according to Annex G clause G.1.5. Count the number of NACKs, ACKs and statDTXs on the UL PUCCH during each subtest interval. Pm-dsg is the ratio (statDTX)/(NACK+ACK+statDTX). If Pm-dsg is less than the value specified in table 7.3.2.2.1.4.4-1, pass the UE. Otherwise fail the UE.

5. Repeat steps from 1 to 4 for each subtest in Table 7.3.2.2.1.4.4-1 as appropriate.

7.3.2.2.1.4.3 Message contents

Message contents are according to TS 38.508-1 [6] subclause 4.6.1 and 5.4.2 with the following exceptions:

7.3.2.2.1.4.3.1 Message exceptions for SA

Table 7.3.2.2.1.4.3.1-1: PDCCH-ControlResourceSet

Derivation Path: TS 38.508-1 [6], Table 5.4.2.0-6			
Information Element	**Value/remark**	**Comment**	**Condition**
ControlResourceSet ::= SEQUENCE {			
frequencyDomainResources	11111111 11000000 00000000 00000000 00000000 00000	CORESET to use the least significant 60 RBs of the BWP	
cce-REG-MappingType CHOICE {			
Interleaved SEQUENCE {	Null		
reg-BundleSize	n2		2 for test 1-1
	n6		6 for test 1-2
interleaverSize	n3		3 for test 1-1
}	n2		2 for test 1-2
}			
}			

Table 7.3.2.2.1.4.3.1-2: PDCCH Search Space

Derivation Path: TS 38.508-1 [6], Table 5.4.2.0-7			
Information Element	**Value/remark**	**Comment**	**Condition**
SearchSpace ::= SEQUENCE {			
nrofCandidates SEQUENCE {			
aggregationLevel2	n1	AL2	Test 1-1
aggregationLevel4	n1	AL4	Test 1-2
}			
}			

7.3.2.2.1.4.3.2 Message exceptions for NSA

Same as 7.3.2.2.1.4.3.1.

7.3.2.2.1.4.4 Test requirement

Table 7.3.2.2.1.4.4-1 defines the primary level settings.

For the parameters specified in Table 7.3.2.2.1.3-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 7.3.2.2.1.4.4-1.

Table 7.3.2.2.1.4.4-1: Test requirements with 120 kHz SCS for 1Tx antenna

Test number	Bandwidth	CORESET RB	CORESET duration	Aggregation level	Reference Channel	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
								Pm-dsg (%)	SNR_{BB} (dB)
1-1	100 MHz	60	1	2 CCE	R.PDCCH.5-1.1 TDD	TDLA30-75	1x2 Low	1	7.7
1-2	100 MHz	60	1	4 CCE	R.PDCCH.5-1.2 TDD	TDLA30-300	1x2 Low	1	4.3

7.3.2.2.2 2Rx TDD FR2 PDCCH 2 Tx antenna performance for both SA and NSA

7.3.2.2.2.1 Test Purpose

This test verifies the demodulation performance of PDCCH for two-antenna port with a given SNR for which the average probability of miss-detection of the Downlink Scheduling Grant (Pm-dsg), shall be below the specified value in Table 7.3.2.2.2.3-1.

7.3.2.2.2.2 Test Applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

7.3.2.2.2.3 Minimum conformance requirements

For the parameters specified in Table 7.3.2.2.2.3-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 7.3.2.2.2.3-2. The downlink physical setup is in accordance with Annex C.2.2.

Table 7.3.2.2.2.3-1: Test Parameters

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

Table 7.3.2.2.2.3-2: Minimum performance requirements with 120 kHz SCS for 2Tx Antenna

Test number	Bandwidth	CORESET RB	CORESET duration	Aggregation level	Reference Channel	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
								Pm-dsg (%)	SNR_{BB} (dB)
2-1	100 MHz	60	1	8 CCE	R.PDCCH.5-1.3 TDD	TDLA30-75	2x2 Low	1	1.4
2-2	100 MHz	60	2	16 CCE	R.PDCCH.5-2.1 TDD	TDLA30-75	2x2 Low	1	-1.6

The normative reference for this requirement is TS 38.101-4 [5] clause 7.3.2.2.2.

7.3.2.2.2.4 Test Description

7.3.2.2.2.4.1 Initial Conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.2-1 of TS 38.521-2 [8].

Configurations of PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

Only sub tests shall be tested which are testable according to Table 7.1.1_1-2.

For EN-DC within FR2 operation, setup the LTE link according to Annex D:

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.3.2 for TE diagram and Figure A.3.4.2 for UE diagram.
2. The parameter settings for the cell are set up according to Table 7.3-1 and Table 7.3.2.2.2.3-1 as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-2 [8].
4. Propagation conditions are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR for SA with *Connected without release On, Test Mode On* or EN-DC, DC bearer *MCG* and *SCG, Connected without Release On, Test Mode On* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 7.3.2.2.1.4.3.

7.3.2.2.2.4.2 Test procedure

1. Set the UE in a direction found using one of the test procedures defined in Annex H If no direction found, mark the test as inconclusive.
2. SS transmits PDCCH with DCI format as specified in PDCCH Reference Channel for C_RNTI to transmit the DL RMC according to Table 7.3.2.2.2.4.4-1. The details of PDCCH are specified in Table 7.3.2.2.2.3-1 and Table 7.3.2.2.2.3-2. The details of PDSCH are specified in Table A.3.3.2.5-3. The SS sends downlink MAC padding bits on the DL RMC.
3. Set the parameters of the propagation condition, antenna configuration, the correlation matrix and the SNR according to Table 7.3.2.2.2.4.4-1 as appropriate.
4. Measure the Pm-dsg for a duration sufficient to achieve statistical significance according to Annex G clause G.1.5. Count the number of NACKs, ACKs and statDTXs on the UL PUCCH during each subtest interval. Pm-dsg is the ratio (statDTX)/(NACK+ACK+statDTX). If Pm-dsg is less than the value specified in table 7.3.2.2.2.4.4-1, pass the UE. Otherwise fail the UE.
5. Repeat steps from 1 to 4 for each subtest in Table 7.3.2.2.2.4.4-1 as appropriate.

7.3.2.2.2.4.3 Message contents

Message contents are according to TS 38.508-1 [6] subclause 4.6.1 and 5.4.2 with the following exceptions:

7.3.2.2.2.4.3.1 Message exceptions for SA

Table 7.3.2.2.2.4.3.1-1: PDCCH-ControlResourceSet

Derivation Path: TS 38.508-1 [6], Table 5.4.2.0-6			
Information Element	**Value/remark**	**Comment**	**Condition**
ControlResourceSet ::= SEQUENCE {			
frequencyDomainResources	11111111 11000000 00000000 00000000 00000000 00000	CORESET to use the least significant 60 RBs of the BWP	
Duration	2	SearchSpace Duration of 2 symbols	Test 2-2
cce-REG-MappingType CHOICE {			
Interleaved SEQUENCE {	Null		
reg-BundleSize	n2		
interleaverSize	n3		
}			
}			
}			

Table 7.3.2.2.2.4.3.1-2: PDSCH-TimeDomainResourceAllocationList

Derivation Path: TS 38.508-1 [6], Table 5.4.2.0-27			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-TimeDomainResourceAllocationList ::= SEQUENCE(SIZE(1..maxNrofDL-Allocations)) OF PDSCH-TimeDomainResourceAllocation {	2 entries		Test 2-2
PDSCH-TimeDomainResourceAllocation[1] SEQUENCE {		entry 1	
K0	Not present		
mappingType	typeA		
startSymbolAndLength	53	Start symbol(S)=2, Length(L)=12	Test 2-2
}			
PDSCH-TimeDomainResourceAllocation[2] SEQUENCE {		entry 2	
K0	Not present		
mappingType	typeA		
startSymbolAndLength	100	Start symbol(S)=2, Length(L)=8	Test 2-2
}			
}			

Table 7.3.2.2.2.4.3.1-3: PDCCH Search Space

Derivation Path: TS 38.508-1 [6], Table 5.4.2.0-7			
Information Element	**Value/remark**	**Comment**	**Condition**
SearchSpace ::= SEQUENCE {			
nrofCandidates SEQUENCE {			
aggregationLevel8	n1	AL8	Test 2-1
aggregationLevel16	n1	AL16	Test 2-2
}			
}			

7.3.2.2.2.4.3.2 Message exceptions for NSA

Same as 7.3.2.2.2.4.3.1.

7.3.2.2.2.4.4 Test requirement

Table 7.3.2.2.2.4.4-1 defines the primary level settings.

For the parameters specified in Table 7.3.2.2.2.3-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 7.3.2.2.2.4.4-1.

Table 7.3.2.2.2.4.4-1: Test requirements with 120 kHz SCS

Test number	Bandwidth	CORESET RB	CORESET duration	Aggregation level	Reference Channel	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
								Pm-dsg (%)	SNR_{BB} (dB)
2-1	100 MHz	60	1	8 CCE	R.PDCCH.5-1.3 TDD	TDLA30-75	2x2 Low	1	3.2
2-2	100 MHz	60	2	16 CCE	R.PDCCH.5-2.1 TDD	TDLA30-75	2x2 Low	1	0.2

7.3.2.2.3 2Rx TDD FR2 PDCCH 1 Tx antenna performance for power saving

7.3.2.2.3.1 Test Purpose

This test verifies the demodulation performance of PDCCH under 2 receive antenna conditions and with a given SNR for which the average probability of miss-detection of the Downlink Scheduling Grant (Pm-dsg), shall be below the specified value in Table 7.3.2.2.3.3-2 after receipt wake-up indication in the *DCI format 2_6* PDCCH in DRX off state. The downlink physical setup is in accordance with Annex C.2.1.

7.3.2.2.3.2 Test applicability

This test applies to all types of NR UE release 16 and forward supporting Long DRX Cycle and DRX adaptation.

This test also applies to all types of EUTRA UE release 16 and forward supporting EN-DC and Long DRX Cycle and DRX adaptation.

7.3.2.2.3.3 Minimum conformance requirements

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

The parameters specified in Table 7.3.2.2.3.3-1 are valid for normal PDCCH in DRX on period and PDCCH in DRX off period.

Table 7.3.2.2.3.3-1: Test Parameters

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

For the parameters specified in Table 7.3.2.2.3.3-2, the average probability of a missed downlink scheduling grant (Pm-dsg) observed on PDCCH during DRX on shall be below the specified value in Table 7.3.2.2.3.3-2. The downlink physical setup is in accordance with Annex C.5.1.

Table 7.3.2.2.3.3-2: Minimum performance requirements with 120 kHz SCS

Test number	Bandwidth (MHz)	CORESET RB	CORESET duration	Aggregation level	Reference Channel	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
								Pm-dsg (%)	SNR_{BB} (dB)
3-1	100	60	1	4	R.PDCCH.5-1.2 TDD	TDLA30-300	1x2 Low	1	3.0
				8	R.PDCCH.5-1.4 TDD				

The normative reference for this requirement is TS 38.101-4 [5] clause 7.3.2.2.3.

7.3.2.2.3.4 Test description

7.3.2.2.3.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 and Table 5.3.6-1 of 38.521-1 [7].

Configurations of DRX, DCP, PDCCH before measurement are specified in 7.3.2.2.3.4.3.1 and Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR1 operation, setup the LTE link according to Annex D:

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.3.2 for TE diagram and Figure A.3.4.2 for UE diagram.
2. The parameter settings for the cell are set up according to Table 7.3-1 and Table 7.3.2.2.3.3-1as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2 and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-2 [8].
4. Propagation conditions are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR for SA with *Connected without release On, Test Mode On* or EN-DC, DC bearer *MCG* and *SCG, Connected without Release On, Test Mode On* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 7.3.2.2.3.4.3.

7.3.2.2.3.4.2 Test procedure

1. SS transmits PDCCH with DCI format2_6 as specified in PDCCH Reference Channel for C_RNTI within DRX off state. The Wake-up indication bit in PDCCH is set to 1.
2. Set the UE in a direction found using one of the test procedures defined in Annex H. If no direction found, mark the test as inconclusive.
3. SS transmits PDCCH with DCI format1_1 as specified in PDCCH Reference Channel R.PDCCH. 5-1.2 TDD for C_RNTI to transmit the DL RMC according to Table 7.3.2.2.3.4.4-1. The details of PDCCH are specified in Table 7.3.2.2.3.3-1 and Table 7.3.2.2.3.3-2. The details of PDSCH are specified in Table A.3.3.2.5-3. The SS sends downlink MAC padding bits on the DL RMC.
4. Set the parameters of the propagation condition, antenna configuration, the correlation matrix and the SNR according to Table 7.3.2.2.3.4.4-1 as appropriate.
5. Measure the Pm-dsg for a duration sufficient to achieve statistical significance according to Annex G clause G.1.5. Count the number of NACKs, ACKs and statDTXs on the UL PUCCH during each subtest interval. Pm-dsg is the ratio (statDTX)/(NACK+ACK+statDTX). If Pm-dsg is less than the value specified in table 7.3.2.2.3.4.4-1, pass the UE. Otherwise fail the UE.
6. Repeat steps from 2 to 5 for each subtest in Table 7.3.2.2.3.4.4-1 as appropriate.

7.3.2.2.3.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1.

7.3.2.2.3.4.3.1 Message exceptions for SA

Table 7.3.2.2.3.4.3.1-1: DRX-Config

Derivation Path: TS 38.508-1 [4],Table 4.6.3-56			
Information Element	**Value/remark**	**Comment**	**Condition**
DRX-Config ::= SEQUENCE {			
drx-onDurationTimer CHOICE {			
milliSeconds	ms1		
}			
drx-InactivityTimer	ms1		
drx-HARQ-RTT-TimerDL	0		
drx-HARQ-RTT-TimerUL	0		
drx-RetransmissionTimerDL	sl1		
drx-RetransmissionTimerUL	sl1		
drx-LongCycleStartOffset CHOICE {			
ms10	0		
}			
}			

Table 7.3.2.2.3.4.3.1-2: DCP-Config

Derivation Path: TS 38.508-1 [6], Table 4.6.3-106			
Information Element	**Value/remark**	**Comment**	**Condition**
dcp-Config-r16 CHOICE {			
setup SEQUENCE {			
ps-Offset-r16	40		
sizeDCI-2-6-r16	2		
ps-PositionDCI-2-6-r16	0		
}			
}			

Table 7.3.2.2.3.4.3.1-3: PDCCH-Config

Derivation Path: TS 38.508-1 [6],Table 4.6.3-95			
Information Element	**Value/remark**	**Comment**	**Condition**
PDCCH-Config::= SEQUENCE {			
controlResourceSetToAddModList SEQUENCE(SEQUENCE(SIZE (1..3)) OF ControlResourceSet ::= SEQUENCE {	2 entry		
ControlResourceSet[1]	ControlResourceSet1		
ControlResourceSet[2]	ControlResourceSet2		
}			
searchSpacesToAddModList SEQUENCE(SIZE (1..10)) OF SearchSpace ::= SEQUENCE {	1 entry		
SearchSpace[1]	SearchSpace		
}			
searchSpacesToAddModListExt-r16 SEQUENCE(SIZE (1..10)) OF SearchSpace {	1 entry		
searchSpaceExt-r16[1]	SearchSpaceExt		
}			
}			

Table 7.3.2.2.3.4.3.1-4: PDCCH-ControlResourceSet1

Derivation Path: TS 38.508-1 [6], Table 5.4.2.0-6			
Information Element	**Value/remark**	**Comment**	**Condition**
ControlResourceSet ::= SEQUENCE {			
frequencyDomainResources	11111111 11000000 00000000 00000000 00000000 00000	CORESET to use the least significant 60 RBs of the BWP	
cce-REG-MappingType CHOICE {			
Interleaved SEQUENCE {	Null		
reg-BundleSize	n6		2
interleaverSize	n2		3
}			
}			
}			

Table 7.3.2.2.3.4.3.1-5: PDCCH-ControlResourceSet2

Derivation Path: TS 38.508-1 [6], Table 5.4.2.0-6			
Information Element	**Value/remark**	**Comment**	**Condition**
ControlResourceSet ::= SEQUENCE {			
controlResourceSetId	2		
frequencyDomainResources	11111111 11000000 00000000 00000000 00000000 00000	CORESET to use the least significant 60 RBs of the BWP	
Duration	1	SearchSpace duration of 1 symbol	
cce-REG-MappingType CHOICE {			
Interleaved SEQUENCE {			
reg-BundleSize	n6		
interleaverSize	n2		
}			
}			
tci-StatesPDCCH-ToAddList {	1	TCI State #1	
}			
}			

Table 7.3.2.2.3.4.3.1-6: PDCCH Search Space

Derivation Path: TS 38.508-1 [6], Table 5.4.2.0-7			
Information Element	**Value/remark**	**Comment**	**Condition**
SearchSpace ::= SEQUENCE {			
nrofCandidates SEQUENCE {			
aggregationLevel4	n1	AL4	
}			
}			

Table 7.3.2.2.3.4.3.1-7: PDCCH *Search Space Ext*

Derivation Path: TS 38.508-1 [6], Table 5.4.2.0-7a			
Information Element	**Value/remark**	**Comment**	**Condition**
SearchSpaceExt-r16 ::= SEQUENCE {			
controlResourceSetId-r16	2		
searchSpaceType-r16 SEQUENCE {			
common SEQUENCE {			
dci-Format2-6-r16 SEQUENCE {	NULL		
}			
}			
}			
}			

7.3.2.2.3.4.3.2 Message exceptions for NSA

Same as 7.3.2.2.3.4.3.1.

7.3.2.2.3.4.4 Test requirement

Table 7.3.2.2.3.4.4-1 defines the primary level settings.

For the parameters specified in Table 5.3-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 7.3.2.2.3.4.4-1.

Table 7.3.2.2.3.4.4-1: Minimum performance with 120 kHz SCS

Test number	Bandwidth (MHz)	CORESET RB	CORESET duration	Aggregation level	Reference Channel	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
								Pm-dsg (%)	SNR_{BB} (dB)
3-1	100	60	1	4	R.PDCCH.5-1.2 TDD	TDLA30-300	1x2 Low	1	4.7
				8	R.PDCCH.5-1.4 TDD				

7.4 PBCH demodulation requirements

TS 38.101-4 shall specify the PBCH performance requirements and has recommended that these requirements do not need to be tested.

7.5 Sustained downlink data rate provided by lower layers

7.5.1 FR2 Sustained downlink data rate performance for single carrier

7.5.1.1 Test Purpose

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.

7.5.1.2 Test Applicability

This test applies to all types of NR UE release 15 and forward.

7.5.1.3 Minimum conformance requirements

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

The requirements and procedure defined below apply using operating band instead of CA configuration, and bandwidth instead of bandwidth combination.

The test parameters are determined by the following procedure:

- Step 1: Calculate the date rate for all supported CA configurations and set of per component carrier (CC) UE capabilities among all supported UE capabilities:
  - Use Table 7.5.1.3-3 to determine the MCS (=MCS1) achieving the largest data rate [clause 4.1.2 of TS 38.306 [14]] based on UE capabilities.
  - Use Table 7.5.1.3-4 to determine the largest MCS (=MCS2) requiring SNR below test equipment maximum achievable SNR for that CA configuration.
  - Compute the data rate for CA configuration using the MCS = min(MCS1,MCS2) and the following equation for each CC in CA bandwidth combination.

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

where

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

TBS_j is the total number of DL-SCH transport block bits calculated based on methodology in Clause 5.1.3.2 of TS 38.214 [12] and using parameters from Table 7.5.1.3-1

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

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

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

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

The test parameters are specified in Table 7.5.1.3-1.

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

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

Table 7.5.1.3-1: Test parameters for FR2 TDD

Parameter		Unit	Value
PDSCH transmission scheme			Transmission scheme 1
PTRS epre-Ratio			0
Channel bandwidth		MHz	Channel bandwidth from selected CA bandwidth combination
Common serving cell parameters	Physical Cell ID		0
	SSB position in burst		First SSB in Slot #0
	SSB periodicity	ms	20
	First DMRS position for Type A PDSCH mapping		2
Cross carrier scheduling			Not configured
Active DL BWP index			1
Actual carrier configuration	Offset between Point A and the lowest usable subcarrier on this carrier (Note 3)	RBs	0
	Subcarrier spacing	kHz	60 or 120
DL BWP configuration #1	RB Offset		0
	Number of contiguous PRB		Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-2 [7] for tested channel bandwidth and subcarrier spacing
	Subcarrier spacing	kHz	60 or 120
	Cyclic prefix		Normal
PDCCH configuration	Slots for PDCCH monitoring		Each slot
	Symbols with PDCCH		Symbols #0
	Number of PRBs in CORESET		Table 7.5A.1-2
	Number of PDCCH candidates and aggregation levels		1/8
	CCE-to-REG mapping type		Non-interleaved
	DCI format		1-1
	TCI State		TCI state #1
	PDCCH &PDCCH DMRS Precoding configuration		Single Panel Type I, Random per slot with equal probability of precoder index 0 and 2, and with REG bundling granularity for number of Tx larger than 1
PDSCH configuration	Mapping type		Type A
	k0		0
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		wideband
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
	Starting symbol (S)		1
	Length (L)		13
PDSCH DMRS configuration	DMRS Type		Type 1
	Number of additional DMRS		1
	Length		1
	Antenna ports indexes		{1000} for 1 Layer CCs {1000, 1001} for 2 Layers CCs
	Number of PDSCH DMRS CDM group(s) without data		1
PTRS configuration	Frequency density (K_{PT-RS})		2
	Time density (L_{PT-RS})		1
CSI-RS for tracking	Subcarrier indexes in the PRB used for CSI-RS		k_0 = 3 for CSI-RS resource 1,2,3,4
	OFDM symbols in the PRB used for CSI-RS		l_0 = 6 for CSI-RS resource 1 and 3 l_0 = 10 for CSI-RS resource 2 and 4
	Number of CSI-RS ports (X)		1 for CSI-RS resource 1,2,3,4
	CDM Type		'No CDM' for CSI-RS resource 1,2,3,4

	Density (ρ)			3 for CSI-RS resource 1,2,3,4
	CSI-RS periodicity		Slots	60 kHz SCS: 80 for CSI-RS resource 1,2,3,4 120 kHz SCS: 160 for CSI-RS resource 1,2,3,4
	CSI-RS offset		Slots	60 kHz SCS: 40 for CSI-RS resource 1 and 2 41 for CSI-RS resource 3 and 4 120 kHz SCS: 80 for CSI-RS resource 1 and 2 81 for CSI-RS resource 3 and 4
	Frequency Occupation			Start PRB 0 Number of PRB = ceil(BWP size/4)*4
	QCL info			TCI state #0
NZP CSI-RS for CSI acquisition	Subcarrier indexes in the PRB used for CSI-RS			$k_0 = 4$
	OFDM symbols in the PRB used for CSI-RS			$l_0 = 13$
	Number of CSI-RS ports (X)			Same as number of transmit antenna
	CDM Type			'FD-CDM2'
	Density (ρ)			1
	CSI-RS periodicity		Slots	60 kHz SCS: 80 120 kHz SCS: 160
	CSI-RS offset			0
	Frequency Occupation			Start PRB 0 Number of PRB = ceil(BWP size/4)*4
	QCL info			TCI state #1
ZP CSI-RS for CSI acquisition	Subcarrier indexes in the PRB used for CSI-RS			$k_0 = 0$
	OFDM symbols in the PRB used for CSI-RS			$l_0 = 12$
	Number of CSI-RS ports (X)			4
	CDM Type			'FD-CDM2'
	Density (ρ)			1
	CSI-RS periodicity		Slots	60 kHz SCS: 80 120 kHz SCS: 160
	CSI-RS offset			0
	Frequency Occupation			Start PRB 0 Number of PRB = ceil(BWP size/4)*4
CSI-RS for beam refinement	First subcarrier index in the PRB used for CSI-RS			k_0=0 for CSI-RS resource 1,2
	First OFDM symbol in the PRB used for CSI-RS			$l_0 = 8$ for CSI-RS resource 1 $l_0 = 9$ for CSI-RS resource 2
	Number of CSI-RS ports (X)			1 for CSI-RS resource 1,2
	CDM Type			'No CDM' for CSI-RS resource 1,2
	Density (ρ)			3 for CSI-RS resource 1,2
	CSI-RS periodicity		Slots	60 kHz SCS: 80 for CSI-RS resource 1,2 120 kHz SCS: 160 for CSI-RS resource 1,2
	CSI-RS offset		Slots	0 for CSI-RS resource 1,2
	Frequency Occupation			Start PRB 0 Number of PRB = ceil(BWP size/4)*4
	Repetition			ON
	QCL info			TCI state #1
TCI state #0	Type 1 QCL information	SSB index		SSB #0
		QCL Type		Type C
	Type 2 QCL information	SSB index		SSB #0
		QCL Type		Type D
TCI state #1	Type 1 QCL information	CSI-RS resource		CSI-RS resource 1 from 'CSI-RS for tracking' configuration
		QCL Type		Type A
	Type 2 QCL information	CSI-RS resource		CSI-RS resource 1 from 'CSI-RS for tracking' configuration
		QCL Type		Type D

Maximum number of code block groups for ACK/NACK feedback			1
Number of HARQ Processes			10 for FR2.60-1 and 8 for FR2.120-1
K1 value			Specific to each UL-DL pattern
Maximum number of HARQ transmission			4
HARQ ACK/NACK bundling			Multiplexed
Redundancy version coding sequence			{0,2,3,1}
TDD UL-DL pattern			60 kHz SCS: FR2.60-1 120 kHz SCS: FR2.120-1
PDSCH & PDSCH DMRS Precoding configuration			Single Panel Type I, Precoder index 0 per slot with Wideband granularity for Rank 2
Symbols for all unused REs			OP.1 FDD as defined in Annex A.5.1.1 OP.1 TDD as defined in Annex A.5.2.1
Propagation condition			Static propagation condition No external noise sources are applied
Antenna configuration	1 layer CCs		1x2 or 1x4
	2 layers CCs		2x2 or 2x4
Physical signals, channels mapping and precoding			As specified in Annex B.4.1
Note 1: PDSCH is scheduled only on full DL slots not containing SSB or TRS. Note 2: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH transmission. Note 3: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-2 [7] for tested channel bandwidth and subcarrier spacing.			

Table 7.5.1.3-2: Number of PRBs in CORESET

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

Table 7.5.1.3-3: MCS indexes for indicated UE capabilities

Maximum number of PDSCH MIMO layers	Maximum modulation format (Note 1)	Scaling factor	MCS (Note 2)
1	6	1	27
1	6	0.8	23
1	6	0.75	22
1	6	0.4	14
1	4	1	16
1	4	0.8	16
1	4	0.75	16
1	4	0.4	10
1	2	1	9
1	2	0.8	9
1	2	0.75	9
1	2	0.4	4
2	6	1	27
2	6	0.8	23
2	6	0.75	22
2	6	0.4	14
2	4	1	16
2	4	0.8	16
2	4	0.75	16
2	4	0.4	10
2	2	1	9
2	2	0.8	9
2	2	0.75	9
2	2	0.4	4
Note 1: For the band(s) on which UE supporting “Maximum modulation format” of 8, the MCS index is derived from the rows with “Maximum modulation format” of 6. Note 2: MCS Index is based on MCS index Table 1 defined in clause 5.1.3.1 of TS 38.214 [12].			

Table 7.5.1.3-4: SNR required to achieve 85% of peak throughput under AWGN conditions

MCS Index (Note 1)	SNR_{BB}(dB) for maximum number of PDSCH MIMO Layers = 1	SNR_{BB}(dB) for maximum number of PDSCH MIMO Layers = 2
13	6.2	9.0
14	7.2	9.9
15	8.2	10.9
16	8.7	11.6
17	10.1	13.2
18	10.7	13.7
19	11.7	14.7
20	12.7	15.6
21	13.6	16.5
22	14.8	17.6
23	15.6	18.6
24	16.9	19.7
25	18.3	21.2
26	19.3	22.3
27	20.5	23.3
Note 1: MCS Index is based on MCS index Table 1 defined in clause 5.1.3.1 of TS 38.214 [12].		

The normative reference for this requirement is TS 38.101-4 [5], clause 7.5.1.

7.5.1.4 Test description

7.5.1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 of TS 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 4.3.1.1.

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.1 for TE diagram (without fader and AWGN) and clause A.3.2.2 for UE diagram.
2. The parameter settings for the NR cell are initially set up according to Table 7.5.1.3-1 as appropriate.
3. Downlink signals for the NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1, and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].
4. Propagation conditions for the NR cell are set according to Annex B.1.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR with *Connected without release On, Test Loop Function On with UE Test Loop Mode A with UL_PDCP_SDU_SIZE = 0* according to TS 38.508-1 [6] clause 4.5.4. Message content are defined in clause 7.5.1.4.3.
6. SS shall transmit UECapabilityEnquiry message.
7. The UE shall transmit UECapabilityInformation message.
8. Using the UE capabilities advertised in the *UE-CapabilityRAT-Container* of the type *UE-NR-Capability*, and the procedure outlined in 7.5.1.3 determine one set of parameters that would provide the largest data rate.
9. Setup up the NR cell using these parameters for the test.
10. Configure the TBsize, DL RMC, UL RMC, PDCP size from Annex A.3.2_1 and Annex A.2.2 for UL as appropriate.

7.5.1.4.2 Test procedure

1. SS configures T-reordering timer to be infinity.
2. SS sends a PDCP reestablishment via RRC Reconfiguration message requesting for PDCP Status Report.
3. SS sets the counters N_{DL_newtx} N_{DL_retx} to 0.
4. For each new DL HARQ transmission the SS generates sufficient PDCP SDUs (max PDCP SDU size and minimum number of consecutive PDCP SDUs) to fill up the TB in accordance with Annex A.3.2_1. The SS ciphers the PDCP SDUs, concatenates the resultant PDCP PDUs to form an RLC PDU and then a MAC PDU. The SS transmits the MAC PDU. The SS increments then N_{DL_newtx} by one
5. If PHY requests a DL HARQ retransmission, the SS performs a HARQ retransmission and increments N_{DL_retx} by one.
6. Steps 5 to 6 are repeated at every TTI for at least 300 frames and the SS waits for 300ms to let any HARQ retransmissions and RLC retransmissions to finish.
7. SS sends a PDCP reestablishment via RRC Reconfiguration message requesting for PDCP Status Report.
8. The SS calculates the TB success rate as $A = 100\% * N_{DL\_correct\_rx} / (N_{DL\_newtx} + N_{DL\_retx})$.

10. SS computes the PDCP SDU loss by looking into the FMC and Bitmap field in the PDCP Status Report. PDCP SDU loss B = COUNT reported in the Bitmap field of PDCP Stata Report.

11. The UE passes the test if A ≥ 85% TB success rates and B = 0.

Note 1: In case of RLC PDU retransmission, the number of new required PDCP SDUs is as many as to fill the rest of TB.

7.5.1.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 5.4.2 with the following exceptions

Table 7.5.1.4.3-0: CLOSE UE TEST LOOP (in the preamble)

Derivation Path: 38.509 clause 6.3.1			
Information Element	**Value/remark**	**Comment**	**Condition**
Protocol discriminator	1 1 1 1		
Skip indicator	0 0 0 0		
Message type	1 0 0 0 0 0 0 0		
UE test loop mode	0 0 0 0 0 0 0 0	UE test loop mode A	
UE test loop mode A LB setup			
Length of UE test loop mode A LB setup list in bytes	0 0 0 0 0 0 1 1	Length of one LB setup DRB (3 bytes)	
LB setup DRB	0 0 0 0 0 0 0 0, 0 0 0 0 0 0 0 0, 0 0 Q5 Q4 Q3 Q2 Q1 Q0	UL PDCP SDU size = 0 Q5 = 1 (for NR Data Radio Bearers) Q4..Q0 = Data Radio Bearer identity number -1 for the radio bearer. See 38.509 clause 6.3.1	
UE test loop mode B LB setup	Not present		

Table 7.5.1.4.3-1: RadioBearerConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3-132			
Information Element	**Value/remark**	**Comment**	**Condition**
RadioBearerConfig ::= SEQUENCE {			
drb-ToAddModList SEQUENCE (SIZE (1..maxDRB)) OF SEQUENCE {	1 entry		DRB1
cnAssociation CHOICE {			
sdap-Config	SDAP-Config		
}			
drb-Identity	DRB-Identity using condition DRB1		
reestablishPDCP	true		DRB1 AND Re-establish_PDCP
pdcp-Config	PDCP-Config		
}			

Table 7.5.1.4.3-2: *PDCP-Config*

Derivation Path: TS 38.508-1 [6], Table 4.6.3-99			
Information Element	**Value/remark**	**Comment**	**Condition**
PDCP-Config ::= SEQUENCE {			
drb SEQUENCE {			
discardTimer	infinity		
pdcp-SN-Size-UL	len18bits		
pdcp-SN-Size-DL	len18bits		
headerCompression CHOICE {			
notUsed	Null		
}			
integrityProtection	Not present		
statusReportRequired	true		
outOfOrderDelivery	Not present		
}			
t-Reordering	Not present		
}			

7.5.1.5 Test requirement

The TB success rate of greater than 85% with no PDCP SDU loss shall be sustained during at least 300 frames.

7.5A.1 FR2 Sustained downlink data rate performance for carrier aggregation

7.5A.1.1 FR2 SDR performance for CA

7.5A.1.1 Test Purpose

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.

7.5A.1.2 Test Applicability

This test applies to all types of NR UE release 15 and forward supporting 2DLCA.

7.5A.1.3 Minimum conformance requirements

Same as 7.5.1.3

7.5A.1.4 Test description

7.5A.1.4.1 Initial conditions

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.1 for TE diagram (without fader and AWGN) and clause A.3.2.2 for UE diagram.
2. The parameter settings for the NR cell are initially set up according to Table 7.5.1.3-1 as appropriate.
3. Downlink signals for the NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1, and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].
4. Propagation conditions for the NR cell are set according to Annex B.1.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR with *Connected without release On, Test Loop Function On with UE Test Loop Mode A with UL_PDCP_SDU_SIZE = 0* according to TS 38.508-1 [6] clause 4.5.4. Message content are defined in clause 7.5.1.4.3.

6. Configure SCC according to Annex C.0, C.1 and C.2 for all downlink physical channels.
7. The SS shall configure SCC as per TS 38.508-1 [6] clause 5.5.1.
8. SS activates SCC by sending the activation MAC-CE (Refer TS 38.321 [18], clauses 5.9, 6.1.3.10). Wait for at least 1 second (Refer TS 38.133[19], clause9.3).
9. SS shall transmit UECapabilityEnquiry message.
10. The UE shall transmit UECapabilityInformation message.
11. Using the UE capabilities advertised in the *UE-CapabilityRAT-Container* of the type *UE-NR-Capability*, and the procedure outlined in 7.5.1.3 determine one set of parameters that would provide the largest data rate.
12. Setup up the NR cells using these parameters for the test.
13. Configure the TBsize, DL RMC, UL RMC, PDCP size from Annex A.3.2_1 and Annex A.2.2 for UL as appropriate.

7.5A.1.4.2 Test procedure

1. SS configures T-reordering timer to be infinity.
2. SS sends a PDCP reestablishment via RRC Reconfiguration message requesting for PDCP Status Report.
3. SS sets the counters N_{DL_newtx} N_{DL_retx} to 0.
4. For each new DL HARQ transmission the SS generates sufficient PDCP SDUs (max PDCP SDU size and minimum number of consecutive PDCP SDUs) to fill up the TB on both PCC and SCC in accordance with Annex A.3.2_1. The SS ciphers the PDCP SDUs, concatenates the resultant PDCP PDUs to form an RLC PDU and then a MAC PDU. The SS transmits the MAC PDU. The SS increments then N_{DL_newtx} by one
5. If PHY requests a DL HARQ retransmission, the SS performs a HARQ retransmission and increments N_{DL_retx} by one.
6. Steps 5 to 6 are repeated at every TTI for at least 300 frames and the SS waits for 300ms to let any HARQ retransmissions and RLC retransmissions to finish.
7. SS sends a PDCP reestablishment via RRC Reconfiguration message requesting for PDCP Status Report.
8. The SS calculates the TB success rate as A = 100%* $N_{DL\_correct\_rx}$ / (N_{DL_newtx} + N_{DL_retx}).
10. SS computes the PDCP SDU loss by looking into the FMC and Bitmap field in the PDCP Status Report. PDCP SDU loss B = COUNT reported in the Bitmap field of PDCP Stata Report.
11. The UE passes the test if A ≥ 85% TB success rates and B = 0.

Note 1: In case of RLC PDU retransmission, the number of new required PDCP SDUs is as many as to fill the rest of TB.

7.5A.1.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 5.4.2 with the following exceptions

Table 7.5A.1.4.3-0: CLOSE UE TEST LOOP (in the preamble)

Derivation Path: 38.509 clause 6.3.1			
Information Element	**Value/remark**	**Comment**	**Condition**
Protocol discriminator	1 1 1 1		
Skip indicator	0 0 0 0		
Message type	1 0 0 0 0 0 0 0		
UE test loop mode	0 0 0 0 0 0 0 0	UE test loop mode A	
UE test loop mode A LB setup			
Length of UE test loop mode A LB setup list in bytes	0 0 0 0 0 0 1 1	Length of one LB setup DRB (3 bytes)	
LB setup DRB	0 0 0 0 0 0 0 0, 0 0 0 0 0 0 0 0, 0 0 Q5 Q4 Q3 Q2 Q1 Q0	UL PDCP SDU size = 0 Q5 = 1 (for NR Data Radio Bearers) Q4..Q0 = Data Radio Bearer identity number -1 for the radio bearer. See 38.509 clause 6.3.1	
UE test loop mode B LB setup	Not present		

Table 7.5A.1.4.3-1: RadioBearerConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3-132			
Information Element	**Value/remark**	**Comment**	**Condition**
RadioBearerConfig ::= SEQUENCE {			
drb-ToAddModList SEQUENCE (SIZE (1..maxDRB)) OF SEQUENCE {	1 entry		DRB1
cnAssociation CHOICE {			
sdap-Config	SDAP-Config		
}			
drb-Identity	DRB-Identity using condition DRB1		
reestablishPDCP	true		DRB1 AND Re-establish_PDCP
pdcp-Config	PDCP-Config		
}			

Table 7.5A.1.4.3-2: *PDCP-Config*

Derivation Path: TS 38.508-1 [6], Table 4.6.3-99			
Information Element	**Value/remark**	**Comment**	**Condition**
PDCP-Config ::= SEQUENCE {			
drb SEQUENCE {			
discardTimer	infinity		
pdcp-SN-Size-UL	len18bits		
pdcp-SN-Size-DL	len18bits		
headerCompression CHOICE {			
notUsed	Null		
}			
integrityProtection	Not present		
statusReportRequired	true		
outOfOrderDelivery	Not present		
}			
t-Reordering	Not present		
}			

7.5A.1.5 Test requirement

The TB success rate of greater than 85% with no PDCP SDU loss shall be sustained during at least 300 frames on each CC.

8 CSI reporting requirements (Radiated requirements)

8.1 General

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

For conformance testing involving FR2 test cases in this specification, the UE under test shall be pre-configured with UL Tx diversity schemes disabled to account for single polarization System Simulator (SS) in the test environment. The UE under test may transmit with dual polarization.

8.1.1 Applicability of requirements

8.1.1.1 General

The minimum performance requirements are applicable to the FR2 operating bands defined in TS 38.101-2 [3] with F_{DL_high} not exceeding 40000 MHz.

The minimum performance requirements in Clause 8 are mandatory for UE supporting NR operation, except test cases listed in Clause 8.1.1.3, 8.1.1.4.

8.1.1.2 Applicability of requirements for different number of RX antenna ports

UE shall support 2 RX ports for different RF operating bands. The UE requirements applicability is defined in Table 8.1.1.2-1.

Table 8.1.1.2-1: Requirements applicability

Supported RX antenna ports	Test type	Test list
UE supports 2RX antenna	CQI	All tests in Clause 8.2.2
	PMI	All tests in Clause 8.3.2
	RI	All tests in Clause 8.4.2

8.1.1.3 Applicability of requirements for optional UE features

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

Table 8.1.1.3-1: Requirements applicability for optional UE features

UE feature/capability [14]	Test type		Test list	Applicability notes
256QAM modulation scheme for PDSCH for FR2 (*pdsch-256QAM-FR2*)	FR2 TDD	CQI	Clause 8.2.2.2.2.1_1 (Tests 3 and 4)	The test coverage can be considered fulfilled without executing of Test 1 and 2 from Clause 8.2.2.2.2.1 if UE passes Test 3 and 4 from Clause 8.2.2.2.2.1_1

8.1.1.4 Applicability of requirements for mandatory UE features with capability signalling

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

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

UE feature/capability [14]	Test type		Test list	Applicability notes
Supported maximum number of PDSCH MIMO layers (*maxNumberMIMO-LayersPDSCH)*	FR2 TDD	CQI	Clause 8.2.2.2.1.1	The requirements apply only in case the PDSCH MIMO rank in the test case does not exceed UE PDSCH MIMO layers capability
		RI	Clause 8.4.2.2	
Support of 1 port PTRS (*onePortsPTRS*)	FR2 TDD	CQI	Clause 8.2	
		PMI	Clause 8.3	
		RI	Clause 8.4	

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

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

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

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

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

A single uplink CC is configured for all tests.

8.1.1.5.2 Test coverage for different number of component carriers

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

8.1.1_1 Applicability of test requirements due to maximum achievable SNR

The current assumption of maximum testable SNR_{BB} for PC3, Max device size ≤ 30 cm under fading conditions is specified in Tables 7.1.1_1-1 and 7.1.1_1-1a.

The current assumption of maximum testable SNR_{BB} for indirect far field (IFF), PC3, Max device size ≤ 30 cm without fading conditions is specified in Tables 8.1.1_1-0 and 8.1.1_1-1.

Table 8.1.1_1-0: Current assumption of maximum testable SNR_{BB} under fading for modulations up to 256 QAM for CSI scenarios

Operating Band / Frequency	Maximum testable SNR_{BB} (dB)		
	CHBW 50 MHz	CHBW 100 MHz	CHBW 200 MHz
n257 mid	26.3	23.2	20.1
n258 mid	26.3	23.2	20.1
n259 mid	16.0	12.8	9.6
n260 mid	20.1	16.9	13.8
n261 mid	26.3	23.2	20.1

Table 8.1.1_1-1: Current assumption of maximum testable SNR_{BB} without fading for modulations up to 256 QAM

Operating Band / Frequency	Maximum testable SNR_{BB} (dB)		
	CHBW 50 MHz	CHBW 100 MHz	CHBW 200 MHz
n257 mid	28.7	25.5	22.5
n258 mid	28.7	25.5	22.5
n259 mid	18.4	15.2	12.1
n260 mid	22.5	19.3	16.3
n261 mid	28.7	25.5	22.5

Based on the current assumption of maximum testable SNR_{BB}, the applicability of test points is defined in Table 8.1.1_1-2 for indirect far field (IFF), PC3, Max device size ≤ 30 cm under fading conditions.

Table 8.1.1_1-2: Testability of test requirements due to maximum achievable SNR per band

Test Case	Test point	CHBW / MHz	Fading	SNR test requirement	Test Point Applicability				
					n257	n258	n259	n260	n261
8.2.2.2.1.1	1	100	No	9	x	x	x	x	x
	2	100	No	15	x	x	x	x	x
8.2.2.2.2.1	1	100	Yes	7	x	x	x	x	x
	2	100	Yes	13	x	x	x	x	x
8.2.2.2.2.1_1	3	50	Yes	8	x	x	x	x	x
	4	50	Yes	21	x	x	TBD	TBD	x
8.2A.3.1.1	1	BW_{agg} ≤ 200	No	10	x	x	x	x	x
		BW_{agg} > 200	No	10	TBD	TBD	TBD	TBD	TBD
8.2A.3.1.2	1	BW_{agg} ≤ 200	No	12	x	x	x	x	x
		BW_{agg} > 200	No	12	TBD	TBD	TBD	TBD	TBD
8.2A.3.1.3	1	BW_{agg} ≤ 200	No	12	x	x	x	x	x
		BW_{agg} > 200	No	12	TBD	TBD	TBD	TBD	TBD
8.4.2.2.1	1	100	Yes	0	x	x	X	x	x
	2	100	Yes	16	x	x	x	x	x
	3	100	Yes	16	x	x	x	x	x

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 transmission scheme			Transmission scheme 1
Duplex Mode			TDD
PTRS *epre-Ratio*			0
Actual carrier configuration	Offset between Point A and the lowest usable subcarrier on this carrier (Note 3)	RBs	0
	Subcarrier spacing	kHz	120
DL BWP configuration #1	Cyclic prefix		Normal
	RB offset	RBs	0
	Number of contiguous PRB	PRBs	Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-2 [3] for tested channel bandwidth and subcarrier spacing
Active DL BWP index			1
Common serving cell parameters	Physical Cell ID		0
	SSB position in burst		First SSB in Slot #0
	SSB periodicity	ms	20
PDCCH configuration	Slots for PDCCH monitoring		Each slot
	Symbols with PDCCH		0,1
	Number of PDCCH candidates and aggregation levels		1/AL8
	DCI format		1_1
	TCI state		TCI state #1
	PDCCH & PDCCH DMRS Precoding configuration		Multi-path fading propagation conditions: Single Panel Type I, Random per slot with equal probability of each applicable i1, i2 combination, and with REG bundling granularity for number of Tx larger than 1 Static propagation conditions: Single Panel Type I, Random precoder chosen from precoder index 0 and 2, selection updated per slot
Cross carrier scheduling			Not configured
PDSCH configuration	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		12
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS configuration	DMRS Type		Type 1
	Number of additional DMRS		1
	DMRS ports indexes		{1000} for Rank1 {1000,1001} for Rank2
	Maximum number of OFDM symbols for DL front loaded DMRS		1
	Number of PDSCH DMRS CDM group(s) without data		2
PTRS configuration	Frequency density (K_{PT-RS})		2
	Time density (L_{PT-RS})		1
	Resource Element Offset		2

CSI-RS for tracking	First subcarrier index in the PRB used for CSI-RS (k_0)			0 for CSI-RS resource 1,2,3,4
	First OFDM symbol in the PRB used for CSI-RS (l_0)			4 for CSI-RS resource 1 and 3 8 for CSI-RS resource 2 and 4
	Number of CSI-RS ports (X)			1 for CSI-RS resource 1,2,3,4
	CDM Type			No CDM for CSI-RS resource 1,2,3,4
	Density (ρ)			3 for CSI-RS resource 1,2,3,4
	CSI-RS periodicity		slot	120kHz SCS: 160 for CSI-RS resource 1,2,3,4
	CSI-RS offset		slot	120 kHz SCS: 80 for CSI-RS resource 1 and 2 81 for CSI-RS resource 3 and 4
	Frequency Occupation			Start PRB 0 Number of PRB = BWP size
	QCL info			TCI state #0
NZP CSI-RS for CSI acquisition	Frequency Occupation			Start PRB 0 Number of PRB = BWP size
	QCL info			TCI state #1
ZP CSI-RS for CSI acquisition	Frequency Occupation			Start PRB 0 Number of PRB = BWP size
CSI-RS for beam refinement	First subcarrier index in the PRB used for CSI-RS			k_0=0 for CSI-RS resource 1,2
	First OFDM symbol in the PRB used for CSI-RS			l_0 = 8 for CSI-RS resource 1 l_0 = 9 for CSI-RS resource 2
	Number of CSI-RS ports (X)			1 for CSI-RS resource 1,2
	CDM Type			'No CDM' for CSI-RS resource 1,2
	Density (ρ)			3 for CSI-RS resource 1,2
	CSI-RS periodicity		Slots	120 kHz SCS: 160 for CSI-RS resource 1,2
	CSI-RS offset		Slots	0 for CSI-RS resource 1,2
	Repetition			ON
	QCL info			TCI state #1
TCI state #0	Type 1 QCL information	SSB index		SSB #0
		QCL Type		Type C
	Type 2 QCL information	SSB index		SSB #0
		QCL Type		Type D
TCI state #1	Type 1 QCL information	CSI-RS resource		CSI-RS resource 1 from 'CSI-RS for tracking' configuration
		QCL Type		Type A
	Type 2 QCL information	CSI-RS resource		CSI-RS resource 1 from 'CSI-RS for tracking' configuration
		QCL Type		Type D
Number of HARQ Processes				8
HARQ ACK/NACK bundling				Multiplexed
Redundancy version coding sequence				{0,2,3,1}
K1 value (PDSCH-to-HARQ-timing-indicator)				For FR2.120-1: 3 if mod (i.5) = 0, 6 if mod(i,5) = 2 For FR2.120-2: 11 if mod(i,8) = 0, 7]if mod(i,8) = 4, 6]if mod(i,8) = 5, where i is slot index per radio fame with values 0-79.
Symbols for unused REs				OCNG as specified in A.5
Physical signals, channels mapping and precoding				As specified in Annex B.4.1

Note 1: PDSCH is not scheduled on slots containing CSI-RS or slots which are not full DL.
Note 2: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH transmission.
Note 3: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-2 [3] for tested channel bandwidth and subcarrier spacing.

8.2 Reporting of Channel Quality Indicator (CQI)

8.2.1 1RX requirements

TBD

8.2.2 2RX requirements

8.2.2.1 FDD

TBD

8.2.2.2 TDD

8.2.2.2.1 CQI reporting under AWGN conditions

8.2.2.2.1.1 2Rx TDD FR2 periodic wideband CQI reporting under AWGN performance for both SA and NSA

8.2.2.2.1.1.1 Test Purpose

The purpose of this test is to verify the variance of the wideband CQI reports is within the limits defined and a PDSCH BLER of 10% falls between the transport format based median CQI-1 and median CQI or the transport format based median CQI and median CQI +1.

8.2.2.2.1.1.2 Test Applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

8.2.2.2.1.1.3 Minimum requirement for periodic CQI reporting

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.

For the parameters specified in Table 8.2.2.2.1.1.3-1, 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 8.2.2.2.1.1.3-1 Test parameters

Parameter		Unit	Test 1	Test 2
Bandwidth		MHz	100	
Subcarrier spacing		kHz	120	
Duplex Mode			TDD	
TDD Slot Configuration			FR2.120-2 Annex A.1.3	
SNR_{BB}		dB	8 / 9	14 / 15
Propagation channel			AWGN	
Antenna configuration			2×2 with static channel specified in Annex B.1	
Beamforming Model			As specified in Annex B.4.1	
ZP CSI-RS configuration	CSI-RS resource Type		*Periodic*	
	Number of CSI-RS ports (*X*)		4	
	CDM Type		*FD-CDM2*	
	Density (ρ)		1	
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		8	
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		13	
	CSI-RS periodicity and offset	slot	8/1	
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		*Periodic*	
	Number of CSI-RS ports (*X*)		2	
	CDM Type		*fd-CDM2*	
	Density (ρ)		1	
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		6	
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		13	
	NZP CSI-RS-timeConfig periodicity and offset	slot	8/1	
CSI-IM configuration	CSI-IM resource Type		Periodic	
	CSI-IM RE pattern		1	
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(8, 13)	
	CSI-IM timeConfig periodicity and offset	slot	8/1	
ReportConfigType			*Periodic*	
CQI-table			Table 1	
reportQuantity			*cri-RI-PMI-CQI*	
timeRestrictionForChannelMeasurements			*Not configured*	
timeRestrictionForInterferenceMeasurements			*Not configured*	
cqi-FormatIndicator			*Wideband*	
pmi-FormatIndicator			*Wideband*	
Sub-band Size		RB	8	
csi-ReportingBand			111111111	
CSI-Report periodicity and offset		slot	8/3	
aperiodicTriggeringOffset			*Not configured*	
Codebook configuration	Codebook Type		*typeI-SinglePanel*	
	Codebook Mode		1	
	(CodebookConfig-N1,CodebookConfig-N2)		*Not configured*	
	CodebookSubsetRestriction		010000	
	RI Restriction		N/A	
Physical channel for CSI report			PUCCH	
CQI/RI/PMI delay		ms	8.375	
Maximum number of HARQ transmission			1	
Measurement channel			As specified in Table A.4-1, TBS.1-2	

The normative reference for this requirement is TS 38.101-4 [5] clause 8.2.2.2.1.1.

8.2.2.2.1.1.4 Test Description

8.2.2.2.1.1.4.1 Initial Conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.2-1 of TS 38.521-2 [8].

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

Only sub tests shall be tested which are testable according to Table 7.1.1_1-2.

For EN-DC within FR2 operation, setup the LTE radiated link according to Annex D:

1. Connection between SS, AWGN noise source and the UE antenna is shown in TS 38.508-1 [6] Annex A, Figure A.3.3.2 for TE diagram and Figure A.3.4.2 for UE diagram.

2. The parameter settings for the NR cell are set up according to Table 8.1.2-1 and Table 8.2.2.2.1.1.3-1 and as appropriate.

3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1, and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-2 [8].

4. Propagation conditions for NR cell are set according to Annex B.0.

5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR for SA with *Connected without release On, Test Mode On* or EN-DC, DC bearer *MCG* and *SCG, Connected without release On, Test Mode On for NSA* according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 8.2.2.2.1.1.4.3.

8.2.2.2.1.1.4.2 Test Procedure

1. Set the UE in a direction that satisfies the 3 normative criteria specified in Annex H.0. If no direction found mark the test as inconclusive.

2. Set the parameters of bandwidth, SCS, reference Channel, the propagation condition, antenna configuration and the SNR according to Table 8.2.2.2.1.1.3-1.

3. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to CQI value 2 and keep it regardless of the wideband CQI value sent by the UE. The SS sends downlink MAC padding bits on the DL RMC. Continue transmission of the PDSCH until 2000 wideband CQI reports have been gathered. In this process the SS collects wideband CQI reports every 1 ms and also cases where UE transmits nothing in its CQI timing are also counted as wideband CQI reports.

4. Set up a relative frequency distribution for the reported wideband CQI-values, Calculate the median value (wideband Median CQI is the wideband CQI that is at or crosses 50% distribution from the lower wideband CQI side). This CQI-value is declared as wideband Median CQI value.

5. If Median CQI is not equal to 1 or 15 and 1800 or more of the wideband CQI values are in the range (Median CQI - 1) ≤ Median CQI ≤ (Median CQI + 1) then continue with step 6, otherwise go to step 9.

6. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to the wideband median-CQI value and shall not react to the UE's wideband CQI reports. The SS sends downlink MAC padding bits on the DL RMC. For any PDSCH transmitted by the SS, record the associated ACK, NACK and statDTX responses. The responses are then filtered as follows: for the sequence of responses for each HARQ process, discard all the statDTX responses. Continue to gather data until the number of filtered ACK+NACK responses reaches 1000.

For the filtered ACK and NACK responses if the ratio (NACK / ACK + NACK) ≤ 0.1 then go to step 7, otherwise go to step 8.

7. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to the wideband median-CQI+1 value and shall not react to the UE's wideband CQI reports. The SS sends downlink MAC padding bits on the DL RMC. For any PDSCH, transmitted by the SS, record and filter the ACK, NACK and statDTX responses as in step 8 until 1000 filtered ACK+NACK responses are gathered.

   If the ratio (NACK /ACK + NACK) > 0.1

   then pass the UE for this test and go to step 10, otherwise go to step 9.

8. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to the wideband median-CQI-1 value and shall not react to the UE's wideband CQI reports. The SS sends downlink MAC padding bits on the DL RMC. For any PDSCH, transmitted by the SS, record and filter the ACK, NACK and statDTX responses as in step 6 until 1000 filtered ACK+NACK responses are gathered.

   If the ratio (NACK /ACK + NACK) ≤ 0.1

   then pass the UE for this test and go to step 10, otherwise go to step 9.

9. If both SNR points of the test have not been tested, then repeat the same procedure (steps 1 to 8) for the other SNR point as appropriate. Otherwise fail the UE.

10. Repeat step 1 to 9 for Test2.

8.2.2.2.1.1.4.3 Message Contents

Message contents are according to TS 38.508-1 [6] subclause 4.6.1 and 5.4.2 with the following exceptions:

8.2.2.2.1.1.4.3_1 Message exceptions for SA

Table 8.2.2.2.1.1.4.3_1-1: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], Table 4.6.3-39			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ReportConfig ::= SEQUENCE {			
reportConfigType CHOICE {		Periodic	
periodic SEQUENCE {			
reportSlotConfig	CSI-ReportPeriodicityAndOffset	8/1	
}			
}			
reportFreqConfiguration SEQUENCE {			
csi-ReportingBand CHOICE{			
Subbands9	111111111		
}			
}			
}			

Table 8.2.2.2.1.1.4.3_1-2: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], Table 4.6.3-25			
Information Element	**Value/remark**	**Comment**	**Condition**
CodebookConfig ::= SEQUENCE {			
codebookType CHOICE {			
type1 SEQUENCE {			
subType CHOICE {			
typeI-SinglePanel SEQUENCE {			
nrOfAntennaPorts CHOICE {			
Two SEQUENCE {			
twoTX-codebookSubsetRestriction	010000		
}			
}			
}			
}			
}			
}			
}			

Table 8.2.2.2.1.1.4.3_1-3: SchedulingRequestResourceConfig

Derivation Path: TS 38.508-1 [6], Table 4.6.3-157			
Information Element	**Value/remark**	**Comment**	**Condition**
SchedulingRequestResourceConfig ::= SEQUENCE {			
periodicityAndOffset CHOICE {			
Sl80	7		
}			
}			

8.2.2.2.1.1.4.3_2 Message exceptions for NSA

Same as 8.2.2.2.1.1.4.3_1.

8.2.2.2.1.1.5 Test Requirements

The pass/fail decision is as specified in the test procedure in clause 8.2.2.2.1.1.4.2.

There are no parameters in the test setup or measurement process whose variation impacts the results so there are no applicable test tolerances for this test.

8.2.2.2.2 CQI reporting under fading conditions

8.2.2.2.2.1 2Rx TDD FR2 aperiodic wideband CQI reporting under fading performance for both SA and NSA

8.2.2.2.2.1.1 Test Purpose

To verify the variance of the wideband CQI reports is within the limits defined, that the ratio of the throughput is within the limits defined and that the average PDSCH BLER is greater than or equal to 1% for the indicated transport format.

8.2.2.2.2.1.2 Test Applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

8.2.2.2.2.1.3 Minimum requirement for aperiodic CQI reporting

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 8.2.2.2.2.1.3-1 and using the downlink physical channels specified in Annex C.5.1, the minimum requirements are specified by the following:

a) a CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least α % of the time, where α% is specified in Table 8.2.2.2.2.1.3-2;

b) the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be ≥ γ, where γ is specified in Table 8.2.2.2.2.1.3-2;

c) when transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater or equal to 0.01.

Table 8.2.2.2.2.1.3-1: Test parameters

Parameter		Unit	Test 1	Test 2
Bandwidth		MHz	100	
Subcarrier spacing		kHz	120	
Duplex Mode			TDD	
TDD Slot Configuration			FR2.120-2 Annex A.1.3	
SNR_{BB}		dB	6 | 7	12 | 13
Propagation channel			TDLA30-35	
Antenna configuration			2×2 ULA High	
Beamforming Model			As specified in Annex B.4.1	
ZP CSI-RS configuration	CSI-RS resource Type		*Periodic*	
	Number of CSI-RS ports (*X*)		4	
	CDM Type		*FD-CDM2*	
	Density (ρ)		1	
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		8	
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		13	
	CSI-RS interval and offset	slot	8/1	
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		*Aperiodic*	
	Number of CSI-RS ports (*X*)		2	
	CDM Type		*fd-CDM2*	
	Density (ρ)		1	
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		6	
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		13	
	NZP CSI-RS-timeConfig interval and offset	slot	Not configured	
	aperiodicTriggeringOffset		0	
CSI-IM configuration	CSI-IM resource Type		Aperiodic	
	CSI-IM RE pattern		1	
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(8, 13)	
	CSI-IM timeConfig interval and offset	slot	Not configured	
ReportConfigType			*Aperiodic*	
CQI-table			Table 1	
reportQuantity			*cri-RI-PMI-CQI*	
timeRestrictionForChannelMeasurements			*Not configured*	
timeRestrictionForInterferenceMeasurements			*Not configured*	
cqi-FormatIndicator			*Wideband*	
pmi-FormatIndicator			*Wideband*	
Sub-band Size		RB	8	
csi-ReportingBand			111111111	
CSI-Report periodicity and offset		slot	Not configured	
Aperiodic Report Slot Offset			6	
CSI request			1 in slots i, where mod(i, 8) = 1, otherwise it is equal to 0	
reportTriggerSize			1	
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM	
Codebook configuration	Codebook Type		*typeI-SinglePanel*	
	Codebook Mode		1	

	(CodebookConfig-N1,CodebookConfig-N2)		*Not configured*
	CodebookSubsetRestriction		000001
	RI Restriction		N/A
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	1.375
Maximum number of HARQ transmission			1
Measurement channel			As specified in Table A.4-1, TBS.1-1

Table 8.2.2.2.2.1.3-2 Minimum requirements

	Test 1	Test 2
α [%]	2	2
γ	1.05	1.05

The normative reference for this requirement is TS 38.101-4 [5] clause 8.2.2.2.2.1.

8.2.2.2.2.1.4 Test Description

8.2.2.2.2.1.4.1 Initial Conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.2-1 of TS 38.521-2 [8].

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

Only sub tests shall be tested which are testable according to Table 7.1.1_1-2.

For EN-DC within FR2 operation, setup the LTE radiated link according to Annex D:

1. Connection between SS, the faders, AWGN noise source and the UE antenna is shown in TS 38.508-1 [6] Annex A, Figure A.3.3.2 for TE diagram and Figure A.3.4.2 for UE diagram.
2. The parameter settings for the NR cell are set up according to Table 8.1.2-1 and Table 8.2.2.2.2.1.3-1 and as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1, and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-2 [8].
4. Propagation conditions for NR cell are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR for SA with *Connected without release On, Test Mode On* or EN-DC, DC bearer *MCG* and *SCG, Connected without release On, Test Mode On for NSA* according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 8.2.2.2.2.1.4.3.

8.2.2.2.2.1.4.2 Test Procedure

1. Set the UE in a direction that satisfies the 3 normative criteria specified in Annex H.0. If no direction found mark the test as inconclusive.
2. Set the parameters of bandwidth, reference Channel, the propagation condition, antenna configuration and the SNR according to Table 8.2.2.2.2.1.5-1.

3. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to CQI value 2 and keep it regardless of the wideband CQI value sent by the UE. The SS sends downlink MAC padding bits on the DL RMC. Continue transmission of the PDSCH until 6000 wideband CQI reports have been gathered. In this process the SS collects wideband CQI reports every 1 ms and also cases where UE transmits nothing in its CQI timing are also counted as wideband CQI reports.

4. Set up a relative frequency distribution for the reported wideband CQI-values, Calculate the median value (wideband Median CQI is the wideband CQI that is at or crosses 50% distribution from the lower wideband CQI side). This CQI-value is declared as Median CQI value.

5. If Median CQI value is not equal to 1 or 15 and 120 (α%) or more of the wideband CQI values are outside the range (Median CQI - 1) ≤ Median CQI ≤ (Median CQI + 1) then continue with step 6, otherwise go to step 8.

6. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to the Median CQI value from step 4 and shall not react to the UE's wideband CQI reports. The SS sends downlink MAC padding bits on the DL RMC. Measure the average throughput according to Annex G.3.3 and G.3.4.

   Declare the throughput as t_{median}.

7. The SS shall transmit PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to the UE's reported wideband CQI value. The SS sends downlink MAC padding bits on the DL RMC. For any PDSCH transmitted by the SS, record the associated ACK, NACK and statDTX responses. The responses are then filtered as follows: for the sequence of responses for each HARQ process, discard all the statDTX responses. Continue to gather data until the number of filtered ACK+NACK responses reaches 1000. Record the BLER (NACK / ACK + NACK) and measure the average throughput according to Annex G.3.3 and G.3.4. Declare the throughput as t.

   If the recorded BLER ≥ 0.01 and t / t_{median} ≥ γ then pass the UE for this test and go to step 9.

8. If both SNR points of the test have not been tested, then repeat the same procedure (steps 2 to 7) for the other SNR point as appropriate. Otherwise fail the UE.

9. Repeat step 2 to 8, with test conditions according to the table 8.2.2.2.2.1.5-1, for Test2 as appropriate.

8.2.2.2.2.1.4.3 Message Contents

Message contents are according to TS 38.508-1 [6] subclause 4.6.1 and 5.4.2 with the following exceptions:

8.2.2.2.2.1.4.3_1 Message exceptions for SA

Table 8.2.2.2.2.1.4.3_1-1: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], Table 4.6.3-39			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ReportConfig ::= SEQUENCE {			
reportConfigType CHOICE {		Aperiodic	
aperiodic SEQUENCE {			
reportSlotOffsetList	6		
}			
}			
reportFreqConfiguration SEQUENCE {			
csi-ReportingBand CHOICE{			
Subbands9	111111111		
}			
}			
}			

Table 8.2.2.2.2.1.4.3_1-2: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], Table 4.6.3-25			
Information Element	**Value/remark**	**Comment**	**Condition**
CodebookConfig ::= SEQUENCE {			
codebookType CHOICE {			
type1 SEQUENCE {			
subType CHOICE {			
typeI-SinglePanel SEQUENCE {			
nrOfAntennaPorts CHOICE {			
Two SEQUENCE {			
twoTX-codebookSubsetRestriction	000001		
}			
}			
}			
}			
}			
}			
}			

Table 8.2.2.2.2.1.4.3_1-3: SchedulingRequestResourceConfig

Derivation Path: TS 38.508-1 [6], Table 4.6.3-157			
Information Element	**Value/remark**	**Comment**	**Condition**
SchedulingRequestResourceConfig ::= SEQUENCE {			
periodicityAndOffset CHOICE {			
Sl80	7		
}			
}			

8.2.2.2.2.1.4.3_2 Message exceptions for NSA

Same as in 8.2.2.2.2.1.4.3_1.

8.2.2.2.2.1.5 Test Requirements

Table 8.2.2.2.2.1.5-1 Test parameters

Parameter		Unit	Test 1		Test 2	
Bandwidth		MHz	100			
Subcarrier spacing		kHz	120			
Duplex Mode			TDD			
TDD Slot Configuration			FR2.120-2 Annex A.1.3			
SNR_{BB}		dB	6+ TT	7+ TT	12 +T T	13 +T T
Propagation channel			TDLA30-35			
Antenna configuration			2×2 ULA High			
Beamforming Model			As specified in Annex B.4.1			
ZP CSI-RS configuration	CSI-RS resource Type		*Periodic*			
	Number of CSI-RS ports (*X*)		4			
	CDM Type		*FD-CDM2*			
	Density (ρ)		1			
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		8			
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		13			
	CSI-RS interval and offset	slot	8/1			
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		*Aperiodic*			
	Number of CSI-RS ports (*X*)		2			
	CDM Type		*fd-CDM2*			
	Density (ρ)		1			
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		6			
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		13			
	NZP CSI-RS-timeConfig interval and offset	slot	Not configured			
	aperiodicTriggeringOffset		0			
CSI-IM configuration	CSI-IM resource Type		Aperiodic			
	CSI-IM RE pattern		1			
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(8, 13)			
	CSI-IM timeConfig interval and offset	slot	Not configured			
ReportConfigType			*Aperiodic*			
CQI-table			Table 1			
reportQuantity			*cri-RI-PMI-CQI*			
timeRestrictionForChannelMeasurements			*Not configured*			
timeRestrictionForInterferenceMeasurements			*Not configured*			
cqi-FormatIndicator			*Wideband*			
pmi-FormatIndicator			*Wideband*			
Sub-band Size		RB	8			
csi-ReportingBand			111111111			
CSI-Report periodicity and offset		slot	Not configured			
Aperiodic Report Slot Offset			6			
CSI request			1 in slots i, where mod(i, 8) = 1, otherwise it is equal to 0			
reportTriggerSize			1			
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains			

			pointers to NZP CSI-RS and CSI-IM
Codebook configuration	Codebook Type		*typeI-SinglePanel*
	Codebook Mode		1
	(CodebookConfig-N1,CodebookConfig-N2)		*Not configured*
	CodebookSubsetRestriction		000001
	RI Restriction		N/A
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	1.375
Maximum number of HARQ transmission			1
Measurement channel			As specified in Table A.4-1, TBS.1-1
Note 1: TT = 0dB			

Table 8.2.2.2.2.1.5-2 Test requirements

	Test 1	Test 2
α [%]	2	2
γ	1.05 - TT	1.05 - TT
Note 1: TT = 0.01		

8.2.2.2.2.1_1 2Rx TDD FR2 aperiodic CQI wideband reporting under fading performance for both SA and NSA – 256QAM (Rel-16 and forward)

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

- Test point applicability is TBD for all bands in Table 8.1.1_1-2.

8.2.2.2.2.1_1.1 Test Purpose

To verify the variance of the wideband CQI reports is within the limits defined, that the ratio of the throughput is within the limits defined and that the average PDSCH BLER is greater than or equal to 1% for the indicated transport format.

8.2.2.2.2.1_1.2 Test Applicability

This test applies to all types of NR UE release 16 and forward supporting DL 256QAM.

This test also applies to all types of EUTRA UE release 16 and forward supporting EN-DC and NR DL 256QAM.

8.2.2.2.2.1_1.3 Minimum requirement for aperiodic CQI reporting

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_1.3-1 and using the downlink physical channels specified in Annex C.5.1, the minimum requirements are specified by the following:

a) a CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least α % of the time, where α% is specified in Table 8.2.2.2.2.1_1.3-2;

b) the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be ≥ γ, where γ is specified in Table 8.2.2.2.2.1_1.3-2;

c) when transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater or equal to 0.01.

Table 8.2.2.2.2.1_1.3-1: Test parameters

Parameter		Unit	Test 3	Test 4
Bandwidth		MHz	50	
Subcarrier spacing		kHz	120	
Duplex Mode			TDD	
TDD Slot Configuration			FR2.120-2 Annex A.1.3	
SNR_{BB}		dB	7	8	20	21
Propagation channel			TDLA30-35	
Antenna configuration			2×2 ULA High	
Beamforming Model			As specified in Annex B.4.1	
ZP CSI-RS configuration	CSI-RS resource Type		*Periodic*	
	Number of CSI-RS ports (*X*)		4	
	CDM Type		*FD-CDM2*	
	Density (ρ)		1	
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		8	
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		13	
	CSI-RS interval and offset	slot	8/1	
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		*Aperiodic*	
	Number of CSI-RS ports (*X*)		2	
	CDM Type		*fd-CDM2*	
	Density (ρ)		1	
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		6	
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		13	
	NZP CSI-RS-timeConfig interval and offset	slot	Not configured	
	aperiodicTriggeringOffset		0	
CSI-IM configuration	CSI-IM resource Type		Aperiodic	
	CSI-IM RE pattern		1	
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(8, 13)	
	CSI-IM timeConfig interval and offset	slot	Not configured	
ReportConfigType			*Aperiodic*	
CQI-table			Table 2	
reportQuantity			*cri-RI-PMI-CQI*	
timeRestrictionForChannelMeasurements			*Not configured*	
timeRestrictionForInterferenceMeasurements			*Not configured*	
cqi-FormatIndicator			*Wideband*	
pmi-FormatIndicator			*Wideband*	
Sub-band Size		RB	8	
csi-ReportingBand			111111111	
CSI-Report periodicity and offset		slot	Not configured	
Aperiodic Report Slot Offset			6	
CSI request			1 in slots i, where mod(i, 8) = 1, otherwise it is equal to 0	
reportTriggerSize			1	
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM	
Codebook configuration	Codebook Type		*typeI-SinglePanel*	
	Codebook Mode		1	

	(CodebookConfig-N1,CodebookConfig-N2)		*Not configured*
	CodebookSubsetRestriction		000001
	RI Restriction		N/A
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	1.375
Maximum number of HARQ transmission			1
Measurement channel			As specified in Table A.4-2, TBS.2-7

Table 8.2.2.2.2.1_1.3-2 Minimum requirements

	Test 3	Test 4
α [%]	2	2
γ	1.05	1.05

The normative reference for this requirement is TS 38.101-4 [5] clause 8.2.2.2.2.1.

8.2.2.2.2.1_1.4 Test Description

Same test description as in clause 8.2.2.2.2.1.4 with the following exception:

- Table 8.2.2.2.2.1_1.3-1 instead of 8.2.2.2.2.1.3-1
- Table 8.2.2.2.2.1_1.4.1- instead of 8.2.2.2.2.1.4.3_1-1
- Table 8.2.2.2.2.1_1.5-1 instead of 8.2.2.2.2.1.5-1
- In test procedures, Test 3 and Test 4 are configured and tested.

Table 8.2.2.2.2.1_1.4.1-1: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], Table 4.6.3-39			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ReportConfig ::= SEQUENCE {			
reportConfigType CHOICE {		Aperiodic	
aperiodic SEQUENCE {			
reportSlotOffsetList	6		
}			
}			
reportFreqConfiguration SEQUENCE {			
csi-ReportingBand CHOICE{			
Subbands9	111111111		
}			
}			
cqi-Table	table2		Test 3 and 4
}			

8.2.2.2.2.1_1.5 Test Requirements

Table 8.2.2.2.2.1_1.5-1 Test parameters

Parameter		Unit	Test 3	Test 4		
Bandwidth		MHz	50			
Subcarrier spacing		kHz	120			
Duplex Mode			TDD			
TDD Slot Configuration			FR2.120-2 Annex A.1.3			
SNR_{BB}		dB	7+ TT	8+ TT	20 +T T	21 +T T
Propagation channel			TDLA30-35			
Antenna configuration			2×2 ULA High			
Beamforming Model			As specified in Annex B.4.1			
ZP CSI-RS configuration	CSI-RS resource Type		*Periodic*			
	Number of CSI-RS ports (*X*)		4			
	CDM Type		*FD-CDM2*			
	Density (ρ)		1			
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		8			
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		13			
	CSI-RS interval and offset	slot	8/1			
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		*Aperiodic*			
	Number of CSI-RS ports (*X*)		2			
	CDM Type		*fd-CDM2*			
	Density (ρ)		1			
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		6			
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		13			
	NZP CSI-RS-timeConfig interval and offset	slot	Not configured			
	aperiodicTriggeringOffset		0			
CSI-IM configuration	CSI-IM resource Type		Aperiodic			
	CSI-IM RE pattern		1			
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(8, 13)			
	CSI-IM timeConfig interval and offset	slot	Not configured			
ReportConfigType			*Aperiodic*			
CQI-table			Table 2			
reportQuantity			*cri-RI-PMI-CQI*			
timeRestrictionForChannelMeasurements			*Not configured*			
timeRestrictionForInterferenceMeasurements			*Not configured*			
cqi-FormatIndicator			*Wideband*			
pmi-FormatIndicator			*Wideband*			
Sub-band Size		RB	8			
csi-ReportingBand			111111111			
CSI-Report periodicity and offset		slot	Not configured			
Aperiodic Report Slot Offset			6			
CSI request			1 in slots i, where mod(i, 8) = 1, otherwise it is equal to 0			
reportTriggerSize			1			
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains			

			pointers to NZP CSI-RS and CSI-IM
Codebook configuration	Codebook Type		*typeI-SinglePanel*
	Codebook Mode		1
	(CodebookConfig-N1,CodebookConfig-N2)		*Not configured*
	CodebookSubsetRestriction		000001
	RI Restriction		N/A
Physical channel for CSI report			PUSCH
CQI/RI/PMI delay		ms	1.375
Maximum number of HARQ transmission			1
Measurement channel			As specified in Table A.4-2, TBS.2-7
Note 1: TT = 0dB			

Table 8.2.2.2.2.1_1.5-2 Test requirements

	Test 3	Test 4
α [%]	2	2
γ	1.05 - TT	1.05 - TT
Note 1: TT = 0.01		

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

8.2A.1 General

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

8.2A.2 1RX requirements

(Void)

8.2A.3 2RX requirements

8.2A.3.1 CQI reporting definition under AWGN conditions

8.2A.3.1.0 Minimum requirement for periodic CQI reporting

For the CA CQI reporting test defined in Table 8.2A.3.1.0-4, the test requirements and the test parameters are defined as below.

For each CC, the test parameters are specified in Table 8.2A.3.1.0-1.

For CA with 2 DL CC, for the SNR configuration specified in Table 8.2A.3.1.0-2, and using the downlink physical channels specified in Annex C.5.1 on each CC, the difference between the wideband CQI indices of PCell and SCell reported shall be such that

$$\text{wideband CQI}_{\text{PCell}} - \text{wideband CQI}_{\text{SCell}} \geq 2$$

for more than 90% of the time.

For CA with 3 or more DL CC, for the SNR configuration specified in Table 8.2A.3.1.0-3, and using the downlink physical channels specified in Annex C.5.1 on each cell, the difference between the wideband CQI indices of PCell and SCell1 reported, and the difference between the wideband CQI indices of SCell1 and SCell2, 3… reported shall be such that

$$\text{wideband CQI}_{\text{PCell}} - \text{wideband CQI}_{\text{SCell1}} \geq 2$$

$$\text{wideband CQI}_{\text{SCell1}} - \text{wideband CQI}_{\text{SCell2, 3...}} \geq 2$$

for more than 90% of the time.

Table 8.2A.3.1.0-1: CA CQI reporting test parameters for each CC

Parameter		Unit	Value
Subcarrier spacing		kHz	120
Duplex Mode			TDD
TDD Slot Configuration			FR2.120-2 Annex A.1.3
Propagation channel			AWGN
Antenna configuration			1×2 with static channel specified in Annex B.1
ZP CSI-RS configuration	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (*X*)		4
	CDM Type		FD-CDM2
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		8
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		13
	CSI-RS periodicity and offset	slot	8/1
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Periodic
	Number of CSI-RS ports (*X*)		1
	CDM Type		No CDM
	Density (ρ)		1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		6
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		13
	NZP CSI-RS-timeConfig periodicity and offset	slot	8/1
CSI-IM configuration	CSI-IM resource Type		Periodic
	CSI-IM RE pattern		1
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(8, 13)
	CSI-IM timeConfig periodicity and offset	slot	8/1
ReportConfigType			Periodic
CQI-table			Table 1
reportQuantity			cri-RI-PMI-CQI
timeRestrictionForChannelMeasurements			Not configured
timeRestrictionForInterferenceMeasurements			Not configured
cqi-FormatIndicator			Wideband
pmi-FormatIndicator			Wideband
Sub-band Size		RB	8 for 50MHz, 100MHz, 16 for 200MHz, 32 for 400MHz
csi-ReportingBand			111111111
CSI-Report periodicity and offset		slot	8/3
aperiodicTriggeringOffset			Not configured
Physical channel for CSI report			PUCCH
CQI/RI/PMI delay		ms	8.375
Maximum number of HARQ transmission			1
Measurement channel			Derived as per section 5.1.3.2 of TS 38.214 [12]

Table 8.2A.3.1.0-2: SNR configurations for 2 DL CA

Parameter	PCell	SCell
SNR (dB)	10.0	4.0

Table 8.2A.3.1.0-3: SNR configurations for 3 or more DL CA

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

Table 8.2A.3.1.0-4: List of CA CQI reporting test

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

The normative reference for this requirement is TS 38.101-4 [5], clause 8.2A.3.1.1.

8.2A.3.1.1 2Rx CQI reporting accuracy under AWGN conditions for CA (2DL CA)

Editor's note: The following aspects are either missing or not yet determined:

- Test point applicability is TBD for all bands and BW_{agg} > 200 MHz in Table 8.1.1_1-2.

8.2A.3.1.1.1 Test Purpose

To verify that the CQI is correctly reported in accordance with the CQI definition given in TS 38.214 [12] for each CC with multiple cells configured for periodic reporting.

8.2A.3.1.1.2 Test applicability

This test applies to all types of NR UE release 15 and forward that supports 2DL CA.

8.2A.3.1.1.3 Test description

8.2A.3.1.1.3.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.2-1 of TS 38.521-2 [8].

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR2 operation, setup the LTE link according to Annex D

CA capability to be tested: test any one of the supported CA capabilities with largest aggregated CA bandwidth combination, as specified in 8.1.1.5.1.

CA configuration to be tested: For the selected CA capability, test any one of the supported CA configurations with largest aggregated CA bandwidth combination, as specified in 8.1.1.5.1.

1. Connection between SS, the AWGN noise source and the UE is shown in TS 38.508-1 [6] Annex A, Figure A.3.3.2 for TE diagram and Figure A.3.4.2 for UE diagram.

2. The parameter settings for the NR cell are set up according to Table 8.1.2-1, and Table 8.2A.3.1.0-1 to Table 6.2A.3.1.0-3 as appropriate.

3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-2 [8].

4. Propagation conditions are set according to Annex B.1.

5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR for SA with *Connected without release On, Test Mode On* or EN-DC, DC bearer *MCG* and *SCG, Connected without release On, Test Mode On* for NSA according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 8.2A.3.1.1.3.3.

8.2A.3.1.1.1.3.2 Test Procedure

1. Set the UE in a direction that satisfies the 3 normative criteria specified in Annex H.0. If no direction found, mark the test as inconclusive.

2. Set the parameters of bandwidth, reference channel, propagation condition, antenna configuration and SNR configuration according to Table 8.2A.3.1.0-1 to Table 8.2A.3.1.0-4 as appropriate.

3. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC on both PCC and SCC. The SS sends downlink MAC padding bits on the DL RMC.

4. The SS shall start gathering CQI reports, and will continue gathering CQI reports until 2000 wideband CQI reports have been gathered for each PCC and SCC. For each CSI report calculate the respective difference CQI_{P-S} = wideband CQI_{PCell} − wideband CQI_{SCell}.

5. If more than 1800 values of CQI_{P-S} are ≥ 2 pass the UE. Otherwise fail the UE.

8.2A.3.1.1.1.3.3 Message contents

8.2A.2.1.1.1.3.3_1 Message exceptions for SA

Table 8.2A.2.1.1.1.3.3_1-1: CSI-RS-ResourceMapping

Derivation Path: TS 38.508-1 [6], Table 5.4.2.4-2			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
row2	0000 0010 0000	K0= 6, row2	
}			
density CHOICE {			
one	NULL		
}			
}			

Table 8.2A.2.1.1.1.3.3_1-2: NZP CSI-ResourcePeriodicityAndOffset

Derivation Path: TS 38.508-1 [6], Table 5.4.2.4-2a			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourcePeriodicityAndOffset ::= CHOICE {			
slot8	3		
}			

Table 8.2A.2.1.1.1.3.3_1-3: CSI-IM-Resource

Derivation Path: TS 38.508-1 [6], Table 5.4.2.4-6			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-IM-Resource ::= SEQUENCE {			
periodicityAndOffset SEQUENCE {			
slot8	1		
}			
}			

Table 6.2A.2.1.1.1.3.3_1-4: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], Table 5.4.2.4-12		
Information Element	**Value/remark**	**Condition**
CSI-ReportConfig ::= SEQUENCE {		
subbandSize	8	For 50MHz and 100MHz CHBW.
	16	For 200MHz CHBW.
	32	For 400MHz CHBW.
}		

8.2A.2.1.1.1.3.3_2 Message exceptions for NSA

Same as specified in 8.2A.2.1.1.1.3.3_2.

8.2A.3.1.1.1.3.4 Test Requirements

The pass fail decision is as specified in the test procedure in clause 8.2A.3.1.1.1.3.2.

There are no parameters in the test setup or measurement process whose variation impacts the results so there are no applicable test tolerances for this test.

8.2A.3.1.2 2Rx CQI reporting accuracy under AWGN conditions for CA (3DL CA)

Editor's note: The following aspects are either missing or not yet determined:

- Test point applicability is TBD for all bands and BW_{agg} > 200 MHz in Table 8.1.1_1-2.

8.2A.3.1.2.1 Test Purpose

Same with 8.2A.3.1.1.1.

8.2A.3.1.2.2 Test applicability

This test applies to all types of NR UE release 15 and forward that supports 3DL CA.

8.2A.3.1.2.3 Test description

8.2A.3.1.2.3.1 Initial conditions

Same with 8.2A.3.1.1.3.1.

8.2A.3.1.1.2.3.2 Test Procedure

1. Set the UE in a direction that satisfies the 3 normative criteria specified in Annex H.0. If no direction found, mark the test as inconclusive.
2. Set the parameters of bandwidth, reference channel, propagation condition, antenna configuration and SNR configuration according to Table 8.2A.3.1.0-1 to Table 8.2A.3.1.0-4 as appropriate.
3. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC on both PCC and SCC. The SS sends downlink MAC padding bits on the DL RMC.
4. The SS shall start gathering CQI reports, and will continue gathering CQI reports until 2000 wideband CQI reports have been gathered for each PCC and SCCs. For each CSI report calculate the respective difference $CQI_{P\text{-}S1}$ = wideband CQI_{PCell} – wideband CQI_{SCell1} and the respective difference $CQI_{S1\text{-}S2}$ = wideband CQI_{SCell1} – wideband CQI_{SCell2}.
5. If more than 1800 values of $CQI_{P\text{-}S1}$ are ≥ 2 and more than 1800 values of $CQI_{S1\text{-}S2}$ are ≥ 2, pass the UE. Otherwise fail the UE.

8.2A.3.1.1.2.3.3 Message contents

Same with 8.2A.3.1.1.1.3.3.

8.2A.3.1.1.2.3.4 Test Requirements

The pass fail decision is as specified in the test procedure in clause 8.2A.3.1.1.2.3.2.

There are no parameters in the test setup or measurement process whose variation impacts the results so there are no applicable test tolerances for this test.

8.2A.3.1.3 2Rx CQI reporting accuracy under AWGN conditions for CA (4DL CA)

Editor's note: The following aspects are either missing or not yet determined:

- Test point applicability is TBD for all bands and BW_{agg} > 200 MHz in Table 8.1.1_1-2.

8.2A.3.1.3.1 Test Purpose

Same with 8.2A.3.1.1.1.

8.2A.3.1.3.2 Test applicability

This test applies to all types of NR UE release 15 and forward that supports 4DL CA.

8.2A.3.1.3.3 Test description

8.2A.3.1.3.3.1 Initial conditions

Same with 8.2A.3.1.1.3.1.

8.2A.3.1.1.3.3.2 Test Procedure

1. Set the UE in a direction that satisfies the 3 normative criteria specified in Annex H.0. If no direction found, mark the test as inconclusive.
2. Set the parameters of bandwidth, reference channel, propagation condition, antenna configuration and SNR configuration according to Table 8.2A.3.1.0-1 to Table 8.2A.3.1.0-4 as appropriate.
3. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC on both PCC and SCC. The SS sends downlink MAC padding bits on the DL RMC.
4. The SS shall start gathering CQI reports, and will continue gathering CQI reports until 2000 wideband CQI reports have been gathered for each PCC and SCCs. For each CSI report calculate the respective difference $CQI_{P\text{-}S1}$ = wideband CQI_{PCell} – wideband $CQI_{SCell1,}$ the respective difference $CQI_{S1\text{-}S2}$ = wideband CQI_{SCell1} – wideband CQI_{SCell2} and the respective difference $CQI_{S1\text{-}S3}$ = wideband CQI_{SCell1} – wideband CQI_{SCell3}.
5. If more than 1800 values of $CQI_{P\text{-}S1}$ are ≥ 2, more than 1800 values of $CQI_{S1\text{-}S2}$ are ≥ 2 and more than 1800 values of $CQI_{S1\text{-}S3}$ are ≥ 2, pass the UE. Otherwise fail the UE.

8.2A.3.1.1.3.3.3 Message contents

Same with 8.2A.3.1.1.1.3.3.

8.2A.3.1.1.3.3.4 Test Requirements

The pass fail decision is as specified in the test procedure in clause 8.2A.3.1.1.3.3.2.

There are no parameters in the test setup or measurement process whose variation impacts the results so there are no applicable test tolerances for this test.

8.3 Reporting of Precoding Matrix Indicator (PMI)

8.3.0 General

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

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

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

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

8.3.1 1RX requirements (Void)

8.3.2 2RX requirements

8.3.2.1 FDD

TBD

8.3.2.2 TDD

8.3.2.2.1 2Rx TDD FR2 Single PMI with 2TX TypeI-SinglePanel codebook for both SA and NSA

8.3.2.2.1.1 Test purpose

The purpose of this test is to test the accuracy of the Precoding Matrix Indicator (PMI) reporting such that the system throughput is maximized based on the precoders configured according to the UE reports.

8.3.2.2.1.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

8.3.2.2.1.3 Minimum conformance requirements

For the parameters specified in Table 8.3.2.2.1.3-1, and using the downlink physical channels specified in Annex C.5.1, the minimum requirements are specified in Table 8.3.2.2.1.3-2.

Table 8.3.2.2.1.3-1: Test parameters (single layer)

Parameter		Unit	Test 1	Test 2
Bandwidth		MHz	100	100
Subcarrier spacing		kHz	120	120
TDD DL-UL configuration			FR2.120-2 as specified in Annex A.1.3	FR2.120-1 as specified in Annex A.1.3
Propagation channel			TDLA30-35	TDLA30-35
Antenna configuration			2 x 2 ULA Low	2 x 2 ULA Low
Beamforming Model			As specified in Annex B.4.1	As specified in Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Periodic	Periodic
	Number of CSI-RS ports (*X*)		4	4
	CDM Type		FD-CDM2	FD-CDM2
	Density (ρ)		1	1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 4, (8,-)	Row 4, (8,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(13,-)	(13,-)
	CSI-RS interval and offset	slot	8/1	5/1
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Aperiodic	Aperiodic
	Number of CSI-RS ports (*X*)		2	2
	CDM Type		FD-CDM2	FD-CDM2
	Density (ρ)		1	1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 3, (6,-)	Row 3, (6,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(13,-)	(13,-)
	CSI-RS interval and offset	slot	Not configured	Not configured
	aperiodicTriggering Offset		0	0
CSI-IM configuration	CSI-IM resource Type		Aperiodic	Aperiodic
	CSI-IM RE pattern		Pattern 1	Pattern 1
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(8,13)	(8,13)
	CSI-IM timeConfig interval and offset	slot	Not configured	Not configured
ReportConfigType			Aperiodic	Aperiodic
CQI-table			Table 1	Table 1
reportQuantity			cri-RI-PMI-CQI	cri-RI-PMI-CQI
timeRestrictionForChannelMeasurements			Not configured	Not configured
timeRestrictionForInterferenceMeasurements			Not configured	Not configured
cqi-FormatIndicator			Wideband	Wideband

pmi-FormatIndicator			Wideband	Wideband
Sub-band Size		RB	8	8
csi-ReportingBand			111111111	111111111
CSI-Report interval and offset		slot	Not configured	Not configured
Aperiodic Report Slot Offset			6	8
CSI request			1 in slots i, where mod(i, 8) = 1, otherwise it is equal to 0	1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0
reportTriggerSize			1	1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM	One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
Codebook configuration	Codebook Type		typeI-SinglePanel	typeI-SinglePanel
	Codebook Mode		1	1
	(CodebookConfig-N1,CodebookConfig-N2)		N/A	N/A
	CodebookSubsetRestriction		001111	001111
	RI Restriction		N/A	N/A
Physical channel for CSI report			PUSCH	PUSCH
CQI/RI/PMI delay		ms	1.375	1.75
Maximum number of HARQ transmission			4	4
Measurement channel			R.PDSCH.5-8.1 TDD	R.PDSCH.5-7.1 TDD
Note 1: For random precoder selection, the precoder shall be updated in each slot (0.125 ms granularity). Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-4)], this reported PMI cannot be applied at the gNB downlink before slot#(n+4)]. Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3.				

Table 8.3.2.2.1.3-2: Minimum requirement

Parameter	Test 1	Test 2
γ	1.05	1.05

8.3.2.2.1.4 Test description

8.3.2.2.1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.2-1 of TS 38.521-2 [8].

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR2 operation, setup the LTE radiated link according to Annex D:

1. Connection between SS, the faders, AWGN noise source and the UE antenna is shown in TS 38.508-1 [6] Annex A, Figure A.3.3.2 for TE diagram and Figure A.3.4.2 for UE diagram.
2. The parameter settings for the NR cell are set up according to Table 8.1.2-1 and Table 8.3.2.2.1.3-1 and as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-2 [8].
4. Propagation conditions for NR cell are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR for SA with *Connected without release On, Test Mode On* or EN-DC, DC bearer *MCG* and *SCG, Connected without release On, Test Mode On for NSA* according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 8.3.2.2.1.4.3.

8.3.2.2.1.4.2 Test procedure

1. Set the UE in a direction that satisfies the 3 normative criteria specified in Annex H.0.If no direction found, mark the test as inconclusive.
2. Set the parameters of bandwidth, the propagation condition, antenna configuration and measurement channel according to Table 8.3.2.2.1.3-1 as appropriate.
3. The SS shall transmit PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC with precoding matrix according to PMI report from the UE. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission to carry the PUSCH CQI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. Establish t_{ue} and SNR_{ue} according to Annex G.3.2.
4. Set SNR to SNR_{ue}. The SS shall transmit PDSCH with randomly selected precoding matrix from codebook (Table 5.2.2.2.1-5 in TS 38.214 [12]) every slot regardless of PMI reports from the UE. Note that each precoding matrix shall be selected in equal probabilities. The SS sends downlink MAC padding bits on the DL RMC. SS schedules the UL transmission to carry the PUSCH CSI feedback via PDCCH DCI format [0_1] with aperiodic CSI request triggered. Measure t_{rnd} according to Annex G.3.3.
5. Calculate $\gamma = \frac{t_{ue}}{t_{rnd}}$. If the ratio ≥ γ which is specified in table 8.3.2.2.1.5-1, then the test is pass. Otherwise, the test is fail.
6. Repeat steps from 3 to 5 for each subtest in Table 8.3.2.2.1.3-1 as appropriate.

8.3.2.2.1.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clauses 4.6.1 and 5.4.2 with the following exceptions:

8.3.2.2.1.4.3_1 Message exceptions for SA

Table 8.3.2.2.1.4.3_1-1: CSI-ResourceConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-41			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourceConfig ::= SEQUENCE {			
resourceType	Aperiodic		CSI-RS for CSI Acquisition
	Periodic		CSI-RS for Tracking or Beam Refinement
}			

Table 8.3.2.2.1.4.3_1-2: CSI-RS-ResourceMapping for NZP-CSI-RS for Tracking

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-45			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
row1	0001		
}			
nrofPorts	p1	1 for CSI-RS resource 1,2,3,4	
firstOFDMSymbolInTimeDomain	4	l_0 = 4 for CSI-RS resource 1 and 3	
	8	l_0 = 8 for CSI-RS resource 2 and 4	
}			

Table 8.3.2.2.1.4.3_1-3: CSI-RS-ResourceMapping for NZP-CSI-RS for Acquisition

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-45			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
row3	001000		
}			
nrofPorts	p2		
firstOFDMSymbolInTimeDomain	13		
}			

Table 8.3.2.2.1.4.3_1-4: CSI-RS-ResourceMapping for NZP-CSI-RS for Beam Refinement

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-45			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
row1	0001		
}			
nrofPorts	p1		
firstOFDMSymbolInTimeDomain	8	l_0 = 8 for CSI-RS resource 1	
	9	l_0 = 9 for CSI-RS resource 2	
}			

Table 8.3.2.2.1.4.3_1-5: CSI-RS-ResourceMapping for ZP-CSI-RS

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-45			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
row4	100		
}			
nrofPorts	p4		
firstOFDMSymbolInTimeDomain	13		
}			

Table 8.3.2.2.1.4.3_1-6: ZP CSI-ResourcePeriodicityAndOffset

Derivation Path: Table 4.6.3-43			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourcePeriodicityAndOffset ::= CHOICE {			
slots8	1		Test 1
slots5	1		Test 2
}			

Table 8.3.2.2.1.4.3_1-7: CSI-IM-Resource

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-34			
Information Element	**Value/remark**	**Comment**	**Condition**
csi-IM-ResourceElementPattern CHOICE {			
pattern1 SEQUENCE {			
subcarrierLocation-p1	s8		
symbolLocation-p1	13		
}			
}			

Table 8.3.2.2.1.4.3_1-8: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], Table 4.6.3-25			
Information Element	**Value/remark**	**Comment**	**Condition**
CodebookConfig ::= SEQUENCE {			
codebookType CHOICE {			
type1 SEQUENCE {			
subType CHOICE {			
typeI-SinglePanel SEQUENCE {			
nrOfAntennaPorts CHOICE {			
Two SEQUENCE {			
twoTX-codebookSubsetRestriction	001111		
}			
}			
TypeI-SinglePanel-ri-Restriction	11111111		
}			
}			
}			
}			
}			

Table 8.3.2.2.1.4.3_1-9: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-39			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ReportConfig ::= SEQUENCE {			
reportConfigType CHOICE {			
aperiodic SEQUENCE {			
reportSlotOffsetList	6		Test 1
	8		Test 2
}			
}			
reportFreqConfiguration SEQUENCE {			
csi-ReportingBand CHOICE {			
subbands9	111111111		
}			
}			
subbandSize	value2		
}			

8.3.2.2.1.4.3_2 Message exceptions for NSA

Same as 8.3.2.2.1.4.3_1.

8.3.2.2.1.5 Test requirement

Table 8.3.2.2.1.5-1: Test requirement (TDD)

Parameter	Test 1	Test 2
γ	1.04	1.04

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

8.4.2.2.1 2Rx TDD FR2 RI reporting for both SA and NSA

-8.4.2.2.1.1 Test Purpose

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.

8.4.2.2.1.2 Test Applicability

This test applies to all types of NR UE release 15 and forward.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

8.4.2.2.1.3 Minimum requirement

The minimum performance requirement in Table 8.4.2.2.1.3-2 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 8.4.2.2.1.3-1, and using the downlink physical channels specified in Annex C.2.2, the minimum requirements are specified in Table 8.4.2.2.1.3-2.

Table 8.4.2.2.1.3-1: RI Test (TDD)

Parameter		Unit	Test 1	Test 2	Test 3
Bandwidth		MHz	100	100	100
Subcarrier spacing		kHz	120	120	120
Duplex Mode			TDD	TDD	TDD
TDD Slot Configuration			FR2.120-2	FR2.120-2	FR2.120-2
SNR		dB	0	16	16
Propagation channel			TDLA30-35	TDLA30-35	TDLA30-35
Antenna configuration			ULA Low 2x2	ULA Low 2x2	XP High 2x2
Beamforming Model			As defined in Annex B.4.1	As defined in Annex B.4.1	As defined in Annex B.4.1
ZP CSI-RS configuration	CSI-RS resource Type		Periodic	Periodic	Periodic
	Number of CSI-RS ports (*X*)		4	4	4
	CDM Type		FD-CDM2	FD-CDM2	FD-CDM2
	Density (ρ)		1	1	1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 4, (8,-)	Row 4, (8,-)	Row 4, (8,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(13,-)	(13,-)	(13,-)
	CSI-RS interval and offset	slot	8/1	8/1	8/1
NZP CSI-RS for CSI acquisition	CSI-RS resource Type		Aperiodic	Aperiodic	Aperiodic
	Number of CSI-RS ports (*X*)		2	2	2
	CDM Type		FD-CDM2	FD-CDM2	FD-CDM2
	Density (ρ)		1	1	1
	First subcarrier index in the PRB used for CSI-RS (k_0, k_1)		Row 3 (6,-)	Row 3 (6,-)	Row 3 (6,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(13,-)	(13,-)	(13,-)
	NZP CSI-RS-timeConfig interval and offset	slot	Not configured	Not configured	Not configured
	aperiodicTriggeringOffset		0	0	0
CSI-IM configuration	CSI-IM resource Type		Aperiodic	Aperiodic	Aperiodic
	CSI-IM RE pattern		Pattern 1	Pattern 1	Pattern 1
	CSI-IM Resource Mapping (k_{CSI-IM},l_{CSI-IM})		(8,13)	(8,13)	(8,13)
	CSI-IM timeConfig interval and offset	slot	Not configured	Not configured	Not configured
ReportConfigType			Aperiodic	Aperiodic	Aperiodic
CQI-table			Table 1	Table 1	Table 1
reportQuantity			cri-RI-PMI-CQI	cri-RI-PMI-CQI	cri-RI-PMI-CQI
timeRestrictionForChannelMeasurements			not configured	not configured	not configured
timeRestrictionForInterferenceMeasurements			not configured	not configured	not configured
cqi-FormatIndicator			Wideband	Wideband	Wideband
pmi-FormatIndicator			Wideband	Wideband	Wideband
Sub-band Size		RB	8	8	8
csi-ReportingBand			111111111	111111111]	111111111
CSI-Report interval and offset		slot	Not configured	Not configured	Not configured
Aperiodic Report Slot Offset			6	6	6
CSI request			1 in slots i, where mod(i, 8) = 1, otherwise it is equal to 0	1 in slots i, where mod(i, 8) = 1, otherwise it is equal to 0	1 in slots i, where mod(i, 8) = 1, otherwise it is equal to 0
reportTriggerSize			1	1	1
CSI-AperiodicTriggerStateList			One State with one Associated Report Configuration Associated Report	One State with one Associated Report Configuration Associated	One State with one Associated Report Configuration Associated

			Configuration contains pointers to NZP CSI-RS and CSI-IM	Report Configuration contains pointers to NZP CSI-RS and CSI-IM	Report Configuration contains pointers to NZP CSI-RS and CSI-IM
Codebook configuration	Codebook Type		typeI-SinglePanel	typeI-SinglePanel	typeI-SinglePanel
	Codebook Mode		1	1	1
	(CodebookConfig-N1,CodebookConfig-N2)		N/A	N/A	N/A
	CodebookSubsetRestriction		010000 for fixed rank 2, 010011 for following rank	000011 for fixed rank 1, 010011 for following rank	000011 for fixed rank 1, 010011 for following rank
	RI Restriction		N/A	N/A	N/A
Physical channel for CSI report			PUSCH	PUSCH	PUSCH
CQI/RI/PMI delay		ms	1.375	1.375	1.375
Maximum number of HARQ transmission			1	1	1
RI Configuration			Fixed RI = 2 and follow RI	Fixed RI = 1 and follow RI	Fixed RI = 1 and follow RI
Note 1: Measurements channels are specified in Table A.4-1. TBS.1-1 is used for Rank 1 case. TBS.1-2 is used for Rank 2 case.					

Table 8.4.2.2.1.3-2: Minimum requirement (TDD)

	Test 1	Test 2	Test 3
γ_1	N/A	1.05	1.05
γ_2	1.0	N/A	N/A

The normative reference for this requirement is TS 38.101-4 [5] clause 8.4.2.2.

8.4.2.2.1.4 Test Description

8.4.2.2.1.4.1 Initial Conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.2-1 of TS 38.521-2 [8].

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

Only sub tests shall be tested which are testable according to Table 7.1.1_1-2.

For EN-DC within FR2 operation, setup the LTE radiated link according to Annex D:

1. Connection between SS, the faders, AWGN noise source and the UE antenna is shown in TS 38.508-1 [6] Annex A, Figure A.3.3.2 for TE diagram and Figure A.3.4.2 for UE diagram.

2. The parameter settings for the NR cell are set up according to Table 8.1.2-1 and Table 8.4.2.2.1.3-1 and as appropriate.

3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-2 [8].

4. Propagation conditions for NR cell are set according to Annex B.0.

5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR for SA with *Connected without release On, Test Mode On* or EN-DC, DC bearer *MCG* and *SCG, Connected without release On, Test Mode On for NSA* according to TS 38.508-1 [6] clause 4.5. Message content are defined in clause 8.4.2.2.1.4.3.

8.4.2.2.1.4.2 Test Procedure

1. Set the UE in a direction that satisfies the 3 normative criteria specified in Annex H.0. If no direction found mark the test as inconclusive.
2. Set the parameters of bandwidth, reference channel, the propagation condition, antenna configuration, antenna correlation, Codebook configuration, Beamforming Model, RI configuration and SNR according to Table 8.4.2.2.1.3-1 as appropriate. Measure the t_{fix} according to Annex G.3.3.
3. The SS shall send PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to the UE reported CQI (wideband CQI), PMI and fixed RI as defined in Table 8.4.2.2.1.3-1. The SS sends downlink MAC padding bits on the DL RMC.
4. Propagation conditions are set according to Annex B.2.
5. The SS shall transmit an RRC Connection Reconfiguration message to set codebookSubsetRestriction as for UE reported RI according to Table 8.4.2.2.1.3-1.
6. The UE shall transmit RRC Connection Reconfiguration Complete message.
7. Propagation conditions are set according to Table 8.4.2.2.1.3-1.
8. The SS shall send PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to the UE reported CQI (wideband CQI), PMI and RI. The SS sends downlink MAC padding bits on the DL RMC. Measure $t_{reported}$ according to Annex G.3.3.

   If the ratio ($t_{reported}$ / t_{fix}) satisfies the requirement in Table 8.4.2.2.1.5-1, then pass the UE for this test and go to step 9. Otherwise, declare a FAIL verdict.
9. If all tests have not been done, then repeat the same procedure (steps 1 to 8) with test conditions according to the Table 8.4.2.2.1.3-2 for the other Tests as appropriate. Otherwise, declare a PASS verdict.

8.4.2.2.1.4.3 Message Contents

Message contents are according to TS 38.508-1 [6] clauses 4.6.1 and 5.4.2 with the following exceptions:

8.4.2.2.1.4.3_1 Message exceptions for SA

Table 8.4.2.2.1.4.3_1-1: SchedulingRequestResourceConfig

Derivation Path: TS 38.508-1 [6], Table 4.6.3-157			
Information Element	**Value/remark**	**Comment**	**Condition**
SchedulingRequestResourceConfig ::= SEQUENCE {			
periodicityAndOffset CHOICE {			
sl80	7		
}			
}			

Table 8.4.2.2.1.4.3_1-2: CSI-ResourceConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-41			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourceConfig ::= SEQUENCE {			
resourceType	Aperiodic		CSI-RS for CSI Acquisition, CSI-IM-Resource
	Periodic		CSI-RS for Tracking or Beam Refinement
}			

Table 8.4.2.2.1.4.3_1-3: *CodebookConfig*

Derivation Path: TS 38.508-1 [6], clause 4.6.2, Table 4.6.3-25			
Information Element	**Value/remark**	**Comment**	**Condition**
nrOfAntennaPorts CHOICE {			
Two SEQUENCE {			
twoTX-CodebookSubsetRestriction	010000	Fixed rank 2	Test 1
	000011	Fixed rank 1	Test 2, Test 3
	010011	Following rank	Test 1, Test 2, Test 3
}			
}			
typeI-SinglePanel-ri-Restriction	11111111	Non restriction	

Table 8.4.2.2.1.4.3_1-4: CSI-ReportConfig

Derivation Path: TS 38.508-1 [6], clause 4.6.3, Table 4.6.3-39			
Information Element	**Value/remark**	**Comment**	**Condition**
reportConfigType CHOICE {			
aperiodic SEQUENCE {			
reportSlotOffsetList	6		
}			
reportFreqConfiguration SEQUENCE {			
csi-ReportingBand CHOICE {			
subbands9	111111111		
}			
}			
subbandSize	value2		
}			

8.4.2.2.1.4.3_2 Message exceptions for NSA

Same as 8.4.2.2.1.4.3_1.

8.4.2.2.1.5 Test Requirements

Table 8.4.2.2.1.5-1: Test Requirement (TDD)

	Test 1	**Test 2**	**Test 3**
γ_1	N/A	1.04	1.04
γ_2	0.99	N/A	N/A

9 Demodulation performance requirements for interworking

9.1 General

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

For conformance testing involving FR2 test cases in this specification, the UE under test shall be pre-configured with UL Tx diversity schemes disabled to account for single polarization System Simulator (SS) in the test environment. The UE under test may transmit with dual polarization.

9.1.1 Applicability of requirements

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

- For UEs supporting NR/5GC, EN-DC and NE-DC,
  - The performance requirements specified in Clause 5 will be verified only for NR/5GC except for the sustained downlink data rate test specified in Clause 5.5 and 5.5A.
  - The performance requirements specified in Clause 7 will be verified only for NR/5GC except for the sustained downlink data rate test specified in Clause 7.5.
  - The sustained downlink data rate tests specified in Clauses 5.5, 5.5A and 7.5 for NR/5GC and in Clause 9.4B for EN-DC and NE-DC are verified separately.
- The FR1 EN-DC test cases with the NR TDD DL-UL configurations which are not aligned with LTE's can be tested on the corresponding EN-DC band combinations where UE supports simultaneous transmission and reception.
- For UEs supporting NR FR1 CA and/or NR CA including FR1 and FR2, the requirements applicability is specified in Table 9.1.1-1.

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

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

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

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

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

- For UEs supporting NR-DC including FR1 and FR2, if the FR2 requirements in Clause 7.2 and Clause 7.3 are tested, the test coverage can be considered fulfilled without executing requirements in Clause 9.2B.2 and Clause 9.3B.2.

- For UEs supporting NR-DC between FR1 and FR2, if requirements in Clause 9.4A.1 are tested under same or higher data rate as in Clause 9.4B.2, the test coverage can be considered fulfilled without executing the requirements in Clause 9.4B.2.

- For UEs supporting NE-DC and EN-DC, the test coverage of demodulation performance requirements can be considered fulfilled, if the demodulation requirements in Clause 5 and Clause 9.4B.1 are executed for UE under test in the standalone mode.

- For UEs supporting NE-DC and not supporting EN-DC, the test coverage of demodulation performance requirements can be considered fulfilled, if the demodulation requirements in Clause 5 and Clause 9.4B.3 are executed for UE under test.

- For UEs supporting NGEN-DC, the test coverage of demodulation performance requirements can be considered fulfilled, if the demodulation requirements in Clause 5 and Clause 9.4B.1 are executed for UE under test.

9.1.1.1 Applicability of requirements for optional UE features

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

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

9.1.1.2 Applicability of requirements for mandatory UE features with capability signalling

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

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

9.1.2 E-UTRA Cell setup

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

9.1.2.1 FDD

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

The measurement channels in Table 9.1.2.1-2 and OCNG pattern OP.1 FDD are specified in TS 36.521-1 [16]. The physical channel setup with downlink power allocation is according to Annex C.3.2 of TS 36.521-1 [16].

Table 9.1.2.1-1: Common Test Parameters (FDD)

Parameter	Unit	Value
Cyclic prefix		Normal
Physical Cell ID		0
Number of PDCCH symbols	symbols	1
PHICH Ng (Note 1)		1
PHICH duration		Normal
Number of HARQ processes per component carrier	Processes	8
Maximum number of HARQ transmission		4
Redundancy version coding sequence		{0,0,1,2} for 64QAM
Propagation condition		Static propagation condition No external noise sources are applied
Transmission mode		1
Transmission time difference between E-UTRA cell and NR cell(s)	µs	0
Antenna configuration		All NR cells are in FR1: 1x2 Any NR cell is in FR2: 1 Tx[Note 1]
Codebook subset restriction		10
Symbols for all unused REs		OCNG in Annex A.5
Note 1: As the link can be provided over the air, the UE Rx antenna configuration is not relevant for the test configuration and has no impact on the test implementation.		

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

Test setup	Bandwidth (MHz)	Downlink power allocation (dB)		
		ρ_A	ρ_B	σ
1	5	0	0	0
2	10	0	0	0
3	15	0	0	0
4	20	0	0	0

9.1.2.2 TDD

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

The measurement channels in Table 9.1.2.2-2 and OCNG pattern OP.1 TDD are specified in TS 36.521-1 [16]. The physical channel setup with downlink power allocation is according to Annex C.3.2 of TS 36.521-1 [16].

Table 9.1.2.2-1: Common Test Parameters (TDD)

Parameter	Unit	Value
UL DL configuration		2 (Note1)
Special subframe configuration		7
Number of PDCCH symbols	symbols	1
PHICH Ng (Note 3)		1
PHICH duration		Normal
Cyclic prefix		Normal
Cell ID		0
Maximum number of HARQ transmission		4
Redundancy version coding sequence		{0,0,1,2} for 64QAM
Propagation condition		Static propagation condition No external noise sources are applied
Transmission mode		1
Transmission time difference between E-UTRA cell and NR cell(s)	µs	0
Antenna configuration		All NR cells are in FR1: 1x2 Any NR cell is in FR2: 1 Tx Note 2
Codebook subset restriction		10
Symbols for all unused REs		OCNG in Annex A.5

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

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

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

Test setup	Bandwidth (MHz)	Downlink power allocation (dB)		
		ρ_A	ρ_B	σ
1	10	0	0	0
2	15	0	0	0
3	20	0	0	0

9.2 Void

9.2A PDSCH Demodulation for CA

9.2A.1 NR CA between FR1 and FR2

FFS

9.2B PDSCH Demodulation for DC

9.2B.1 EN-DC

9.2B.1.1 EN-DC within FR1

The NR PDSCH demodulation performance requirements and test case details for this test case 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

The NR PDSCH demodulation performance requirements and test case details for this test case 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

FFS

9.3 Void

9.3A PDCCH Demodulation for CA

9.3A.1 NR CA between FR1 and FR2

FFS

9.3B PDCCH Demodulation for DC

9.3B.1 EN-DC

9.3B.1.1 EN-DC within FR1

The NR PDCCH demodulation performance requirements and test case details for this test case 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

The NR PDCCH demodulation performance requirements and test case details for this test case 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

FFS

9.4 Void

9.4A SDR test for CA

FFS

9.4B SDR test for DC

9.4B.1 EN-DC

9.4B.1.1 Sustained downlink data rate performance for EN-DC within FR1

9.4B.1.1.1 Test Purpose

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

9.4B.1.1.2 Test Applicability

This test applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

9.4B.1.1.3 Minimum conformance requirements

During the test, the PDSCH performance on both the NR cell(s) and LTE cell(s) shall be verified.

The TB success rate shall be higher than 85% when NR PDSCH is scheduled with MCS defined for the selected EN-DC bandwidth combination and with the downlink physical channel setup according to Annex C.3.1 and when E-UTRA PDSCH is scheduled with FRC defined for the selected EN-DC bandwidth combination and with the downlink physical channel setup according to Annex C.3.2 from TS 36.101 [X].

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

The common test parameters for NR cell are specified in Table 9.4B.1.1.3-1. The parameters specified in Table 9.4B.1.1.3-2 are applicable for tests on FDD NR cell and parameters specified in Table 9.4B.1.1.3-3 are applicable for tests on TDD NR cell.

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

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

Table 9.4B.1.1.3-1: Common test parameters for FDD or TDD NR band

Parameter		Unit	Value
PDSCH transmission scheme			Transmission scheme 1
EPRE ratio of PTRS to PDSCH		dB	N/A
Channel bandwidth		MHz	Channel bandwidth from selected CA bandwidth combination
Common serving cell parameters	Physical Cell ID		0
	SSB position in burst		First SSB in Slot #0
	SSB periodicity	ms	20
	First DMRS position for Type A PDSCH mapping		2
Cross carrier scheduling			Not configured
Active DL BWP index			1
Actual carrier configuration	Offset between Point A and the lowest usable subcarrier on this carrier (Note 2)	RBs	0
	Subcarrier spacing	kHz	15 or 30
DL BWP configuration #1	RB offset	RBs	0
	Number of contiguous PRB		Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-1 [2] for tested channel bandwidth and subcarrier spacing
	Subcarrier spacing	kHz	15 or 30
	Cyclic prefix		Normal
PDCCH configuration	Slots for PDCCH monitoring		Each slot
	Symbols with PDCCH		Symbols #0
	Number of PRBs in CORESET		Table 9.4B.1.1.3-4
	Number of PDCCH candidates and aggregation levels		2/AL2 for 15 kHz / 5 MHz and 30 kHz / 15 MHz 2/AL4 for 15 kHz / 10 MHz, 30 kHz / 10 MHz and 30 kHz / 20 MHz 2/AL8 for other greater combinations
	CCE-to-REG mapping type		Non-interleaved
	DCI format		1_1
	TCI State		TCI state #1
	PDCCH & PDCCH DMRS Precoding configuration		For 2Tx: Single Panel Type I, Random precoder chosen from precoder index 0 and 2, selection updated per slot For 4Tx: Single Panel Type I, Random precoder chosen from precoders with i_1,1 in {1,2,3,5,6,7} and i_2 in {0,2}, selection updated per slot
PDSCH configuration	Mapping type		Type A
	k0		0
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		WB
	Resource allocation type		Type 0
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS configuration	DMRS Type		Type 1
	Number of additional DMRS		1
	Length		1
	Antenna ports indexes		{1000} for 1 Layer CCs {1000, 1001} for 2 Layers CCs {1000 – 1003} for 4 Layers CCs
	Number of PDSCH DMRS CDM group(s) without data		1 for 1 layer and 2 layers CCs 2 for 4 Layers CCs
PTRS configuration			PTRS is not configured

CSI-RS for tracking	Subcarrier indexes in the PRB used for CSI-RS			k_0 = 3 for CSI-RS resource 1,2,3,4
	OFDM symbols in the PRB used for CSI-RS			l_0 = 6 for CSI-RS resource 1 and 3 l_0 = 10 for CSI-RS resource 2 and 4
	Number of CSI-RS ports (X)			1 for CSI-RS resource 1,2,3,4
	CDM Type			'No CDM' for CSI-RS resource 1,2,3,4
	Density (ρ)			3 for CSI-RS resource 1,2,3,4
	CSI-RS periodicity		Slots	15 kHz SCS: 20 for CSI-RS resource 1,2,3,4 30 kHz SCS: 40 for CSI-RS resource 1,2,3,4
	CSI-RS offset		Slots	15 kHz SCS: 10 for CSI-RS resource 1 and 2 11 for CSI-RS resource 3 and 4 30 kHz SCS: 20 for CSI-RS resource 1 and 2 21 for CSI-RS resource 3 and 4
	Frequency Occupation			Start PRB 0 Number of PRB = BWP size
	QCL info			TCI state #0
NZP CSI-RS for CSI acquisition	Subcarrier indexes in the PRB used for CSI-RS			k_0 = 4
	OFDM symbols in the PRB used for CSI-RS			l_0 = 12
	Number of CSI-RS ports (X)			Same as number of transmit antenna
	CDM Type			'FD-CDM2'
	Density (ρ)			1
	CSI-RS periodicity			15 kHz SCS: 20 30 kHz SCS: 40
	CSI-RS offset			0
	Frequency Occupation			Start PRB 0 Number of PRB = BWP size
	QCL info			TCI state #1
ZP CSI-RS for CSI acquisition	Subcarrier indexes in the PRB used for CSI-RS			k_0 = 0
	OFDM symbols in the PRB used for CSI-RS			l_0 = 12
	Number of CSI-RS ports (X)			4
	CDM Type			'FD-CDM2'
	Density (ρ)			1
	CSI-RS periodicity			15 kHz SCS: 20 30 kHz SCS: 40
	CSI-RS offset			0
	Frequency Occupation			Start PRB 0 Number of PRB = BWP size
TCI state #0	Type 1 QCL information	SSB index		SSB #0
		QCL Type		Type C
	Type 2 QCL information	SSB index		N/A
		QCL Type		N/A
TCI state #1	Type 1 QCL information	CSI-RS resource		CSI-RS resource 1 from 'CSI-RS for tracking' configuration
		QCL Type		Type A
	Type 2 QCL information	CSI-RS resource		N/A
		QCL Type		N/A
Maximum 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}
PDSCH & PDSCH DMRS Precoding configuration				Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i_1, i_2 combination with PRB bundling granularity
Symbols for all unused REs				OCNG Annex A.5
Propagation condition				Static propagation condition

			No external noise sources are applied
Antenna configuration	1 layer CCs		1x2 or 1x4
	2 layers CCs		2x2 or 2x4
	4 layers CCs		4x4
Physical signals, channels mapping and precoding			As specified in Annex B.4.1
Note 1: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH transmission Note 2: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-1 [2] for tested channel bandwidth and subcarrier spacing			

Table 9.4B.1.1.3-2: Additional test parameters for NR FDD band

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

Table 9.4B.1.1.3-3: Additional test parameters for NR TDD band

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

Table 9.4B.1.1.3-4: Number of PRBs in CORESET for NR cell

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 9.4B.1.1.3-5: MCS indexes for indicated UE capabilities for NR cell

Maximum number of PDSCH MIMO layers	Maximum modulation format	Scaling factor	MCS
1	8	1	26
1	8	0.8	21
1	8	0.75	20
1	8	0.4	11
1	6	1	27
1	6	0.8	23
1	6	0.75	22
1	6	0.4	14
1	4	1	16
1	4	0.8	16
1	4	0.75	16
1	4	0.4	10
1	2	1	9
1	2	0.8	9
1	2	0.75	9
1	2	0.4	4
2	8	1	26
2	8	0.8	21
2	8	0.75	20
2	8	0.4	11
2	6	1	27
2	6	0.8	23
2	6	0.75	22
2	6	0.4	14
2	4	1	16
2	4	0.8	16
2	4	0.75	16
2	4	0.4	10
2	2	1	9
2	2	0.8	9
2	2	0.75	9
2	2	0.4	4
4	8	1	26
4	8	0.8	23
4	8	0.75	22
4	8	0.4	12
4	6	1	27
4	6	0.8	24
4	6	0.75	23
4	6	0.4	14
4	4	1	16
4	4	0.8	16
4	4	0.75	16
4	4	0.4	11
4	2	1	9
4	2	0.8	9
4	2	0.75	9
4	2	0.4	5

Table 9.4B.1.1.3-6: Additional test setup for E-UTRA CC

Parameter	Unit	Value
Inter-TTI Distance		1
Number of OFDM symbols for PDCCH per component carrier	OFDM symbols	1
Cross carrier scheduling		Not configured
Propagation condition		Static propagation condition No external noise sources are applied
$\hat{E}_s$ at antenna port	dBm/15kHz	-85
Antenna configuration	2 layer CC	2x2 or 2x4
	4 layer CC	4x4
Codebook subset restriction	2 layer CC	10
	4 layer CC	1000
Downlink power allocation	2 layer CC	ρ_A = -3dB, ρ_B = -3dB, σ = 0dB
	4 layer CC	ρ_A = -6dB, ρ_B = -6dB, σ = 3dB

Table 9.4B.1.1.3-7: E-UTRA FRC for SDR test (FDD)

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

Table 9.4B.1.1.3-8: E-UTRA FRC for SDR test (TDD)

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

9.4B.1.1.3.1 Procedure for test parameter selection

The test parameters are determined by the following procedure:

- Select one EN-DC bandwidth combination among all supported EN-DC configurations and set of per component carrier (CC) UE capabilities among all supported UE capabilities that provides the largest data rate [TS 38.306 [14, Section 4.1.2]].

  - Set of per NR CC UE capabilities include channel bandwidth, subcarrier spacing, number of PDSCH MIMO layers, modulation format and scaling factor TS 38.306 [14] Section 4.1.2]].

  - Set of per E-UTRA CC UE capabilities includes channel bandwidth, number of PDSCH MIMO layers and modulation format [TS 38.306 [14] Section 4.1.2]].

  - When there are multiple sets of EN-DC bandwidth combinations and UE capabilities with same largest data rate, select one among sets with the smallest aggregated channel bandwidth.

- For each NR FR1 CC in EN-DC bandwidth combination, use Table 9.4B.1.1.3-5 to determine MCS based on test parameters and indicated UE capabilities.

- For each E-UTRA CC in EN-DC bandwidth combination, use Table 9.4B.1.1.3-7 and Table 9.4B.1.1.3-8 to determine FRC based on test parameters and indicated UE capabilities.

Pasting relevant portion of max data rate equation from TS 38.306 [14] section 4.1

For NR, the approximate data rate for a given number of aggregated carriers in a band or band combination is computed as follows.

$$\text{data rate (in Mbps)} = 10^{-6} \cdot \sum_{j=1}^{J} \left(v_{Layers}^{(j)} \cdot Q_m^{(j)} \cdot f^{(j)} \cdot R_{\max} \cdot \frac{N_{PRB}^{BW(j),\mu} \cdot 12}{T_s^{\mu}} \cdot \left(1 - OH^{(j)}\right) \right)$$

wherein

J is the number of aggregated component carriers in a band or band combination

R_{max} = 948/1024

For the j-th CC,

$v_{Layers}^{(j)}$ is the maximum number of supported layers given by higher layer parameter *maxNumberMIMO-LayersPDSCH* for downlink and maximum of higher layer parameters *maxNumberMIMO-LayersCB-PUSCH* and *maxNumberMIMO-LayersNonCB-PUSCH* for uplink.

$Q_m^{(j)}$ is the maximum supported modulation order given by higher layer parameter *supportedModulationOrderDL* for downlink and higher layer parameter *supportedModulationOrderUL* for uplink.

$f^{(j)}$ is the scaling factor given by higher layer parameter *scalingFactor* and can take the values 1, 0.8, 0.75, and 0.4.

μ is the numerology (as defined in TS 38.211 [6])

T_s^{μ} is the average OFDM symbol duration in a subframe for numerology μ, i.e. $T_s^{\mu} = \frac{10^{-3}}{14 \cdot 2^{\mu}}$. Note that normal cyclic prefix is assumed.

$N_{PRB}^{BW(j),\mu}$ is the maximum RB allocation in bandwidth $BW^{(j)}$ with numerology μ, as defined in 5.3 TS 38.101-1 [2] and 5.3 TS 38.101-2 [3], where $BW^{(j)}$ is the UE supported maximum bandwidth in the given band or band combination.

$OH^{(j)}$ is the overhead and takes the following values

0.14, for frequency range FR1 for DL

0.18, for frequency range FR2 for DL

0.08, for frequency range FR1 for UL

0.10, for frequency range FR2 for UL

NOTE: Only one of the UL or SUL carriers (the one with the higher data rate) is counted for a cell operating SUL.

For EUTRA in case of MR-DC, the approximate data rate for a given number of aggregated carriers in a band or band combination is computed as follows.

Data rate (in Mbps) = $10^{-3} \cdot \sum_{j=1}^{J} TBS_j$

wherein

J is the number of aggregated EUTRA component carriers in MR-DC band combination

TBS_j is the total maximum number of DL-SCH transport block bits received within a 1ms TTI for j-th CC, as derived from TS36.213 [22] based on the UE supported maximum MIMO layers for the j-th carrier, and based on the modulation order and number of PRBs based on the bandwidth of the j-th carrier.

The approximate maximum data rate can be computed as the maximum of the approximate data rates computed using the above formula for each of the supported band or band combinations.

For MR-DC, the approximate maximum data rate is computed as the sum of the approximate maximum data rates from NR and EUTRA

The normative reference for this requirement is TS 38.101-4 [5], clause 9.4B.1.1.

9.4B.1.1.4 Test description

9.4B.1.1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR and E-UTRA operating bands specified in Table 5.3.5-1 of TS 38.521-1.

Configurations of NR PDSCH and NR PDCCH before measurement are specified in Annex C.

E-UTRA configurations before measurement are specified in at Table 9.4B.1.1.3-6.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [6] Annex A, in Figure A.3.1.7.1 for TE diagram (without fader and AWGN) and clause A.3.2.2 for UE diagram.
2. Downlink signals for the NR cell are initially set up according to Annexes C.0, C.1, C.2, C.3.1, and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-1 [7].
3. Downlink signals for E-UTRA cell are initially set up according to TS 36.521-1 [16] Annex C.0 and uplink signals according to TS 36.521-1 [16] Annex H
4. Propagation conditions are set according to TS 36.521-1 [16] and TS 38.521-1 [7] Annex B.0 for E-UTRA CG and NR CG respectively.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity EN-DC, DC bearer *MCG(s)* and *SCG*, Connected without release *On*, *Test Loop Function On with UE Test Loop Mode A with UL_PDCP_SDU_SIZE = 0* for MCG DRB and SCG DRB according to TS 38.508-1 [6] clause 4.5.4. Message content are defined in clause 5.5.1.4.3.
6. SS sends a RRCConnectionReconfiguration message to change PDCP version of MCG DRB to NR PDCP.
7. SS shall transmit UECapabilityEnquiry message containing *UE-CapabilityRAT-Request* with *rat-Type* set to *eutra-nr* and *eutra*.
8. The UE shall transmit UECapabilityInformation message.
9. Using the UE capabilities advertised in the *UE-CapabilityRAT-Container* of the type *UE-MRDC-Capability and UE-EUTRA-Capability*, and the procedure outlined in 9.4B.1.1.3.1 determine one EN-DC bandwidth combination that would provide the largest aggregated data rate.
10. Setup up the NR CG and E-UTRA CG using these parameters for the test.

11. Configure the NR CG TBsize, NR CG DL RMC, NR CG UL RMC from Annex A.3.2_1 and Annex A.2.2 for UL as appropriate. Configure the E-UTRA CG TBsize, DL RMC and UL RMC from Table 9.4B.1.1.3-7, Table 9.4B.1.1.3-8 as appropriate.

9.4B.1.1.4.2 Test procedure

1. SS configures T-reordering timer to be infinity for both E-UTRA MCG DRB and NR SCG DRB.
2. SS sends a PDCP reestablishment via RRCConnectionReconfigurationmessage requesting for PDCP Status Report for both E-UTRA MCG DRB and NR SCG DRB.
3. SS sets the counters N_{DL_newtx} N_{DL_retx} per NR CG and E-UTRA CG to 0.
4. For each new DL HARQ transmission the SS generates sufficient NR PDCP SDUs (max PDCP SDU size and minimum number of consecutive PDCP SDUs) to fill up the TB in accordance with Annex A.3.2_1 for both E-UTRA MCG DRB and NR SCG DRB. The SS ciphers the PDCP SDUs, concatenates the resultant PDCP PDUs to form an RLC PDU and then a MAC PDU. The SS transmits the MAC PDU per NR CG and E-UTRA CG. The SS increments then N_{DL_newtx} by one per CG.
5. If PHY requests a DL HARQ retransmission, the SS performs a HARQ retransmission and increments N_{DL_retx} by one for that CG accordingly.
6. Steps 5 to 6 are repeated at every TTI for at least 300 frames and the SS waits for 300ms to let any HARQ retransmissions and RLC retransmissions to finish.
7. SS sends a PDCP reestablishment via RRCConnectionReconfigurationmessage requesting for PDCP Status Report for both E-UTRA MCG and NR SCG DRB.
8. The SS calculates the TB success rate per NR CG and E-UTRA CG as A = 100% $N_{DL\_correct\_rx}$ */ (N_{DL_newtx} + N_{DL_retx}).
9. SS computes the PDCP SDU loss by looking into the FMC and Bitmap field in the PDCP Status Report. PDCP SDU loss B = COUNT reported in the Bitmap field of PDCP Status Report.
10. The UE passes the test if A ≥ 85% TB success rates for both NR CG and E-UTRA CG and B = 0.

NOTE 1: In case of RLC PDU retransmission, the number of new required PDCP SDUs is as many as to fill the rest of TB.

9.4B.1.1.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 5.4.2 with the following exceptions

Table 9.4B.1.1.4.3-0: CLOSE UE TEST LOOP (MCG and SCG DRB in the preamble)

Derivation Path: 38.509 clause 6.3.1			
Information Element	**Value/remark**	**Comment**	**Condition**
Protocol discriminator	1 1 1 1		
Skip indicator	0 0 0 0		
Message type	1 0 0 0 0 0 0 0		
UE test loop mode	0 0 0 0 0 0 0 0	UE test loop mode A	
UE test loop mode A LB setup			
Length of UE test loop mode A LB setup list in bytes	0 0 0 0 1 1 0 0	Length of two LB setup DRB (6 bytes)	
LB setup DRB[1]	0 0 0 0 0 0 0 0, 0 0 0 0 0 0 0 0, 0 0 0 Q4 Q3 Q2 Q1 Q0	UL PDCP SDU size = 0 Q4..Q0 = MCG Data Radio Bearer identity number -1 for the radio bearer. See 38.509 clause 6.3.1	
LB setup DRB[2]	0 0 0 0 0 0 0 0, 0 0 0 0 0 0 0 0, 0 0 0 Q4 Q3 Q2 Q1 Q0	UL PDCP SDU size = 0 Q4..Q0 = SCG Data Radio Bearer identity number -1 for the radio bearer. See 38.509 clause 6.3.1	
UE test loop mode B LB setup	Not present		

Table 9.4B.1.1.4.3-1 to -7: Void

Table 9.4B.1.1.4.3-8: RadioBearerConfig (Initial Conditions, Step 5)

Derivation Path: TS 38.508-1 [6], clause 4.6.3-132			
Information Element	**Value/remark**	**Comment**	**Condition**
RadioBearerConfig ::= SEQUENCE {			
drb-ToAddModList SEQUENCE (SIZE (1..maxDRB)) OF DRB-ToAddMod {	1 entry		
DRB-ToAddMod[1] SEQUENCE {		entry 1	
cnAssociation CHOICE {			
eps-BearerIdentity	Dedicated EPS bearer ID		
}			
drb-Identity	DRB-Identity of the SCG DRB		
reestablishPDCP	Not Present		
pdcp-Config	PDCP-Config	Table 9.4B.1.1.4.3-8A	
}			
}			

Table 9.4B.1.1.4.3-8A: *PDCP-Config*

Derivation Path: TS 38.508-1 [6], Table 4.6.3-99			
Information Element	**Value/remark**	**Comment**	**Condition**
PDCP-Config ::= SEQUENCE {			
drb SEQUENCE {			
discardTimer	infinity		
pdcp-SN-Size-UL	len18bits		
pdcp-SN-Size-DL	len18bits		
headerCompression CHOICE {			
notUsed	Null		
}			
integrityProtection	Not present		
statusReportRequired	true		
outOfOrderDelivery	Not present		
}			
t-Reordering	Not present		
}			

Table 9.4B.1.1.4.3-9: *RRCConnectionReconfiguration* (Initial conditions, step6)

Derivation Path: TS 36.508 [7], Table 4.6.1-8 with condition HO			
Information Element	**Value/remark**	**Comment**	**Condition**
RRCConnectionReconfiguration ::= SEQUENCE {			
criticalExtensions CHOICE {			
c1 CHOICE {			
rrcConnectionReconfiguration-r8 SEQUENCE {			
mobilityControlInfo	As per Table 4.6.5-1 of TS 36.508 [19]		
radioResourceConfigDedicated	RadioResourceConfigDedicated-MCG-DRB-NR-PDCP	As per Table 9.4B.1.1.4.3-10	
nonCriticalExtension SEQUENCE {			
nonCriticalExtension SEQUENCE {			
nonCriticalExtension SEQUENCE {			
nonCriticalExtension SEQUENCE {			
nonCriticalExtension SEQUENCE {			
nonCriticalExtension SEQUENCE {			
nonCriticalExtension SEQUENCE {			
nonCriticalExtension SEQUENCE {			
nr-Config-r15	Not present		
nr-RadioBearerConfig1-r15	OCTET STRING containing RadioBearerConfig according to TS 38.508-1 [6], Table 4.6.3-132 with conditions MCG_NR_PDCP		
}			
}			
}			
}			
}			
}			
}			
}			
}			
}			
}			
}			

Table 9.4B.1.1.4.3-10: *RadioResourceConfigDedicated-MCG-DRB-NR-PDCP*

Derivation Path: TS 36.508 [7], Table 4.6.3-19			
Information Element	**Value/remark**	**Comment**	**Condition**
RadioResourceConfigDedicated-MCG-DRB-NR-PDCP ::= SEQUENCE {			
drb-ToAddModList SEQUENCE (SIZE (1..maxDRB)) OF DRB-ToAddMod {	1 entry		
DRB-ToAddMod[1]	DRB-ToAddMod-MCG-DRB-NR-PDCP	entry 1 As per Table 9.4B.1.1.4.3-11	
}			
drb-ToReleaseList SEQUENCE (SIZE (1..maxDRB)) OF DRB-Identity {	1 entry		
DRB-Identity[1]	Same as the DRB identity associated with the default EPS bearer	entry 1	
}			
physicalConfigDedicated	PhysicalConfigDedicated-DEFAULT with condition RBC-HO		
}			

Table 9.4B.1.1.4.3-11: DRB-ToAddMod-MCG-DRB-NR-PDCP

Derivation Path: TS 36.508 [19], Table 4.8.2.1.7-1			
Information Element	**Value/remark**	**Comment**	**Condition**
DRB-ToAddMod ::= SEQUENCE {			
eps-BearerIdentity	Same as the default EPS bearer Identity		
drb-Identity	Same as the DRB identity associated with the default EPS bearer		
pdcp-Config	Not present		
reestablishPDCP	Not present		
}			

Table 9.4B.1.1.4.3-12: RadioBearerConfig (Test procedure, step 2 and step 7)

Derivation Path: TS 38.508-1 [6], clause 4.6.3-132			
Information Element	**Value/remark**	**Comment**	**Condition**
RadioBearerConfig ::= SEQUENCE {			
drb-ToAddModList SEQUENCE (SIZE (1..maxDRB)) OF DRB-ToAddMod {	2 entries		
DRB-ToAddMod[1] SEQUENCE {		entry 1	
cnAssociation CHOICE {			
eps-BearerIdentity	Default EPS bearer ID		
}			
drb-Identity	DRB-Identity of the MCG DRB		
reestablishPDCP	true		
pdcp-Config	PDCP-Config		
}			
DRB-ToAddMod[2] SEQUENCE {		entry 2	
cnAssociation CHOICE {			
eps-BearerIdentity	Dedicated EPS bearer ID		
}			
drb-Identity	DRB-Identity of the SCG DRB		
reestablishPDCP	true		
pdcp-Config	PDCP-Config		
}			

9.4B.1.1.5 Test requirement

The PDCP SDU success rate of greater than 85% shall be sustained during at least 300 frames.

9.4B.1.2 Sustained downlink data rate performance for EN-DC including FR2 NR carrier

Editor's Note: MU analysis is complete for up to 100 MHz ChBW.

9.4B.1.2.1 Test Purpose

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

9.4B.1.2.2 Test Applicability

This test applies to all types of EUTRA UE release 15 and forward supporting EN-DC.

9.4B.1.2.3 Minimum conformance requirements

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

The TB success rate shall be higher than 85% when NR PDSCH is scheduled with MCS defined for the selected EN-DC bandwidth combination and with the downlink physical channel setup according to Annex C.2.2.

The TB success rate of delivered PDCP SDU(s) by Layer2 is defined as TB success rate = 100%*NDL_correct_rx/ (NDL_newtx + NDL_retx), where NDL_newtx is the number of newly transmitted DL transport blocks, NDL_retx is the number of retransmitted DL transport blocks, and DL_correct_rx is the number of correctly received DL transport blocks. All the above numbers of transmitted, retransmitted or correctly received DL transport blocks are calculated as the sum of the numbers of DL transport blocks per CG used for DC.

The test parameters are specified in Tables 9.4B.1.2.3-1, 9.4B.1.2.3-2.

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

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

Table 9.4B.1.2.3-1: Test parameters for FR2 TDD

Parameter		Unit	Value
PDSCH transmission scheme			Transmission scheme 1
PTRS epre-Ratio			0
Channel bandwidth		MHz	Channel bandwidth from selected CA bandwidth combination
Common serving cell parameters	Physical Cell ID		0
	SSB position in burst		First SSB in Slot #0
	SSB periodicity	ms	20
	First DMRS position for Type A PDSCH mapping		2
Cross carrier scheduling			Not configured
Active DL BWP index			1
Actual carrier configuration	Offset between Point A and the lowest usable subcarrier on this carrier (Note 3)	RBs	0
	Subcarrier spacing	kHz	60 or 120
DL BWP configuration #1	RB Offset		0
	Number of contiguous PRB		Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-2 [3] for tested channel bandwidth and subcarrier spacing
	Subcarrier spacing	kHz	60 or 120
	Cyclic prefix		Normal
PDCCH configuration	Slots for PDCCH monitoring		Each slot
	Symbols with PDCCH		Symbols #0
	Number of PRBs in CORESET		Table 7.5A.1-2
	Number of PDCCH candidates and aggregation levels		1/8
	CCE-to-REG mapping type		Non-interleaved
	DCI format		1-1
	TCI State		TCI state #1
	PDCCH &PDCCH DMRS Precoding configuration		Single Panel Type I, Random per slot with equal probability of precoder index 0 and 2, and with REG bundling granularity for number of Tx larger than 1
PDSCH configuration	Mapping type		Type A
	k0		0
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		WB
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
	Starting symbol (S)		1
	Length (L)		13
PDSCH DMRS configuration	DMRS Type		Type 1
	Number of additional DMRS		1
	Length		1
	Antenna ports indexes		{1000} for 1 Layer CCs {1000, 1001} for 2 Layers CCs
	Number of PDSCH DMRS CDM group(s) without data		1
PTRS configuration	Frequency density ($K_{PT\text{-}RS}$)		2
	Time density ($L_{PT\text{-}RS}$)		1
CSI-RS for tracking	Subcarrier indexes in the PRB used for CSI-RS		k_0 = 3 for CSI-RS resource 1,2,3,4
	OFDM symbols in the PRB used for CSI-RS		l_0 = 6 for CSI-RS resource 1 and 3 l_0 = 10 for CSI-RS resource 2 and 4
	Number of CSI-RS ports (X)		1 for CSI-RS resource 1,2,3,4
	CDM Type		'No CDM' for CSI-RS resource

				1,2,3,4
	Density (ρ)			3 for CSI-RS resource 1,2,3,4
	CSI-RS periodicity		Slots	60 kHz SCS: 80 for CSI-RS resource 1,2,3,4 120 kHz SCS: 160 for CSI-RS resource 1,2,3,4
	CSI-RS offset		Slots	60 kHz SCS: 40 for CSI-RS resource 1 and 2 41 for CSI-RS resource 3 and 4 120 kHz SCS: 80 for CSI-RS resource 1 and 2 81 for CSI-RS resource 3 and 4
	Frequency Occupation			Start PRB 0 Number of PRB = BWP size
	QCL info			TCI state #0
NZP CSI-RS for CSI acquisition	Subcarrier indexes in the PRB used for CSI-RS			$k_0 = 4$
	OFDM symbols in the PRB used for CSI-RS			$l_0 = 13$
	Number of CSI-RS ports (X)			Same as number of transmit antenna
	CDM Type			'FD-CDM2'
	Density (ρ)			1
	CSI-RS periodicity		Slots	60 kHz SCS: 80 120 kHz SCS: 160
	CSI-RS offset			0
	Frequency Occupation			Start PRB 0 Number of PRB = BWP size
	QCL info			TCI state #1
ZP CSI-RS for CSI acquisition	Subcarrier indexes in the PRB used for CSI-RS			$k_0 = 0$
	OFDM symbols in the PRB used for CSI-RS			$l_0 = 12$
	Number of CSI-RS ports (X)			4
	CDM Type			'FD-CDM2'
	Density (ρ)			1
	CSI-RS periodicity		Slots	60 kHz SCS: 80 120 kHz SCS: 160
	CSI-RS offset			0
	Frequency Occupation			Start PRB 0 Number of PRB = BWP size
CSI-RS for beam refinement	First subcarrier index in the PRB used for CSI-RS			k_0=0 for CSI-RS resource 1,2
	First OFDM symbol in the PRB used for CSI-RS			$l_0 = 8$ for CSI-RS resource 1 $l_0 = 9$ for CSI-RS resource 2
	Number of CSI-RS ports (X)			1 for CSI-RS resource 1,2
	CDM Type			'No CDM' for CSI-RS resource 1,2
	Density (ρ)			3 for CSI-RS resource 1,2
	CSI-RS periodicity		Slots	60 kHz SCS: 80 for CSI-RS resource 1,2 120 kHz SCS: 160 for CSI-RS resource 1,2
	CSI-RS offset		Slots	0 for CSI-RS resource 1,2
	Repetition			ON
	QCL info			TCI state #1
TCI state #0	Tyoe 1 QCL information	SSB index		SSB #0
		QCL Type		Type C
	Tyoe 2 QCL information	SSB index		SSB #0
		QCL Type		Type D
TCI state #1	Tyoe 1 QCL information	CSI-RS resource		CSI-RS resource 1 from 'CSI-RS for tracking' configuration
		QCL Type		Type A
	Tyoe 2 QCL information	CSI-RS resource		CSI-RS resource 1 from 'CSI-RS for tracking' configuration
		QCL Type		Type D
Maximum number of code block groups for ACK/NACK				1

feedback			
Number of HARQ Processes			10 for FR2.60-1 and 8 for FR2.120-1
K1 value			Specific to each UL-DL pattern
Maximum number of HARQ transmission			4
HARQ ACK/NACK bundling			Multiplexed
Redundancy version coding sequence			{0,2,3,1}
TDD UL-DL pattern			60 kHz SCS: FR2.60-1 120 kHz SCS: FR2.120-1
PDSCH & PDSCH DMRS Precoding configuration			Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i1, i2 combination, and with Wideband granularity for Rank 2
Symbols for all unused REs			OCNG Annex A.5
Propagation condition			Static propagation condition No external noise sources are applied
Antenna configuration	1 layer CCs		1x2 or 1x4
	2 layers CCs		2x2 or 2x4
Physical signals, channels mapping and precoding			As specified in Annex B.4.1
Note 1: PDSCH is scheduled only on full DL slots not containing SSB or TRS. Note 2: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH transmission. Note 3: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-2 [3] for tested channel bandwidth and subcarrier spacing.			

Table 9.4B.1.2.3-2: Number of PRBs in CORESET

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

Table 9.4B.1.2.3-3: MCS indexes for indicated UE capabilities

Maximum number of PDSCH MIMO layers	Maximum modulation format	Scaling factor	MCS
1	6	1	27
1	6	0.8	23
1	6	0.75	22
1	6	0.4	14
1	4	1	16
1	4	0.8	16
1	4	0.75	16
1	4	0.4	10
1	2	1	9
1	2	0.8	9
1	2	0.75	9
1	2	0.4	4
2	6	1	27
2	6	0.8	23
2	6	0.75	22
2	6	0.4	14
2	4	1	16
2	4	0.8	16
2	4	0.75	16
2	4	0.4	10
2	2	1	9
2	2	0.8	9
2	2	0.75	9
2	2	0.4	4

Table 9.4B.1.2.3-4: SNR required to achieve 85% of peak throughput under AWGN conditions

MCS Index (Note 1)	SNR_{BB}(dB) for maximum number of PDSCH MIMO Layers = 1	SNR_{BB}(dB) for maximum number of PDSCH MIMO Layers = 2
13	6.2	9.0
14	7.2	9.9
15	8.2	10.9
16	8.7	11.6
17	10.1	13.2
18	10.7	13.7
19	11.7	14.7
20	12.7	15.6
21	13.6	16.5
22	14.8	17.6
23	15.6	18.6
24	16.9	19.7
25	18.3	21.2
26	19.3	22.3
27	20.5	23.3
Note 1: MCS Index is based on MCS Table defined in clause 5.1.3 of TS 38.214 [12] when 256QAM is not enabled.		

The normative reference for this requirement is TS 38.101-4 [5], clause 9.4B.1.2.

9.4B.1.2.3.1 Procedure for test parameter selection

The test parameters are determined by the following procedure:

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

Pasting relevant portion of max data rate equation from TS 38.306 [14] section 4.1

For NR, the approximate data rate for a given number of aggregated carriers in a band or band combination is computed as follows.

$$\text{data rate (in Mbps)} = 10^{-6} \cdot \sum_{j=1}^{J} \left(v_{Layers}^{(j)} \cdot Q_m^{(j)} \cdot f^{(j)} \cdot R_{\max} \cdot \frac{N_{PRB}^{BW(j),\mu} \cdot 12}{T_s^{\mu}} \cdot \left(1 - OH^{(j)}\right) \right)$$

wherein

J is the number of aggregated component carriers in a band or band combination

R_{max} = 948/1024

For the j-th CC,

$v_{Layers}^{(j)}$ is the maximum number of supported layers given by higher layer parameter *maxNumberMIMO-LayersPDSCH* for downlink and maximum of higher layer parameters *maxNumberMIMO-LayersCB-PUSCH* and *maxNumberMIMO-LayersNonCB-PUSCH* for uplink.

$Q_m^{(j)}$ is the maximum supported modulation order given by higher layer parameter *supportedModulationOrderDL* for downlink and higher layer parameter *supportedModulationOrderUL* for uplink.

$f^{(j)}$ is the scaling factor given by higher layer parameter *scalingFactor* and can take the values 1, 0.8, 0.75, and 0.4.

μ is the numerology (as defined in TS 38.211 [6])

T_s^μ is the average OFDM symbol duration in a subframe for numerology μ, i.e. $T_s^\mu = \frac{10^{-3}}{14 \cdot 2^\mu}$. Note that normal cyclic prefix is assumed.

$N_{PRB}^{BW(j),\mu}$ is the maximum RB allocation in bandwidth $BW^{(j)}$ with numerology μ, as defined in 5.3 TS 38.101-1 [2] and 5.3 TS 38.101-2 [3], where $BW^{(j)}$ is the UE supported maximum bandwidth in the given band or band combination.

$OH^{(j)}$ is the overhead and takes the following values

0.14, for frequency range FR1 for DL

0.18, for frequency range FR2 for DL

0.08, for frequency range FR1 for UL

0.10, for frequency range FR2 for UL

NOTE: Only one of the UL or SUL carriers (the one with the higher data rate) is counted for a cell operating SUL.

For EUTRA in case of MR-DC, the approximate data rate for a given number of aggregated carriers in a band or band combination is computed as follows.

Data rate (in Mbps) = $10^{-3} \cdot \sum_{j=1}^{J} TBS_j$

wherein

J is the number of aggregated EUTRA component carriers in MR-DC band combination

TBS_j is the total maximum number of DL-SCH transport block bits received within a 1ms TTI for j-th CC, as derived from TS36.213 [22] based on the UE supported maximum MIMO layers for the j-th carrier, and based on the modulation order and number of PRBs based on the bandwidth of the j-th carrier.

The approximate maximum data rate can be computed as the maximum of the approximate data rates computed using the above formula for each of the supported band or band combinations.

For MR-DC, the approximate maximum data rate is computed as the sum of the approximate maximum data rates from NR and EUTRA

9.4B.1.2.4 Test description

9.4B.1.2.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1 of 38.521-1.

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 5.2.2.

For EN-DC within FR2 operation, setup the LTE radiated link according to Annex D:

1. Connection between SS, the faders, AWGN noise source and the UE is shown in TS 38.508-1 [6] Annex A, Figure A.3.3.2 for TE diagram and Figure A.3.4.2 for UE diagram.
2. The parameter settings for the NR cell are set up according to Table 7.2-1 and Table 7.2.2.2.1.0-2 and as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, and uplink signals according to Annexes G.0, G.1, G.2, G.3.1 of TS 38.521-2 [8].
4. Propagation conditions for NR cell are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters *Test Mode On*, (EN-DC, DC bearer *MCG* and *SCG), Connected without release On, Test Loop Function On with UE Test Loop Mode A with UL_PDCP_SDU_SIZE = 0* according to TS 38.508-1 [6] clause 4.5.4. Message content are defined in clause 9.4B.1.2.4.3.
6. SS shall transmit UECapabilityEnquiry message containing *UE-CapabilityRAT-Request* with *rat-Type* set to *eutra-nr* and *eutra*.
7. The UE shall transmit UECapabilityInformation message.
8. Using the UE capabilities advertised in the *UE-CapabilityRAT-Container* of the type *UE-MRDC-Capability and UE-EUTRA-Capability*, and the procedure outlined in 9.4B.1.2.3.1 determine one EN-DC bandwidth combination that would provide the largest aggregated data rate.
9. Setup up the NR CG for these parameters for the test.

9.4B.1.2.4.2 Test Procedure

1. Set the UE in a direction that satisfies the 3 normative criteria specified in Annex H.0. If no direction found, mark the test as inconclusive.
2. Based on the maximum SNR capability of the FR2 chamber, determine the max MCS index from table 9.4B.1.2.3-4 to be configured for this test.
3. Configure the NR CG TBsize, NR CG DL RMC, NR CG UL RMC from Annex A.3.2_1 and Annex A.2.2 for UL as appropriate based on the MCS index chosen in step 2.
4. SS configures T-reordering timer to be infinity for NR SCG DRB.
5. SS sends a PDCP reestablishment via RRC Reconfiguration message requesting for PDCP Status Report for NR SCG DRB.
6. SS sets the counters N_{DL_newtx} N_{DL_retx} per NR CG to 0.
7. For each new DL HARQ transmission the SS generates sufficient NR PDCP SDUs (max PDCP SDU size and minimum number of consecutive PDCP SDUs) to fill up the TB in accordance with Annex A.3.2_1 for NR SCG

DRB. The SS ciphers the PDCP SDUs, concatenates the resultant PDCP PDUs to form an RLC PDU and then a MAC PDU. The SS transmits the MAC PDU per NR CG. The SS increments then N_{DL_newtx} by one per CG.

8. If PHY requests a DL HARQ retransmission, the SS performs a HARQ retransmission and increments N_{DL_retx} by one for that CG accordingly.

9. Steps 7 and 8 are repeated at every TTI for at least 300 frames and the SS waits for 300ms to let any HARQ retransmissions and RLC retransmissions to finish.

10. SS sends a PDCP reestablishment via RRC Reconfiguration message requesting for PDCP Status Report for NR SCG DRB.

11. The SS calculates the TB success rate per NR CG as A = 100% $N_{DL\_correct\_rx}$ */ (N_{DL_newtx} + N_{DL_retx}).

12. SS computes the PDCP SDU loss by looking into the FMC and Bitmap field in the PDCP Status Report. PDCP SDU loss B = COUNT reported in the Bitmap field of PDCP Status Report.

13. The UE passes the test if A ≥ 85% TB success rates for NR CG and B = 0.

NOTE 1: In case of RLC PDU retransmission, the number of new required PDCP SDUs is as many as to fill the rest of TB.

9.4B.1.2.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 5.4.2 with the following exceptions

Table 9.4B.1.2.4.3-0: CLOSE UE TEST LOOP (in the preamble)

Derivation Path: 38.509 clause 6.3.1			
Information Element	**Value/remark**	**Comment**	**Condition**
Protocol discriminator	1 1 1 1		
Skip indicator	0 0 0 0		
Message type	1 0 0 0 0 0 0 0		
UE test loop mode	0 0 0 0 0 0 0 0	UE test loop mode A	
UE test loop mode A LB setup			
Length of UE test loop mode A LB setup list in bytes	0 0 0 0 0 0 1 1	Length of one LB setup DRB (3 bytes)	
LB setup DRB	0 0 0 0 0 0 0 0, 0 0 0 0 0 0 0 0, 0 0 0 Q4 Q3 Q2 Q1 Q0	UL PDCP SDU size = 0 Q4..Q0 = Data Radio Bearer identity number for the default radio bearer. See 38.509 clause 6.3.1	
UE test loop mode B LB setup	Not present		

Table 9.4B.1.1.4.3-1: PDCCH-ControlResourceSet-spCellConfigDedicated

Derivation Path: TS 38.508-1 [6], Table 4.6.3-28			
Information Element	**Value/remark**	**Comment**	**Condition**
ControlResourceSet ::= SEQUENCE {			
frequencyDomainResources	CORESET value according to Table 9.4B.1.2.3-2 as applicable		
}			
}			

Table 9.4B.1.1.4.3-2: PDCCH *Search Space*

Derivation Path: TS 38.508-1 [6], Table 4.6.3-162			
Information Element	**Value/remark**	**Comment**	**Condition**
SearchSpace ::= SEQUENCE {			
monitoringSymbolsWithinSlot	10000000000000	Symbols 0	
nrofCandidates SEQUENCE {			
aggregationLevel1	n0		
aggregationLevel2	n0		
aggregationLevel4	n0		
aggregationLevel8	n1	AL8	
aggregationLevel16	n0		
}			
}			

Table 9.4B.1.1.4.3-3: RadioBearerConfig

Derivation Path: TS 38.508 [6], clause 4.6.3-132			
Information Element	**Value/remark**	**Comment**	**Condition**
RadioBearerConfig ::= SEQUENCE {			
drb-ToAddModList SEQUENCE (SIZE (1..maxDRB)) OF SEQUENCE {	1 entry		EN-DC_DRB
cnAssociation CHOICE {			
eps-BearerIdentity	6		
}			
drb-Identity	DRB-Identity using condition DRB2		
reestablishPDCP	true		EN-DC_DRB AND Re-establish_PDCP
pdcp-Config	PDCP-Config		
}			

Table 9.4B.1.1.4.3-4: *PDCP-Config*

Derivation Path: TS 38.508 [6], Table 4.6.3-99			
Information Element	**Value/remark**	**Comment**	**Condition**
PDCP-Config ::= SEQUENCE {			
drb SEQUENCE {			
discardTimer	infinity		
pdcp-SN-Size-UL	len18bits		
pdcp-SN-Size-DL	len18bits		
headerCompression CHOICE {			
notUsed	Null		
}			
integrityProtection	Not present		
statusReportRequired	true		
outOfOrderDelivery	Not present		
}			
t-Reordering	Not present		
}			

9.4B.1.2.5 Test requirement

The PDCP SDU success rate of greater than 85% shall be sustained during at least 300 frames.

9.4B.2

9.4B.3 NE-DC

9.4B.3.1 Sustained downlink data rate performance for NE-DC within FR1

The sustained downlink data rate performance for NR CC and E-UTRA CC along with test case details for this test case are specified in clause 9.4B.1.1.

10 CSI reporting requirements for interworking

10.1 General

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

The definition of frequency ranges (FR1 and FR2) are specified in table 5.1-1 of TS 38.101-3 [4].

For conformance testing involving FR2 test cases in this specification, the UE under test shall be pre-configured with UL Tx diversity schemes disabled to account for single polarization System Simulator (SS) in the test environment. The UE under test may transmit with dual polarization.

10.1.1 Applicability of requirements

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

- For UEs supporting NR/5GC, EN-DC and NE-DC,
  - The performance requirements specified in Clause 6 will be verified only for NR/5GC mode.
  - The performance requirements specified in Clause 8 will be verifiedonly for NR/5GC mode.
- The FR1 EN-DC test cases with the NR TDD DL-UL configurations which are not aligned with LTE's can be tested on the corresponding EN-DC band combinations where UE supports simultaneous transmission and reception.
- For UEs supporting NR-DC including FR1 and FR2, if the FR2 requirements in Clause 8.2, Clause 8.3 and Clause 8.4 are tested, the test coverage can be considered fulfilled without executing requirements in Clause 10.2B.2, Clause 10.3B.2 and Clause 10.4B.2.
- For UEs supporting NE-DC, the test coverage of CSI reporting requirements can be considered fulfilled, if the CSI reporting requirements in Clause 6 are executed for UE under test in the standalone mode.
- For UEs supporting NGEN-DC, the test coverage of CSI reporting requirements can be considered fulfilled, if the CSI reporting requirements in Clause 6 are executed for UE under test.
- For UEs supporting EN-DC including FR2 and/or EN-DC including FR1 and FR2, the requirements applicability is specified in Table 10.1.1-1.

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

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

10.1.1.1 Applicability of requirements for optional UE features

10.1.1.2 Applicability of requirements for mandatory UE features with capability signalling

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

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

10.2 Void

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

FFS

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

10.2B.1 EN-DC

10.2B.1.1 EN-DC within FR1

The NR CQI requirements and test case details for this test case are specified in Section 6.2.

During the test, only the CQI requirements on the NR cell shall be verified.

10.2B.1.2 EN-DC including FR2 NR carrier

The NR CQI requirements and test case details for this test case are specified in Section 8.2.

During the test, only the CQI performance on the NR cell(s) on FR2 carriers shall be verified.

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

The CSI performance requirements are verified according to section 10.2B.1.1 for EN-DC with FR1 NR carrier only and section 10.2B.1.2 for EN-DC with FR2 NR carrier only.

During the test for EN-DC with FR2 NR carriers, only the CSI performance requirements on the FR2 carriers are verified.

No CSI requirement for FR1 NR or LTE carriers is specified for EN-DC including FR2 carrier(s).

10.2B.2 NR DC between FR1 and FR2

FFS

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

FFS

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

10.3B.1 EN-DC

10.3B.1.1 EN-DC within FR1

The NR PMI requirements and test case details for this test case are specified in Section 6.3.

During the test, only the PMI requirements on the NR cell shall be verified.

10.3B.1.2 EN-DC including FR2 NR carrier

The NR PMI requirements and test case details for this test case are specified in Section 8.3.

During the test, only the PMI performance on the NR cell(s) on FR2 carriers shall be verified.

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

The PMI performance requirements are verified according to section 10.3B.1.1 for EN-DC with FR1 NR carrier only and section 10.3B.1.2 for EN-DC with FR2 NR carrier only.

During the test for EN-DC with FR2 NR carriers, only the PMI performance requirements on the FR2 carriers are verified.

No PMI requirement for FR1 NR or LTE carriers is specified for EN-DC including FR2 carrier(s).

10.3B.2 NR DC between FR1 and FR2

FFS

10.4A Reporting of Rank Indicator (RI) for CA

FFS

10.4B Reporting of Rank Indicator (RI) for DC

10.4B.1 EN-DC

10.4B.1.1 EN-DC within FR1

The NR RI requirements and test case details for this test case are specified in Section 6.4.

During the test, only the RI requirements on the NR cell shall be verified.

10.4B.1.2 EN-DC including FR2 NR carrier

The NR RI requirements and test case details for this test case are specified in Section 8.4.

During the test, only the RI performance on the NR cell(s) on FR2 carriers shall be verified.

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

The RI performance requirements are verified according to section 10.4B.1.1 for EN-DC with FR1 NR carrier only and section 10.4B.1.2 for EN-DC with FR2 NR carrier only.

During the test for EN-DC with FR2 NR carriers, only the RI performance requirements on the FR2 carriers are verified.

No RI requirement for FR1 NR or LTE carriers is specified for EN-DC including FR2 carrier(s).

10.4B.2 NR DC between FR1 and FR2

FFS

11 V2X requirements

This clause contains the performance requirements for the sidelink physical channels specified for V2X Sidelink Communication.

11.1 Demodulation performance requirements (Conducted requirements)

11.1.1 General

11.1.1.1 Applicability of requirements

11.1.1.1.1 General

The minimum performance requirements are applicable to all V2X operating bands defined in TS 38.101-1[2] Clause 5.2E.

The minimum performance requirements in Clause 11.1 are mandatory for UE supporting NR SL operation (*sl-Reception-r16*), except test cases listed in Clause 11.1.1.1.2.

11.1.1.1.2 Applicability of requirements for mandatory UE V2X features with capability signalling

The performance requirements in Table 11.1.1.1.2-1 shall apply for V2X UEs which support mandatory UE features with capability signalling only.

Table 11.1.1.1.2-1: Requirements applicability for mandatory features with UE capability signalling

UE feature/capability [14]	Test type		Test list	Applicability notes
Support of synchronization sources for NR sidelink (*sync-Sidelink-r16*)	FR1	PSSCH	Clause 11.1.2.1.1 Clause 11.1.6.1.1 Clause 11.1.7.1.1	
		PSCCH	Clause 11.1.3.1.1 Clause 11.1.8.1.1	
		PSBCH	Clause 11.1.4.1.1	
		PSFCH	Clause 11.1.5.1.1 Clause 11.1.9.1.1	
Supports of PSFCH format 0 (*psfch-FormatZeroSidelink-r16)*	FR1	PSSCH	Clause 11.1.2.1.1 Clause 11.1.6.1.1 Clause 11.1.7.1.1	
		PSCCH	Clause 11.1.3.1.1 Clause 11.1.8.1.1	
		PSFCH	Clause 11.1.5.1.1 Clause 11.1.9.1.1	

11.1.1.2 Common test parameters

Parameters specified in Table 11.1.1.2-1 are applied for all test cases in this clause unless otherwise stated.

Table 11.1.1.2-1: Common test parameters

Parameter		Unit	Value
Carrier configuration	Offset between Point A and the lowest usable subcarrier on this carrier (Note 1)	RBs	0
	Subcarrier spacing	kHz	30
SL BWP configuration #1	Cyclic prefix		Normal
	RB offset	RBs	0
	Number of contiguous PRB	PRBs	Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-1 [2] for tested channel bandwidth and subcarrier spacing
PT-RS configuration			PT-RS is not configured
Resource pool configuration	PSCCH Time resource	Symbols	2
	PSCCH Frequency resource	PRBs	10
	PSFCH number of cyclic shift pairs		n1
	PSFCH hopping ID		0
	PSFCH candidate resource type		allocSubCH
	Set of PRBs for PSFCH transmission		ones(1,100) for 40 MHz and ones(1,50) for 20 MHz
	PSSCH RSRP threshold		66 (infinity dBm)
	Synchronization reference		GNSS
	Subchannel size	PRBs	10
	Number of sub-channels		5 for 20 MHz and 10 for 40 MHz
	Start PRB for first sub-channel		0
	Time resource bitmap		ones(1, 160)
Note 1: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-1 [2] for tested channel bandwidth and subcarrier spacing.			

The normative reference for this requirement is TS 38.101-4 [5] clause 11.1.1.2.

11.1.2 PSSCH demodulation requirements

11.1.2.1 2Rx requirements

11.1.2.1.1 2Rx FR1 PSSCH performance

11.1.2.1.1.0 Minimum requirements

The minimum requirements are specified in Table 11.1.2.1.1.0-2 with the test parameters specified in Table 11.1.2.1.1.0-1. In this test scenario, GNSS or GNSS-equivalent synchronization source is used and sidelink UE 1 transmits PSCCH and PSSCH.

Table 11.1.2.1.1.0-1: Test parameters

Parameter		Unit	Value		
			Test 1	Test 2	Test 3
Active cell(s)			None		
Sidelink UE 1	Sidelink transmissions		PSCCH + PSSCH		
	PSSCH DMRS pattern (Note 1)		{3,4}	{2,3}	{2,2}
	Index of sub-channel allocation		[0,1]	[0,1]	[0]
	Timing offset (Note 2)	μs	CP/2-12*64*Tc		
	Frequency offset (Note 3)	Hz	+600		
	Synchronization		GNSS or GNSS-equivalent		
	Antenna configuration		1x2 Low		
PSFCH resource period		Slot	4	4	4
MinTimeGapPSFCH		Slot	3	3	3
Note 1: {x, y}: x and y means the number of DMRS symbols for slot with PSFCH transmission and without PSFCH transmission, respectively. Note 2: Time offset of transmitted Sidelink UE signal with respect to GNSS referring timing. Note 3: Frequency offset of transmitted Sidelink UE signal with respect to GNSS reference frequency.					

Table 11.1.2.1.1.0-2: Minimum performance

Test num.	Reference channel	Bandwidth (MHz)/ Subcarrier spacing(kHz)	Modulation format and code rate	Propagation condition	Reference value	
					PSSCH BLER (%)	SNR(dB) of PSSCH
1	R.PSSCH.2-1.1	20 / 30	QPSK, 0.30	TDLA30-2700	10%	3.4
2	R.PSSCH.2-1.2	20 / 30	16QAM, 0.37	TDLA30-1400		8.8
3	R.PSSCH.2-1.3	20 / 30	64QAM, 0.43	TDLA30-180		14.8

The normative reference for this requirement is TS 38.101-4 [5], clause 11.1.2.1.1.

11.1.2.1.1_1 2Rx FR1 PSSCH performance - single active PSSCH link

11.1.2.1.1_1.1 Test purpose

The purpose is to verify the PSSCH for V2X demodulation performance with a single active PSSCH link.

11.1.2.1_1.1.2 Test applicability

This test case applies to all types of NR UE release 16 and forward which support NR sidelink communication, as specified in Table 11.1.1.1.2-1.

11.1.2.1_1.1.3 Test description

11.1.2.1_1.1.3.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in 38.521-1 [7] subclause 5.3E.

PSCCH and PSSCH reference measurement channels are set according to Table 11.1.1.2-1, Table 11.1.2.1.1.0-1 and Annex A.6 as appropriate.

Configurations of the GNSS simulator are specified in TS 38.508-1 [6] Table 4.11.2-2 and the GNSS simulator is configured for Scenario #1: static in Geographical area #1. Geographical area #1 is also pre-configured in the UE.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Low Range, as defined in TS 38.508-1 [6] clause 4.3.1.8.

Channel Bandwidths to be tested: As specified per test number in Table 11.1.2.1.1.0-2 as defined in TS 38.508-1 [6] clause 4.3.1.8.

1. Connect the SS, the faders, and the AWGN noise source to the UE antenna connectors, connect the SS COM port to the UE COM port, and connect the GNSS simulator to the UE GNSS RX antenna connector as shown in TS 38.508-1 [6] Annex A, Figure A.3.1.9.1(TE part) and Figure A.3.2.7.1 (UE part).

2. The parameter settings for the V2X sidelink transmission over PC5 interface are pre-configured according to TS 38.508-1 [6] clause 4.10.1. Message content exceptions are defined in clause 11.1.2.1_1.1.3.3.

3. Sidelink physical channels and signals are initially set up according to Table 11.1.1.2-1, Table 11.1.2.1.1.0-1 and Annex A.6 as appropriate.

4. Propagation conditions are set according to Annex B.0.

5. Ensure the UE is in state 4-A with generic procedure parameters Test Loop Function = *On* according to TS 38.508-1 [6] clause 4.4A.2. The UE is configured as the receiving UE. Message contents are defined in clause 11.1.2.1.1_1.3.3.

6. The GNSS simulator is triggered to start step 1 of Scenario #1 to simulate a location in the centre of Geographical area #1. Wait for the UE to acquire the GNSS signal.

11.1.2.1.1_1.3.2 Test procedure

1. Sidelink UE1 transmits PSCCH/PSSCH RMC according to *SL-PreconfigurationNR* and Table 11.1.2.1.1.0-1. The sidelink UE1 transmits MAC padding bits on the sidelink RMC.

2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix and the SNR according to Table 11.1.2.1.4-1 as appropriate.

3. Measure the average PSSCH BLER according to the test method described in Annex G.5 for a duration sufficient to achieve statistical significance. If the measured average PSSCH BLER is less than the reference value in Table 11.1.2.1.4-1 pass the UE. Otherwise fail the UE.

4. Repeat steps from 1 to 3 for each subtest in Table 11.1.2.1.1_1.4-1 as appropriate.

11.1.2.1.1_1.3.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 5.4.3 with the following exceptions.

Table 11.1.2.1.1_1.3.3-1: Physical layer parameters for SCI format 1-A

Derivation Path: TS 38.508-1 [6] Table 4.3.6.2.1.1-1			
Parameter	**Value**	**Value in binary**	**Condition**
DMRS pattern	indicates the 2nd entry in sl-PSSCH-DMRS-TimePatternList-r16 if mod (i, 4), else indicates the 3rd entry in sl-PSSCH-DMRS-TimePatternList-r16. where i is the logical slot index belong to resource pool per 1024 radio frame as specified in 38.214 [12] clause 8	"01"B if mod (i, 4) = 0 "10"B if mod (i, 4) ≠ 0	Test 1
	indicates the 1st entry in sl-PSSCH-DMRS-TimePatternList-r16 if mod (i, 4), else indicates the 2nd entry in sl-PSSCH-DMRS-TimePatternList-r16.	"00"B if mod (i, 4) = 0 "01"B if mod (i, 4) ≠ 0	Test 2
	indicates the 1st entry in sl-PSSCH-DMRS-TimePatternList-r16	"00"B	Test 3

Table 11.1.2.1.1_1.3.3-2: *SL-ResourcePool*

Derivation Path: TS 38.508-1 [6] Table 5.4.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
SL-ResourcePool-r16 ::= SEQUENCE {			
sl-PSSCH-Config-r16 CHOICE {			
setup SEQUENCE {			
sl-PSSCH-DMRS-TimePatternList-r16 SEQUENCE (SIZE (1..3)) OF INTEGER (2..4) {	3 entries		
INTEGER[1]	2	entry 1	
INTEGER[2]	3	entry 2	
INTEGER[3]	4	entry 3	
}			
}			

11.1.2.1.4 Test Requirements

For the parameters specified in Table 11.1.2.1.0-1 and SNR specified in Table 11.1.2.1.1_1.4-1, the average PSSCH BLER obtained in step 3 shall be below the reference value specified in Table 11.1.2.1.1_1.4-1. The PSSCH sidelink reference channels are defined in Annex A Table A.6.2.2-1.

Table 11.1.2.1.1_1.4-1: Test performance

Test num.	Reference channel	Bandwidth (MHz)/ Subcarrier spacing(kHz)	Modulation format and code rate	Propagation condition	Reference value	
					PSSCH BLER (%)	SNR(dB) of PSSCH
1	R.PSSCH.2-1.1	20 / 30	QPSK, 0.30	TDLA30-2700	10%	4.2
2	R.PSSCH.2-1.2	20 / 30	16QAM, 0.37	TDLA30-1400		9.6
3	R.PSSCH.2-1.3	20 / 30	64QAM, 0.43	TDLA30-180		15.6

11.1.3 PSCCH demodulation requirements

11.1.3.1 2Rx requirements

11.1.3.1.1 2Rx FR1 PSCCH performance

11.1.3.1.1.0 Minimum requirements

The minimum requirements are specified in Table 11.1.3.1.1.0-2 with the test parameters specified in Table 11.1.3.1.1.0-1. In this test scenario, GNSS or GNSS-equivalent synchronization source is used and sidelink UE 1 transmits PSCCH and PSSCH.

Table 11.1.3.1.1.0-1: Test parameters

Parameter		Unit	Test 1
Active cell(s)			None
Sidelink UE 1	Sidelink Transmissions		PSCCH+PSSCH
	Timing offset (Note 1)	μs	CP/2-12*64*Tc
	Frequency offset (Note 2)	Hz	+600
	Synchronization		GNSS or GNSS-equivalent
	Antenna configuration		1x2 Low
	PSSCH RMC		R.PSSCH.2-1.1
NOTE 1: Time offset of transmitted Sidelink UE signal with respect to GNSS reference timing. NOTE 2: Frequency offset of transmitted Sidelink UE signal with respect to GNSS reference frequency. NOTE 3: OCC index i for PSCCH DMRS is randomly selected from {0, 1, 2} for each PSCCH transmission.			

Table 11.1.3.1.1.0-2: Minimum performance

Test number	PSCCH Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Propagation condition	Reference value	
				Probability of missed PSCCH (%)	SNR (dB) of PSCCH
1	R.PSCCH.2-1.1	20 / 30	TDLA30-1400	1	4.7

The normative reference for this requirement is TS 38.101-4 [5], clause 11.1.3.1.1.

11.1.3.1.1_1 2Rx FR1 PSCCH performance - single active PSSCH link

11.1.3.1.1_1.1 Test purpose

The purpose is to verify the PSCCH for V2X demodulation performance with a single active PSSCH link.

11.1.3.1.1_1.2 Test applicability

This test case applies to all types of NR UE release 16 and forward which support NR sidelink communication, as specified in Table 11.1.1.1.2-1.

11.1.3.1.1_1.3 Test description

11.1.3.1.1_1.3.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in 38.521-1 [7] subclause 5.3E.

PSCCH and PSSCH reference measurement channels are set according to Table 11.1.1.2-1, Table 11.1.3.1.1.0-1 and Annex A.6 as appropriate.

Configurations of the GNSS simulator are specified in TS 38.508-1 [6] Table 4.11.2-2 and the GNSS simulator is configured for Scenario #1: static in Geographical area #1. Geographical area #1 is also pre-configured in the UE.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Low Range, as defined in TS 38.508-1 [6] clause 4.3.1.8.

Channel Bandwidths to be tested: As specified per test number in Table 11.1.3.1.1.0-2 as defined in TS 38.508-1 [6] clause 4.3.1.8.

1. Connect the SS, the faders, and the AWGN noise source to the UE antenna connectors, connect the SS COM port to the UE COM port, and connect the GNSS simulator to the UE GNSS RX antenna connector as shown in TS 38.508-1 [6] Annex A, Figure A.3.1.9.1(TE part) and Figure A.3.2.7.1 (UE part).

2. The parameter settings for the V2X sidelink transmission over PC5 interface are pre-configured according to TS 38.508-1 [6] clause 4.10.1. Message content exceptions are defined in clause 11.1.3.1.1_1.3.3.

3. Sidelink physical channels and signals are initially set up according to Table 11.1.1.2-1, Table 11.1.3.1.1.0-1 and Annex A.6 as appropriate.

4. Propagation conditions are set according to Annex B.0.

5. Ensure the UE is in state 4-A with generic procedure parameters Test Loop Function = *On* according to TS 38.508-1 [6] clause 4.4A.2. The UE is configured as the received UE. Message contents are defined in clause 11.1.3.1.1_1.3.3.

6. The GNSS simulator is triggered to start step 1 of Scenario #1 to simulate a location in the centre of Geographical area #1. Wait for the UE to acquire the GNSS signal.

11.1.3.1.1_1.3.2 Test procedure

1. Sidelink UE1 transmits PSCCH/PSSCH RMC according to *SL-PreconfigurationNR* and Table 11.1.3.1.1.0-1. The sidelink UE1 transmits MAC padding bits on the sidelink RMC.
2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix and the SNR according to Table 11.1.3.1.1_1.4-1 as appropriate.
3. Measure the probability of PSCCH miss-detection according to the test method described in Annex G.5 for a duration sufficient to achieve statistical significance. If the measured probability of PSCCH miss-detection is less than the reference value in Table 11.1.3.1.1_1.4-1 pass the UE. Otherwise fail the UE.
4. Repeat steps from 1 to 3 for each subtest in Table 11.1.3.1.1_1.4-1 as appropriate.

11.1.3.1.1_1.3.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 5.4.3.

11.1.3.1.1_1.4 Test Requirements

For the parameters specified in Table 11.1.3.1.0-1 and SNR specified in Table 11.1.3.1.4-1, the average PSSCH BLER obtained in step 3 shall be below the reference value specified in Table 11.1.3.1.4-1. The PSSCH sidelink reference channels are defined in Annex A Table A.6.2.2-1.

Table 11.1.3.1.4-1: Test performance requirements

Test number	PSCCH Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Propagation condition	Reference value	
				Probability of missed PSCCH (%)	SNR (dB) of PSCCH
1	R.PSCCH.2-1.1	20 / 30	TDLA30-1400	1	5.5

11.1.4 PSBCH demodulation requirements

11.1.4.1 2Rx requirements

11.1.4.1.1 2Rx FR1 PSBCH performance

11.1.4.1.1.0 Minimum requirements

The minimum requirements are specified in Table 11.1.4.1.1.0-2 with the test parameters specified in Table 11.1.4.1.1.0-1. The Sidelink UE 1 transmits PSBCH to UE and the UE is synchronized to SLSS of Sidelink UE 1.

RAN4 has recommended that these requirements do not need to be tested.

Table 11.1.4.1.1.0-1: Test parameters

Parameter		Unit	Test 1
Active cell(s)			None
Sidelink UE 1	Sidelink Transmissions		SLSS+PSBCH (Note 3)
	slssid		0
	Time offset (Note 1)	μs	0
	Frequency offset (Note 2)	Hz	0
	Synchronization source		GNSS
	Antenna configuration		1x2 Low
Note 1: Time offset of transmitted Sidelink UE 1 signal with respect to GNSS reference timing. Note 2: Frequency offset of transmitted Sidelink UE 1 signal with respect to GNSS reference frequency. Note 3: PSBCH transmits together with corresponding SLSS in the same slot.			

Table 11.1.4.1.1.0-2: Minimum performance

Test number	Bandwidth (MHz) / Subcarrier spacing (kHz)	PSBCH Reference channel	Propagation condition	Reference value	
				Probability of missed PSBCH (%)	SNR (dB)
1	20 / 30	R.PSBCH.2-1	TDLA30-180	1	0.1

The normative reference for this requirement is TS 38.101-4 [5], clause 11.1.4.1.1.

11.1.5 PSFCH demodulation requirements

11.1.5.1 2Rx requirements

11.1.5.1.1 2Rx FR1 PSFCH performance

11.1.5.1.1.0 Minimum requirements

11.1.5.1.1.0.1 NACK missed detection requirements

The minimum requirements are specified in Table 11.1.5.1.1.0.1-2 with the test parameters specified in Table 11.1.5.1.0.1-1. In this test scenario, GNSS or GNSS-equivalent synchronization source is used and sidelink UE 1 receives PSCCH and PSSCH sent by the UE under test and transmits PSFCH.

Table 11.1.5.1.1.0.1-1: Test parameters

Parameter	unit	Test 1
Allocated resource blocks	RB	1
The number of PSFCH symbols (Note 1)	symbol	2
Number of information bits	bit	1
Synchronization source		GNSS
Timing offset (Note 2)	μs	CP/2-12*64*Tc
Frequency offset (Note 3)	Hz	600
PSFCH resource period	Slots	1
Antenna configuration		1x2 Low
Note 1 First symbol is included. First symbol is used for AGC and not used for demodulation. Note 2 Time offset of transmitted Sidelink UE signal with respect to GNSS referring timing. Note 3 Frequency offset of transmitted Sidelink UE signal with respect to GNSS reference frequency.		

Table 11.1.5.1.1.0.1-2: Minimum performance

Test num.	Bandwidth (MHz) / Subcarrier spacing (kHz)	Propagation condition	Reference value	
			NACK missed detection probability (%)	SNR (dB)
1	20 / 30	TDLA30-180	1	9.5

The normative reference for this requirement is TS 38.101-4 [5], clause 11.1.5.1.1.1.

11.1.5.1.1.0.2 DTX to NACK requirements

The DTX to NACK probability, i.e. the probability that NACK is detected when nothing was sent:

$$\text{Prob}(\text{PSFCH DTX} \rightarrow \text{NACK bits}) = \frac{\#(\text{false NACK bits})}{\#(\text{PSFCH DTX}) * \#(\text{NACK bits})}$$

where:

- #(false NACK bits) denotes the number of detected NACK bits.
- #(NACK bits) denotes the number of encoded bits per slot
- #(PSFCH DTX) denotes the number of DTX occasions

The DTX to NACK probability shall not exceed 1% with the test parameters are configured in Table 11.1.5.1.1.0.1-1.

The normative reference for this requirement is TS 38.101-4 [5], clause 11.1.5.1.1.2.

11.1.5.1.1_1 2Rx FR1 PSCCH performance - single active PSSCH link

11.1.5.1.1_1.1 Test purpose

The purpose is to verify the PSFCH for V2X demodulation performance with a single active PSSCH link.

11.1.5.1.1_1.2 Test applicability

This test case applies to all types of NR UE release 16 and forward which support NR sidelink communication, as specified in Table 11.1.1.1.2-1.

11.1.5.1.1_1.3 Test description

11.1.5.1.1_1.3.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in 38.521-1 [7] subclause 5.3E.

PSCCH and PSSCH reference measurement channels are set according to Table 11.1.1.2-1 and Annex A.6 as appropriate.

Configurations of the GNSS simulator are specified in TS 38.508-1 [6] Table 4.11.2-2 and the GNSS simulator is configured for Scenario #1: static in Geographical area #1. Geographical area #1 is also pre-configured in the UE.

Test Environment: Low, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [6] clause 4.3.1.8.

Channel Bandwidths to be tested: As specified per test number in Table 11.1.5.1.1.0.1-2 as defined in TS 38.508-1 [6] clause 4.3.1.8.

1. Connect the SS, the faders, and the AWGN noise source to the UE antenna connectors, connect the SS COM port to the UE COM port, and connect the GNSS simulator to the UE GNSS RX antenna connector as shown in TS 38.508-1 [6] Annex A, Figure A.3.1.9.1(TE part) and Figure A.3.2.7.1 (UE part).
2. The parameter settings for the V2X sidelink transmission over PC5 interface are pre-configured according to TS 38.508-1 [6] clause 4.10.1. Message content exceptions are defined in clause 11.1.5.1.1_1.3.3.
3. Sidelink physical channels and signals are initially set up according to Table 11.1.1.2-1, Table 11.1.5.1.1.0.1-1 and Annex A.6 as appropriate.
4. Propagation conditions are set according to Annex B.0.
5. Ensure the UE is in state 4-A with generic procedure parameters Test Loop Function = *On* according to TS 38.508-1 [6] clause 4.4A.2. The UE is configured as the transmitting UE and operates in NACK-only HARQ groupcast mode. Message contents are defined in clause 11.1.5.1.1_1.3.3.
6. The GNSS simulator is triggered to start step 1 of Scenario #1 to simulate a location in the centre of Geographical area #1. Wait for the UE to acquire the GNSS signal.

11.1.5.1.1_1.3.2 Test procedure

1. The UE under test transmits PSCCH/PSSCH in every PSCCH/PSSCH duration for NR sidelink communication according to *SL-PreconfigurationNR*. The Sidelink UE1 receives the PSSCH sent by the UE under test. For every PSSCH received, the Sidelink UE1 sends NACK on PSFCH if the corresponding PSFCH falls in even slot and sends nothing if the corresponding PSFCH falls in odd slot.

2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix and the SNR according to Table 11.1.5.1.1_1.4-1 as appropriate.

3. Measure probability of NACK miss-detection and DTX to NACK probability according to the test method described in Annex G.5 for a duration sufficient to achieve statistical significance. Pass the UE if the measured probability of PSFCH miss-detection is less than the reference value in Table 11.1.5.1.1_1.4-1 and the measured DTX to NACK probability is not exceed the reference value in clause 11.1.5.1.1.0.2. Otherwise fail the UE.

4. Repeat steps from 1 to 3 for each subtest in Table 11.1.5.1.1_1.4-1 as appropriate.

11.1.5.1.1_1.3.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 5.4.3 with the following exceptions.

Table 11.1.5.1.1_1.3.3-1: *SL-ResourcePool*

Derivation Path: TS 38.508-1 [6] Table 5.4.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
SL-ResourcePool-r16 ::= SEQUENCE {			
sl-PSFCH-Config-r16 CHOICE {			
setup SEQUENCE {			
sl-PSFCH-Period-r16	sl1		
}			
}			
}			

11.1.5.1.1_1.4 Test Requirements

For the parameters specified in Table 11.1.5.1.0-1 and SNR specified in Table 11.1.5.1.1_1.4-1, the NACK missed detection probability obtained in step 3 shall be below the reference value specified in Table 11.1.5.1.1_1.4-1.

For the parameters specified in Table 11.1.5.1.1.0.1-1, the DTX to NACK probability shall not exceed 1%.

Table 11.1.5.1.1_1.4-1: Test performance requirements

Test num.	Bandwidth (MHz) / Subcarrier spacing (kHz)	Propagation condition	Reference value	
			NACK missed detection probability (%)	SNR (dB)
1	20 / 30	TDLA30-180	1	10.3

11.1.6 Power imbalance performance with two links

11.1.6.1 2Rx requirements

11.1.6.1.1 2Rx FR1 Power imbalance performance

11.1.6.1.1.0 Minimum requirements

The minimum requirements are specified in Table 11.1.6.1.1.0-2 with the test parameters specified in Table 11.1.6.1.1.0-1. In this test scenario, The Sidelink UE 1 and 2 are synchronized to GNSS or GNSS-equivalent synchronization reference.

Table 11.1.6.1.1.0-1: Test parameters

Parameter		Unit	Test 1
Active cell(s)			None
Active Sidelink UE(s)			Sidelink UE 1, Sidelink UE 2
Sidelink UE 1	Sidelink Transmissions		PSCCH + PSSCH
	PSSCH DMRS pattern(Note 1)		{2,3}
	Sub-channel allocation		Sub-channel 0
	Time offset (Note 2)	μs	0
	Frequency offset (Note 3)	Hz	0
	Antenna configuration		1x2 Low
	PSFCH periodicity	Slots	4
	MinTimeGapPSFCH	Slots	3
Sidelink UE 2	Sidelink Transmissions		PSCCH + PSSCH
	PSSCH DMRS pattern(Note 1)		{2,3}
	Sub-channel allocation		Sub-channel 3
	Time offset (Note 2)	μs	0
	Frequency offset (Note 3)	Hz	0
	Antenna configuration		1x2 Low
	PSFCH periodicity	Slots	4
	MinTimeGapPSFCH	Slots	3
Note 1: {x, y}: x and y means the number of DMRS symbols for slot with PSFCH transmission and without PSFCH transmission, respectively. Note 2: Time offset of transmitted Sidelink UE signal with respect to GNSS reference timing. Note 3: Frequency offset of transmitted Sidelink UE signal with respect to GNSS reference frequency.			

Table 11.1.6.1.1.0-2: Minimum performance

Test number	Bandwidth (MHz)/ Subcarrier spacing(kHz)	Sidelink UE	PSSCH Reference channel	Modulation format and code rate	Propagation condition	Reference value	
						PSSCH BLER (%)	SNR (dB) of PSSCH
1	20 / 30	1	R.PSSCH.2-1.4	QPSK, 0.30	AWGN	(Note 1)	30.35
		2	R.PSSCH.2-1.4	QPSK, 0.30	AWGN	10	4.8
Note 1: There is no BLER requirement for Sidelink UE 1.							

The normative reference for this requirement is TS 38.101-4 [5], clause 11.1.6.1.1.

11.1.6.1.1_1 2Rx FR1 Power imbalance performance - two active PSSCH link

11.1.6.1.1_1.1 Test purpose

The purpose is to verify the demodulation performance when receiving PSSCH transmissions from two Sidelink UEs with power imbalance in one slot.

11.1.6.1.1_1.2 Test applicability

This test case applies to all types of NR UE release 16 and forward which support NR sidelink communication, as specified in Table 11.1.1.1.2-1.

11.1.6.1.1_1.3 Test description

11.1.6.1.1_1.3.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in 38.521-1 [7] subclause 5.3E.

PSCCH and PSSCH reference measurement channels are set according to Table 11.1.1.2-1, Table 11.1.6.1.1.0-1 and Annex A.6 as appropriate.

Configurations of the GNSS simulator are specified in TS 38.508-1 [6] Table 4.11.2-2 and the GNSS simulator is configured for Scenario #1: static in Geographical area #1. Geographical area #1 is also pre-configured in the UE.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Low Range, as defined in TS 38.508-1 [6] clause 4.3.1.8.

Channel Bandwidths to be tested: As specified per test number in Table 11.1.6.1.1.0 as defined in TS 38.508-1 [6] clause 4.3.1.8.

1. Connect the SS, the faders, and the AWGN noise source to the UE antenna connectors, connect the SS COM port to the UE COM port, and connect the GNSS simulator to the UE GNSS RX antenna connector as shown in TS 38.508-1 [6] Annex A, Figure A.3.1.9.1(TE part) and Figure A.3.2.7.1 (UE part).

2. The parameter settings for the V2X sidelink transmission over PC5 interface are pre-configured according to TS 38.508-1 [6] clause 4.10.1. Message content exceptions are defined in clause 11.1.6.1.1_1.3.3.

3. Sidelink physical channels and signals are initially set up according to Table 11.1.1.2-1, Table 11.1.6.1.1.0-1 and Annex A.6 as appropriate.

4. Propagation conditions are set according to Annex B.0.

5. Ensure the UE is in state 4-A with generic procedure parameters Test Loop Function = *On* according to TS 38.508-1 [6] clause 4.4A.2. The UE is configured as the receiving UE. Message contents are defined in clause 11.1.6.1.1_1.3.3.

6. The GNSS simulator is triggered to start step 1 of Scenario #1 to simulate a location in the centre of Geographical area #1. Wait for the UE to acquire the GNSS signal.

11.1.6.1.1_1.3.2 Test procedure

1. Sidelink UE1 and Sidelink UE2 transmit PSCCH/PSSCH RMC according to *SL-PreconfigurationNR* and Table 11.1.6.1.1.0-1. Both sidelink UE1 and sidelink UE2 transmit MAC padding bits on their sidelink RMC respectively.

2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix and the SNR according to Table 11.1.6.1.1_1.4-1 as appropriate.

3. Measure the average PSSCH BLER of sidelink UE2 according to the test method described in Annex G.5 for a duration sufficient to achieve statistical significance. If the measured average PSSCH BLER of sidelink UE2 is less than the reference value in Table 11.1.6.1.1_1.4-1 pass the UE. Otherwise fail the UE.

4. Repeat steps from 1 to 3 for each subtest in Table 11.1.6.1..1_14-1 as appropriate.

11.1.6.1.1_1.3.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 5.4 with the following exceptions.

Table 11.1.6.1.1_1.3.3-1: Physical layer parameters for SCI format 1-A

Derivation Path: TS 38.508-1 [6] Table 4.3.6.2.1.1-1			
Parameter	**Value**	**Value in binary**	**Condition**
DMRS pattern	indicates the 1st entry in sl-PSSCH-DMRS-TimePatternList-r16 if mod (i, 4), else indicates the 2nd entry in sl-PSSCH-DMRS-TimePatternList-r16. where i is the logical slot index belong to resource pool per 1024 radio frame as specified in 38.214 [12] clause 8	"0"B if mod (i, 4) = 0 "1"B if mod (i, 4) ≠ 0	

Table 11.1.6.1.1_1.3.3-2: *SL-ResourcePool*

Derivation Path: TS 38.508-1 [6] Table 5.4.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
SL-ResourcePool-r16 ::= SEQUENCE {			
sl-PSSCH-Config-r16 CHOICE {			
setup SEQUENCE {			
sl-PSSCH-DMRS-TimePatternList-r16 SEQUENCE (SIZE (1..3)) OF INTEGER (2..4) {	2 entries		
INTEGER[1]	2	entry 1	
INTEGER[2]	3	entry 2	
}			
}			

11.1.6.1.1_1.4 Test Requirements

For the parameters specified in Table 11.1.6.1.1.0-1 and SNR specified in Table 11.1.6.1.1.4-1, the average PSSCH BLER of sidelink UE2 obtained in step 3 shall be below the reference value specified in Table 11.1.6.1.1_1.4-1. The PSSCH sidelink reference channels are defined in Annex A Table A.6.2.2-1.

Table 11.1.6.1.1_1.4-1: Test performance

Test number	Bandwidth (MHz)/ Subcarrier spacing(kHz)	Sidelink UE	PSSCH Reference channel	Modulation format and code rate	Propagation condition	Reference value	
						PSSCH BLER (%)	SNR (dB) of PSSCH
1	20 / 30	1	R.PSSCH.2-1.4	QPSK, 0.30	AWGN	(Note 1)	30.35
		2	R.PSSCH.2-1.4	QPSK, 0.30	AWGN	10	5.4
Note 1: There is no BLER requirement for Sidelink UE 1.							

11.1.7 HARQ buffer soft combining

11.1.7.1 2Rx requirements

11.1.7.1.1 2Rx FR1 HARQ buffer soft combining performance

11.1.7.1.1.0 Minimum requirements

The minimum requirements are specified in Table 11.1.7.1.1.0-2 with the test parameters specified in Table 11.1.7.1.1.0-1. In this test scenario, GNSS or GNSS-equivalent synchronization source is used and all sidelink UE i ($0 \leq i \leq n$) transmit PSCCH and PSSCH.

Table 11.1.7.1.1.0-1: Test parameters

Parameter		Unit	Test 1
Active cell(s)			None
Active Sidelink UE(s)			Sidelink UE i, $0 \leq i < n$ (Note 1,2)
Sidelink UE i, $0 \leq i < n$	Sidelink Transmissions		PSCCH + PSSCH
	PSSCH DMRS pattern		{2}
	Time gap between initial transmission and retransmission	Slots	[*n* (Note 3)]
	Timing offset (Note 4)	μs	0
	Frequency offset (Note 5)	Hz	0
	Synchronization source		GNSS or GNSS-equivalent
	Antenna configuration		1x2 Low
	Redundancy version coding sequence		{0,2}

PSFCH resource period	Slots	1
Note 1: *n* is the number of HARQ process UE can support (based on IE harq-RxProcessSidelink) Note 2: When *n* = 16 or 24, sidelink UEs transmit one by one circularly for every slot; When *n*=32, the first 31 UEs transmit signal one by one circularly for every slot and in the first subchannel, and the 32nd UE transmits signal in the first slot but in the second subchannel; When *n*=48, the first 31 UEs transmit signal one by one circularly for every slot and in the first subchannel, the next 17 UEs transmit signal in the same slot as the first 17 UEs but in the second subchannel; When *n*=64, first 31 UEs transmit signal one by one circularly for every slot and in the first subchannel, the next 31 UEs transmit signal one by one circularly for every slot and in the second subchannel, the last 2 UEs transmit signal in the same slot as the first 2 UEs in the third subchannel Note 3: *k* = *n* if *n* < 32, otherwise *k* = 31 Note 4: Time offset of transmitted Sidelink UE signal is with respect to GNSS reference timing. Note 5: Frequency offset of transmitted Sidelink UE signal with respect to GNSS reference frequency.		

Table 11.1.7.1.1.0: Minimum performance

Test num.	Bandwidth (MHz) / Subcarrier spacing(kHz)	PSSCH Reference channel	Propagation condition	Reference value	
				PSSCH BLER (%)	SNR (dB) of PSSCH
1	20 / 30	R.PSSCH.2-1.5	AWGN	5	10.9

The normative reference for this requirement is TS 38.101-4 [5], clause 11.1.7.1.1

11.1.7.1.1_1 2Rx FR1 HARQ buffer soft combining performance - maximum number of HARQ processes11.1.7.1.1_1.1 Test purpose

The purpose is to verify the maximum number of HARQ processes per TTI supported by the V2X UE.

11.1.7.1.1_1.2 Test applicability

This test case applies to all types of NR UE release 16 and forward which support NR sidelink communication, as specified in Table 11.1.1.1.2-1.

11.1.7.1.1_1.3 Test description

11.1.7.1.1_1.3.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in 38.521-1 [7] subclause 5.3E.

PSCCH and PSSCH reference measurement channels are set according to Table 11.1.1.2-1, Table 11.1.7.1.1.0-1 and Annex A.6 as appropriate.

Configurations of the GNSS simulator are specified in TS 38.508-1 [6] Table 4.11.2-2 and the GNSS simulator is configured for Scenario #1: static in Geographical area #1. Geographical area #1 is also pre-configured in the UE.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Low Range, as defined in TS 38.508-1 [6] clause 4.3.1.8.

Channel Bandwidths to be tested: As specified per test number in Table 11.1.7.1.1.0-2 as defined in TS 38.508-1 [6] clause 4.3.1.8.

1. Connect the SS, the faders, and the AWGN noise source to the UE antenna connectors, connect the SS COM port to the UE COM port, and connect the GNSS simulator to the UE GNSS RX antenna connector as shown in TS 38.508-1 [6] Annex A, Figure A.3.1.9.1(TE part) and Figure A.3.2.7.1 (UE part).

2. The parameter settings for the V2X sidelink transmission over PC5 interface are pre-configured according to TS 38.508-1 [6] clause 4.10.1. Message content exceptions are defined in clause 11.1.7.1.1_1.3.3.

3. Sidelink physical channels and signals are initially set up according to Table 11.1.1.2-1, Table 11.1.7.1.1.0-1 and Annex A.6 as appropriate.

4. Propagation conditions are set according to Annex B.0.

5. Determine the number of sidelink UEs, i.e. N, as:

   - N = 16 if pc_harq_RxProcessSidelink_n16 = true
   - N = 24 if pc_harq_RxProcessSidelink_n24 = true
   - N = 32 if pc_harq_RxProcessSidelink_n32 = true
   - N = 48 if pc_harq_RxProcessSidelink_n48 = true
   - N = 64 if pc_harq_RxProcessSidelink_n64 = true

6. Ensure the UE is in state 4-A with generic procedure parameters Test Loop Function = *On* according to TS 38.508-1 [6] clause 4.4A.2. The UE is configured as the received UE. Message contents are defined in clause 11.1.7.1.1_1.3.3.

7. The GNSS simulator is triggered to start step 1 of Scenario #1 to simulate a location in the centre of Geographical area #1. Wait for the UE to acquire the GNSS signal.

11.1.7.1.1_1.3.2 Test procedure

1. Sidelink UE i, $0 \leq i < N$, transmits PSCCH/PSSCH RMC according to *SL-PreconfigurationNR* and Table 11.1.7.1.1.0-1. The sidelink UE i, $0 \leq i < N$ transmits MAC padding bits on the sidelink RMC.

2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix and the SNR according to Table 11.1.7.1.1_1.4-1 as appropriate.

3. Measure the average PSSCH BLER according to the test method described in Annex G.5 for a duration sufficient to achieve statistical significance. If the measured average PSSCH BLER is less than the reference value in Table 11.1.7.1.1_1.4-1 pass the UE. Otherwise fail the UE.

4. Repeat steps from 1 to 3 for each subtest in Table 11.1.7.1.1_1.4-1 as appropriate.

11.1.7.1.1_1.3.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 5.4 with the following exceptions.

Table 11.1.7.1.1_1.3.3-1: Physical layer parameters for SCI format 1-A

Derivation Path: TS 38.508-1 [6] Table 4.3.6.2.1.1-1			
Parameter	**Value**	**Value in binary**	**Condition**
DMRS pattern	Not present	-	

Table 11.1.7.1.1_1.3.3-2: *SL-ResourcePool*

Derivation Path: TS 38.508-1 [6] Table 5.4.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
SL-ResourcePool-r16 ::= SEQUENCE {			
sl-PSSCH-Config-r16 CHOICE {			
setup SEQUENCE {			
sl-PSSCH-DMRS-TimePatternList-r16 SEQUENCE (SIZE (1..3)) OF INTEGER (2..4) {	1 entry		
INTEGER[1]	2	entry 1	
}			
}			
}			
}			

11.1.7.1.1_1.4 Test Requirements

For the parameters specified in Table 11.1.7.1.0-1 and SNR specified in Table 11.1.7.1.1_1.4-1, the average PSSCH BLER obtained in step 3 shall be below the reference value specified in Table 11.1.7.1.1_1.4-1. The PSSCH sidelink reference channels are defined in Annex A Table A.6.2.2-1.

Table 11.1.7.1.1_1.4-1: Test performance

Test num.	Bandwidth (MHz) / Subcarrier spacing(kHz)	PSSCH Reference channel	Propagation condition	Reference value	
				PSSCH BLER (%)	SNR (dB) of PSSCH
1	20 / 30	R.PSSCH.2-1.5	AWGN	5	11.5

11.1.8 PSCCH decoding capability test

11.1.8.1 2Rx requirements

11.1.8.1.1 2Rx FR1 PSCCH decoding capability

11.1.8.1.1.0 Minimum requirements

The minimum requirements are specified in Table 11.1.8.1.1.0-2 with the test parameters specified in Table 11.1.8.1.1.0-1. In this test scenario, GNSS or GNSS-equivalent synchronization source is used and sidelink UE 1 transmits PSCCH and PSSCH and the test procedure is specified as follows:

- 10 UEs transmit PSCCHs and corresponding PSSCHs to the tested UE per slot with each UE occupying one subchannel.
- x UEs transmit PSCCHs and corresponding PSSCHs with high priority level on x subchannels that are randomly selected from 10 subchannels per slot and 10-x UEs transmit PSCCHs and corresponding PSSCHs with low priority level on the remaining subchannels. The indication of priority level specified in Clause 5.4.3.3 of TS 23.287 [23] and Clause 5.22.1.3.1 of TS 38.321 [24] is included in PSCCH.

Where x equals to:

- The number of PSFCH(s) resources that the tested UE can transmit in a slot (i.e. IE *psfch-TxNumber* specified in clause 4.2.16.1.6 of TS 38.306 [14]) if the number of PSFCH(s) resources that the tested UE can transmit in a slot is less than 10
- 10, otherwise.

The probability of PSCCH miss detection is calculated as follows:

$$\text{Prob}(\text{PSCCH miss detection}) = \frac{\#(\text{missing ACK/NACK})}{\#(\text{Tx high priority PSCCH/PSSCH})}$$

Where:

- #(Tx high priority PSCCH/PSSCH) denotes the total number of transmitted PSCCH/PSSCH with high priority level.
- #(missing ACK/NACK) denotes the total number of missing ACK/NACK with high priority.

Table 11.1.8.1.1.0-1: Test parameters

Parameter		Unit	Value
Member ID (Note 1)			0
Sidelink UE i, 0 ≤ i ≤ 9 (Note 5)	Sidelink Transmissions		PSCCH + PSSCH
	Timing offset (Note 2)	μs	0
	Frequency offset (Note 3)	Hz	0

	Synchronization source			GNSS
	Propagation Channel			Static propagation condition without external noise
	Antenna configuration			1x2 Low
	PSSCH RMC			R.PSSCH.2-1.1
	PSCCH RMC (Note 4)			R.PSCCH.2-1.1
	Source ID			0
	PSFCH periodicity		Slots	1
	MinTimeGapPSFCH		Slots	2
	PSFCH Resource (Note 6)	RB index		10*i
		CS pair index		0
Note 1: Member ID is an identifier uniquely identifying a member. Note 2: Time offset of transmitted Sidelink UE signal with respect to GNSS reference timing. Note 3: Frequency offset of transmitted Sidelink UE signal with respect to GNSS reference frequency. Note 4: OCC index for PSCCH DMRS is randomly selected between {0, 1, 2} for each PSCCH transmission as per in Clause 8.4.1.3.2 of TS 38.211 [9]. Note 5: Each UE occupies one sub-channel so that all sub-channels are filled. Note 6: The mapping procedure of PSSCH resource and PSFCH resource is specified in Clause 16.3 of TS 38.213 [11].				

Table 11.1.8.1.1.0-2: Minimum performance

Test Number	Bandwidth (MHz) / Subcarrier spacing(kHz)	PSCCH Reference channel	Propagation Channel	Reference value
				Probability of missed PSCCH (%)
1	40 / 30	R.PSCCH.2-1.1	Static propagation condition without external noise	1

The normative reference for this requirement is TS 38.101-4 [5], clause 11.1.8.1.1.

11.1.8.1.1_1 2Rx FR1 PSCCH decoding capability - maximum number of received PSCCHs

11.1.8.1.1_1.1 Test purpose

The purpose is to verify the maximum number of received PSCCHs per TTI supported by the V2X UE.

11.1.8.1.1_1.2 Test applicability

This test case applies to all types of NR UE release 16 and forward which support NR sidelink communication, as specified in Table 11.1.1.1.2-1.

11.1.8.1.1_1.3 Test description

11.1.8.1.1_1.3.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in 38.521-1 [7] subclause 5.3E.

PSCCH and PSSCH reference measurement channels are set according to Table 11.1.1.2-1, Table 11.1.8.1.1.0-1 and Annex A.6 as appropriate.

Configurations of the GNSS simulator are specified in TS 38.508-1 [6] Table 4.11.2-2 and the GNSS simulator is configured for Scenario #1: static in Geographical area #1. Geographical area #1 is also pre-configured in the UE.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Low Range, as defined in TS 38.508-1 [6] clause 4.3.1.8.

Channel Bandwidths to be tested: As specified per test number in Table 11.1.8.1.1.0-2 as defined in TS 38.508-1 [6] clause 4.3.1.8.

1. Connect the SS, the faders, and the AWGN noise source to the UE antenna connectors, connect the SS COM port to the UE COM port, and connect the GNSS simulator to the UE GNSS RX antenna connector as shown in TS 38.508-1 [6] Annex A, Figure A.3.1.9.1(TE part) and Figure A.3.2.7.1 (UE part).

2. The parameter settings for the V2X sidelink transmission over PC5 interface are pre-configured according to TS 38.508-1 [6] clause 4.10.1. Message content exceptions are defined in clause 11.1.8.1.1_1.3.3.

3. Sidelink physical channels and signals are initially set up according to Table 11.1.1.2-1, Table 11.1.8.1.1.0-1 and Annex A.6 as appropriate.

4. Propagation conditions are set according to Annex B.0.

5. Determine the number of sidelink UE transmitting PSSCH with high priority, i.e. x, as follows:

   - x = 4 if pc_psfch_TxNumber_n4 = true;

   - x = 8 if pc_psfch_TxNumber_n8 = true;

   - x = 10 if pc_psfch_TxNumber_n16 = true.

6. Ensure the UE is in state 4-A with generic procedure parameters Test Loop Function = *On* according to TS 38.508-1 [6] clause 4.4A.2. The UE is configured as the received UE. Message contents are defined in clause 11.1.8.1.1_1.3.3.

7. The GNSS simulator is triggered to start step 1 of Scenario #1 to simulate a location in the centre of Geographical area #1. Wait for the UE to acquire the GNSS signal.

11.1.8.1.1_1.3.2 Test procedure

1. Sidelink UE 0~9 transmit PSCCH/PSSCH RMC according to *SL-PreconfigurationNR* and Table 11.1.8.1.0-1. The SS randomly chooses x sidelink UEs among sidelink UE 0~9 to transmit PSSCHs with high priority and let the remaining 10-x sidelink UEs transmit PSSCH with low priority level. The sidelink UE 0~9 transmit MAC padding bits on the sidelink RMC.

2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix and the SNR according to Table 11.1.8.1.1_1.4-1 as appropriate.

3. Measure the probability of missed PSCCH according to clause 11.1.8.1.1.0 for a duration sufficient to achieve statistical significance as given in Annex G.5. If the measured probability of PSCCH miss-detection is less than the reference value in Table 11.1.8.1.1_1.4-1 pass the UE. Otherwise fail the UE.

4. Repeat steps from 1 to 3 for each subtest in Table 11.1.8.1.1_1.4-1 as appropriate.

11.1.8.1.1_1.3.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 5.4.3 with the following exceptions.

Table 11.1.8.1.1_1.3.3-1: *SL-ResourcePool*

Derivation Path: TS 38.508-1 [6] Table 5.4.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
SL-ResourcePool-r16 ::= SEQUENCE {			
sl-PSFCH-Config-r16 CHOICE {			
setup SEQUENCE {			
sl-PSFCH-Period-r16	sl1		
sl-MinTimeGapPSFCH-r16	sl2		
}			
}			
}			

11.1.8.1_1.1.4 Test Requirements

For the parameters specified in Table 11.1.8.1.1.0-1 and SNR specified in Table 11.1.8.1.1_1.4-1, the average PSSCH BLER obtained in step 3 shall be below the reference value specified in Table 11.1.8.1.1_1.4-1. The PSSCH sidelink reference channels are defined in Annex A Table A.6.2.2-1.

Table 11.1.8.1.1_1.4-1: Test performance requirements

Test Number	Bandwidth (MHz) / Subcarrier spacing(kHz)	PSCCH Reference channel	Propagation Channel	Reference value
				Probability of missed PSCCH (%)
1	40 / 30	R.PSCCH.2-1.1	Static propagation condition without external noise	1

11.1.9 PSFCH decoding capability Test

11.1.9.1 2Rx requirements

11.1.9.1.1 2Rx FR1 PSFCH decoding capability

11.1.9.1.0 Minimum requirements

The minimum requirements are specified in Table 11.1.9.1.1.0-2 with the test parameters specified in Table 11.1.9.1.1.0-1. In each slot, a group of UEs transmits PSFCHs to the tested UE.

Table 11.1.9.1.1.0-1: Test parameters

Parameter		Unit	Test 1
HARQ-ACK information			ACK or NACK
Source ID of tested UE			0
Sidelink UE i, 0 ≤ i ≤ N-1(Note 3)	Sidelink transmissions for		PSFCH
	Timing offset (Note 1)	μs	0
	Frequency offset (Note 2)	Hz	0
	Synchronization source		GNSS or GNSS-equivalent
	Propagation Channel		Static propagation condition No external noise sources are applied
	Antenna configuration		1x2 Low
	Member ID(Note 4)		i
	PSFCH resource allocation(Note 5)		N UEs transmit PSFCHs one by one on each RB with CS pair index 0. i.e. UE 0 transmits PSFCH on RB 0, UE 1 transmits PSFCH on RB 1,…, UE (N-1) transmits PSFCH on RB N-1
	PSFCH periodicity	Slots	1

Note 1: Time offset of transmitted Sidelink UE signal with respect to GNSS reference timing.
Note 2: Frequency offset of transmitted Sidelink UE signal with respect to GNSS reference frequency.
Note 3: N equals to the number of PSFCH(s) resources that UE can receive in a slot as specified in Clause 4.2.16.1.6 of TS 38.306[14] (IE *psfch-RxNumber*)) .
Note 4: Member ID is an identifier uniquely identifying a member
Note 5: All PSFCHs in a slot are corresponding to one PSSCH that occupies all sub channels.

Table 11.1.9.1.1.0-2: Minimum performance

Test Number	Bandwidth (MHz) / Subcarrier spacing(kHz)	Propagation Channel	Reference value	
			Probability of success detection slot with ACK only	Probability of success detection slot with NACK or DTX

1	40 / 30	Static propagation condition without external noise	99	99
Note 1: The probability of success detection slot with ACK only is the probability that the corresponding PSSCH is not retransmitted when Option A is selected. Note 2: The probability of success detection slot with NACK or DTX is the probability that the corresponding PSSCH is retransmitted when Option B or option C is selected.				

The normative reference for this requirement is TS 38.101-4 [5], clause 11.1.9.1.1.1.

11.1.9.1.1_1 2Rx FR1 PSFCH decoding capability - maximum number of received PSFCHs

11.1.9.1_1.1.1 Test purpose

The purpose is to verify the maximum number of PSFCHs received by UE per slot in group cast scenario by using ACK/NACK feedback mode.

11.1.9.1_1.1.2 Test applicability

This test case applies to all types of NR UE release 16 and forward which support NR sidelink communication, as specified in Table 11.1.1.1.2-1.

11.1.9.1_1.1.3 Test description

11.1.9.1_1.1.3.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in 38.521-1 [7] subclause 5.3E.

PSCCH and PSSCH reference measurement channels are set according to Table 11.1.1.2-1 and Annex A.6 as appropriate.

Configurations of the GNSS simulator are specified in TS 38.508-1 [6] Table 4.11.2-2 and the GNSS simulator is configured for Scenario #1: static in Geographical area #1. Geographical area #1 is also pre-configured in the UE.

Test Environment: Normal, as defined in TS 38.508-1 [6] clause 4.1.

Frequencies to be tested: Low Range, as defined in TS 38.508-1 [6] clause 4.3.1.8.

Channel Bandwidths to be tested: As specified per test number in Table 11.1.9.1.1.0-2 as defined in TS 38.508-1 [6] clause 4.3.1.8.

1. Connect the SS, the faders, and the AWGN noise source to the UE antenna connectors, connect the SS COM port to the UE COM port, and connect the GNSS simulator to the UE GNSS RX antenna connector as shown in TS 38.508-1 [6] Annex A, Figure A.3.1.9.1(TE part) and Figure A.3.2.7.1 (UE part).

2. The parameter settings for the V2X sidelink transmission over PC5 interface are pre-configured according to TS 38.508-1 [6] clause 4.10.1. Message content exceptions are defined in clause 11.1.9.1_1.1.3.3.

3. Sidelink physical channels and signals are initially set up according to Table 11.1.1.2-1, Table 11.1.9.1.1.0-1 and Annex A.6 as appropriate.

4. Propagation conditions are set according to Annex B.0.

5. Determine the number of sidelink UEs, i.e. N, as follows:

   - N = 5 if pc_psfch_RxNumber_n5 = true;
   - N = 15 if pc_psfch_RxNumber_n15 = true;
   - N = 25 if pc_psfch_RxNumber_n25 = true;

- N = 32 if pc_psfch_RxNumber_n32 = true;
- N = 35 if pc_psfch_RxNumber_n35 = true;
- N = 45 if pc_psfch_RxNumber_n45 = true;
- N = 50 if pc_psfch_RxNumber_n50 = true;
- N = 64 if pc_psfch_RxNumber_n64 = true;

6. Ensure the UE is in state 4-A with generic procedure parameters Test Loop Function = *On* according to TS 38.508-1 [6] clause 4.4A.2. The UE is configured as the transmitting UE and operates in ACK/NACK HARQ groupcast mode. Message contents are defined in clause 11.1.9.1_1.1.3.3.
7. The GNSS simulator is triggered to start step 1 of Scenario #1 to simulate a location in the centre of Geographical area #1. Wait for the UE to acquire the GNSS signal.

11.1.9.1_1.1.3.2 Test procedure

1. The UE under test transmits PSCCH/PSSCH in every PSCCH/PSSCH duration for NR sidelink communication according to *SL-PreconfigurationNR*. The Sidelink UEs receive the PSSCH sent by the UE under test and send PSFCH. Information transmitted in each PSFCH is randomly selected from Option A, Option B and Option C with probability of 50%, 25% and 25% respectively. Transmitted PSFCHs are related to one PSSCH which is transmitted by tested UE and occupies all the subchannels.
   - Option A: All the UEs in the group transmit ACKs
   - Option B: One UE transmits NACK and the rest of UEs transmit ACKs. The PSFCH resource index with NACK is random per slot
   - Option C: One UE transmits nothing (i.e. DTX) and the rest of UEs transmit ACKs. The PSFCH resource index of the DTX is random per slot.
2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix and the SNR according to Table 11.1.9.1_1.1.4-1 as appropriate.
3. Measure probability of success detection slot with ACK only, and probability of success detection slot with NACK or DTX according to the test method described in Annex G.5 for a duration sufficient to achieve statistical significance. Pass the UE if the measured probability of success detection slot with ACK only, and probability of success detection slot with NACK or DTX are no less than the reference value in Table 11.1.9.1.1_1.4-1. Otherwise fail the UE.
4. Repeat steps from 1 to 3 for each subtest in Table 11.1.9.1.1_1.4-1 as appropriate.

11.1.9.1.1_1.3.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 5.4.3 with the following exceptions.

Table 11.1.9.1.1_1.3.3-1: *SL-ResourcePool*

Derivation Path: TS 38.508-1 [6] Table 5.4.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
SL-ResourcePool-r16 ::= SEQUENCE {			
sl-PSFCH-Config-r16 CHOICE {			
setup SEQUENCE {			
sl-PSFCH-Period-r16	sl1		
}			
}			
}			

11.1.9.1.1_1.4 Test Requirements

For the parameters specified in Table 11.1.9.1.0-1 and SNR specified in Table 11.1.9.1.1_1.4-1, the probability of success detection slot with ACK only, and probability of success detection slot with NACK or DTX obtained in step 3 shall be no less the reference value specified in Table 11.1.9.1.1_1.4-1.

Table 11.1.9.1.1_1.4-1: Test performance requirements

Test Number	Bandwidth (MHz) / Subcarrier spacing(kHz)	Propagation Channel	Reference value	
			Probability of success detection slot with ACK only	Probability of success detection slot with NACK or DTX
1	40 / 30	Static propagation condition without external noise	99	99
Note 1: The probability of success detection slot with ACK only is the probability that the corresponding PSSCH is not retransmitted when Option A is selected.				
Note 2: The probability of success detection slot with NACK or DTX is the probability that the corresponding PSSCH is retransmitted when Option B or option C is selected.				