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TECHNICAL SPECIFICATION

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Contents

Foreword

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

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The present document is part 4 of a multi-part Technical Specification (TS) covering the New Radio (NR) User Equipment (UE) conformance specification, which is divided in the following parts:

FFS.

1 Scope

The present document specifies the measurement procedures for the conformance test of the user equipment (UE) that contain performance requirements as part of 5G-NR.

The requirements are listed in different clauses only if the corresponding parameters deviate. More generally, tests are only applicable to those mobiles that are intended to support the appropriate functionality. To indicate the circumstances in which tests apply, this is noted in the "*definition and applicability*" part of the test.

For example only Release 15 and later UE declared to support 5G-NR shall be tested for this functionality. In the event that for some tests different conditions apply for different releases, this is indicated within the text of the test itself.

2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone".

[3] 3GPP TS 38.101-2: "NR; User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone"

[4] 3GPP TS 38.101-3: "NR; User Equipment (UE) radio transmission and reception; Part 3: Range 1 and Range 2 Interworking operation with other radios".

[5] 3GPP TS 38.101-4: "NR; User Equipment (UE) radio transmission and reception; Part 4: Performance requirements".

[6] 3GPP TS 38.508-1: "5GS; User Equipment (UE) conformance specification; Part 1: Common test environment"

[7] 3GPP TS 38.521-1: "NR; User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: Range 1 Standalone"

[8] 3GPP TS 38.521-2: "NR; User Equipment (UE) conformance specification; Radio transmission and reception; Part 2: Range 2 Standalone"

[9] 3GPP TS 38.211: "NR; Physical channels and modulation".

[10] 3GPP TS 38.212: "NR; Multiplexing and channel coding".

[11] 3GPP TS 38.213: "NR; Physical layer procedures for control".

[12] 3GPP TS 38.214: "NR; Physical layer procedures for data".

[13] 3GPP TS 37.340: "Evolved Universal Terrestrial Radio Access (E-UTRA) and NR; Multi-connectivity", Stage 2.

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

[15] 3GPP TR 38.901: "Study on channel model for frequencies from 0.5 to 100 GHz".

[16] 3GPP TS 36.521-1: "E-UTRA; User Equipment (UE) conformance specification; Radio transmission and reception; Part1: conformance testing"

[17] 3GPP TS 36.211: "Physical Channels and Modulation".

[18] Recommendation ITU-R M.1545: "Measurement uncertainty as it applies to test limits for the terrestrial component of International Mobile Telecommunications-2000".

[19] GPP TS 36.508: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); Common test environments for User Equipment (UE) conformance testing".

[20] 3GPP TS 38.331: “Radio Resource Control (RRC) protocol specification”.

[21] 3GPP TS 38.521-3: "NR; User Equipment (UE) conformance specification; Radio transmission and reception; Part 3: Range 1 and Range 2 Interworking operation with other radios"

3 Definition of terms, symbols and abbreviations

3.1 Terms

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

aggregated channel bandwidth: The RF bandwidth in which a UE transmits and receives multiple contiguously aggregated carriers.

carrier aggregation: Aggregation of two or more component carriers in order to support wider transmission bandwidths.

carrier aggregation band: A set of one or more operating bands across which multiple carriers are aggregated with a specific set of technical requirements.

carrier aggregation bandwidth class: A class defined by the aggregated transmission bandwidth configuration and maximum number of component carriers supported by a UE.

carrier aggregation configuration: A combination of CA operating band(s) and CA bandwidth class(es) supported by a UE.

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

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

FR1: Frequency range 1 as defined in TS 38.101-3 [4] clause 5.1.

FR2: Frequency range 2 as defined in TS 38.101-3 [4] clause 5.1.

PDSCH mapping type A or B: A type of PDSCH allocation sent in the RRC message which defines the time domain allocation of PDSCH DMRS symbols. PDSCH mapping type A is slot based assignment with fixed starting OFDM symbol with variable length. PDSCH mapping type B is non-slot based assignment used for configuring min-slots.

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

3.2 Symbols

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

μ	Subcarrier spacing configuration as defined in TS 38.211 [9] clause 4.2]
N_{oc}	The power spectral density of a white noise source with average power per RE normalized to the subcarrier spacing as defined in Section 4.4.3 for conducted requirements and Section 4.5.3 for radiated requirements

3.3 Abbreviations

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

CA	Carrier Aggregation
CC	Component Carrier
CCE	Control Channel Element
CORESET	Control Resource Set
CP	Cyclic Prefix
CSI	Channel-State Information
CSI-IM	CSI Interference Measurement
CSI-RS	CSI Reference Signal
CW	Codeword
CQI	Channel Quality Indicator
CRC	Cyclic Redundancy Check
CRI	CSI-RS Resource Indicator
DC	Dual Connectivity
DCI	Downlink Control Information
DL	Downlink
DMRS	Demodulation Reference Signal
DPS	Dynamic Point Selection
EPRE	Energy Per Resource Element
EN-DC	E-UTRA-NR Dual Connectivity
FR	Frequency Range
FRC	Fixed Reference Channel
HARQ	Hybrid Automatic Repeat Request
HST	High Speed Train
HST-SFN	High Speed Train Single Frequency Network
LI	Layer Indicator
MAC	Medium Access Control
MCS	Modulation and Coding Scheme
MIB	Master Information Block
NR	New Radio
NSA	Non-Standalone Operation Mode
OCNG	OFDMA Channel Noise Generator
OFDM	Orthogonal Frequency Division Multiplexing
OFDMA	Orthogonal Frequency Division Multiple Access
PBCH	Physical Broadcast Channel
Pcell	Primary Cell
PDCCH	Physical Downlink Control Channel
PDSCH	Physical Downlink Shared Channel
PMI	Precoding Matrix Indicator
PRB	Physical Resource Block
PRG	Physical resource block group
PSS	Primary Synchronization Signal
PTRS	Phase Tracking Reference Signal
PUCCH	Physical Uplink Control Channel
PUSCH	Physical Uplink Shared Channel
QCL	Quasi Co-location
RB	Resource Block
RBG	Resource Block Group
RE	Resource Element
REG	Resource Element Group
RI	Rank Indicator
RRC	Radio Resource Control
SA	Standalone operation mode
SCS	Subcarrier Spacing
SINR	Signal-to-Interference-and-Noise Ratio
SNR	Signal-to-Noise Ratio

SS	Synchronization Signal
SSB	Synchronization Signal Block
SSS	Secondary Synchronization Signal
TCI	Transmission Configuration Indicator
TDM	Time division multiplexing
TTI	Transmission Time Interval
UL	Uplink
VRB	Virtual Resource Block

4 General

4.1 Relationship between minimum requirements and test requirements

TS 38.101-4 [5] is a Single-RAT and interwork specification for NR UE, covering minimum performance requirements of both conducted and radiated requirements. Conformance to the TS 38.101-4 [5] is demonstrated by fulfilling the test requirements specified in the present document.

The Minimum Requirements given in TS 38.101-4 [5]makes no allowance for measurement uncertainty (MU). The present document defines test tolerances (TT). These test tolerances are individually calculated for each test. The test tolerances are used to relax the minimum requirements in TS 38.101-4 [5] to create test requirements. For some requirements, including regulatory requirements, the test tolerance is set to zero.

The measurement results returned by the test system are compared - without any modification - against the test requirements as defined by various levels of "Shared Risk" principle as described below

a) Core specification value is not relaxed by any relaxation value (TT=0). For each single measurement, the probability of a borderline good UE being judged as FAIL equals the probability of a borderline bad UE being judged as PASS.

- Test tolerances equal to 0 (TT=0) are considered in this specification.

b) Core specification value is relaxed by a relaxation value (TT>0). For each single measurement, the probability of a borderline bad UE being judged as PASS is greater than the probability of a borderline good UE being judged as FAIL.

- Test tolerances lower than measurement uncertainty and greater than 0 (0 < TT < MU) are considered in this specification.

- Test tolerances high up to measurement uncertainty (TT = MU) are considered in this specification which is also known as “Never fail a good DUT” principle.

c) Core specification value is tightened by a stringent value (TT<0). For each single measurement, the probability of a borderline good UE being judged as FAIL is greater than the probability of a borderline bad UE being judged as PASS.

Test tolerances lower than 0 (TT<0) are not considered in this specification..

The “Never fail a good DUT” and the “Shared Risk” principles are defined in Recommendation ITU-R M.1545 [18].

4.2 Applicability of minimum requirements

The applicability of each requirement is described under each clause in 5.1, 6.1, 7.1, 8.1, 9.1 and 10.1 of TS 38.101-4.

The conducted minimum requirements specified in the present document shall be met in all applicable scenarios for FR1. The radiated minimum requirements specified in the present document shall be met in all applicable scenarios for FR2. The interwork minimum requirement specified in the present document shall be met in all applicable scenarios for NR interworking operation.

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

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

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

4.3 Specification suffix information

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

Table 4.3-1: Definition of suffixes

Clause suffix	Variant
None	Single Carrier
A	Carrier Aggregation (CA)
B	Dual-Connectivity (DC)
C	Supplement Uplink (SUL)

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

4.4 Conducted requirements

4.4.0 Introduction

The requirements are defined for the following modes:

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

4.4.1 Reference point

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

4.4.2 SNR definition

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

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

Where:

- N_{RX} denotes the number of receiver antenna connectors and the superscript receiver antenna connector *j*.
- The above SNR definition assumes that the REs are not precoded, and does not account for any gain which can be associated to the precoding operation.

- Unless otherwise stated, the SNR refers to the SSS wanted signal.
- The downlink SSS transmit power is defined as the linear average over the power contributions in [W] of all resource elements that carry the SSS within the operating system bandwidth.
- The power ratio of other wanted signals to the SSS is defined in clause C.3.1..

4.4.3 Noc

4.4.3.1 Introduction

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

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

4.4.3.2 Noc for NR operating bands in FR1

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

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

4.4.3.2.1 Derivation of Noc values for NR operating bands in FR1

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

$$Noc_{Band\_X,\ SCS\_Y,\ CBW\_Z} = REFSENS_{Band\_X,\ SCS\_Y,\ CBW\_Z} - 10*\log10(12*SCS\_Y*nPRB) + D - SNR_{REFSENS} + \Delta_{thermal}$$

where

- $REFSENS_{Band\_X,\ SCS\_Y,\ CBW\_Z}$ is the REFSENS value in dBm for Band X, SCS Y and CBW Z specified in Table 7.3.2-1 of TS 38.101-1 [2]
- 12 is the number of subcarriers in a PRB
- SCS Y is the subcarrier spacing associated with the REFSENS value
- nPRB is the maximum number of PRB for SCS Y and CBW Z associated with the REFSENS value, and is specified in Table 5.3.2-1 of TS 38.101-1 [2]
- D is diversity gain equal to 3 dB
- $SNR_{REFSENS}$ = -1 dB is the SNR used for simulation of REFSENS
- $\Delta_{thermal}$ is the amount of dB that the wanted noise is set above UE thermal noise, giving a defined rise in total noise. $\Delta_{thermal}$ = 16dB, giving a rise in total noise of 0.1dB, regarded as insignificant**.**

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

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

4.4.4 Es

4.4.4.1 Introduction

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

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

4.4.4.2 Es for NR operating bands in FR1

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

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

4.4.4.2.1 Derivation of Es values for NR operating bands in FR1

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

$Es_{Band\_X,\ SCS\_Y,\ CBW\_Z} = REFSENS_{Band\_X,\ SCS\_Y,\ CBW\_Z} - 10*\log10(12*SCS\_Y*nPRB) + D - SNR_{REFSENS} + dB_{EVM} + \Delta_{thermal}$

where:

- $REFSENS_{Band\_X,\ SCS\_Y,\ CBW\_Z}$ is the REFSENS value in dBm for Band X, SCS Y and CBW Z specified in Table 7.3.2-1 of TS 38.101-1 [2]
- 12 is the number of subcarriers in a PRB
- SCS Y is the subcarrier spacing associated with the REFSENS value
- nPRB is the maximum number of PRB for SCS Y and CBW Z associated with the REFSENS value, and is specified in Table 5.3.2-1 of TS 38.101-1 [2]
- D is diversity gain equal to 3 dB
- $SNR_{REFSENS}$ = -1 dB is the SNR used for simulation of REFSENS
- dB_{EVM} is the SNR of the applied signal due to EVM impairment on the wanted Es. An allowed EVM of 3% gives a dB_{EVM} of 30.5dB, derived as 20*log10(1/0.03)**.**
- $\Delta_{thermal}$ is the amount of dB that the impairment due to EVM on the wanted Es is set above UE thermal noise, giving a defined rise in total impairment. $\Delta_{thermal}$ = 7.6dB, giving a rise in total impairment of 0.7dB, regarded as acceptable**.**

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

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

4.5 Radiated requirements

4.5.0 Introduction

The requirements are defined for the following modes:

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

4.5.1 Reference point

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

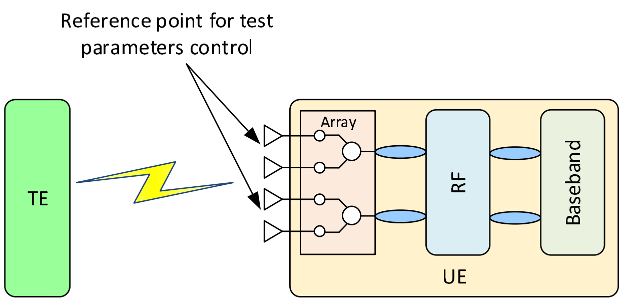

Figure 4.5.1-1: Reference point for radiated Demodulation and CSI requirements

4.5.2 SNR definition

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

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

where Δ_{BB} is specified in clause 4.5.3.

The reference point SNR is defined as:

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

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

4.5.3 Noc

4.5.3.1 Introduction

For Mode 1 conditions radiated testing of demodulation and CSI requirements it is not feasible in practice to use signal levels high enough to make the noise contribution of the UE negligible. Demodulation requirements are therefore specified with the applied noise higher than the UE peak EIS level in TS 38.101-2 [3] by a defined amount, so that the impact of UE noise floor is limited to no greater than a value Δ_{BB} at the specified Noc level. As UEs have EIS levels that are dependent on operating band and power class, Noc level is dependent on operating band and power class.

The Noc power level for test case execution shall be further increased by 5.19dB for UE power class 3 on top of the Noc power level defined in 4.5.3.2.

4.5.3.2 Noc for NR operating bands in FR2

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

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

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

For PC3 multi-band devices, the Noc power level (Noc_{MB}) shall increase by multi-band relaxation defined in TS 38.101-2 [3] Table 6.2.1.3-4.

$$Noc_{MB} = Noc_{SB} + \Sigma MB_P$$

- Noc_{SB} is the Noc defined in Table 4.5.3.2-1
- ΣMB_P values are specified in TS 38.101-2 [3].

For CA case, the Noc power level (Noc_{CA}) shall increase by a relaxation factor defined in TS 38.101-2 [3] Table 7.3A.2.1-1:

$$Noc_{CA} = Noc_{SC} + \Delta R_{IB}$$

- Noc_{SC} is derived by assuming UE supports single carrier.
- ΔR_{IB} values are specified in TS 38.101-2 [3].

4.5.3.3 Derivation of Noc values for NR operating bands in FR2

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

$$Noc = REFSENS_{PC3,\ n260,\ 50MHz} - 10Log_{10}(SCS_{REFSENS} \times PRB_{REFSENS} \times 12) - SNR_{REFSENS} + \Delta_{thermal}$$

where:

- $REFSENS_{PC3,\ n260,\ 50MHz}$ is the REFSENS value in dBm specified for Power Class 3 UE in Band n260 for 50MHz Channel bandwidth in TS 38.101-2 [3] Table 7.3.2.3-1.
- $SCS_{REFSENS}$ is a subcarrier spacing associated with N_{RB} for 50MHz in TS 38.101-2 [3] Table 5.3.2-1, chosen as 120 kHz.
- $PRB_{REFSENS}$ is N_{RB} associated with subcarrier spacing 120 kHz for 50MHz in TS 38.101-2 [3] Table 5.3.2-1 and is 32.
- 12 is the number of subcarriers in a PRB
- $SNR_{REFSSENS}$ = -1 dB is the SNR used for simulation of R EFSENS.
- $\Delta_{thermal}$ is the amount of dB that the wanted noise is set above UE thermal noise, giving a rise in total noise of Δ_{BB}. $\Delta_{thermal}$ = 6 dB, giving a rise in total noise of 1 dB**.**

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

The following methodology to define the Noc level for UE power class X (PC_X) and operating band Y (Band_Y) is used for the single carrier case and single band devices:

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

where REFSENS values are specified in TS 38.101-2 [3].

4.5.4 Angle of arrival

Unless otherwise stated, the downlink signal and noise are aligned to arrive in the UE Rx beam peak direction as defined in TS 38.101-2 [3].

4.5.5 Es

For Mode 2 the test system shall transmit the wanted signal with power level Es which is the best achievable power level by the test system.

The test system shall be able to determine achievable Es level and the maximum achievable SNR level

4.6 Test coverage across 5G NR architecture options

The test cases in the present document cover both Standalone (FR1, FR2) as well as Non-Standalone FR1 and FR2 (E-UTRA and 5G NR interworking) testing. Below shall be the understanding with respect to coverage across 5G NR architecture options:

1) Unless otherwise stated within the test case, it shall be understood that test requirements are agnostic of the NSA architecture option configured within the test. The test coverage across NSA options shall be considered fulfilled by execution of the NSA test case using one NSA option. Subsequently the test results can be leveraged to other NSA options.

2) Only one SA or NSA architecture option type is identified and utilized in the definition of each test case within this test specification. NSA test cases are configured using Connectivity EN-DC i.e. NSA Option 3 and Standalone (SA) test cases are configured using Connectivity NR i.e. SA Option 2, which shall be the default architecture options used for NSA and SA test execution respectively.

3) If a UE does not support NSA Option 3, any other supported NSA option can be configured to execute the test. This is accomplished by appropriately picking the generic procedure parameter from Table 4.5.1-2. The leverage rule detailed in (1) would apply.

Table 4.6-1: Generic procedure parameter summary for SA

Generic Procedure Parameter to use in Initial Conditions		Description	5G NR SA Architecture Option supported by UE
Connectivity	*NR*	NG-RAN NR Radio Access	SA Option 2
	E-UTRA	NG-RAN E-UTRA Radio Access	SA Option 5

Editor's Note: Any additional test config details needed for SA Option 5 is FFS

Table 4.6-2: Generic procedure parameter summary for NSA

Generic Procedure Parameter to use in Initial Conditions		Description	5G NR NSA Architecture Option supported by UE
Connectivity	**NSA**		
	EN-DC	E-UTRA-NR Dual Connectivity	NSA Option 3
	NGEN-DC	NG-RAN E-UTRA-NR Dual Connectivity	NSA Option 4
	NE-DC	NR-E-UTRA Dual Connectivity	NSA Option 7

Editor's Note: Any additional test config details needed for NSA Options 4 and 7 are FFS

5 Demodulation performance requirements (Conducted requirements)

5.1 General

5.1.1 Applicability of requirements

5.1.1.1 General

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

The minimum performance requirements in Clause 5 are mandatory for UE supporting NR operation, except test cases listed in Clauses 5.1.1.3, 5.1.1.4.

5.1.1.2 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 [3]. The UE requirements applicability for UEs with different number of RX antenna ports is defined in Table 5.1.1.2-1.

Table 5.1.1.2-1: Requirements applicability

Supported RX antenna ports	Test type	Test list
UE supports only 2RX	PDSCH	All tests in Clause 5.2.2
	PDCCH	All tests in Clause 5.3.2
	PBCH	All tests in Clause 5.4.2
UE supports only 4RX or both 2RX and 4RX	PDSCH	All tests in Clause 5.2.3
	PDCCH	All tests in Clause 5.3.3
	PBCH	All tests in Clause 5.4.2 or 5.4.3 Note 1
Note 1: : Requirements for PBCH with 4Rx is up to UE declaration		

5.1.1.3 Applicability of requirements for optional UE features

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

Table 5.1.1.3-1: Requirements applicability for optional UE features

UE feature/capability [14]	Test type		Test list	Applicability notes
SU-MIMO Interference Mitigation advanced receiver	FR1 FDD	PDSCH	Clause 5.2.2.1.1 (Test 3-1) Clause 5.2.3.1.1 (Test 5-1)	
	FR1 TDD	PDSCH	Clause 5.2.2.2.1 (Test 3-1) Clause 5.2.3.2.1 (Test 5-1)	
Alternative additional DMRS position for co-existence with LTE CRS (*additionalDMRS-DL-Alt)*	FR1 FDD	PDSCH	Clause 5.2.2.1.4 (Test 1-2) Clause 5.2.3.1.4 (Test 1-2)	
Basic DL NR-NR CA operation (*supportedBandCombinationList*)	NR CA	SDR	Clause 5.5A.1	1) Up to 16 DL carriers 2) Same numerology across carrier for data/control channel at a given time
Enhanced demodulation processing for HST-SFN joint transmission scheme with velocity up to 500km/h	FR1 FDD	PDSCH	Clause 5.2.2.1.9 (Test 1-1) Clause 5.2.3.1.9 (Test 1-1)	
	FR1 TDD	PDSCH	Clause 5.2.2.2.9 (Test 1-1) Clause 5.2.3.2.9 (Test 1-1)	

5.1.1.4 Applicability of requirements for mandatory UE features with capability signalling

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

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

UE feature/capability [14]	Test type		Test list	Applicability notes
256QAM modulation scheme for PDSCH for FR1 (*pdsch-256QAM-FR1*)	FR1 FDD	PDSCH	Clause 5.2.2.1.1 (Test 1-3) Clause 5.2.3.1.1 (Test 1-3)	
	FR1 TDD	PDSCH	Clause 5.2.2.2.1 (Test 1-3) Clause 5.2.3.2.1 (Test 1-3)	
PDSCH mapping type B (*pdsch-MappingTypeB*)	FR1 FDD	PDSCH	Clause 5.2.2.1.3 Clause 5.2.3.1.3	
	FR1 TDD	PDSCH	Clause 5.2.2.2.3 Clause 5.2.3.2.3	
Rate-matching around LTE CRS (rateMatchingLTE-CRS)	FR1 FDD	PDSCH	Clause 5.2.2.1.4 Clause 5.2.3.1.4	For UEs supporting "Alternative additional DMRS position for co-existence with LTE CRS", if Test 1-2 is tested, the test coverage can be considered fulfilled without executing Test 1-1. Otherwise, only Test 1-1 is tested.
Supported maximum number of ports across all configured NZP-CSI-RS resources per CC (*maxConfigNumberPortsAcrossNZP-CSI-RS-PerCC*)	FR1 FDD	PDSCH	Clause 5.2.2.1.4 (Tests 1-1, 1-2) Clause 5.2.3.1.1 (Tests 3-1, 4-1, 5-1) Clause 5.2.3.1.4 (Tests 1-1, 1-2) Clause 5.2.3.2.1 (Tests 3-1, 4-1, 5-1)	The requirements apply only in case the number of NZP-CSI-RS ports in the test case satisfies UE capability on maximum number of NZP-CSI-RS ports
	FR1 TDD	PDSCH	Clause 5.2.3.2.1 (Tests 3-1, 4-1, 5-1)	
Supported maximum number of PDSCH MIMO layers (*maxNumberMIMO-LayersPDSCH*)	FR1 FDD	PDSCH	Clause 5.2.2.1.1 (Tests 2-1, 2-2, 3-1) Clause 5.2.2.1.2 Clause 5.2.3.1.1 (Tests 2-1, 2-2, 3-1, 4-1, 5-1) Clause 5.2.3.1.2	The requirements apply only in case the PDSCH MIMO rank in the test case does not exceed UE PDSCH MIMO layers capability
	FR1 TDD	PDSCH	Clause 5.2.2.2.1 (Tests 2-1, 2-2, 3-1) Clause 5.2.2.2.2 Clause 5.2.3.2.1 (Tests 2-1, 2-2, 3-1, 4-1, 5-1) Clause 5.2.3.2.2	
Support number of active TCI states per BWP per CC, including control and data *(maxNumberActiveTCI-PerBWP)*	FR1 FDD	PDSCH	Clause 5.2.2.1.10 Clause 5.2.3.1.10	For the value of "*maxNumberActiveTCI-PerBWP*" other than n1, if Test 1-2 is tested, the test coverage can be considered fulfilled without executing Test 1-1. Otherwise, only Test 1-1 is tested.
	FR1 TDD	PDSCH	Clause 5.2.2.2.10 Clause 5.2.3.2.10	

5.1.1.5 Applicability of CA requirements

5.1.1.5.1 Definition of CA capability

The definition with respect to CA capabilities is given as in Table 5.1.1.5.1-1.

Table 5.1.1.5.1-1: 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 38.101-1[2]. CA_N corresponds to NR CA configurations and bandwidth combination sets defined in Section 5.5A.2 of TS 38.101-1[2]. CA_AX corresponds to NR CA configurations and bandwidth combination sets defined in Section 5.5A.3 of TS 38.101-1[2].	

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

The performance requirement for CA UE demodulation tests in Section 5.2A are defined independent of CA configurations and bandwidth combination sets specified in Section 5.5A of TS 38.101-1[2]. For UEs supporting different CA configurations and bandwidth combination sets, the applicability and test rules are defined in Table 5.1.1.5.2-1 and Table 5.1.1.5.2-2. For simplicity, CA configuration below refers to combination of CA configuration and bandwidth combination set.

Table 5.1.1.5.2-1: 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 5.2A.2.1 and 5.2A.3.1	CA_C, CA_N, CA_AX	Table 5.1.1.5.2-2	Largest aggregated CA bandwidth combination	Any of CCs
Test 2 in Section 5.2A.2.1 and 5.2A.3.1	CA_C, CA_N, CA_AX	Table 5.1.1.5.2-2	Largest aggregated CA bandwidth combination	Any of CCs
Test 3 in Section 5.2A.2.1 and 5.2A.3.1	CA_AX	Table 5.1.1.5.2-2	Largest aggregated CA bandwidth combination	TDD CC if supported, otherwise FDD CC
Test 4 in Clause 5.2A.2.1 and 5.2A.3.1 (NOTE 2)	CA_AX	Table 5.1.1.5.2-2	Largest aggregated CA bandwidth combination	Any of CCs
Test 5 in Section 5.2A.2.1 and 5.2A.3.1 (NOTE 3)	CA_AX	Table 5.1.1.5.2-2	Largest aggregated CA bandwidth combination	15 kHz CC is supported, otherwise 30 kHz CC
NOTE 1: In case CA_AX with different number of X is supported, [scenarios with maximum number of X and with the largest aggregated channel bandwidth are tested]. NOTE 2: These scenarios are only tested for UEs which are not verified with Test 3 in Section 5.2A.2.1 and 5.2A.3.1 NOTE 3: These scenarios are only tested for UEs which are not verified with Test 4 in Section 5.2A.2.1 and 5.2A.3.1				

Table 5.1.1.5.2-2: Selection of CA configurations

CA capability	Step 1	Step 2	Step 3	Step 4
CA_C or CA_N	Select the CA configurations with the maximum number of CCs, for which the supported maximum number of MIMO layers is not lower than 2.	Select any one of CA configurations, which contain CA bandwidth combination with the largest aggregated channel bandwidth and supported maximum data rate is not lower than the tested date rate, among all the selected CA configurations from Step 1.	N/A	N/A
CA_AX	Select the CA configurations with the maximum number of CCs, for which the supported maximum number of MIMO layers is not lower than 2.	Select any one of CA configurations, which contain CA bandwidth combination with the largest aggregated channel bandwidth and supported maximum data rate is not lower than the tested date rate, among all the selected CA configurations from Step 1.	Select the CA configurations with the largest number of bands and with the maximum number of CCs, for which the supported maximum number of MIMO layers is not lower than 2.	Select any one of CA configurations, which contain CA bandwidth combination with the largest aggregated channel bandwidth and supported maximum data rate is not lower than the tested date rate, among all the selected CA configurations from Step 3.
NOTE 1: For CA_AX capability, if CA configuration from step 2 is CA configuration with the largest number of bands then Step 3 and Step 4 are skipped. Otherwise, the two CA configurations selected from Step 2 and Step 4 are used for testing. NOTE 2: Maximum supported data rate for Step 2 and Step 4 is calculated based clause 4.1.2 of TS 38.306 [14]. NOTE 3: Tested data rate for Step 2 and Step 4 is calculated based on the equation $DataRate = 10^{-3}\sum_{j=1}^{J} TBS_j 2^{\mu_j}$ and FRCs used in the test.				

5.1.1.5.3 Antenna connection for CA tests with 4 RX

FFS

5.1.1.7 Applicability of different requirements for HST

The applicability rules for different HST requirements in section 5 are specified in Table 5.1.1.7-1.

Table 5.1.1.7-1: Applicability of requirements for HST

If UE has passed			UE can skip			Applicability notes
Test type		Test list	Test type		Test list	
FR1 FDD	PDSCH	Clause 5.2.2.1.1 (Test 1-6)	FR1 FDD	PDSCH	Clause 5.2.2.1.1 (Test 1-5)	
FR1 TDD	PDSCH	Clause 5.2.2.2.1 (Test 1-11)	FR1 TDD	PDSCH	Clause 5.2.2.2.1 (Test 1-7)	
FR1 FDD	PDSCH	Clause 5.2.3.1.1 (Test 1-6)	FR1 FDD	PDSCH	Clause 5.2.3.1.1 (Test 1-5)	
FR1 TDD	PDSCH	Clause 5.2.3.2.1 (Test 1-11)	FR1 TDD	PDSCH	Clause 5.2.3.2.1 (Test 1-7)	
FR1 FDD	PDSCH	Clause 5.2.2.1.9 (Test 1-1)	FR1 FDD	PDSCH	Clause 5.2.2.1.1 (Test 1-5)	
FR1 TDD	PDSCH	Clause 5.2.2.2.9 (Test 1-1)	FR1 TDD	PDSCH	Clause 5.2.2.2.1 (Test 1-7 and 1-11)	
FR1 FDD	PDSCH	Clause 5.2.3.1.9 (Test 1-1)	FR1 FDD	PDSCH	Clause 5.2.3.1.1 (Test 1-5)	
FR1 TDD	PDSCH	Clause 5.2.3.2.9 (Test 1-1)	FR1 TDD	PDSCH	Clause 5.2.3.2.1 (Test 1-7 and 1-11)	
FR1 FDD	PDSCH	Clause 5.2.2.1.1 (Test 1-7)	FR1 FDD	PDSCH	Clause 5.2.2.1.1 (Test 1-1)	
FR1 FDD	PDSCH	Clause 5.2.3.1.1 (Test 1-7)	FR1 FDD	PDSCH	Clause 5.2.3.1.1 (Test 1-1)	
FR1 FDD	PDSCH	Clause 5.2.2.1.10 (Test 1-1 or 1-2)	FR1 FDD	PDSCH	Clause 5.2.2.1.1 (Test 1-5)	
FR1 TDD	PDSCH	Clause 5.2.2.2.10 (Test 1-1 or 1-2)	FR1 TDD	PDSCH	Clause 5.2.2.2.1 (Test 1-7 and 1-11)	
FR1 FDD	PDSCH	Clause 5.2.3.1.10 (Test 1-1 or 1-2)	FR1 FDD	PDSCH	Clause 5.2.3.1.1 (Test 1-5)	
FR1 TDD	PDSCH	Clause 5.2.3.2.10 (Test 1-1 or 1-2)	FR1 TDD	PDSCH	Clause 5.2.3.2.1 (Test 1-7 and 1-11)	

5.2 PDSCH demodulation requirements

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

Table 5.2-1: Common test parameters

Parameter		Unit	Value
PDSCH transmission scheme			Transmission scheme 1
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	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
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	Symbols	0, 1
	Number of PRBs in CORESET		Table 5.2-2 for tested channel bandwidth and subcarrier spacing
	Number of PDCCH candidates and aggregation levels		1/AL8
	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 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	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)		Same as number of transmit antenna
	CDM Type		'No CDM' for 1 transmit antenna 'FD-CDM2' for 2 and 4 transmit antenna
	Density (ρ)		1
	CSI-RS periodicity	Slots	15 kHz SCS: 20 30 kHz SCS: 40
	CSI-RS offset	Slots	0
	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	15 kHz SCS: 20 30 kHz SCS: 40
	CSI-RS offset		Slots	0
	Frequency Occupation			Start PRB 0 Number of PRB = BWP size
PDSCH DMRS configuration	Antenna ports indexes			{1000} for Rank 1 tests {1000, 1001} for Rank 2 tests {1000-1002} for Rank 3 tests {1000-1003} for Rank 4 tests
	Position of the first DMRS for PDSCH mapping type A			2
	Number of PDSCH DMRS CDM group(s) without data			1 for Rank 1 and Rank 2 tests 2 for Rank 3 and Rank 4 tests
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
PT-RS configuration				PT-RS is not configured
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 PRB bundling granularity
Symbols for all unused REs				OCNG 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 38.101-1 [2] for tested channel bandwidth and subcarrier spacing.				

Table 5.2-2: Number of PRBs in CORESET

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

The normative reference for this requirement is TS 38.101-4 [5] clause 5.2

5.2.1 1RX requirements (Void)

5.2.2 2RX requirements

5.2.2.1 FDD

5.2.2.1.1 2Rx FDD FR1 PDSCH mapping Type A performance

5.2.2.1.1.0 Minimum conformance requirements

The performance requirements are specified in Table 5.2.2.1.1.0-3 and Table 5.2.2.1.1.0-4, with the test parameters defined in table 5.2.2.1.1.0-2 and the downlink physical channel setup according to Annex C.2.1.

The test purposes are specified in Table 5.2.2.1.1.0-1.

Table 5.2.2.1.1.0-1: 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, 1-2, 1-3, 1-5, 2-1, 2-2
Verify the PDSCH mapping Type A HARQ soft combining performance under 2 receive antenna conditions.	1-4
Verify the PDSCH mapping Type A performance requirements for Enhanced Receiver Type 1 under 2 receive antenna conditions.	3-1

Table 5.2.2.1.1.0-2: Test Parameters for Testing

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

Number of HARQ Processes		8 for Test 1-4 4 for other tests
The number of slots between PDSCH and corresponding HARQ-ACK information		2

Table 5.2.2.1.1.0-3: Minimum performance for Rank 1

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

Table 5.2.2.1.1.0-4: Minimum performance for Rank 2

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

Table 5.2.2.1.1.0-5: Minimum performance for Rank 2 and Enhanced Receiver Type 1

Test num.	Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	Correlation matrix and antenna configuration	Reference value	
						Fraction of maximum throughput (%)	SNR (dB)
3-1	R.PDSCH.1-2.2 FDD	10 / 15	16QAM, 0.48	TDLA30-10	2x2, ULA Medium	70	17.6

The normative reference for this requirement is TS 38.101-4 [5], clause 5.2.2.1.1.

5.2.2.1.1_1 2Rx FDD FR1 PDSCH mapping Type A performance - 2x2 MIMO with baseline receiver for both SA and NSA

5.2.2.1.1_1.1 Test purpose

To verify the PDSCH mapping Type A normal performance under 2 receive antenna conditions and with different channel models, MCSs and number of MIMO layers for a specified downlink Reference Measurement Channel (RMC) to achieve a certain throughput and as well verify the HARQ soft combining with default baseline receiver configuration, for Rank 1 and Rank 2 scenarios.

5.2.2.1.1_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.

5.2.2.1.1_1.3 Test description

5.2.2.1.1_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 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 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.3.1.7.1 for TE diagram and clause A.3.2.2 for UE diagram.
2. The parameter settings for the cell are set up according to Table 5.2-1 and Table 5.2.2.1.1.0-2 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 38.521-1 [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 contents are defined in clause 5.2.2.1.1_1.3.3.

5.2.2.1.1_1.3.2 Test procedure

1. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Tables 5.2.2.1.1_1.4-1 and 5.2.2.1.1_1.4-2. The SS sends downlink MAC padding bits on the DL RMC.
2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix and the SNR according to Tables 5.2.2.1.1_1.4-1 and 5.2.2.1.1_1.4-2 as appropriate.
3. Measure the average throughput 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 during each subtest and decide pass or fail according to Table G.1.5-1 in Annex G clause G.1.5.
4. Repeat steps from 1 to 3 for each subtest in Table s 5.2.2.1.1_1.4-1 and 5.2.2.1.1_1.4-2 as appropriate.

5.2.2.1.1_1.3.3 Message contents

Message contents are according to TS 38.508-1 [6] clauses 4.6.1 and 5.4.2.

5.2.2.1.1_1.3.3_1 Message exceptions for SA

Table 5.2.2.1.1_1.3.3_1-1: *PDSCH-Config*

Derivation Path: TS 38.508-1 [6], Table 5.4.2-18			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-Config ::= SEQUENCE {			
prb-BundlingType CHOICE {			
staticBundling SEQUENCE {			
bundleSize	n4, n2	n4 for test 1-1 n2 for other tests	
}			
}			
}			

Table 5.2.2.1.1_1.3.3_1-2: DMRS-DownlinkConfig

Derivation Path: TS 38.508-1 [6], Table 5.4.2-16			
Information Element	**Value/remark**	**Comment**	**Condition**
DMRS-DownlinkConfig ::= SEQUENCE {			
dmrs-AdditionalPosition	pos2	For test 1-1 and 1-5	
	pos1	For other tests	
}			

Table 5.2.2.1.1_1.3.3_1-3: PDSCH-ServingCellConfig

Derivation Path: TS 38.508-1 [6], Table 5.4.2-17			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-ServingCellConfig ::= SEQUENCE {			
nrofHARQ-ProcessesForPDSCH	n8, n4	n8 for Test 1-4 n4 for other tests	
}			

Table 5.2.2.1.1_1.3.3_1-4: CSI-ResourcePeriodicityAndOffset for CSI Tracking

Derivation Path: TS 38.508-1 [6], Table 5.4.2-6			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourcePeriodicityAndOffset ::= CHOICE {			
slots10	1 (for CSI-RS resources 1 and 2) 2 (for CSI-RS resources 3 and 4)	For test 1-5: CSI-RS offset: 1 for CSI-RS resources 1 and 2 2 for CSI-RS resources 3 and 4 CSI-RS periodicity: 10 slots	
slots40	20 (for CSI-RS resources 1 and 2) 21 (for CSI-RS resources 3 and 4)	For test 2-2: CSI-RS offset: 20 for CSI-RS resources 1 and 2 21 for CSI-RS resources 3 and 4 CSI-RS periodicity: 40 slots	
slots20	10 (for CSI-RS resources 1 and 2) 11 (for CSI-RS resources 3 and 4)	For other tests: CSI-RS offset: 10 for CSI-RS resources 1 and 2 11 for CSI-RS resources 3 and 4 CSI-RS periodicity: 20 slots	
}			

5.2.2.1.1_1.3.3_2 Message exceptions for NSA

Same as 5.2.2.1.1_1.3.3_1

5.2.2.1.1_1.4 Test requirement

Tables 5.2.2.1.1_1.4-1 and 5.2.2.1.1_1.4-2 define the primary level settings.

The fraction of maximum throughput percentage for the downlink reference measurement channels specified in Annex A 3.2.1 for each throughput test shall meet or exceed the specified value in Table 5.2.2.1.1_1.4-1 and Table 5.2.2.1.1_1.4-2 for the specified SNR including test tolerances for all throughput tests.

Table 5.2.2.1.1_1.4-1: Test Requirements for Rank 1

Test num.	Reference channel	Modulation format	Propagation condition	Correlation matrix and antenna configuration	Reference value	
					Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-1.1 FDD	QPSK, 0.30	TDLB100-400	2x2, ULA Low	70	0.1
1-2	R.PDSCH.1-1.2 FDD	QPSK, 0.30	TDLC300-100	2x2, ULA Low	70	1.1
1-3	R.PDSCH.1-4.1 FDD	256AM, 0.82	TDLA30-10	2x2, ULA Low	70	25.6
1-4	R.PDSCH.1-2.1 FDD	16QAM, 0.48	TDLC300-100	2x2, ULA Low	30	2
1-5	R.PDSCH.1-8.1 FDD	16QAM, 0.48	HST-750	1x2	70	7.1

Table 5.2.2.1.1_1.4-2: Test Requirements for Rank 2

Test num.	**Reference channel**	**Modulation format and code rate**	**Propagation condition**	**Correlation matrix and antenna configuration**	**Reference value**	
					Fraction of maximum throughput (%)	**SNR (dB)**
2-1	R.PDSCH.1-3.1 FDD	64QAM, 0.51	TDLA30-10	2x2, ULA Low	70	20.4
2-2	R.PDSCH.2-1.1 FDD	64QAM, 0.51	TDLA30-10	2x2, ULA Low	70	20.7

5.2.2.1.1_2 2Rx FDD FR1 PDSCH mapping Type A performance - 2x2 MIMO with enhanced receiver type 1 for both SA and NSA

5.2.2.1.1_2.1 Test purpose

To verify the PDSCH mapping Type A normal performance under 2 receive antenna conditions and with different channel models, MCSs and number of MIMO layers for a specified downlink Reference Measurement Channel (RMC) to achieve a certain throughput and as well verify the HARQ soft combining with enhanced receiver type 1 configuration, for Rank 2 scenarios.

5.2.2.1.1_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.

5.2.2.1.1_2.3 Test description

Same test description as in clause 5.2.2.1.1_1.3.

5.2.2.1.1_2.3.1 Initial conditions

Same initial conditions as in clause 5.2.2.1.1_1.3.1.

5.2.2.1.1_2.3.2 Test procedure

Same test procedure as in clause 5.2.2.1.1_1.3.2.

5.2.2.1.1_2.3.3 Message contents

Same message contents as in clause 5.2.2.1.1_1.3.3.

5.2.2.1.1_2.3.3_1 Message exceptions for SA

Same message exceptions for SA as in clause 5.2.2.1.1_1.3.3_1.

5.2.2.1.1_2.3.3_2 Message exceptions for NSA

Same message exceptions for NSA as in clause 5.2.2.1.1_1.3.3_2.

5.2.2.1.1_2.3.4 Test requirement

Same test requirement as in clause 5.2.2.1.1_1.3.4.

Table 5.2.2.1.1_2.3.4-1: Test Requirements for Rank 2

Test num.	Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	Correlation matrix and antenna configuration	Reference value	
						Fraction of maximum throughput (%)	SNR (dB)
3-1	R.PDSCH.1-2.2 FDD	10 / 15	16QAM, 0.48	TDLA30-10	2x2, ULA Medium	70	18.6

5.2.2.1.2 2Rx FDD FR1 PDSCH mapping Type A and CSI-RS overlapped with PDSCH performance

5.2.2.1.2.0 Minimum conformance requirements

The performance requirements are specified in Table 5.2.2.1.2.0-3, with the addition of test parameters in table 5.2.2.1.2.0-2 and the downlink physical channel setup according to Annex C.2.1.

The test purposes are specified in Table 5.2.2.1.2.0-1.

Table 5.2.2.1.2.0-1: Tests purpose

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

Table 5.2.2.1.2.0-2: Test parameters

Parameter		Unit	Value
Duplex mode			FDD
Active DL BWP index			1
PDSCH configuration	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		12
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	PRB size		Config2
	Resource allocation type		Type 0
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS configuration	DMRS Type		Type 1
	Number of additional DMRS		1
	Length		1
NZP CSI-RS for CSI acquisition	OFDM symbols in the PRB used for CSI-RS		l_0 = 13
	CSI-RS periodicity	Slots	5
ZP CSI-RS for CSI acquisition	Subcarrier index in the PRB used for CSI-RS		(k_0, k_1, k_2, k_3)=(2, 4, 6, 8)
	Number of CSI-RS ports (X)		8
	CSI-RS periodicity	Slots	5
Number of HARQ Processes			4
K1 value (PDSCH-to-HARQ-timing-indicator)			2

Table 5.2.2.1.2.0-3: Minimum performance for Rank 2

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

The normative reference for this requirement is TS 38.101-4 [5] clause 5.2.2.1.2.

5.2.2.1.2_1 2Rx FDD FR1 PDSCH mapping Type A and CSI-RS overlapped with PDSCH performance - 2x2 MIMO with baseline receiver for both SA and NSA

5.2.2.1.2_1.1 Test purpose

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

5.2.2.1.2_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 EUTRA UE release 15 and forward supporting EN-DC.

5.2.2.1.2_1.3 Test description

5.2.2.1.2_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 and Table 5.3.6-1 of 38.521-1 [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 4.3.1.

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.3.1.6.2 for TE diagram and section A.3.2 for UE diagram.
2. The parameter settings for the cell are set up according to Table 5.2-1 and Table 5.2.2.1.1.0-2 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 38.521-1 [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 contents are defined in clause 5.2.2.1.2_1.3.3.

5.2.2.1.2_1.3.2 Test procedure

1. SS transmits PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to Table 5.2.2.1.2_1.4-1. The SS sends downlink MAC padding bits on the DL RMC.
2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix and the SNR according to Table 5.2.2.1.2_1.4-1.
3. 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 Annex G.1.4.

5.2.2.1.2_1.3.3 Message contents

Message contents are according to TS 38.508-1 [6] clauses 4.6.1 and 5.4.2.

5.2.2.1.2_1.3.3_1 Message exceptions for SA

Same as for test number 1-2 in 5.2.2.1.1_1.3.3_1 with following exceptions:

Table 5.2.2.1.2_1.3.3_1-1: NZP CSI-RS-ResourceMapping for CSI Acquisition

Derivation Path: TS 38.508-1 [6], Table 5.4.2-9			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
firstOFDMSymbolInTimeDomain	13	l_0 = 13	
}			

Table 5.2.2.1.2_1.3.3_1-2: CSI-ResourcePeriodicityAndOffset for ZP and NZP CSI Acquisition

Derivation Path: TS 38.508-1 [6], Table 5.4.2-10			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourcePeriodicityAndOffset ::= CHOICE {			
slots5	0	CSI-RS offset: 0 CSI-RS periodicity: 5 slots	
}			

Table 5.2.2.1.2_1.3.3_1-3: ZP CSI-RS-ResourceMapping for CSI Acquisition

Derivation Path: TS 38.508-1 [6], clause 5.4.2-12			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	011110	(k0, k1, k2, k3)=(2, 4, 6, 8)	
}			
nrofPorts	P8	Number of CSI-RS ports (X) = 8	
firstOFDMSymbolInTimeDomain	12	l_0 = 12	
cdm-Type	fd-CDM2		
density CHOICE {			
one	NULL	Density (ρ) = 1	
}			
freqBand	CSI-FrequencyOccupation	Frequency Occupation: Start PRB 0 (see Table 4.6.3-33 in TS 38.508-1) Number of PRB = 52 (see Table 5.4.2-15:in TS 38.508-1 [6].	
}			

Table 5.2.2.1.2_1.3.3_1-4: Void

5.2.2.1.2_1.3.3_2 Message exceptions for NSA

Same as 5.2.2.1.2_1.3.3_1

5.2.2.1.2_1.4 Test requirement

Table 5.2.2.1.2.0-2 defines the primary level settings.

The fraction of maximum throughput percentage for the downlink reference measurement channels specified in Annex A for each throughput test shall meet or exceed the specified value in Table 5.2.2.1.2_1.4-1 for the specified SNR including test tolerances for all throughput tests.

Table 5.2.2.1.2_1.4-1: Test Requirements for Rank 2

Test num.	Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	Correlation matrix and antenna configuration	Reference value	
						Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-5.1 FDD	10 / 15	16QAM, 0.48	TDLC300-100	2x2, ULA Low	70	15.7

5.2.2.1.3 2Rx FDD FR1 PDSCH mapping Type B performance

5.2.2.1.3.0 Minimum conformance requirements

The performance requirements are specified in Table 5.2.2.1.3.0-3, with the addition of test parameters in Table 5.2.2.1.3.0-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.1.3.0-1.

Table 5.2.2.1.3.0-1: Tests purpose

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

Table 5.2.2.1.3.0-2: Test parameters

Parameter		Unit	Value
Duplex mode			FDD
Active DL BWP index			1
PDSCH configuration	Mapping type		Type B
	k0		0
	Starting symbol (S)		5
	Length (L)		7
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
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			4
The number of slots between PDSCH and corresponding HARQ-ACK information			2

Table 5.2.2.1.3.0-3: Minimum performance for Rank 1

Test num.	Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	Correlation matrix and antenna configuration	Reference value	
						Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-1.3 FDD	10 / 15	QPSK, 0.30	TDLA30-10	2x2, ULA Low	70	-0.9

The normative reference for this requirement is TS 38.101-4 [5], clause 5.2.2.1.3.

5.2.2.1.3_1 2Rx FDD FR1 PDSCH mapping Type B performance - 2x2 MIMO with baseline receiver for both SA and NSA

5.2.2.1.3_1.1 Test purpose

To verify PDSCH mapping Type B performance under 2 receive antenna conditions.

5.2.2.1.3_1.2 Test applicability

This test applies to all types of NR UE release 15 and forward supporting PDSCH mapping type B.

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

5.2.2.1.3_1.3 Test description

5.2.2.1.3_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 5.3.5-1 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 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.3.1.7.1 for TE diagram and clause A.3.2.3.4 for UE diagram.
2. The parameter settings for the cell are set up according to Table 5.2-1 and Table 5.2.2.1.3.0-2 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 5.2.2.1.3_1.3.3.

5.2.2.1.3_1.3.2 Test procedure

1. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Table 5.2.2.1.3_1.4-1. The SS sends downlink MAC padding bits on the DL RMC.
2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix and the SNR according to Table 5.2.2.1.3_1.4-1 as appropriate.
3. Measure the average throughput 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 during each subtest and decide pass or fail according to Table G.1.5-1 in Annex G clause G.1.5.

5.2.2.1.3_1.3.3 Message contents

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

5.2.2.1.3_1.3.3_1 Message exceptions for SA

Table 5.2.2.1.3_1.3.3_1-1: PDSCH-ServingCellConfig

Derivation Path: TS 38.508-1 [6], Table 5.4.2-17			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-ServingCellConfig ::= SEQUENCE {			
nrofHARQ-ProcessesForPDSCH	n4		
}			

Table 5.2.2.1.3_1.3.3_1-2: PDSCH-TimeDomainResourceAllocationList

Derivation Path: TS 38.508-1 [6], Table 5.4.2-19			
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	89	Start symbol(S)=5, Length(L)=7	
}			
PDSCH-TimeDomainResourceAllocation[2] SEQUENCE {			
K0	Not present		
mappingType	typeA		
startSymbolAndLength	53	Start symbol(S)=2, Length(L)=12	
}			
}			

Table 5.2.2.1.3_1.3.3_1-3: *PDSCH-Config*

Derivation Path: TS 38.508-1 [6], Table 4.6.3-100			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-Config ::= SEQUENCE {			
dmrs-DownlinkForPDSCH-MappingTypeB CHOICE {			
setup	DMRS-DownlinkConfig		
}			
}			

5.2.2.1.3_1.3.3_2 Message exceptions for NSA

Same as 5.2.2.1.3_1.3.3_1

5.2.2.1.3_1.4 Test requirement

Table 5.2.2.1.3_1.4-1 define the primary level settings.

The fraction of maximum throughput percentage for the downlink reference measurement channels specified in Annex A 3.2.1 for each throughput test shall meet or exceed the specified value in Table 5.2.2.1.3_1.4-1 for the specified SNR including test tolerances for all throughput tests.

Table 5.2.2.1.3_1.4-1: Test Requirements for Rank 1

Test num.	Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	Correlation matrix and antenna configuration	Reference value	
						Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-1.3 FDD	10 / 15	QPSK, 0.30	TDLA30-10	2x2, ULA Low	70	0.1

5.2.2.1.4 2Rx FDD FR1 PDSCH Mapping Type A and LTE-NR coexistence performance

5.2.2.1.4.0 Minimum conformance requirements

The performance requirements are specified in Table 5.2.2.1.4.0-3, with the addition of test parameters in Table 5.2.2.1.4.0-2 and the downlink physical channel setup according to Annex C.2.1.

The test purposes are specified in Table 5.2.2.1.4.0-1.

Table 5.2.2.1.4.0-1: Tests purpose

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

Table 5.2.2.1.4.0-2: Test parameters

Parameter		Unit	Value
Duplex mode			FDD
Active DL BWP index			1
NR UL transmission with a 7.5 kHz shift to the LTE raster			true
PDCCH configuration	Symbols with PDCCH		Symbol# 2
PDSCH configuration	Mapping type		Type A
	k0		0
	Starting symbol (S)		3
	Length (L)		9 for Test 1-1 11 for Test 1-2
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS configuration	DMRS Type		Type 1
	Position of the first DM-RS for downlink		3
	Number of additional DMRS		1
	Maximum number of OFDM symbols for DL front loaded DMRS		1
CRS for rate matching (Note 1)	LTE carrier centre subcarrier location		Same as NR carrier centre subcarrier location
	LTE carrier BW	MHz	10
	Number of antenna ports		4
	v-shift		0
Number of HARQ Processes			4
The number of slots between PDSCH and corresponding HARQ-ACK information			2
Note 1: No MBSFN is configured on LTE carrier			

Table 5.2.2.1.4.0-3: Minimum performance for Rank 1

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

The normative reference for this requirement is TS 38.101-4 [5], clause 5.2.2.1.4.

5.2.2.1.4_1 2Rx FDD FR1 PDSCH Mapping Type A and LTE-NR coexistence performance - 4x2 MIMO with baseline receiver for both SA and NSA

5.2.2.1.4_1.1 Test purpose

To verify the Verify the PDSCH mapping Type A normal performance under 2 receive antenna conditions with CRS rate matching configured.

5.2.2.1.4_1.2 Test applicability

Test 1-1 applies to all types of NR UE release 15 and forward supporting capability IE *rateMatchingLTE-CRS* but not supporting capability IE *additionalDMRS-DL-Alt*.

Test1-1 also applies to all types of EUTRA UE release 15 and forward supporting EN-DC and capability IE *rateMatchingLTE-CRS* but not supporting capability IE *additionalDMRS-DL-Alt*.

Test 1-2 applies to all types of NR UE release 15 and forward supporting capability IE *additionalDMRS-DL-Alt* and *rateMatchingLTE-CRS*.

Test 1-2 also applies to all types of EUTRA UE release 15 and forward supporting EN-DC and capability IE *additionalDMRS-DL-Alt* and *rateMatchingLTE-CRS*.

5.2.2.1.4_1.3 Test description

5.2.2.1.4_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 4.3.1.

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.3.1.7.6 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 5.2-1, Table 5.2.2.1.4.0-2 and Table 5.2.2.1.4.0-3 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.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 contents are defined in clause 5.2.2.1.4_1.3.3.

5.2.2.1.4_1.3.2 Test procedure

1. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Table 5.2.2.1.4.0-3. The SS sends downlink MAC padding bits on the DL RMC.

2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix and the SNR according to Table 5.2.2.1.4_1.3.4-1.

3. Measure the average throughput 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 during each subtest and decide pass or fail according to Table G.1.5-1 in Annex G clause G.1.5.

5.2.2.1.4_1.3.3 Message contents

5.2.2.1.4_1.3.3_1 Message exceptions for SA

As defined in clause 5.4.2 of TS 38.508-1 [6] with the following exceptions:

Table 5.2.2.1.4_1.3.3_1-1: PDSCH-TimeDomainResourceAllocationList

Derivation Path: TS 38.508-1 [6], Table 5.4.2-19			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-TimeDomainResourceAllocationList::= SEQUENCE(SIZE(1..maxNrofDL-Allocations)) OF {	2 entry		FR1
PDSCH-TimeDomainResourceAllocation[1] SEQUENCE {			
k0	0		
mappingType	typeA		
startSymbolAndLength	94	Start symbol(S)=3, Length(L)=9 for Test 1-1	
	66	Start symbol(S)=3, Length(L)=11 for Test 1-2	
}			
PDSCH-TimeDomainResourceAllocation[2] SEQUENCE {			
k0	0		
mappingType	typeA		
startSymbolAndLength	66	Start symbol(S)=3, Length(L)=11 for Test 1-2	
}			
}			

Table 5.2.2.1.4_1.3.3_1-2: *SearchSpace*

Derivation Path: TS 38.508-1 [6], Table 4.6.3-162 and 5.4.2-4 using condition USS, FR1_10MHz, Long_DCI			
Information Element	**Value/remark**	**Comment**	**Condition**
SearchSpace ::= SEQUENCE {			
monitoringSymbolsWithinSlot	00100000000000		
}			

Table 5.2.2.1.4_1.3.3_1-3: ServingCellConfigCommon

Derivation Path: TS 38.508-1 [6], **Table 5.4.2-1**			
Information Element	**Value/remark**	**Comment**	**Condition**
ServingCellConfigCommon ::= SEQUENCE {			
dmrs-TypeA-Position	pos3		
lte-CRS-ToMatchAround	RateMatchPatternLTE-CRS		
}			

Table 5.2.2.1.4_1.3.3_1-4: RateMatchPatternLTE-CRS

Derivation Path: TS 38.508-1 [6], Table 5.4.2-20			
Information Element	**Value/remark**	**Comment**	**Condition**
RateMatchPatternLTE-CRS ::= SEQUENCE {			
carrierFreqDL	Same as NR carrier centre subcarrier location		
carrierBandwidthDL	n50	10MHz	
mbsfn-SubframeConfigList	Not present		
nrofCRS-Ports	n4		
v-Shift	n0		
}			

Table 5.2.2.1.4_1.3.3_1-5: *Void*

Table 5.2.2.1.4_1.3.3_1-6: *FrequencyInfoUL-SIB*

Derivation Path: TS 38.508-1 [6], Table 4.6.3-62			
Information Element	**Value/remark**	**Comment**	**Condition**
FrequencyInfoUL-SIB SEQUENCE {			
frequencyShift7p5khz	true		
}			

Table 5.2.2.1.4_1.3.3_1-7: PDCCH-ControlResourceSet

Derivation Path: Table 4.6.3-28			
Information Element	**Value/remark**	**Comment**	**Condition**
ControlResourceSet ::= SEQUENCE {			
controlResourceSetId	1		
frequencyDomainResources	11111111 00000000 00000000 00000000 00000000 00000	CORESET to use the least significant 48 RBs of the BWP	
duration	1	SearchSpace duration of 1 symbol from third symbol	
}			

5.2.2.1.4_1.3.3_2 Message exceptions for NSA

Same as 5.2.2.1.4_1.3.3_1 with the following exceptions:

Table 5.2.2.1.4_1.3.3_2-1: *SearchSpace for CSS*

Derivation Path: TS 38.508-1 [6], Table 4.6.3-162 and 5.4.2-4 using condition USS, FR1_10MHz, Long_DCI			
Information Element	**Value/remark**	**Comment**	**Condition**
SearchSpace ::= SEQUENCE {			
searchSpaceId	SearchSpaceId with condition CSS		CSS
controlResourceSetId	1		
monitoringSlotPeriodicityAndOffset CHOICE {			
sl1	NULL		
}			
duration	Not present	1 slot per default	
monitoringSymbolsWithinSlot	00100000000000		
}			

5.2.2.1.4_1.3.4 Test requirement

Table 5.2.2.1.4.0-3 defines the primary level settings.

The fraction of maximum throughput percentage for the downlink reference measurement channels specified in Annex A for each throughput test shall meet or exceed the specified value in Table 5.2.2.1.4_1.3.4-1 for the specified SNR including test tolerances for all throughput tests.

Table 5.2.2.1.4_1.3.4-1: Test requirement for Rank 1

Test num.	Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	Correlation matrix and antenna configuration	Reference value	
						Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-7.1 FDD	10 / 15	QPSK, 0.30	TDLA30-10	4x2, ULA Low	70	0.0
1-2	R.PDSCH.1-7.2 FDD	10 / 15	QPSK, 0.30	TDLA30-10	4x2, ULA Low	70	0.0

5.2.2.2 TDD

5.2.2.2.1 2Rx TDD FR1 PDSCH mapping Type A performance

5.2.2.2.1.0 Minimum conformance requirements

The performance requirements are specified in Table 5.2.2.2.1.0-3 and Table 5.2.2.2.1.0-4, with the addition of test parameters in Table 5.2.2.2.1.0-2 and the downlink physical channel setup according to Annex C.2.1.

The test purposes are specified in Table 5.2.2.2.1.0-1.

Table 5.2.2.2.1.0-1: 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, 1-2, 1-3, 1-5, 1-6, 1-7, 1-8, 1-9, 2-1, 2-2
Verify the PDSCH mapping Type A HARQ soft combining performance under 2 receive antenna conditions.	1-4
Verify the PDSCH mapping Type A performance requirements for Enhanced Receiver Type 1 under 2 receive antenna conditions.	3-1

Table 5.2.2.2.1.0-2: Test parameters

Parameter		Unit	Value
Duplex mode			TDD
Active DL BWP index			1
PDSCH configuration	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		Specific to each Reference channel
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		4 for Tests 1-1, 1-8, 1-9 2 for other tests
	Resource allocation type		Test 1-2: Type 1 with start RB = 50, L_{RBs} = 6 Other tests: Type 0
	RBG size		Test 1-2: N/A Other tests: Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS configuration	DMRS Type		Type 1
	Number of additional DMRS		2 for Tests 1-1 , 1-7, 1-8, 1-9 1 for other tests
	Maximum number of OFDM symbols for DL front loaded DMRS		1
CSI-RS for tracking	First OFDM symbol in the PRB used for CSI-RS		Tests 1-8, 1-9: l0 = 4 for CSI-RS resource 1 and 3 l0 = 8 for CSI-RS resource 2 and 4 Other tests; Table 5.2-1.
	CSI-RS periodicity	Slots	Test 1-7: 20 for CSI-RS resource 1,2,3,4. Other tests: Table 5.2-1.
	CSI-RS offset	Slots	Test 1-7: 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4. Other tests: Table 5.2-1.
	Frequency Occupation		Test 1-7: Start PRB 0 Number of PRB = 52 Other tests: Table 5.2-1.
Number of HARQ Processes			16 for Test 1-4 10 for Test 1-9 8 for other tests
The number of slots between PDSCH and corresponding HARQ-ACK information			Specific to each TDD UL-DL pattern and as defined in Annex A.1.2

Table 5.2.2.2.1.0-3: 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.2-1.1 TDD	40 / 30	QPSK, 0.30	FR1.30-1A	TDLB100-400	2x2, ULA Low	70	-1.1
1-2	R.PDSCH.2-1.2 TDD	40 / 30	QPSK, 0.30	FR1.30-1	TDLC300-100	2x2, ULA Low	70	0.2
1-3	R.PDSCH.2-4.1 TDD	40 / 30	256QAM, 0.82	FR1.30-1	TDLA30-10	2x2, ULA Low	70	25.3
1-4	R.PDSCH.2-2.1 TDD	40 / 30	16QAM, 0.48	FR1.30-1	TDLC300-100	2x2, ULA Low	30	1.6
1-5	R.PDSCH.2-5.1 TDD	40 / 30	QPSK, 0.30	FR1.30-2	TDLA30-10	2x2, ULA Low	70	-0.9
1-6	R.PDSCH.2-6.1 TDD	40 / 30	QPSK, 0.30	FR1.30-3	TDLA30-10	2x2, ULA Low	70	-0.8
1-7	R.PDSCH.2-10.1 TDD	40 / 30	16QAM, 0.48	FR1.30-1	HST-1000	1x2	70	6.4
1-8	R.PDSCH.2-11.1 TDD	40 / 30	QPSK, 0.30	FR1.30-5	TDLB100-400	2x2, ULA Low	70	-1.0
1-9	R.PDSCH.2-12.1 TDD	40 / 30	QPSK, 0.30	FR1.30-6	TDLB100-400	2x2, ULA Low	70	-1.1

Table 5.2.2.2.1.0-4: Minimum performance for Rank 2

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

Table 5.2.2.2.1.0-5: Minimum performance for Rank 2 and EnhancedReceiver Type 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)
3-1	R.PDSCH.2-2.2 TDD	40 / 30	16QAM, 0.48	FR1.30-1	TDLA30-10	2x2, ULA Medium	70	18.0

The normative reference for this requirement is TS 38.101-4 [5] clause 5.2.2.2.1.0.

5.2.2.2.1_1 2Rx TDD FR1 PDSCH mapping Type A performance - 2x2 MIMO with baseline receiver for both SA and NSA

5.2.2.2.1_1.1 Test Purpose

Verify the PDSCH mapping Type A normal performance under 2 receive antenna conditions and with different channel models, MCSs and number of MIMO layers

5.2.2.2.1_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.

5.2.2.2.1_1.3 Test Description

5.2.2.2.1_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 5.3.5-1 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.

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 clause A.3.2.2 for UE diagram.

2. The parameter settings for the NR cell are set up according to Table 5.2-1 and Table 5.2.2.2.1.0-2 and as appropriate.

3. Downlink signals for the 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 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 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 5.2.2.2.1_1.4.3.

5.2.2.2.1_1.3.2 Test Procedure

1. SS transmits PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to Table 5.2.2.2.1_1.4-1 and Table 5.2.2.2.1_1.4-2. The SS sends downlink MAC padding bits on the DL RMC.

2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix and the SNR according to Tables 5.2.2.2.1_1.4-1 and 5.2.2.2.1_1.4-2 as appropriate.

3. Measure the average throughput 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 during each subtest and decide pass or fail according to Tables G.1.5-2 in Annex G clause G.1.5.

4. Repeat steps from 1 to 3 for each subtest in Table 5.2.2.2.1_1.4-1 and Table 5.2.2.2.1_1.4-2 as appropriate.

5.2.2.2.1_1.3.3 Message Contents

Message contents are according to TS 38.508-1 [6] subclauses 4.6.1 and 5.4.2.

5.2.2.2.1_1.3.3_1 Message exceptions for SA

Table 5.2.2.2.1_1.3.3_1-1: Void

Table 5.2.2.2.1_1.3.3_1-2: Void

Table 5.2.2.2.1_1.3.3_1-3: *PDSCH-Config*

Derivation Path: TS 38.508-1 [6], Table 5.4.2-18			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-Config ::= SEQUENCE {			
dmrs-DownlinkForPDSCH-MappingTypeA CHOICE {			
setup	DMRS-DownlinkConfig		
}			
mcs-Table	qam256	256qam table for test 1-3	
	Not present	64qam table for all tests except test 1-3	
prb-BundlingType CHOICE {			
staticBundling SEQUENCE {			
bundleSize	n4, n2	n4 for test 1-1 n2 for other tests	
}			
}			
}			

Table 5.2.2.2.1_1.3.3_1-4: DMRS-DownlinkConfig

Derivation Path: TS 38.508-1 [6], Table 5.4.2-16			
Information Element	**Value/remark**	**Comment**	**Condition**
DMRS-DownlinkConfig ::= SEQUENCE {			
dmrs-AdditionalPosition	pos2	For tests 1-1, 1-7, 1-8, and 1-9	
	pos1	For other tests	
}			

Table 5.2.2.2.1_1.3.3_1-5: PDSCH-ServingCellConfig

Derivation Path: TS 38.508-1 [6], Table 5.4.2-17			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-ServingCellConfig ::= SEQUENCE {			
nrofHARQ-ProcessesForPDSCH	n16, n10, n8	n16 for Test 1-4, n10 for Test 1-9 n8 for other tests	
}			

Table 5.2.2.2.1_1.3.3_1-6: RACH-ConfigGeneric

Derivation Path: TS 38.508-1 [6], Table 4.6.3-130			
Information Element	**Value/remark**	**Comment**	**Condition**
RACH-ConfigGeneric ::= SEQUENCE {			
prach-ConfigurationIndex	163	Only for test 2-2	
}			

Table 5.2.2.2.1_1.3.3_1-7: CSI-ResourcePeriodicityAndOffset for CSI Tracking

Derivation Path: TS 38.508-1 [6], Table 5.4.2-6			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourcePeriodicityAndOffset ::= CHOICE {			
Slots20	1 (for CSI-RS resources 1 and 2) 2 (for CSI-RS resources 3 and 4)	For test 1-7: CSI-RS offset: 1 for CSI-RS resources 1 and 2 2 for CSI-RS resources 3 and 4 CSI-RS periodicity: 20 slots	
Slots40	20 (for CSI-RS resources 1 and 2) 21 (for CSI-RS resources 3 and 4)	For other tests: CSI-RS offset: 20 for CSI-RS resources 1 and 2 21 for CSI-RS resources 3 and 4 CSI-RS periodicity: 40 slots	
}			

Table 5.2.2.2.1_1.3.3_1-8: CSI-FrequencyOccupation for CSI Tracking

Derivation Path: TS 38.508-1 [6], Table 5.4.2-7			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-FrequencyOccupation ::= SEQUENCE {			
nrofRBs	52	52 for tests 1-7, 2-2	
	108	108 for other tests	
}			

Table 5.2.2.2.1_1.3.3_1-9: SchedulingRequestResourceConfig

Derivation Path: TS 38.508-1 [6], Table 4.6.3-157			
Information Element	**Value/remark**	**Comment**	**Condition**
SchedulingRequestResourceConfig ::= SEQUENCE {			
periodicityAndOffset CHOICE {			
sl20	7	For test 1-9	
sl20	5	For test 2-2	
}			
}			

Table 5.2.2.2.1_1.3.3_1-10: Physical layer parameters for DCI format 1_1

Derivation Path: TS 38.508-1 [6], Table 5.4.2.0-1			
Parameter	**Value**	**Value in binary**	**Condition**
PUCCH resource indicator	*PUCCH-ResourceId[1]* = 6 in pucch-ResourceSetID[1] or *PUCCH-ResourceId[1]* = 14 in pucch-ResourceSetID[2] as defined in Table 4.6.3-112 (Mapping as per Table 9.2.3-2 in TS 38.213)	‘110’B	Slot S1 for test 1-9

5.2.2.2.1_1.3.3_2 Message exceptions for NSA

Same as 5.2.2.2.1_1.3.3_1.

5.2.2.2.1_1.4 Test Requirements

Table 5.2.2.2.1_1.3-2 defines the primary level settings.

The fraction of maximum throughput percentage for the downlink reference measurement channels specified in Annex A.3.2.2 for each throughput test shall meet or exceed the specified value in Table 5.2.2.2.1_1.4-1 and 1 and Table 5.2.2.2.1_1.4-2 for the specified SNR including test tolerances for all throughput tests

Table 5.2.2.2.1_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.2-1.1 TDD	40 / 30	QPSK, 0.30	FR1.30-1A	TDLB100-400	2x2, ULA Low	70	-0.2
1-2	R.PDSCH.2-1.2 TDD	40 / 30	QPSK, 0.30	FR1.30-1	TDLC300-100	2x2, ULA Low	70	1.1
1-3	R.PDSCH.2-4.1 TDD	40 / 30	256QAM, 0.82	FR1.30-1	TDLA30-10	2x2, ULA Low	70	26.3
1-4	R.PDSCH.2-2.1 TDD	40 / 30	16QAM, 0.48	FR1.30-1	TDLC300-100	2x2, ULA Low	30	2.5
1-5	R.PDSCH.2-5.1 TDD	40 / 30	QPSK, 0.30	FR1.30-2	TDLA30-10	2x2, ULA Low	70	0.1
1-6	R.PDSCH.2-6.1 TDD	40 / 30	QPSK, 0.30	FR1.30-3	TDLA30-10	2x2, ULA Low	70	0.2
1-7	R.PDSCH.2-10.1 TDD	40 / 30	16QAM, 0.48	FR1.30-1	HST-1000	1x2	70	7.3
1-8	R.PDSCH.2-11.1 TDD	40 / 30	QPSK, 0.30	FR1.30-5	TDLB100-400	2x2, ULA Low	70	-0.1
1-9	R.PDSCH.2-12.1 TDD	40 / 30	QPSK, 0.30	FR1.30-6	TDLB100-400	2x2, ULA Low	70	-0.2

Table 5.2.2.2.1_1.4-2: Test requirement for Rank 2

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)
2-1	R.PDSCH.2-3.1 TDD	40 / 30	64QAM, 0.50	FR1.30-1	TDLA30-10	2x2, ULA Low	70	20.8
2-2	R.PDSCH.2-9.1 TDD	20 / 30	64QAM, 0.50	FR1.30-4	TDLA30-10	2x2, ULA Low	70	20.8

5.2.2.2.1_2 2Rx TDD FR1 PDSCH mapping Type A performance - 2x2 MIMO with enhanced receiver type 1 for both SA and NSA

5.2.2.2.1_2.1 Test Purpose

Verify the PDSCH mapping Type A normal performance under 2 receive antenna conditions and with different channel models, MCSs and number of MIMO layers

5.2.2.2.1_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.

5.2.2.2.1_2.3 Test Description

Same test description as in clause 5.2.2.2.1_1.4 with the following exception:

- Table 5.2.2.2.1_2.4-1 instead of 5.2.2.2.1_1.4-1

5.2.2.2.1_2.4 Test Requirements

Table 5.2.2.2.1_1.3-2 defines the primary level settings.

The fraction of maximum throughput percentage for the downlink reference measurement channels specified in Annex A.3.2.2 for each throughput test shall meet or exceed the specified value in Table 5.2.2.2.1.4.4-1 for the specified SNR including test tolerances for all throughput tests.

Table 5.2.2.2.1_2.4-1: Test requirement for Rank 2 and EnhancedReceiver Type 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)
3-1	R.PDSCH.2-2.2 TDD	40 / 30	16QAM, 0.48	FR1.30-1	TDLA30-10	2x2, ULA Medium	70	19.0

5.2.2.2.2 2Rx TDD FR1 PDSCH mapping Type A and CSI-RS overlapped with PDSCH performance

5.2.2.2.2_1 2Rx TDD FR1 PDSCH mapping Type A and CSI-RS overlapped with PDSCH performance - 2x2 MIMO with baseline receiver for both SA and NSA

5.2.2.2.2_1.1 Test Purpose

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

5.2.2.2.2_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.

5.2.2.2.2_1.3 Minimum conformance requirements

The performance requirements are specified in Table 5.2.2.2.2_1.3-3, with the addition of test parameters in table 5.2.2.2.2_1.3-2 and the downlink physical channel setup according to Annex C.2.1.

The test purposes are specified in Table 5.2.2.2.2_1.3-1.

Table 5.2.2.2.2_1.3-1: Tests purpose

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

Table 5.2.2.2.2_1.3-2: Test parameters

Parameter		Unit	Value
Duplex mode			TDD
Active DL BWP index			1
PDSCH configuration	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		Specific to each Reference channel
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		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
	Length		1
NZP CSI-RS for CSI acquisition	OFDM symbols in the PRB used for CSI-RS		l_0 = 13
	CSI-RS periodicity	Slots	5
ZP CSI-RS for CSI acquisition	Subcarrier index in the PRB used for CSI-RS		(k_0, k_1, k_2, k_3)=(2, 4, 6, 8)
	Number of CSI-RS ports (X)		8
	CSI-RS periodicity	Slots	5
Number of HARQ Processes			8
The number of slots between PDSCH and corresponding HARQ-ACK information			Specific to each TDD UL-DL pattern and as defined in Annex A.1.2

Table 5.2.2.2.2_1.3-3: Minimum performance for Rank 2

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

The normative reference for this requirement is TS 38.101-4 [2] clause 5.2.2.1.2

5.2.2.2.2_1.4 Test Description

5.2.2.2.2_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 5.3.5-1 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 5.1.2.1 and 5.1.2.2.

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.3.1.7.1 for TE diagram and section A.3.2.2 for UE diagram.

2. The parameter settings for the NR cell are set up according to Table 5.2-1 and Table 5.2.2.2.2_1.3-2 and as appropriate.

3. Downlink signals for the 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 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 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 5.2.2.2.2_1.4.3.

5.2.2.2.2_1.4.2 Test Procedure

1. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Table 5.2.2.2.2_1.1-3. The SS sends downlink MAC padding bits on the DL RMC.

2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix and the SNR according to Table 5.2.2.2.2_1.5-1.

3. Measure the average throughput 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 during each subtest and decide pass or fail according to Tables G.1.5-2 in Annex G clause G.1.5.

5.2.2.2.2_1.4.3 Message Contents

Message contents are according to TS 38.508-1 [6] subclauses 4.6.1 and 5.4.2.

5.2.2.2.2_1.4.3_1 Message exceptions for SA

Table 5.2.2.2.2_1.4.3_1-1: Void

Table 5.2.2.2.2_1.4.3_1-2: *PDSCH-Config*

Derivation Path: TS 38.508-1 [6], Table Table 5.4.2-18			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-Config ::= SEQUENCE {			
dataScramblingIdentityPDSCH	0		
dmrs-DownlinkForPDSCH-MappingTypeA CHOICE {			
Setup	DMRS-DownlinkConfig		
}			
resourceAllocation	resourceAllocationType0		Used_for_Type0
prb-BundlingType CHOICE {			
staticBundling SEQUENCE {			
bundleSize		If a bundleSize(Set) value is absent, the UE applies the value n2.	
}			
}			
}			

Table 5.2.2.2.2_1.4.3_1-3: Void

Table 5.2.2.2.2_1.4.3_1-4: PDCCH-ControlResourceSet

Derivation Path: TS 38.508-1 [6], Table 5.4.2-3			
Information Element	**Value/remark**	**Comment**	**Condition**
ControlResourceSet ::= SEQUENCE {			
frequencyDomainResources	11111111 11111111 10000000 00000000 00000000 00000	CORESET to use the least significant 102 RBs of the BWP	
tci-StatesPDCCH-ToAddList {			
	0	TCI State #0	
	1	TCI State #1	
}			
}			

Table 5.2.2.2.2_1.4.3_1-5: Void

Table 5.2.2.2.2_1.4.3_1-6: NZP CSI-RS-ResourceMapping for CSI Acquisition

Derivation Path: TS 38.508-1 [6], Table 5.4.2-9			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
firstOFDMSymbolInTimeDomain	13	l_0 = 13	
}			

Table 5.2.2.2.2_1.4.3_1-7: CSI-ResourcePeriodicityAndOffset for CSI Acquisition for NZP CSI-RS

Derivation Path: TS 38.508-1 [6], Table 5.4.2-10			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourcePeriodicityAndOffset ::= CHOICE {			
Slots5	0	Periodicity 5 slots and offset 0	
}			

Table 5.2.2.2.2_1.4.3_1-8: ZP CSI-RS-ResourceMapping for CSI Acquisition

Derivation Path: TS 38.508-1 [6], Table 5.4.2-13			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
nrofPorts	P8	Eight Ports	
}			

Table 5.2.2.2.2_1.4.3_1-9: DMRS-DownlinkConfig

Derivation Path: TS 38.508 [6], Table 5.4.2-16			
Information Element	**Value/remark**	**Comment**	**Condition**
DMRS-DownlinkConfig ::= SEQUENCE {			
dmrs-AdditionalPosition	Not present	pos2 If the field is absent, the UE applies the value pos2	FR1_TDD,
}			

Table 5.2.2.2.2_1.4.3_1-10: CSI-ResourcePeriodicityAndOffset for CSI Acquisition for ZP CSI-RS

Derivation Path: TS 38.508-1 [6], Table 5.4.2-14			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourcePeriodicityAndOffset ::= CHOICE {			
Slots5	0	Periodicity 5 slots and offset 0	
}			

5.2.2.2.2_1.4.3_2 Message exceptions for NSA

Same as 5.2.2.2.2_1.4.3_2

5.2.2.2.2_1.5 Test Requirements

Table 5.2.2.2.2_1.3-2 defines the primary level settings.

The fraction of maximum throughput percentage for the downlink reference measurement channels specified in Annex A 3.2.2 for each throughput test shall meet or exceed the specified value in Table 5.2.2.2.2_1.3-3 for the specified SNR including test tolerances for all throughput tests

Table 5.2.2.2.2_1.5-1: Test requirement for Rank 2

Test num.	Reference channel	Modulation format and code rate	TDD UL-DL pattern	Propagation condition	Correlation matrix and antenna configuration	Reference value	
						Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.2-7.1 TDD	16QAM, 0.48	FR1.30-1	TDLC300-100	2x2, ULA Low	70	15.7

5.2.2.2.3 2Rx TDD FR1 PDSCH mapping Type B performance

5.2.2.2.3.0 Minimum conformance requirements

The performance requirements are specified in Table 5.2.2.2.3.0-3, with the addition of test parameters in Table 5.2.2.2.3.0-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.2.3.0-1.

Table 5.2.2.2.3.0-1: Tests purpose

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

Table 5.2.2.2.3.0-2: Test parameters

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

Table 5.2.2.2.3.0-3: 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.2-1.3 TDD	40 / 30	QPSK, 0.30	FR1.30-1	TDLA30-10	2x2, ULA Low	70	-0.9

The normative reference for this requirement is TS 38.101-4 [5] clause 5.2.2.2.3.

5.2.2.2.3_1 2Rx TDD FR1 PDSCH mapping Type B performance - 2x2 MIMO with baseline receiver for both SA and NSA

5.2.2.2.3_1.1 Test purpose

To verify the PDSCH mapping Type B normal performance under 2 receive antenna conditions for a specified downlink Reference Measurement Channel (RMC) to achieve a certain throughput with baseline receiver configuration.

5.2.2.2.3_1.2 Test applicability

This test applies to all types of NR UE release 15 and forward supporting PDSCH mapping type B.

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

5.2.2.2.3_1.3 Test description

5.2.2.2.3_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 5.3.5-1 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 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.3.1.7.1 for TE diagram and clause A.3.2.3 for UE diagram.
2. The parameter settings for the cell are set up according to Tables 5.2-1 and 5.2.2.2.3.0-2 and as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, 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 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 5.2.3.2.3_1.3.3.

5.2.2.2.3_1.3.2 Test procedure

1. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Table 5.2.2.2.3.0-2. The SS sends downlink MAC padding bits on the DL RMC.
2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix and the SNR according to Tables 5.2.2.2.3_1.4-1 as appropriate.
3. Measure the average throughput 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 during each subtest and decide pass or fail according to Table G.1.5-1 in Annex G clause G.1.5.

5.2.2.2.3_1.3.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1 and 5.4.2.

5.2.2.2.3_1.3.3_1 Message exceptions for SA

Table 5.2.2.2.3_1.3.3_1-1: 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	Not present		
}			

Table 5.2.2.2.3_1.3.3_1-2: 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	89	Start symbol(S)=5, Length(L)=7	
}			
PDSCH-TimeDomainResourceAllocation[2] SEQUENCE {			
K0	Not present		
mappingType	typeA		
startSymbolAndLength	53	Start symbol(S)=2, Length(L)=12	
}			
}			

5.2.2.2.3_1.3.3_2 Message exceptions for NSA

Same as 5.2.2.2.3_1.3.3_1

5.2.2.2.3_1.4 Test requirement

Table 5.2.2.2.3.0-3 define the primary level settings.

The fraction of maximum throughput percentage for the downlink reference measurement channels specified in Annex A.3.2.2 for each throughput test shall meet or exceed the specified value in Table 5.2.2.2.3_1.4-1 for the specified SNR including test tolerances for all throughput tests.

Table 5.2.2.2.3_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.2-1.3 TDD	40 / 30	QPSK, 0.30	FR1.30-1	TDLA30-10	2x2, ULA Low	70	0.1

5.2.2.2.4 2Rx TDD FR1 PDSCH mapping Type A and LTE-NR coexistence performance

Editor's note: Clause G.1.5, minimum tets time, needs to be updated for the RMC used

5.2.2.2.4.0 Minimum conformance requirements

The performance requirements are specified in Table 5.2.2.2.4.0-3, with the addition of test parameters in Table 5.2.2.2.4.0-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.2.4.0-1.

Table 5.2.2.2.4.0-1: Tests purpose

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

Table 5.2.2.2.4.0-2: Test parameters

Parameter		Unit	Value
Duplex mode			TDD
Active DL BWP index			1
NR UL transmission with a 7.5 kHz shift to the LTE raster			true
PDSCH configuration	Mapping type		Type A
	k0		0
	Starting symbol (S)		3
	Length (L)		9 for Test 1-1 11 for Test 1-2
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS configuration	DMRS Type		Type 1
	Position of the first DM-RS for downlink		3
	Number of additional DMRS		1
	Maximum number of OFDM symbols for DL front loaded DMRS		1
CRS for rate matching (Note 1)	LTE carrier centre subcarrier location		Same as NR carrier centre subcarrier location
	LTE carrier BW	MHz	10
	Number of antenna ports		4
	v-shift		0
Number of HARQ Processes			8
The number of slots between PDSCH and corresponding HARQ-ACK information			Specific to each TDD UL-DL pattern and as defined in Annex A.1.2
Note 1: No MBSFN is configured on LTE carrier			

Table 5.2.2.2.4.0-3: 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.1-1.1 TDD	10 / 15	QPSK, 0.30	FR1.15-1	TDLA30-10	4x2, ULA Low	70	-0.8
1-2	R.PDSCH.1-1.2 TDD	10 / 15	QPSK, 0.30	FR1.15-1	TDLA30-10	4x2, ULA Low	70	-0.8

The normative reference for this requirement is TS 38.101-4 [5] clause 5.2.2.2.4.

5.2.2.2.4_1 2Rx TDD FR1 PDSCH Mapping Type A and LTE-NR coexistence performance - 4x2 MIMO with baseline receiver for both SA and NSA

5.2.2.2.4_1.1 Test purpose

To verify the PDSCH mapping Type A coexistence performance under 2 receive antenna conditions for a specified downlink Reference Measurement Channel (RMC) to achieve a certain throughput with baseline receiver configuration.

5.2.2.2.4_1.2 Test applicability

This test applies to all types of NR UE release 16 and forward supporting capability IE *additionalDMRS-DL-Alt* and *rateMatchingLTE-CRS*.

This test also applies to all types of E-UTRA UE release 16 and forward supporting EN-DC and capability IE *additionalDMRS-DL-Alt* and *rateMatchingLTE-CRS*.

5.2.2.2.4_1.3 Test description

5.2.2.2.4_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 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.3.1.7.1 for TE diagram and clause A.3.2.3 for UE diagram.
2. The parameter settings for the cell are set up according to Tables 5.2-1 and 5.2.2.2.4.0-2 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.
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 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 5.2.2.2.4_1.3.3.

5.2.2.2.4_1.3.2 Test procedure

1. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Table 5.2.2.2.3.0-2. The SS sends downlink MAC padding bits on the DL RMC.
2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix and the SNR according to Tables 5.2.2.2.4_1.4-1 as appropriate.
3. Measure the average throughput 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 during each subtest and decide pass or fail according to Table G.1.5-1 in Annex G clause G.1.5.

5.2.2.2.4_1.3.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1 and 5.4.2.

5.2.2.2.4_1.3.3_1 Message exceptions for SA

Table 5.2.2.2.4_1.3.3_1-1: 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	n8		
}			

Table 5.2.2.2.4_1.3.3_1-2: 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	typeA		
startSymbolAndLength	94	Start symbol(S)=3, Length(L)=9	Test 1-1
	66	Start symbol(S)=3, Length(L)=11	Test 1-2
}			
PDSCH-TimeDomainResourceAllocation[2] SEQUENCE {			
K0	Not present		
mappingType	typeA		
startSymbolAndLength	66	Start symbol(S)=3, Length(L)=11	
}			
}			

5.2.2.2.4_1.3.3_2 Message exceptions for NSA

Same as 5.2.2.2.4_1.3.3_1

5.2.2.2.4_1.4 Test requirement

Table 5.2.2.2.3.0-3 define the primary level settings.

The fraction of maximum throughput percentage for the downlink reference measurement channels specified in Annex A.3.2.2 for each throughput test shall meet or exceed the specified value in Table 5.2.2.2.4_1.4-1 for the specified SNR including test tolerances for all throughput tests.

Table 5.2.2.2.4_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.1-1.1 TDD	10 / 15	QPSK, 0.30	FR1.15-1	TDLA30-10	4x2, ULA Low	70	0.1
1-2	R.PDSCH.1-1.2 TDD	10 / 15	QPSK, 0.30	FR1.15-1	TDLA30-10	4x2, ULA Low	70	0.1

5.2.3 4RX requirements

5.2.3.1 FDD

5.2.3.1.1 4Rx FDD FR1 PDSCH mapping Type A performance

5.2.3.1.1.0 Minimum conformance requirements

The performance requirements are specified in Table 5.2.3.1.1.0-3, Table 5.2.3.1.1.0-4, Table 5.2.3.1.1.0-5, Table 5.2.3.1.1.0-6 and Table 5.2.3.1.1.0-7, with the addition of test parameters in Table 5.2.3.1.1.0-2 and the downlink physical channel setup according to Annex C.2.1.

The test purposes are specified in Table 5.2.3.1.1.0-1.

Table 5.2.3.1.1.0-1: Tests purpose

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

Table 5.2.3.1.1.0-2: Test parameters

Parameter		Unit	Value
Duplex mode			FDD
Active DL BWP index			1
PDSCH configuration	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		12
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		4 for Test 1-1 WB for Test 3-1 2 for other tests
	Resource allocation type		Test 1-2: Type 1 with start RB = 23, L_{RBs} = 6 Other test: Type 0
	RBG size		Test 1-2: N/A Other tests: Config2
	VRB-to-PRB mapping type		Non-interleaved

Parameter		Unit	Value
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS configuration	DMRS Type		Type 1
	Number of additional DMRS		2 for Test 1-1, 1-5, 1-6, 1-7 1 for other tests
	Maximum number of OFDM symbols for DL front loaded DMRS		1
CSI-RS for tracking	CSI-RS periodicity	Slots	Test 1-5, 1-6, 1-7: 10 for CSI-RS resource 1,2,3,4. Other tests: Table 5.2-1.
	CSI-RS offset	Slots	Test 1-5, 1-6, 1-7: 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4. Other tests: Table 5.2-1.
Number of HARQ Processes			8 for Test 1-4, 2-1 4 for other tests
The number of slots between PDSCH and corresponding HARQ-ACK information			2

Table 5.2.3.1.1.0-3: Minimum performance for Rank 1

Test num.	Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	Correlation matrix and antenna configuration	Reference value	
						Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-1.1 FDD	10 / 15	QPSK, 0.30	TDLB100-400	2x4, ULA Low	70	-3.5
1-2	R.PDSCH.1-1.2 FDD	10 / 15	QPSK, 0.30	TDLC300-100	2x4, ULA Low	70	-2.9
1-3	R.PDSCH.1-4.1 FDD	10 / 15	256QAM, 0.82	TDLA30-10	2x4, ULA Low	70	21.0
1-4	R.PDSCH.1-2.1 FDD	10 / 15	16QAM, 0.48	TDLC300-100	2x4, ULA Low	30	-1.5
1-5	R.PDSCH.1-8.1 FDD	10 / 15	16QAM, 0.48	HST-750	1x4	70	3.3
1-6	R.PDSCH.1-8.2 FDD	10 / 15	64QAM, 0.43	HST-972	1x4	70	[6.8]
1-7	R.PDSCH.1-8.1 FDD	10 / 15	16QAM, 0.48	TDLC300-600	2x4	70	[5.8]

Table 5.2.3.1.1.0-4: Minimum performance for Rank 2

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

Table 5.2.3.1.1.0-5: Minimum performance for Rank 3

Test num.	Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	Correlation matrix and antenna configuration	Reference value	
						Fraction of maximum	SNR (dB)

						throughput (%)	
3-1	R.PDSCH.1-2.3 FDD	10 / 15	16QAM, 0.48	TDLA30-10	4x4, ULA Low	70	11.0

Table 5.2.3.1.1.0-6: Minimum performance for Rank 4

Test num.	Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	Correlation matrix and antenna configuration	Reference value	
						Fraction of maximum throughput (%)	SNR (dB)
4-1	R.PDSCH.1-2.4 FDD	10 / 15	16QAM, 0.48	TDLA30-10	4x4, ULA Low	70	15.6

Table 5.2.3.1.1.0-7: Minimum performance for Rank 3 and Enhanced Receiver Type 1

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

The normative reference for this requirement is TS 38.101-4 [5] clause 5.2.3.1.1.

5.2.3.1.1_1 4Rx FDD FR1 PDSCH mapping Type A performance - 2x4 MIMO with baseline receiver for both SA and NSA

Editor's note: Minimum test time is FFS for test point 1-5, 1-6, 1-7. SNR in test requirements table is within square brackets for test point 1-6, 1-7.

5.2.3.1.1_1.1 Test purpose

To verify the PDSCH mapping Type A normal performance under 4 receive antenna conditions and with different channel models, MCSs and number of MIMO layers for a specified downlink Reference Measurement Channel (RMC) to achieve a certain throughput and as well verify the HARQ soft combining with default baseline receiver configuration, for Rank 1 and Rank 2 scenarios.

5.2.3.1.1_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.

5.2.3.1.1_1.3 Test description

5.2.3.1.1_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 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 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.3.1.7.4 for TE diagram and clause A.3.2.5 for UE diagram.

2. The parameter settings for the cell are set up according to Tables 5.2-1 and 5.2.3.1.1.0-2 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 38.521-1 [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 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 5.2.3.1.1_1.3.3.

5.2.3.1.1_1.3.2 Test procedure

1. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Table 5.2.3.1.1.0-3 and Table 5.2.3.1.1.0-4. The SS sends downlink MAC padding bits on the DL RMC.

2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix and the SNR according to Tables 5.2.3.1.1_1.4-1 and 5.2.3.1.1_1.4-2 as appropriate.

3. Measure the average throughput 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 during each subtest and decide pass or fail according to Table G.1.5-1 in Annex G clause G.1.5.

4. Repeat steps from 1 to 4 for each subtest in Tables 5.2.3.1.1_1.4-1 and 5.2.3.1.1_1.4-2 as appropriate.

5.2.3.1.1_1.3.3 Message contents

Message contents are according to TS 38.508-1 [6] clauses 4.6.1 and 5.4.2.

5.2.3.1.1_1.3.3_1 Message exceptions for SA

Table 5.2.3.1.1_1.3.3_1-1: *BWP*

Derivation Path: TS 38.508-1 [6], Table 4.6.3-8			
Information Element	**Value/remark**	**Comment**	**Condition**
BWP ::= SEQUENCE {			
locationAndBandwidth	13750	For Test 2-2 (20MHz BW, SCS 30kHz)	
	14025	For other tests (10MHz BW, SCS 15kHz)	
}			

Table 5.2.3.1.1_1.3.3_1-2: *PDSCH-Config*

Derivation Path: TS 38.508-1 [6], Table 5.4.2-18			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-Config ::= SEQUENCE {			
resourceAllocation	resourceAllocationType0	resourceAllocation Type0 for all tests except test 1-2	
	resourceAllocationType1	resourceAllocation Type1 for test 1-2	
prb-BundlingType CHOICE {			
staticBundling SEQUENCE {			
bundleSize	n4	n4 for test 1-1	
	wideband	wideband for test 3-1	
	Not present	n2 for other tests	
}			
}			
}			

Table 5.2.3.1.1_1.3.3_1-3: DMRS-DownlinkConfig

Derivation Path: TS 38.508-1 [6], Table 5.4.2-16			
Information Element	**Value/remark**	**Comment**	**Condition**
DMRS-DownlinkConfig ::= SEQUENCE {			
dmrs-AdditionalPosition	pos1	pos1 for all tests except test 1-1, 1-5, 1-6, 1-7	
	Not present	pos2 for test 1-1, 1-5, 1-6, 1-7	
}			

Table 5.2.3.1.1_1.3.3_1-4: PDSCH-ServingCellConfig

Derivation Path: TS 38.508-1 [6], Table 5.4.2-17			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-ServingCellConfig ::= SEQUENCE {			
nrofHARQ-ProcessesForPDSCH	Not present	n8 for test 1-4, 2.1	
	n4	n4 for other tests	
}			

Table 5.2.3.1.1_1.3.3_1-5: CSI-ResourcePeriodicityAndOffset for CSI Tracking

Derivation Path: TS 38.508-1 [6], Table 4.6.3-43			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourcePeriodicityAndOffset ::= CHOICE {			
Slots10	1 (for CSI-RS resources 1 and 2) 2 (for CSI-RS resources 3 and 4)	Periodicity 10 slots and offset 1/2 for test 1-5, 1-6, 1-7	
}			

5.2.3.1.1_1.3.3_2 Message exceptions for NSA

Same as 5.2.3.1.1_1.3.3_1

5.2.3.1.1_1.4 Test requirement

Table 5.2.3.1.1.0-3 and Table 5.2.3.1.1.0-4 define the primary level settings.

The fraction of maximum throughput percentage for the downlink reference measurement channels specified in Annex A.3.2.1 for each throughput test shall meet or exceed the specified value in Table 5.2.3.1.1_1.4-1 and Table 5.2.3.1.1_1.4-2 for the specified SNR including test tolerances for all throughput tests.

Table 5.2.3.1.1_1.4-1: Test Requirement for Rank 1

Test num.	Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	Correlation matrix and antenna configuration	Reference value	
						Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-1.1 FDD	10 / 15	QPSK, 0.30	TDLB100-400	2x4, ULA Low	70	-2.6
1-2	R.PDSCH.1-1.2 FDD	10 / 15	QPSK, 0.30	TDLC300-100	2x4, ULA Low	70	-2.0
1-3	R.PDSCH.1-4.1 FDD	10 / 15	256QAM, 0.82	TDLA30-10	2x4, ULA Low	70	22.0
1-4	R.PDSCH.1-2.1 FDD	10 / 15	16QAM, 0.48	TDLC300-100	2x4, ULA Low	30	-0.6
1-5	R.PDSCH.1-8.1 FDD	10 / 15	16QAM, 0.48	HST-750	1x4	70	4.2
1-6	R.PDSCH.1-8.2 FDD	10 / 15	64QAM, 0.43	HST-972	1x4	70	[7.7]
1-7	R.PDSCH.1-8.1 FDD	10 / 15	16QAM, 0.48	TDLC300-600	2x4	70	[6.7]

Table 5.2.3.1.1_1.4-2: Test Requirement for Rank 2

Test num.	Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	Correlation matrix and antenna configuration	Reference value	
						Fraction of maximum throughput (%)	SNR (dB)
2-1	R.PDSCH.1-3.1 FDD	10 / 15	64QAM, 0.50	TDLA30-10	2x4, ULA Low	70	14.5
2-2	R.PDSCH.2-1.1 FDD	20 / 30	64QAM, 0.50	TDLA30-10	2x4, ULA Low	70	14.7

5.2.3.1.1_2 4Rx FDD FR1 PDSCH mapping Type A performance - 4x4 MIMO with baseline receiver for both SA and NSA

5.2.3.1.1_2.1 Test purpose

To verify the PDSCH mapping Type A normal performance under 4 receive antenna conditions and with different channel models, MCSs and number of MIMO layers for a specified downlink Reference Measurement Channel (RMC) to achieve a certain throughput and as well verify the HARQ soft combining with default baseline receiver configuration, for Rank 3 and Rank 4 scenarios.

5.2.3.1.1_2.2 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.

5.2.3.1.1_2.3 Test description

Same test description as in clause 5.2.3.1.1_1.3 with the following exception:

- Step 1 of test procedure to call for Tables 5.2.3.1.1.0-5 and 5.2.3.1.1.0-6 instead of Tables 5.2.3.1.1.0-3 and 5.2.3.1.1.0-4

Table 5.2.3.1.1_2.4-1 instead of 5.2.3.1.1_1.4-1

- Table 5.2.3.1.1_2.4-2 instead of 5.2.3.1.1_1.4-2
- Figure A.3.1.7.5 instead of A.3.1.7.4

5.2.3.1.1_2.4 Test requirement

Table 5.2.3.1.1.0-5 and Table 5.2.3.1.1.0-6 define the primary level settings.

The fraction of maximum throughput percentage for the downlink reference measurement channels specified in Annex A.3.2.1 for each throughput test shall meet or exceed the specified value in Table 5.2.3.1.1_2.4-1 and Table 5.2.3.1.1_2.4-2 for the specified SNR including test tolerances for all throughput tests.

Table 5.2.3.1.1_2.4-1: Test Requirement for Rank 3

Test num.	Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	Correlation matrix and antenna configuration	Reference value	
						Fraction of maximum throughput (%)	SNR (dB)
3-1	R.PDSCH.1-2.3 FDD	10 / 15	16QAM, 0.48	TDLA30-10	4x4, ULA Low	70	12.0

Table 5.2.3.1.1_2.4-2: Test Requirement for Rank 4

Test num.	Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	Correlation matrix and antenna configuration	Reference value	
						Fraction of maximum throughput (%)	SNR (dB)
4-1	R.PDSCH.1-2.4 FDD	10 / 15	16QAM, 0.48	TDLA30-10	4x4, ULA Low	70	16.6

5.2.3.1.1_3 FFS

5.2.3.1.1_4 4Rx FDD FR1 PDSCH mapping Type A performance - 4x4 MIMO with enhanced receiver type 1 for both SA and NSA

5.2.3.1.1_4.1 Test purpose

To verify the PDSCH mapping Type A enhanced performance under 4 receive antenna conditions for a specified downlink Reference Measurement Channel (RMC) to achieve a certain throughput and as well verify the HARQ soft combining with default enhanced receiver type 1 configuration, for Rank 3 scenario.

5.2.3.1.1_4.2 Test applicability

This test applies to all types of NR UE Rel-15 and forward supporting 4 Rx antenna ports and NR enhanced receiver type 1.

This test also applies to all types of EUTRA UE Rel-15 and forward supporting EN-DC, 4 Rx antenna ports and NR enhanced receiver type 1.

5.2.3.1.1_4.3 Test description

Same test description as in clause 5.2.3.1.1_1.3 with the following exception:

- Figure A.3.1.7.5 instead of A.3.1.7.4

Step 1 and 2 of Test procedure as in clause 5.2.3.1.1_1.3.2 are replaced by:

1. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Table 5.2.3.1.1.0-7. The SS sends downlink MAC padding bits on the DL RMC.

2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix and the SNR according to Table 5.2.3.1.1_4.4-1 as appropriate.

5.2.3.1.1_4.4 Test requirement

Table 5.2.3.1.1.0-7 defines the primary level settings.

The fraction of maximum throughput percentage for the downlink reference measurement channels specified in Annex A.3.2.1 for each throughput test shall meet or exceed the specified value in Table 5.2.3.1.1_4.4-1 for the specified SNR including test tolerances for all throughput tests.

Table 5.2.3.1.1_4.4-1: Test Requirement for Rank 3 and Enhanced Receiver Type 1

Test num.	Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	Correlation matrix and antenna configuration	Reference value	
						Fraction of maximum throughput (%)	SNR (dB)
5-1	R.PDSCH.1-2.3 FDD	10 / 15	16QAM, 0.48	TDLA30-10	4x4, ULA Medium A	70	23.3

5.2.3.1.2 4Rx FDD FR1 PDSCH mapping Type A and CSI-RS overlapped with PDSCH performance

5.2.3.1.2.0 Minimum conformance requirements

The performance requirements are specified in Table 5.2.3.1.2.0-3, with the addition of test parameters in Table 5.2.3.1.2.0-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.1.2.0-1.

Table 5.2.3.1.2.0-1: Tests purpose

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

Table 5.2.3.1.2.0-2: Test parameters

Parameter		Unit	Value
Duplex mode			FDD
Active DL BWP index			1
PDSCH configuration	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		12
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS configuration	DMRS Type		Type 1
	Number of additional DMRS		1

	Maximum number of OFDM symbols for DL front loaded DMRS		1
NZP CSI-RS for CSI acquisition	OFDM symbols in the PRB used for CSI-RS		l_0 = 13
	CSI-RS periodicity	Slots	5
ZP CSI-RS for CSI acquisition	Subcarrier index in the PRB used for CSI-RS		(k_0, k_1, k_2, k_3)=(2, 4, 6, 8)
	Number of CSI-RS ports (X)		8
	CSI-RS periodicity	Slots	5
Number of HARQ Processes			4
The number of slots between PDSCH and corresponding HARQ-ACK information			2

Table 5.2.3.1.2.0-3: Minimum performance for Rank 2

Test num.	Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	Correlation matrix and antenna configuration	Reference value	
						Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-5.1 FDD	10 / 15	16QAM, 0.48	TDLC300-100	4x4, ULA Low	70	9.1

The normative reference for this requirement is TS 38.101-4 [5] clause 5.2.3.1.2.

5.2.3.1.2_1 4Rx FDD FR1 PDSCH mapping Type A and CSI-RS overlapped with PDSCH performance - 4x4 MIMO with baseline receiver for both SA and NSA

5.2.3.1.2_1.1 Test purpose

To verify the PDSCH mapping Type A normal performance under 4 receive antenna conditions for a specified downlink Reference Measurement Channel (RMC) to achieve a certain throughput and as well verify the HARQ soft combining with default baseline receiver configuration for CSI-RS overlapped with PDSCH scenario.

5.2.3.1.2_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.

5.2.3.1.2_1.3 Test description

5.2.3.1.2_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 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 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.3.1.7.5 for TE diagram and clause A.3.2.5 for UE diagram.

2. The parameter settings for the cell are set up according to Tables 5.2-1 and 5.2.3.1.2.0-2 and as appropriate.

3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, 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 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 5.2.3.1.2_1.3.3.

5.2.3.1.2_1.3.2 Test procedure

1. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Table 5.2.3.1.2.0-2. The SS sends downlink MAC padding bits on the DL RMC.

2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix and the SNR according to Tables 5.2.3.1.2_1.4-1 as appropriate.

3. Measure the average throughput 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 during each subtest and decide pass or fail according to Table G.1.5-12 in Annex G clause G.1.5.

5.2.3.1.2_1.3.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1 and 5.4.2.

5.2.3.1.2_1.3.3_1 Message exceptions for SA

Table 5.2.3.1.2_1.3.3_1-1: PDSCH-ServingCellConfig

Derivation Path: TS 38.508-1 [6], Table 5.4.2-17			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-ServingCellConfig ::= SEQUENCE {			
nrofHARQ-ProcessesForPDSCH	n4		
}			

Table 5.2.3.1.2_1.3.3_1-2: NZP CSI-RS-ResourceMapping for CSI Acquisition

Derivation Path: TS 38.508-1 [6], Table 5.4.2-9			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
row4	001	k_0=0	
}			
firstOFDMSymbolInTimeDomain	13	l_0 = 13	
}			

Table 5.2.3.1.2_1.3.3_1-3: CSI-ResourcePeriodicityAndOffset for CSI Acquisition

Derivation Path: TS 38.508-1 [6], Table 5.4.2-10			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourcePeriodicityAndOffset ::= CHOICE {			
slots5	0	Periodicity 5 slots and offset 0	
}			

Table 5.2.3.1.2_1.3.3_1-4: ZP CSI-RS-ResourceMapping for CSI Acquisition

Derivation Path: TS 38.508-1 [6], clause 5.4.2-13			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	011110	(k0, k1, k2, k3)=(2, 4, 6, 8)	
}			
nrofPorts	P8	Eight Ports	
firstOFDMSymbolInTimeDomain	12	l_0 = 12	
cdm-Type	fd-CDM2		
density CHOICE {			
one	NULL		
}			
freqBand	CSI-FrequencyOccupation		
}			

5.2.3.1.2_1.3.3_2 Message exceptions for NSA

Same as 5.2.3.1.2_1.3.3_1

5.2.3.1.2_1.4 Test requirement

Table 5.2.3.1.2.0-3 define the primary level settings.

The fraction of maximum throughput percentage for the downlink reference measurement channels specified in Annex A.3.2.1 for each throughput test shall meet or exceed the specified value in Table 5.2.3.1.2_1.4-1 for the specified SNR including test tolerances for all throughput tests.

Table 5.2.3.1.2_1.4-1: Test Requirement for Rank 2

Test num.	Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	Correlation matrix and antenna configuration	Reference value	
						Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-5.1 FDD	10 / 15	16QAM, 0.48	TDLC300-100	4x4, ULA Low	70	10

5.2.3.1.3 4Rx FDD FR1 PDSCH mapping Type B performance

5.2.3.1.3.0 Minimum conformance requirements

The performance requirements are specified in Table 5.2.3.1.3.0-3, with the addition of test parameters in Table 5.2.3.1.3.0-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.1.3.0-1.

Table 5.2.3.1.3.0-1: Tests purpose

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

Table 5.2.3.1.3.0-2: Test parameters

Parameter		Unit	Value
Duplex mode			FDD
Active DL BWP index			1
PDSCH configuration	Mapping type		Type B
	k0		0
	Starting symbol (S)		5
	Length (L)		7
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
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			4
The number of slots between PDSCH and corresponding HARQ-ACK information			2

Table 5.2.3.1.3.0-3: Minimum performance for Rank 1

Test num.	Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	Correlation matrix and antenna configuration	Reference value	
						Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-1.3 FDD	10 / 15	QPSK, 0.30	TDLA30-10	2x4, ULA Low	70	-3.8

The normative reference for this requirement is TS 38.101-4 [5] clause 5.2.3.1.3.

5.2.3.1.3_1 4Rx FDD FR1 PDSCH mapping Type B performance - 2x4 MIMO with baseline receiver for both SA and NSA

5.2.3.1.3_1.1 Test purpose

To verify the PDSCH mapping Type B normal performance under 4 receive antenna conditions for a specified downlink Reference Measurement Channel (RMC) to achieve a certain throughput with baseline receiver configuration.

5.2.3.1.3_1.2 Test applicability

This test applies to all types of NR UE release 15 and forward supporting 4 Rx antenna ports and PDSCH mapping type B.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC and 4 Rx antenna ports and PDSCH mapping type B.

5.2.3.1.3_1.3 Test description

5.2.3.1.3_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 5.3.5-1 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 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.3.1.7.4 for TE diagram and clause A.3.2.5 for UE diagram.
2. The parameter settings for the cell are set up according to Tables 5.2-1 and 5.2.3.1.3.0-2 and as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, 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 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 5.2.3.1.3_1.3.3.

5.2.3.1.3_1.3.2 Test procedure

1. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Table 5.2.3.1.3.0-2. The SS sends downlink MAC padding bits on the DL RMC.
2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix and the SNR according to Tables 5.2.3.1.3_1.4-1 as appropriate.
3. Measure the average throughput 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 during each subtest and decide pass or fail according to Table G.1.5-1 in Annex G clause G.1.5.

5.2.3.1.3_1.3.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1 and 5.4.2.

5.2.3.1.3_1.3.3_1 Message exceptions for SA

Table 5.2.3.1.3_1.3.3_1-1: PDSCH-ServingCellConfig

Derivation Path: TS 38.508-1 [6], Table 5.4.2-17			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-ServingCellConfig ::= SEQUENCE {			
nrofHARQ-ProcessesForPDSCH	n4		
}			

Table 5.2.3.1.3_1.3.3_1-2: PDSCH-TimeDomainResourceAllocationList

Derivation Path: TS 38.508-1 [6], Table 5.4.2-19			
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	89	Start symbol(S)=5, Length(L)=7	
}			
PDSCH-TimeDomainResourceAllocation[2] SEQUENCE {			
K0	Not present		
mappingType	TypeA		
startSymbolAndLength	53	Start symbol(S)=2, Length(L)=12	
}			
}			

5.2.3.1.3_1.3.3_2 Message exceptions for NSA

Same as 5.2.3.1.3_1.3.3_1

5.2.3.1.3_1.4 Test requirement

Table 5.2.3.1.3.0-3 define the primary level settings.

The fraction of maximum throughput percentage for the downlink reference measurement channels specified in Annex A.3.2.1 for each throughput test shall meet or exceed the specified value in Table 5.2.3.1.3_1.4-1 for the specified SNR including test tolerances for all throughput tests.

Table 5.2.3.1.3_1.4-1: Test Requirement for Rank 1

Test num.	Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	Correlation matrix and antenna configuration	Reference value	
						Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-1.3 FDD	10 / 15	QPSK, 0.30	TDLA30-10	2x4, ULA Low	70	-2.8

5.2.3.1.4 4Rx FDD FR1 PDSCH Mapping Type A and LTE-NR coexistence performance

5.2.3.1.4.0 Minimum conformance requirements

The performance requirements are specified in Table 5.2.3.1.4.0-3, with the addition of test parameters in Table 5.2.3.1.4.0-2 and the downlink physical channel setup according to Annex C.2.1.

The test purposes are specified in Table 5.2.3.1.4.0-1.

Table 5.2.3.1.4.0-1: Tests purpose

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

Table 5.2.3.1.4.0-2: Test parameters

Parameter		Unit	Value
Duplex mode			FDD
Active DL BWP index			1
NR UL transmission with a 7.5 kHz shift to the LTE raster			true
PDCCH configuration	Symbols with PDCCH		Symbol# 2
PDSCH configuration	Mapping type		Type A
	k0		0
	Starting symbol (S)		3
	Length (L)		9 for Test 1-1 11 for Test 1-2
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS configuration	DMRS Type		Type 1
	Position of the first DM-RS for downlink		3
	Number of additional DMRS		1
	Maximum number of OFDM symbols for DL front loaded DMRS		1
CRS for rate matching (Note 1)	LTE carrier centre subcarrier location		Same as NR carrier centre subcarrier location
	LTE carrier BW	MHz	10
	Number of antenna ports		4
	v-shift		0
Number of HARQ Processes			4
The number of slots between PDSCH and corresponding HARQ-ACK information			2
Note 1: No MBSFN is configured on LTE carrier			

Table 5.2.3.1.4.0-3: Minimum performance for Rank 1

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

The normative reference for this requirement is TS 38.101-4 [5], clause 5.2.3.1.4.

5.2.3.1.4_1 4Rx FDD FR1 PDSCH Mapping Type A and LTE-NR coexistence performance - 4x4 MIMO with baseline receiver for both SA and NSA

5.2.3.1.4_1.1 Test purpose

Same as 5.2.2.1.4_1.1.

5.2.3.1.4_1.2 Test applicability

Test 1-1 applies to all types of NR UE release 15 and forward supporting 4 Rx antenna ports and capability IE *rateMatchingLTE-CRS* but not supporting capability IE *additionalDMRS-DL-Alt*.

Test1-1 also applies to all types of EUTRA UE release 15 and forward supporting EN-DC supporting 4 Rx antenna ports and capability IE *rateMatchingLTE-CRS* but not supporting capability IE *additionalDMRS-DL-Alt*.

Test 1-2 applies to all types of NR UE release 15 and forward supporting 4 Rx antenna ports and capability IE *additionalDMRS-DL-Alt* and *rateMatchingLTE-CRS*.

Test 1-2 also applies to all types of EUTRA UE release 15 and forward supporting EN-DC supporting 4 Rx antenna ports and capability IE *additionalDMRS-DL-Alt* and *rateMatchingLTE-CRS*.

5.2.3.1.4_1.3 Test description

5.2.3.1.4_1.3.1 Initial conditions

Same as 5.2.2.1.4_1.3.1 with the following exceptions:

- Use Figure A.3.1.7.4 for TE diagram
- Use Figure A.3.2.5 for UE diagram
- Instead of 5.2.2.1.4.x → refer 5.2.2.3.4.x

5.2.3.1.4_1.3.2 Test procedure

Same as 5.2.2.3.4_1.3.2 with the following exceptions:

- Instead of 5.2.2.1.4.x → refer 5.2.2.3.4.x

5.2.3.1.4_1.3.3 Message contents

Same as 5.2.2.1.4_1.3.3.

5.2.3.1.4_1.3.4 Test requirement

Table 5.2.3.1.4.0-3 defines the primary level settings.

The fraction of maximum throughput percentage for the downlink reference measurement channels specified in Annex A for each throughput test shall meet or exceed the specified value in Table 5.2.3.1.4_1.3.4-1 for the specified SNR including test tolerances for all throughput tests.

Table 5.2.3.1.4_1.3.4-1: Test requirement for Rank 1

Test num.	Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	Correlation matrix and antenna configuration	Reference value	
						Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-7.1 FDD	10 / 15	QPSK, 0.30	TDLA30-10	4x4, ULA Low	70	-3.0
1-2	R.PDSCH.1-7.1 FDD	10 / 15	QPSK, 0.30	TDLA30-10	4x4, ULA Low	70	-3.0

5.2.3.2 TDD

5.2.3.2.1 4Rx TDD FR1 PDSCH mapping Type A performance

5.2.3.2.1.0 Minimum conformance requirements for PDSCH Mapping Type A

The performance requirements are specified in Table 5.2.3.2.1.0-3, Table 5.2.3.2.1.0-4, Table 5.2.3.2.1.0-5 and Table 5.2.3.2.1.0-6, with the test parameters defined in Table 5.2.3.2.1.0-2 and the downlink physical channel setup according to Annex C.2.1.

The test purposes are specified in Table 5.2.3.2.1.0-1.

Table 5.2.3.2.1.0-1: Tests purpose

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

Table 5.2.3.2.1.0-2: Test Parameters for Testing

Parameter		Unit	Value
Duplex mode			**TDD**
Active DL BWP index			**1**
PDSCH configuration	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		Specific to each Reference channel
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		4 for Tests 1-1, 1-8, 1-9 WB for Test 3-1 2 for other tests
	Resource allocation type		Test 1-2: Type 1 with start RB = 50, L_{RBs} = 6 Other tests: Type 0
	RBG size		Test 1-2: N/A Other tests: Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS configuration	DMRS Type		Type 1
	Number of additional DMRS		2 for Tests 1-1, 1-7, 1-8, 1-9 1 for other tests
	Maximum number of OFDM symbols for DL front loaded DMRS		1

CSI-RS for tracking	First OFDM symbol in the PRB used for CSI-RS		Tests 1-8, 1-9: l_0 = 4 for CSI-RS resource 1 and 3 l_0 = 8 for CSI-RS resource 2 and 4 Other tests; Table 5.2-1.
	CSI-RS periodicity	Slots	Test 1-7: 20 for CSI-RS resource 1,2,3,4. Other tests: Table 5.2-1.
	CSI-RS offset	Slots	Test 1-7: 1 for CSI-RS resource 1 and 2 2 for CSI-RS resource 3 and 4. Other tests: Table 5.2-1.
	Frequency Occupation		Test 1-7: Start PRB 0 Number of PRB = 52 Other tests: Table 5.2-1.
Number of HARQ Processes			16 for Test 1-4 10 for Test 1-9 8 for other tests
The number of slots between PDSCH and corresponding HARQ-ACK information			Specific to each TDD UL-DL pattern and as defined in Annex A.1.2

Table 5.2.3.2.1.0-3: 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.2-1.1 TDD	40 / 30	QPSK, 0.30	FR1.30-1A	TDLB100-400	2x4, ULA Low	70	-4.1
1-2	R.PDSCH.2-1.2 TDD	40 / 30	QPSK, 0.30	FR1.30-1	TDLC300-100	2x4, ULA Low	70	-2.7
1-3	R.PDSCH.2-4.1 TDD	40 / 30	256QAM, 0.82	FR1.30-1	TDLA30-10	2x4, ULA Low	70	21.6
1-4	R.PDSCH.2-2.1 TDD	40 / 30	16QAM, 0.48	FR1.30-1	TDLC300-100	2x4, ULA Low	30	-1.2
1-5	R.PDSCH.2-5.1 TDD	40 / 30	QPSK, 0.30	FR1.30-2	TDLA30-10	2x4, ULA Low	70	-3.8
1-6	R.PDSCH.2-6.1 TDD	40 / 30	QPSK, 0.30	FR1.30-3	TDLA30-10	2x4, ULA Low	70	-3.6
1-7	R.PDSCH.2-10.1 TDD	40 / 30	16QAM, 0.48	FR1.30-1	HST-1000	1x4	70	3.4
1-8	R.PDSCH.2-11.1 TDD	40 / 30	QPSK, 0.30	FR1.30-5	TDLB100-400	2x4, ULA Low	70	-4.0
1-9	R.PDSCH.2-12.1 TDD	40 / 30	QPSK, 0.30	FR1.30-6	TDLB100-400	2x4, ULA Low	70	-4.0

Table 5.2.3.2.1.0-4: Minimum performance for Rank 2

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

Table 5.2.3.2.1.0-5: Minimum performance for Rank 3

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)
3-1	R.PDSCH.2-2.3 TDD	40 / 30	16QAM, 0.48	FR1.30-1	TDLA30-10	4x4, ULA Low	70	11.1

Table 5.2.3.2.1.0-6: Minimum performance for Rank 4

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)
4-1	R.PDSCH.2-2.4 TDD	40 / 30	16QAM, 0.48	FR1.30-1	TDLA30-10	4x4, ULA Low	70	15.4

Table 5.2.3.2.1.0-7: Minimum performance for Rank 3 and EnhancedReceiver Type 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)
5-1	R.PDSCH.2-2.3 TDD	40 / 30	16QAM, 0.48	FR1.30-1	TDLA30-10	4x4, ULA Medium A	70	22.9

The normative reference for this requirement is TS 38.101-4 [5] clause 5.2.3.2.1.

5.2.3.2.1_1 4Rx TDD FR1 PDSCH mapping Type A performance - 2x4 MIMO with baseline receiver for both SA and NSA

5.2.3.2.1_1.1 Test purpose

To verify the PDSCH mapping Type A normal performance under 4 receive antenna conditions and with different channel models, MCSs and number of MIMO layers for a specified downlink Reference Measurement Channel (RMC) to achieve a certain throughput and as well verify the HARQ soft combining with default baseline receiver configuration, for Rank 1 and Rank 2 scenarios.

5.2.3.2.1_1.2 Test applicability

This test applies to all types of NR UE release 15 and forward, supporting 4Rx antenna ports.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC and 4Rx antenna ports.

5.2.3.2.1_1.3 Test description

5.2.3.2.1_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 5.3.5-1 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 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.3.1.7.4 for TE diagram and clause A.3.2.5 for UE diagram.
2. The parameter settings for the cell are set up according to Table 5.2-1 and Table 5.2.3.2.1.0-2 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 38.521-1 [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 or (EN-DC, DC bearer *MCG* and *SCG, Connected without release On)* for NSA according to TS 38.508-1 [] clause 4.5. Message contents are defined in clause 5.2.3.2.1_1.4.3.

5.2.3.2.1_1.3.2 Test procedure

1. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Table 5.2.3.2.1.0-3 and Table 5.2.3.2.1.0-4. The SS sends downlink MAC padding bits on the DL RMC.
2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix and the SNR according to Tables 5.2.3.2.1_1.3.4-1 and 5.2.3.2.1_1.3.4-2 as appropriate.
3. Measure the average throughput 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 during each subtest and decide pass or fail according to Table G.1.5-1 in Annex G clause G.1.5.
4. Repeat steps from 1 to 3 for each subtest in Tables 5.2.3.2.1_1.3.4-1 and 5.2.3.2.1_1.3.4-2 as appropriate.

5.2.3.2.1_1.3.3 Message contents

Message contents are according to TS 38.508-1 [6] clauses 4.6.1 and 5.4.2.

5.2.3.2.1_1.3.3_1 Message exceptions for SA

Table 5.2.3.2.1_1.3.3_1-1: *BWP*

Derivation Path: TS 38.508-1 [6], Table 4.6.3-8			
Information Element	**Value/remark**	**Comment**	**Condition**
BWP ::= SEQUENCE {			
locationAndBandwidth	13750	For Test 2-2 (20MHz BW, SCS 30kHz)	
	28875	For other tests (40MHz BW, SCS 30kHz)	
}			

Table 5.2.3.2.1_1.3.3_1-2: *PDSCH-Config*

Derivation Path: TS 38.508-1 [6], Table 5.4.2-18			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-Config ::= SEQUENCE {			
prb-BundlingType CHOICE {			
staticBundling SEQUENCE {			
bundleSize	n4	n4 for tests 1-1, 1-8, 1-9	
	wideband	wideband for test 3-1	
	Not present	n2 for other tests	
}			
}			
}			

Table 5.2.3.2.1_1.3.3_1-3: DMRS-DownlinkConfig

Derivation Path: TS 38.508-1 [6], Table 5.4.2-16			
Information Element	**Value/remark**	**Comment**	**Condition**
DMRS-DownlinkConfig ::= SEQUENCE {			
dmrs-AdditionalPosition	pos1	pos1 for all tests except tests 1-1, 1-7, 1-8, 1-9	
	Not present	pos2 for tests 1-1, 1-7, 1-8, 1-9	
}			

Table 5.2.3.2.1_1.3.3_1-4: PDSCH-ServingCellConfig

Derivation Path: TS 38.508-1 [6], Table 5.4.2-17			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-ServingCellConfig ::= SEQUENCE {			
nrofHARQ-ProcessesForPDSCH	Not present	n8 for other tests	
	n16	n16 for test 1-4	
	n10	n10 for test 1-9	
}			

Table 5.2.3.2.1_1.3.3_1-5: CSI-ResourcePeriodicityAndOffset for CSI Tracking

Derivation Path: TS 38.508-1 [6], Table 4.6.3-43			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourcePeriodicityAndOffset ::= CHOICE {			
Slots20	1 (for CSI-RS resources 1 and 2) 2 (for CSI-RS resources 3 and 4)	Periodicity 20 slots and offset 1/2 for test 1-7	
}			

Table 5.2.3.2.1_1.3.3_1-5A: 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	4	For Tests 1-8, 1-9: l_0 = 4 for CSI-RS resource 1 and 3	TRS
	8	For Tests 1-8, 1-9: l_0 = 8 for CSI-RS resource 2 and 4	TRS
}			

Table 5.2.3.2.1_1.3.3_1-6: CSI-FrequencyOccupation for CSI Tracking

Derivation Path: TS 38.508-1 [6], Table 5.4.2-7			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-FrequencyOccupation ::= SEQUENCE {			
nrofRBs	52	52 for tests 1-7, 2-2	TRS
	108	108 for other tests	TRS
}			

Table 5.2.3.2.1_1.3.3_1-7: RACH-ConfigGeneric

Derivation Path: TS 38.508-1 [6], Table 4.6.3-130			
Information Element	**Value/remark**	**Comment**	**Condition**
RACH-ConfigGeneric ::= SEQUENCE {			
prach-ConfigurationIndex	163	Only for test 2-2	
}			

Table 5.2.3.2.1_1.3.3_1-8: SchedulingRequestResourceConfig

Derivation Path: TS 38.508-1 [6], Table 4.6.3-157			
Information Element	**Value/remark**	**Comment**	**Condition**
SchedulingRequestResourceConfig ::= SEQUENCE {			
periodicityAndOffset CHOICE {			
sl20	7	For test 1-9	
sl20	5	For test 2-2	
}			
}			

Table 5.2.3.2.1_1.3.3_1-9: Physical layer parameters for DCI format 1_1

Derivation Path: TS 38.508-1 [6], Table 5.4.2.0-1			
Parameter	**Value**	**Value in binary**	**Condition**
PUCCH resource indicator	*PUCCH-ResourceId[1]* = 6 in pucch-ResourceSetID[1] or *PUCCH-ResourceId[1]* = 14 in pucch-ResourceSetID[2] as defined in Table 4.6.3-112 (Mapping as per Table 9.2.3-2 in TS 38.213)	'110'B	Slot S1 for test 1-9

5.2.3.2.1_1.3.3_2 Message exceptions for NSA

Same as 5.2.3.2.1_1.3.3_1

5.2.3.2.1_1.3.4 Test requirement

Table 5.2.3.2.1.0-2 defines the primary level settings.

The fraction of maximum throughput percentage for the downlink reference measurement channels specified in Annex A clause A.3.2.1 for each throughput test shall meet or exceed the specified value in Table 5.2.3.2.1_1.3.4-1 and Table 5.2.3.2.1_1.3.4-2 for the specified SNR including test tolerances for all throughput tests.

Table 5.2.3.2.1_1.3.4-1: Test Requirements 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.2-1.1 TDD	40 / 30	QPSK, 0.30	FR1.30-1A	TDLB100-400	2x4, ULA Low	70	-3.1
1-2	R.PDSCH.2-1.2 TDD	40 / 30	QPSK, 0.30	FR1.30-1	TDLC300-100	2x4, ULA Low	70	-1.7
1-3	R.PDSCH.2-4.1 TDD	40 / 30	256QAM, 0.82	FR1.30-1	TDLA30-10	2x4, ULA Low	70	22.5
1-4	R.PDSCH.2-2.1 TDD	40 / 30	16QAM, 0.48	FR1.30-1	TDLC300-100	2x4, ULA Low	30	-0.3
1-5	R.PDSCH.2-5.1 TDD	40 / 30	QPSK, 0.30	FR1.30-2	TDLA30-10	2x4, ULA Low	70	-2.8
1-6	R.PDSCH.2-6.1 TDD	40 / 30	QPSK, 0.30	FR1.30-3	TDLA30-10	2x4, ULA Low	70	-2.6
1-7	R.PDSCH.2-10.1 TDD	40 / 30	16QAM, 0.48	FR1.30-1	HST-1000	1x4	70	4.3
1-8	R.PDSCH.2-11.1 TDD	40 / 30	QPSK, 0.30	FR1.30-5	TDLB100-400	2x4, ULA Low	70	-3.1
1-9	R.PDSCH.2-12.1 TDD	40 / 30	QPSK, 0.30	FR1.30-6	TDLB100-400	2x4, ULA Low	70	-3.1

Table 5.2.3.2.1_1.3.4-2: Test Requirements for Rank 2

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)
2-1	R.PDSCH.2-3.1 TDD	40 / 30	64QAM, 0.50	FR1.30-1	TDLA30-10	2x4, ULA Low	70	14.6
2-2	R.PDSCH.2-9.1 TDD	20 / 30	64QAM, 0.50	FR1.30-4	TDLA30-10	2x4, ULA Low	70	14.7

5.2.3.2.1_2 4Rx TDD FR1 PDSCH mapping Type A performance - 4x4 MIMO with baseline receiver for both SA and NSA

5.2.3.2.1_2.1 Test purpose

To verify the PDSCH mapping Type A normal performance under 4 receive antenna conditions and with different channel models, MCSs and number of MIMO layers for a specified downlink Reference Measurement Channel (RMC) to achieve a certain throughput and as well verify the HARQ soft combining with default baseline receiver configuration, for Rank 3 and Rank 4 scenarios.

5.2.3.2.1_2.2 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.

5.2.3.2.1_2.3 Test description

Same test description as in clause 5.2.3.2.1_1.3 with the following exception:

- Figure A.3.1.7.5 instead of A.3.1.7.4

- Step 1 of Test procedure as in clause 5.2.3.2.1_1.3.2 to call for Tables 5.2.3.2.1.0-5 and 5.2.3.2.1.0-6 instead of Table 5.2.3.2.1.0-3 and 5.2.3.2.1.0-4.

- Step 2 and 4 of Test procedure as in clause 5.2.3.2.1_1.3.2 to call for Tables 5.2.3.2.1_2.3.4-1 and 5.2.3.2.1_2.3.4-2 instead of Tables 5.2.3.2.1_1.3.4-1 and 5.2.3.2.1_1.3.4-2.

5.2.3.2.1_2.3.1 Void5.2.3.2.1_2.3.2 Void

5.2.3.2.1_2.3.3 Void

5.2.3.2.1_2.3.4 Test requirement

Table 5.2.3.2.1.0-5 and Table 5.2.3.2.1.0-6 defines the primary level settings.

The fraction of maximum throughput percentage for the downlink reference measurement channels specified in Annex A A.3.2.1 for each throughput test shall meet or exceed the specified value in Table 5.2.3.2.1_2.3.4-1 andTable 5.2.3.2.1_2.3.4-2 for the specified SNR including test tolerances for all throughput tests.

Table 5.2.3.2.1_2.3.4-1: Test Requirements for Rank 3

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)
3-1	R.PDSCH.2-2.3 TDD	40 / 30	16QAM, 0.48	FR1.30-1	TDLA30-10	4x4, ULA Low	70	12.1

Table 5.2.3.2.1_2.3.4-2: Test Requirements for Rank 4

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)
4-1	R.PDSCH.2-2.4 TDD	40 / 30	16QAM, 0.48	FR1.30-1	TDLA30-10	4x4, ULA Low	70	16.4

5.2.3.2.1_3 4Rx TDD FR1 PDSCH mapping Type A performance - 2x4 MIMO with enhanced receiver type 1 for both SA and NSA

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5.2.3.2.1_4 4Rx TDD FR1 PDSCH mapping Type A performance - 4x4 MIMO with enhanced receiver type 1 for both SA and NSA

5.2.3.2.1_4.1 Test purpose

To verify the PDSCH mapping Type A enhanced performance under 4 receive antenna conditions for a specified downlink Reference Measurement Channel (RMC) to achieve a certain throughput and as well verify the HARQ soft combining with default enhanced receiver type 1 configuration, for Rank 3 scenario.

5.2.3.2.1_4.2 Test applicability

This test applies to all types of NR UE release 15 and forward supporting 4 Rx antenna ports and NR enhanced receiver type 1.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC, 4 Rx antenna ports and NR enhanced receiver type1.

5.2.3.2.1_4.3 Test description

Same test description as in clause 5.2.3.2.1_2.3 with the following exception:

- Step 1 of Test procedure as in clause 5.2.3.2.1_1.3.2 to call for Table 5.2.3.2.1.0-7 instead of Table 5.2.3.2.1.0-3 and 5.2.3.2.1.0-4.
- Step 2 and 4 of Test procedure as in clause 5.2.3.2.1_1.3.2 to call for Table 5.2.3.2.1_4.3.4-1 instead of Tables 5.2.3.2.1_1.3.4-1 and 5.2.3.2.1_1.3.4-2.

5.2.3.2.1_4.3.1 Void

5.2.3.2.1_4.3.2 Void

5.2.3.2.1_4.3.3 Void

5.2.3.2.1_4.3.4 Test requirement

Table 5.2.3.2.1.0-7 defines the primary level settings.

The fraction of maximum throughput percentage for the downlink reference measurement channels specified in Annex A A.3.2.1 for each throughput test shall meet or exceed the specified value in Table 5.2.3.2.1_4.3.4-1 for the specified SNR including test tolerances for all throughput tests.

Table 5.2.3.2.1_4.3.4-1: Test Requirements for Rank 3 and Enhanced Receiver Type 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)
5-1	R.PDSCH.2-2.3 TDD	40 / 30	16QAM, 0.48	FR1.30-1	TDLA30-10	4x4, ULA Medium A	70	23.9

5.2.3.2.2 4Rx TDD FR1 PDSCH mapping Type A and CSI-RS overlapped with PDSCH performance

5.2.3.2.2.0 Minimum conformance requirements

The performance requirements are specified in Table 5.2.3.2.2.0-3, with the addition of test parameters in Table 5.2.3.2.2.0-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.2.2.0-1.

Table 5.2.3.2.2.0-1: Tests purpose

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

Table 5.2.3.2.2.0-2: Test parameters

Parameter		Unit	Value
Duplex mode			TDD
Active DL BWP index			1
PDSCH configuration	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		12
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS configuration	DMRS Type		Type 1
	Number of additional DMRS		1
	Maximum number of OFDM symbols for DL front loaded DMRS		1
NZP CSI-RS for CSI acquisition	OFDM symbols in the PRB used for CSI-RS		l_0 = 13
	CSI-RS periodicity	Slots	5
ZP CSI-RS for CSI acquisition	Subcarrier index in the PRB used for CSI-RS		(k_0, k_1, k_2, k_3)=(2, 4, 6, 8)
	Number of CSI-RS ports (X)		8
	CSI-RS periodicity	Slots	5
Number of HARQ Processes			8
The number of slots between PDSCH and corresponding HARQ-ACK information			Specific to each TDD UL-DL pattern and as defined in Annex A.1.2

Table 5.2.3.2.2.0-3: Minimum performance for Rank 2

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

The normative reference for this requirement is TS 38.101-4 [5] clause 5.2.3.2.2.

5.2.3.2.2_1 4Rx TDD FR1 PDSCH mapping Type A and CSI-RS overlapped with PDSCH performance - 2x4 MIMO with baseline receiver for both SA and NSA

5.2.3.2.2_1.1 Test purpose

To verify the PDSCH mapping Type A normal performance under 4 receive antenna conditions for a specified downlink Reference Measurement Channel (RMC) to achieve a certain throughput and as well verify the HARQ soft combining with default baseline receiver configuration for CSI-RS overlapped with PDSCH scenario.

5.2.3.2.2_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.

5.2.3.2.2_1.3 Test description

5.2.3.2.2_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 5.3.5-1 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 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.3.1.7.4 for TE diagram and clause A.3.2.5 for UE diagram.
2. The parameter settings for the cell are set up according to Tables 5.2-1 and 5.2.3.2.2.0-2 and as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, 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 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 5.2.3.2.2_1.3.3.

5.2.3.2.2_1.3.2 Test procedure

1. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Table 5.2.3.2.2.0-2. The SS sends downlink MAC padding bits on the DL RMC.
2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix and the SNR according to Tables 5.2.3.2.2_1.4-1 as appropriate.
3. Measure the average throughput 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 during each subtest and decide pass or fail according to Table G.1.5-12 in Annex G clause G.1.5.

5.2.3.2.2_1.3.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1 and 5.4.2.

5.2.3.2.2_1.3.3_1 Message exceptions for SA

Table 5.2.3.2.2_1.3.3_1-1: PDSCH-ServingCellConfig

Derivation Path: TS 38.508-1 [6], Table 5.4.2-17			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-ServingCellConfig ::= SEQUENCE {			
nrofHARQ-ProcessesForPDSCH	Not present		
}			

Table 5.2.3.2.2_1.3.3_1-2: NZP CSI-RS-ResourceMapping for CSI Acquisition

Derivation Path: TS 38.508-1 [6], Table 5.4.2-9			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
firstOFDMSymbolInTimeDomain	13	l_0 = 13	
}			

Table 5.2.3.2.2_1.3.3_1-3: CSI-ResourcePeriodicityAndOffset for CSI Acquisition

Derivation Path: TS 38.508-1 [6], Table 5.4.2-10			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourcePeriodicityAndOffset ::= CHOICE {			
slots5	0	Periodicity 5 slots and offset 0	
}			

Table 5.2.3.2.2_1.3.3_1-4: ZP CSI-RS-ResourceMapping for CSI Acquisition

Derivation Path: TS 38.508-1 [6], clause 5.4.2-13			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-RS-ResourceMapping ::= SEQUENCE {			
frequencyDomainAllocation CHOICE {			
other	011110	(k0, k1, k2, k3)=(2, 4, 6, 8)	
}			
nrofPorts	P8	Eight Ports	
freqBand	CSI-FrequencyOccupation		
}			

Table 5.2.3.2.2_1.3.3_1-4A: ZP CSI-ResourcePeriodicityAndOffset for CSI Acquisition

Derivation Path: TS 38.508-1 [6], Table 5.4.2-10			
Information Element	**Value/remark**	**Comment**	**Condition**
CSI-ResourcePeriodicityAndOffset ::= CHOICE {			
slots5	0	Periodicity 5 slots and offset 0	
}			

5.2.3.2.2_1.3.3_2 Message exceptions for NSA

Same as 5.2.3.2.2_1.3.3_1

5.2.3.2.2_1.4 Test requirement

Table 5.2.3.2.2.0-3 define the primary level settings.

The fraction of maximum throughput percentage for the downlink reference measurement channels specified in Annex A.3.2.2 for each throughput test shall meet or exceed the specified value in Table 5.2.3.2.2_1.4-1 for the specified SNR including test tolerances for all throughput tests.

Table 5.2.3.2.2_1.4-1: Test Requirement for Rank 2

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.2-7.1 TDD	40 / 30	16QAM, 0.48	FR1.30-1	TDLC300-100	2x4, ULA Low	70	9.9

5.2.3.2.3 4Rx TDD FR1 PDSCH mapping Type B performance

5.2.3.2.3.0 Minimum conformance requirements

The performance requirements are specified in Table 5.2.3.2.3.0-3, with the addition of test parameters in Table 5.2.3.2.3.0-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.3.2.3.0-1.

Table 5.2.3.2.3.0-1: Tests purpose

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

Table 5.2.3.2.3.0-2: Test parameters

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

Table 5.2.3.2.3.0-3: 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,2-1.3 TDD	40 / 30	QPSK, 0.30	FR1.30-1	TDLA30-10	2x4, ULA Low	70	-3.9

The normative reference for this requirement is TS 38.101-4 [5] clause 5.2.3.2.3.

5.2.3.2.3_1 4Rx TDD FR1 PDSCH mapping Type B performance - 2x4 MIMO with baseline receiver for both SA and NSA

5.2.3.2.3_1.1 Test purpose

To verify the PDSCH mapping Type B normal performance under 4 receive antenna conditions for a specified downlink Reference Measurement Channel (RMC) to achieve a certain throughput with baseline receiver configuration.

5.2.3.2.3_1.2 Test applicability

This test applies to all types of NR UE release 15 and forward supporting 4 Rx antenna ports and PDSCH mapping type B.

This test also applies to all types of EUTRA UE release 15 and forward supporting EN-DC and 4 Rx antenna ports and PDSCH mapping type B.

5.2.3.2.3_1.3 Test description

5.2.3.2.3_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 5.3.5-1 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 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.3.1.7.4 for TE diagram and clause A.3.2.5 for UE diagram.

2. The parameter settings for the cell are set up according to Tables 5.2-1 and 5.2.3.2.3.0-2 and as appropriate.

3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2, 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 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 5.2.3.2.3_1.3.3.

5.2.3.2.3_1.3.2 Test procedure

1. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Table 5.2.3.2.3.0-2. The SS sends downlink MAC padding bits on the DL RMC.
2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix and the SNR according to Tables 5.2.3.2.3_1.4-1 as appropriate.
3. Measure the average throughput 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 during each subtest and decide pass or fail according to Table G.1.5-1 in Annex G clause G.1.5.

5.2.3.2.3_1.3.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1 and 5.4.2.

5.2.3.2.3_1.3.3_1 Message exceptions for SA

Table 5.2.3.2.3_1.3.3_1-1: PDSCH-ServingCellConfig

Derivation Path: TS 38.508-1 [6], Table 5.4.2-17			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-ServingCellConfig ::= SEQUENCE {			
nrofHARQ-ProcessesForPDSCH	Not present		
}			

Table 5.2.3.2.3_1.3.3_1-2: PDSCH-TimeDomainResourceAllocationList

Derivation Path: TS 38.508-1 [6], Table 5.4.2-19			
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	89	Start symbol(S)=5, Length(L)=7	
}			
PDSCH-TimeDomainResourceAllocation[2] SEQUENCE {			
K0	Not present		
mappingType	typeA		
startSymbolAndLength	53	Start symbol(S)=2, Length(L)=12	
}			
}			

5.2.3.2.3_1.3.3_2 Message exceptions for NSA

Same as 5.2.3.2.3_1.3.3_1

5.2.3.2.3_1.4 Test requirement

Table 5.2.3.2.3.0-3 define the primary level settings.

The fraction of maximum throughput percentage for the downlink reference measurement channels specified in Annex A.3.2.2 for each throughput test shall meet or exceed the specified value in Table 5.2.3.2.3_1.4-1 for the specified SNR including test tolerances for all throughput tests.

Table 5.2.3.2.3_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,2-1.3 TDD	40 / 30	QPSK, 0.30	FR1.30-1	TDLA30-10	2x4, ULA Low	70	--2.9

5.3 PDCCH demodulation requirements

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

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

Table 5.3-1: Common test Parameters

Parameter			Unit	Value
Carrier configuration	Offset between Point A and the lowest usable subcarrier on this carrier (Note 1)			0
DL BWP configuration #1	Cyclic prefix			Normal
	RB offset		RBs	0
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 (k_0)			0
	First OFDM symbol in the PRB used for CSI-RS (l_0)			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	15 kHz SCS: 20 30 kHz SCS: 40
	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
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

PDCCH & PDCCH DMRS Precoding configuration		Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i_1, i_2 combination with REG bundling granularity for number of Tx larger than 1
Physical signals, channels mapping and precoding		As specified in Annex B.4.1
Symbols for all unused REs		OCNG in Annex A.5
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 [2] clause 5.3.

5.3.1 1RX requirements

(Void)

5.3.2 2RX requirements

5.3.2.1 FDD

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

Table 5.3.2.1-1: Test Parameters

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

5.3.2.1.1 2Rx FDD FR1 PDCCH 1 Tx antenna performance for both SA and NSA

5.3.2.1.1.1 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 5.3.2.1.1.3-1. The downlink physical setup is in accordance with Annex C.2.1.

5.3.2.1.1.2 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.

5.3.2.1.1.3 Minimum conformance requirements

For the parameters specified in Table 5.3.2.1-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 5.3.2.1.1.3-1. The downlink physical setup is in accordance with Annex C.2.1.

Table 5.3.2.1.1.3-1: Minimum performance for 1 Tx PDCCH with 15 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 (dB)
1	10 MHz	24	2	2	R.PDCCH.1-2.1 FDD	TDLA30-10	1x2 Low	1	8.1
2	10 MHz	24	2	2	R.PDCCH.1-2.3 FDD	TDLC300-100	1x2 Low	1	8.2
3	10 MHz	48	2	4	R.PDCCH.1-2.4 FDD	TDLA30-10	1x2 Low	1	5.5
4	10 MHz	48	1	4	R.PDCCH.1-1.1 FDD	TDLA30-10	1x2 Low	1	4.4
5	10 MHz	48	2	16	R.PDCCH.1-2.6 FDD	TDLA30-10	1x2 Low	1	-2.1

The normative reference for this requirement is TS 38.101-4 [2] clause 5.3.

5.3.2.1.1.4 Test description

5.3.2.1.1.4.1 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 [7].

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 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.3.1.7.2 for TE diagram and clause A.3.2.2 for UE diagram.
2. The parameter settings for the cell are set up according to Table 5.3-1 and Table 5.3.2.1.1-1 and as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2 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 contents are defined in clause 5.2.2.1.1.4.3.

5.3.2.1.1.4.2 Test procedure

1. SS transmits PDCCH with DCI format as specified in PDCCH Reference Channel for C_RNTI to transmit the DL RMC according to Table 5.3.2.1.1-1. The details of PDCCH are specified in Table 5.3.1, Table 5.3.2.1-1, Table 5.3.2.1.1.3-1 respectively. The SS sends downlink MAC padding bits on the DL RMC.
2. Set the parameters of the propagation condition, antenna configuration, the correlation matrix and the SNR according to Table 5.3.2.1.1-1 as appropriate.
3. 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 5.3.2.1.1-1, pass the UE. Otherwise fail the UE.
4. Repeat steps from 1 to 3 for each subtest in Table 5.3.2.1.1-1 as appropriate.

5.3.2.1.1.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clauses 4.6.1 and 5.4.2.

5.3.2.1.1.4.3.1 Message exceptions for SA

Table 5.3.2.1.1.4.3.1-1: PDCCH-ControlResourceSet

Derivation Path: TS 38.508-1 [6], Table 5.4.2-3			
Information Element	**Value/remark**	**Comment**	**Condition**
ControlResourceSet ::= SEQUENCE {			
frequencyDomainResources	11111111 00000000 00000000 00000000 00000000 00000	CORESET to use the least significant 48 RBs of the BWP Test 3, 4, 5	
	11110000 00000000 00000000 00000000 00000000 00000	CORESET to use the least significant 24 RBs of the BWP Test 1, 2	
Duration	2	SearchSpace duration of 2 symbols Test 1, 2, 3, 5	
	1	SearchSpace duration of 1 symbol Test 4	
tci-StatesPDCCH-ToAddList {			
	0	TCI State #0	
	1	TCI State #1	
}			
}			

Table 5.3.2.1.1.4.3.1-2: PDCCH *Search Space*

Derivation Path: TS 38.508-1 [6], Table 5.4.2-4			
Information Element	**Value/remark**	**Comment**	**Condition**
SearchSpace ::= SEQUENCE {			
searchSpaceId	2	SearchSpaceId with condition USS	USS
controlResourceSetId	1	ControlResourceSetId	
monitoringSlotPeriodicityAndOffset CHOICE {			
sl1	NULL		
}			
monitoringSymbolsWithinSlot	11000000000000	Symbols 0 and 1	
nrofCandidates SEQUENCE {			
aggregationLevel1	n0		
aggregationLevel2	n1	AL2	Test 1, Test 2
aggregationLevel4	n1	AL4	Test 3, Test 4
aggregationLevel8	n0		
aggregationLevel16	n1	AL16	Test 5
}			
searchSpaceType CHOICE {			
common SEQUENCE {			CSS, SISS
ue-Specific SEQUENCE {			USS
dci-Formats	formats0-1-And-1-1	DCI Format 1_1 for tests 2 and 3	Long_DCI
	formats0-0-And-1-0	DCI Format 1_0 for tests 1, 4, 5	
}			
}			
}			

Table 5.3.2.1.1.4.3.1-3: *PDSCH-Config*

Derivation Path: TS 38.508-1 [6], Table 5.4.2-18			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-Config ::= SEQUENCE {			
TCI-State[1]	TCI-StateId 0		
qcl-type1 {		Type 1 QCL information	
Cell	ServCellIndex		
Bwp-id	1	BWP ID	
referenceSignal	Ssb : 0	SSB # 0	
Qcl-Type	Type C		
}			
qcl-type2 {		Type 2 QCL information	
Cell	ServCellIndex		
Bwp-id	1	BWP ID	
referenceSignal	Ssb : 0	SSB # 0	
Qcl-Type	Type D		
}			
TCI-State[2]	TCI-StateId 1	Type 1 QCL information	
qcl-type1 {			
Cell	ServCellIndex		
Bwp-id	1	BWP ID	
referenceSignal	csi-rs : 0	CSI-RS # 0	
Qcl-Type	Type A		
}			
qcl-type2 {		Type 2 QCL information	
Cell	ServCellIndex		
Bwp-id	1	BWP ID	
referenceSignal	csi-rs : 0	SSB # 0	
Qcl-Type	Type D		
}			
}			
}			

Editor's note: this table is a duplication of the aboveand was renumbered to 3A. Conflict has to be resolved!

Table 5.3.2.1.1.4.3.1-3A: *PDSCH-Config*

Derivation Path: TS 38.508-1 [6], Table 5.4.2-18			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-Config ::= SEQUENCE {			
resourceAllocation	resourceAllocationType1		Test 1, Test 4, Test 5
}			

5.3.2.1.1.4.3.2 Message exceptions for NSA

Same as 5.3.2.1.1.4.3.1

5.3.2.1.1.4.4 Test requirement

Table 5.3.2.1.1.4.4-1 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 5.3.2.1.1.4.4-1.

Table 5.3.2.1.1.4.4-1: Test Requirement for 1Tx PDCCH with 15 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 (dB)
1	10 MHz	24	2	2	R.PDCCH.1-2.1 FDD	TDLA30-10	1x2 Low	1	9.0
2	10 MHz	24	2	2	R.PDCCH.1-2.3 FDD	TDLC300-100	1x2 Low	1	9.1
3	10 MHz	48	2	4	R.PDCCH.1-2.4 FDD	TDLA30-10	1x2 Low	1	6.4
4	10 MHz	48	1	4	R.PDCCH.1-1.1 FDD	TDLA30-10	1x2 Low	1	5.3
5	10MHz	48	2	16	R.PDCCH.1-2.6 FDD	TDLA30-10	1x2 Low	1	-1.2

5.3.2.1.2 2Rx FDD FR1 PDCCH 2 Tx antenna performance for both SA and NSA

5.3.2.1.2.1 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 5.3.2.1.2.3-1. The downlink physical setup is in accordance with Annex C.2.1.

5.3.2.1.2.2 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.

5.3.2.1.2.3 Minimum conformance requirements

For the parameters specified in Table 5.3.2.1-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 5.3.2.1.2.3-1. The downlink physical setup is in accordance with Annex C.2.1.

Table 5.3.2.1.2.3-1: Minimum performance for 2 Tx PDCCH with 15 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 (dB)
1	10 MHz	24	2	4	R.PDCCH.1-2.2 FDD	TDLC300-100	2x2 Low	1	2.0
2	10 MHz	48	2	8	R.PDCCH.1-2.5 FDD	TDLC300-100	2x2 Low	1	-1.3
3	10 MHz	48	1	8	R.PDCCH.1-1.3 FDD	TDLA30-10	2x2 Low	1	-0.2

The normative reference for this requirement is TS 38.101-4 [2] clause 5.3.

5.3.2.1.2.4 Test description

5.3.2.1.2.4.1 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 [7].

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 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.3.1.7.1 for TE diagram and clause A.3.2.2 for UE diagram.

2. The parameter settings for the cell are set up according to Table 5.3-1, Table 5.3.2.1-1 and Table 5.3.2.1.2.3-1 and as appropriate.

3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2 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 contents are defined in clause 5.3.2.1.2.4.3.

5.3.2.1.2.4.2 Test procedure

1. SS transmits PDCCH with DCI format as specified in PDCCH Reference Channelfor C_RNTI to transmit the DL RMC according to Table 5.3.2.1.2.3-1. The details of PDCCH are specified in Table 5.3.1, Table 5.3.2.1-1, Table 5.3.2.1.2.3-1 respectively. The SS sends downlink MAC padding bits on the DL RMC.

2. Set the parameters of the propagation condition, antenna configuration, the correlation matrix and the SNR according to Table 5.3.2.1.2.3-1 as appropriate.

3. 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 5.3.2.1.2.4.4-1, pass the UE. Otherwise fail the UE.

4. Repeat steps from 1 to 3 for each subtest in Table 5.3.2.1.2.3-1 as appropriate.

5.3.2.1.2.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clauses 4.6.1 and 5.4.2.

5.3.2.1.2.4.3.1 Message exceptions for SA

Table 5.3.2.1.2.4.3.1-1: PDCCH-ControlResourceSet

Derivation Path: TS 38.508-1 [6], Table 5.4.2-3			
Information Element	**Value/remark**	**Comment**	**Condition**
ControlResourceSet ::= SEQUENCE {			
frequencyDomainResources	11111111 00000000 00000000 00000000 00000000 00000	CORESET to use the least significant 48 RBs of the BWP Test 2, 3	
	11110000 00000000 00000000 00000000 00000000 00000	CORESET to use the least significant 24 RBs of the BWP Test 1	
Duration	2	SearchSpace duration of 2 symbols Test 1, 2	
	1	SearchSpace duration of 1 symbol Test 3	
tci-StatesPDCCH-ToAddList {			
	0	TCI State #0	
	1	TCI State #1	
}			
}			

Table 5.3.2.1.2.4.3.1-2: PDCCH *Search Space*

Derivation Path: TS 38.508-1 [6], Table 5.4.2-4			
Information Element	**Value/remark**	**Comment**	**Condition**
SearchSpace ::= SEQUENCE {			
nrofCandidates SEQUENCE {			
aggregationLevel1	n0		
aggregationLevel2	n0		
aggregationLevel4	n1	AL4	Test 1
aggregationLevel8	n1	AL8	Test 2, 3
aggregationLevel16	n0		
}			
searchSpaceType CHOICE {			
common SEQUENCE {			CSS, SISS
ue-Specific SEQUENCE {			USS
dci-Formats	formats0-1-And-1-1	DCI Format 1_1 for tests 2 and 3	Long_DCI
	formats0-0-And-1-0	DCI Format 1_0 for test 1	
}			
}			
}			

Table 5.3.2.1.2.4.3.1-3: *PDSCH-Config*

Derivation Path: TS 38.508-1 [6], Table 5.4.2-18			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-Config ::= SEQUENCE {			
resourceAllocation	resourceAllocationType1		Test 1
}			

5.3.2.1.2.4.3.2 Message exceptions for NSA

Same as 5.3.2.1.2.4.3.1

5.3.2.1.2.4.4 Test requirement

Table 5.3.2.1.2.4.4-1 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 5.3.2.1.2.4.4-1.

Table 5.3.2.1.2.4.4-1: Test Requirements for 2 Tx PDCCH with 15 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 (dB)
1	10 MHz	24	2	4	R.PDCCH.1-2.2 FDD	TDLC300-100	2x2 Low	1	3.0
2	10 MHz	48	2	8	R.PDCCH.1-2.5 FDD	TDLC300-100	2x2 Low	1	-0.3
3	10 MHz	48	1	8	R.PDCCH.1-1.3 FDD	TDLA30-10	2x2 Low	1	0.8

5.3.2.2 TDD

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

Table 5.3.2.2-1: Test Parameters

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

5.3.2.2.1 2Rx TDD FR1 PDCCH 1 Tx antenna performance for both SA and NSA

5.3.2.2.1.1 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 5.3.2.2.1.3-1. The downlink physical setup is in accordance with Annex C.2.1.

5.3.2.2.1.2 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.

5.3.2.2.1.3 Minimum conformance requirements

For the parameters specified in Table 5.3.2.2-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 5.3.2.2.1.3-1. The downlink physical setup is in accordance with Annex C.2.1.

Table 5.3.2.2.1.3-1: Minimum performance for PDCCH with 30 kHz SCS

Test number	Band width (MHz)	CORE SET RB	CORESET duration	Aggregation level	Reference Channel	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
								Pm-dsg (%)	SNR (dB)
1	40	102	1	2	R.PDCCH. 2-1.1 TDD	TDLA30-10	1x2 Low	1	7.0
2	40	102	1	4	R.PDCCH. 2-1.2 TDD	TDLC300-100	1x2 Low	1	3.0
3	40	48	2	16	R.PDCCH. 2-2.1 TDD	TDLC300-100	1x2 Low	1	-3.8

The normative reference for this requirement is TS 38.101-4 [5] clause 5.3.2.2.

5.3.2.2.1.4 Test description

5.3.2.2.1.4.1 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 5.3.6-2 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 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 sources 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.3.2.2 for UE diagram.
2. The parameter settings for the cell are set up according to Table 5.3-1, Table 5.3.2.2-1 and Table 5.3.2.2.1.3-1 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 38.521-1 [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 contents are defined in clause 5.3.2.2.1.4.3.

5.3.2.2.1.4.2 Test procedure

1. SS transmits PDSCH via PDCCH with DCI format as specified in PDCCH Reference Channel for C_RNTI to transmit the DL RMC according to Table 5.3.2.2.1.3-1. The details of PDCCH are specified in Table 5.3-1, Table 5.3.2.2-1 and Table 5.3.2.2.1.3-1 respectively. The details of PDSCH are specified in Table A.3.3.2.2-3. The SS sends downlink MAC padding bits on the DL RMC.
2. Set the parameters of the propagation condition, antenna configuration, the correlation matrix and the SNR according to Table 5.3.2.2.1.3-1 as appropriate.
3. 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 5.3.2.2.1.5-1, pass the UE. Otherwise fail the UE.

4. Repeat steps from 1 to 3 for each subtest in Table 5.3.2.2.1.3-1 as appropriate.

5.3.2.2.1.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1 and 5.4.2.

5.3.2.2.1.4.3.1 Message exceptions for SA

Table 5.3.2.2.1.4.3.1-1: PDCCH-ControlResourceSet

Derivation Path: TS 38.508-1 [6], Table 5.4.2-3			
Information Element	**Value/remark**	**Comment**	**Condition**
ControlResourceSet ::= SEQUENCE {			
controlResourceSetId	ControlResourceSetId		
frequencyDomainResources	11111111 00000000 00000000 00000000 00000000 00000	CORESET to use the least significant 48 RBs of the BWP Test 3	
	11111111 11111111 10000000 00000000 00000000 00000	CORESET to use the least significant 102 RBs of the BWP Test 1, 2	
Duration	2	SearchSpace duration of 2 symbols Test 3	
	1	SearchSpace duration of 1 symbol Test 1, 2	
cce-REG-MappingType CHOICE {			
Interleaved SEQUENCE {	Null		Test 1, Test 2
reg-BundleSize	n2		1 Tx
interleaverSize	n3		TDD
}			
nonInterleaved	null		Test 3
}			
precoderGranularity	sameAsREG-bundle		
tci-StatesPDCCH-ToAddList {	0	TCI State #0	
	1	TCI State #1	
}			
}			

Table 5.3.2.2.1.4.3.1-2: PDCCH *Search Space*

Derivation Path: TS 38.508-1 [6], Table 5.4.2-4			
Information Element	**Value/remark**	**Comment**	**Condition**
SearchSpace ::= SEQUENCE {			
searchSpaceId	2	SearchSpaceId with condition USS	USS
controlResourceSetId	1	ControlResourceSetId	
monitoringSlotPeriodicityAndOffset CHOICE {			
sl1	NULL		
}			
nrofCandidates SEQUENCE {			
aggregationLevel2	n1	AL2	Test 1
aggregationLevel4	n1	AL4	Test 2
aggregationLevel16	n1	AL16	Test 3
}			
}			
searchSpaceType CHOICE {			
common SEQUENCE {			CSS, SISS
ue-Specific SEQUENCE {			USS
dci-Formats	formats0-1-And-1-1	DCI Format 1_1 for test 2	Long_DCI
	formats0-0-And-1-0	DCI Format 1_0 for tests 1 and 3	
}			
}			
}			

Table 5.3.2.2.1.4.3.1-3: *PDSCH-Config*

Derivation Path: TS 38.508-1 [6], Table 5.4.2-18			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-Config ::= SEQUENCE {			
TCI-State[1]	TCI-StateId 0		
qcl-type1 {		Type 1 QCL information	
Cell	ServCellIndex		
Bwp-id	1	BWP ID	
referenceSignal	Ssb : 0	SSB # 0	
Qcl-Type	Type C		
}			
qcl-type2 {		Type 2 QCL information	
Cell	ServCellIndex		
Bwp-id	1	BWP ID	
referenceSignal	Ssb : 0	SSB # 0	
Qcl-Type	Type D		
}			
TCI-State[2]	TCI-StateId 1	Type 1 QCL information	
qcl-type1 {			
Cell	ServCellIndex		
Bwp-id	1	BWP ID	
referenceSignal	csi-rs : 0	CSI-RS # 0	
Qcl-Type	Type A		
}			
qcl-type2 {		Type 2 QCL information	
Cell	ServCellIndex		
Bwp-id	1	BWP ID	
referenceSignal	csi-rs : 0	SSB # 0	
Qcl-Type	Type D		
}			
}			
}			

Editor's note: following table was renumbered to 3A. Conflict has to be resolved!

Table 5.3.2.2.1.4.3.1-3A: *PDSCH-Config*

Derivation Path: TS 38.508-1 [6], Table 5.4.2-18			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-Config ::= SEQUENCE {			
resourceAllocation	resourceAllocationType1		Test 1, Test 3
}			

5.3.2.2.1.4.3.2 Message exceptions for NSA

Same as 5.3.2.2.1.4.3.1.

5.3.2.2.1.5 Test requirement

Table 5.3.2.2.1.5-1 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 5.3.2.2.1.5-1.

Table 5.3.2.2.1.5-1: Test Requirement for 1Tx PDCCH with 30 kHz SCS

Test number	Band width (MHz)	CORE SET RB	CORESET duration	Aggregation level	Reference Channel	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
								Pm-dsg (%)	SNR (dB)
1	40	102	1	2	R.PDCCH. 2-1.1 TDD	TDLA30-10	1x2 Low	1	7.9
2	40	102	1	4	R.PDCCH. 2-1.2 TDD	TDLC300-100	1x2 Low	1	3.9
3	40	48	2	16	R.PDCCH. 2-2.1 TDD	TDLC300-100	1x2 Low	1	-2.9

5.3.2.2.2 2Rx TDD FR1 PDCCH 2 Tx antenna performance for both SA and NSA

5.3.2.2.2.1 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 5.3.2.2.2.3-1. The downlink physical setup is in accordance with Annex C.2.1.

5.3.2.2.2.2 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.

5.3.2.2.2.3 Minimum conformance requirements

For the parameters specified in Table 5.3.2.2-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 5.3.2.2.2.3-1. The downlink physical setup is in accordance with Annex C.2.1.

Table 5.3.2.2.2.3-1: Minimum performance for PDCCH with 30 kHz SCS

Test number	Band width (MHz)	CORE SET RB	CORESET duration	Aggregation level	Reference Channel	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
								Pm-dsg (%)	SNR (dB)
1	40	90	1	8	R.PDCCH. 2-1.3 TDD	TDLC300-100	2x2 Low	1	-1.2

The normative reference for this requirement is TS 38.101-4 [5] clause 5.3.2.2.

5.3.2.2.2.4 Test description

5.3.2.2.2.4.1 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 5.3.6-2 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 4.3.1.

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

1. Connect the SS, the faders and AWGN noise sources 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 5.3-1, Table 5.3.2.2-1 and Table 5.3.2.2.2.3-1 as appropriate.
3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2 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 contents are defined in clause 5.3.2.2.2.4.3.

5.3.2.2.2.4.2 Test procedure

1. SS transmits PDSCH via PDCCH with DCI format 1_1 for C_RNTI to transmit the DL RMC according to Table 5.3.2.2.2.3-1. The details of PDCCH are specified in Table 5.3-1, Table 5.3.2.2-1 and Table 5.3.2.2.2.3-1 respectively. The details of PDSCH are specified in Table A.3.3.2.2-3. The SS sends downlink MAC padding bits on the DL RMC.
2. Set the parameters of the propagation condition, antenna configuration, the correlation matrix and the SNR according to Table 5.3.2.2.2.3-1 as appropriate.
3. 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 5.3.2.2.2.5-1, pass the UE. Otherwise fail the UE.

5.3.2.2.2.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clauses 4.6.1 and 5.4.2.

5.3.2.2.2.4.3.1 Message exceptions for SA

Table 5.3.2.2.2.4.3.1-1: PDCCH-ControlResourceSet

Derivation Path: TS 38.508-1 [6], Table 5.4.2-3			
Information Element	**Value/remark**	**Comment**	**Condition**
ControlResourceSet ::= SEQUENCE {			
controlResourceSetId	ControlResourceSetId		
frequencyDomainResources	11111111 11111110 00000000 00000000 00000000 00000	CORESET to use the least significant 90 RBs of the BWP Test 1	
Duration	1	SearchSpace duration of 1 symbols Test 1	
cce-REG-MappingType CHOICE {			
Interleaved SEQUENCE {	Null		
reg-BundleSize	n6		2 Tx
interleaverSize	n3		TDD
}			
}			
precoderGranularity	sameAsREG-bundle		
tci-StatesPDCCH-ToAddList {	0	TCI State #0	
	1	TCI State #1	
}			
}			

Table 5.3.2.2.2.4.3.1-2: PDCCH *Search Space*

Derivation Path: TS 38.508-1 [6], Table 5.4.2-4			
Information Element	**Value/remark**	**Comment**	**Condition**
SearchSpace ::= SEQUENCE {			
searchSpaceId	2	SearchSpaceId with condition USS	USS
controlResourceSetId	1	ControlResourceSetId	
monitoringSlotPeriodicityAndOffset CHOICE {			
sl1	NULL		
}			
nrofCandidates SEQUENCE {			
aggregationLevel8	n1	AL8	Test 1
}			
}			

Table 5.3.2.2.2.4.3.1-3: *PDSCH-Config*

Derivation Path: TS 38.508-1 [6], Table 5.4.2-18			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-Config ::= SEQUENCE {			
TCI-State[1]	TCI-StateId 0		
qcl-type1 {		Type 1 QCL information	
Cell	ServCellIndex		
Bwp-id	1	BWP ID	
referenceSignal	Ssb : 0	SSB # 0	
Qcl-Type	Type C		
}			
qcl-type2 {		Type 2 QCL information	
Cell	ServCellIndex		
Bwp-id	1	BWP ID	
referenceSignal	Ssb : 0	SSB # 0	
Qcl-Type	Type D		
}			
TCI-State[2]	TCI-StateId 1	Type 1 QCL information	
qcl-type1 {			
Cell	ServCellIndex		
Bwp-id	1	BWP ID	
referenceSignal	csi-rs : 0	CSI-RS # 0	
Qcl-Type	Type A		
}			
qcl-type2 {		Type 2 QCL information	
Cell	ServCellIndex		
Bwp-id	1	BWP ID	
referenceSignal	csi-rs : 0	SSB # 0	
Qcl-Type	Type D		
}			
}			
}			

5.3.2.2.2.4.3.2 Message exceptions for NSA

Same as 5.3.2.2.2.4.3.1.

5.3.2.2.2.5 Test requirement

Table 5.3.2.2.2.5-1 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 5.3.2.2.2.5-1.

Table 5.3.2.2.2.5-1: Test Requirement for 2Tx PDCCH with 30 kHz SCS

Test number	Band width (MHz)	CORE SET RB	CORESET duration	Aggregation level	Reference Channel	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
								Pm-dsg (%)	SNR (dB)
1	40	90	1	8	R.PDCCH.2-1.3 TDD	TDLC300-100	2x2 Low	1	-0.2

5.3.3 4RX requirements

5.3.3.1 FDD

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

Table 5.3.3.1-1: Test Parameters

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

5.3.3.1.1 4Rx FDD FR1 PDCCH 1 Tx antenna performance for both SA and NSA

5.3.3.1.1.1 Test Purpose

This test verifies the demodulation performance of PDCCH under 4 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 5.3.3.1.1.3-1. The downlink physical setup is in accordance with Annex C.2.1.

5.3.3.1.1.2 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.

5.3.3.1.1.3 Minimum conformance requirements

For the parameters specified in Table 5.3.3.1-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 5.3.3.1.1.3-1. The downlink physical setup is in accordance with Annex C.2.1.

Table 5.3.3.1.1.3-1: Minimum performance for PDCCH with 15 kHz SCS

Test number	Band width (MHz)	CORESET RB	CORESET duration	Aggregation level	Reference Channel	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
								Pm-dsg (%)	SNR (dB)
1	10	24	2	2	R.PDCCH. 1-2.1 FDD	TDLA30-10	1x4 Low	1	2.2
2	10	24	2	2	R.PDCCH. 1-2.3 FDD	TDLC300-100	1x4 Low	1	2.7
3	10	48	2	4	R.PDCCH. 1-2.4 FDD	TDLA30-10	1x4 Low	1	0.2
4	10	48	1	4	R.PDCCH. 1-1.1 FDD	TDLA30-10	1x4 Low	1	-0.4
5	10	48	2	16	R.PDCCH. 1-2.6 FDD	TDLA30-10	1x4 Medium A	1	-3.2

The normative reference for this requirement is TS 38.101-4 [5] clause 5.3.3.1.

5.3.3.1.1.4 Test description

5.3.3.1.1.4.1 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 [7].

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 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 sources 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.3.2.5 for UE diagram.

2. The parameter settings for the cell are set up according to Table 5.3-1, Table 5.3.3.1-1 and Table 5.3.3.1.1.3-1 as appropriate.

3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2 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 contents are defined in clause 5.3.3.1.1.4.3.

5.3.3.1.1.4.2 Test procedure

1. SS transmits PDCCH with DCI format as specified in PDCCH Reference Channelfor C_RNTI to transmit the DL RMC according to Table 5.3.3.1.1.3-1. The details of PDCCH are specified in Table 5.3-1, Table 5.3.3.1-1 and Table 5.3.3.1.1.3-1 respectively. The SS sends downlink MAC padding bits on the DL RMC.

2. Set the parameters of the propagation condition, antenna configuration, the correlation matrix and the SNR according to Table 5.3.3.1.1.3-1 as appropriate.

3. 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 5.3.3.1.1.5-1, pass the UE. Otherwise fail the UE.

4. Repeat steps from 1 to 3 for each subtest in Table 5.3.3.1.1.3-1 as appropriate.

5.3.3.1.1.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clauses 4.6.1 and 5.4.2.

5.3.3.1.1.4.3.1 Message exceptions for SA

Table 5.3.3.1.1.4.3.1-1: PDCCH-ControlResourceSet

Derivation Path: TS 38.508-1 [6], Table 5.4.2-3			
Information Element	**Value/remark**	**Comment**	**Condition**
ControlResourceSet ::= SEQUENCE {			
controlResourceSetId	ControlResourceSetId		
frequencyDomainResources	11111111 00000000 00000000 00000000 00000000 00000	CORESET to use the least significant 48 RBs of the BWP Test 3, 4, 5	
	11110000 00000000 00000000 00000000 00000000 00000	CORESET to use the least significant 24 RBs of the BWP Test 1, 2	
Duration	2	SearchSpace duration of 2 symbols Test 1, 2, 3, 5	
	1	SearchSpace duration of 1 symbol Test 4	
precoderGranularity	sameAsREG-bundle		
tci-StatesPDCCH-ToAddList {	0	TCI State #0	
	1	TCI State #1	
}			
}			

Table 5.3.3.1.1.4.3.1-2: PDCCH *Search Space*

Derivation Path: TS 38.508-1 [6], Table 5.4.2-4			
Information Element	**Value/remark**	**Comment**	**Condition**
SearchSpace ::= SEQUENCE {			
searchSpaceId	2	SearchSpaceId with condition USS	USS
controlResourceSetId	1	ControlResourceSetId	
monitoringSlotPeriodicityAndOffset CHOICE {			
sl1	NULL		
}			
nrofCandidates SEQUENCE {			
aggregationLevel2	n1	AL2	Test 1, Test 2
aggregationLevel4	n1	AL4	Test 3, Test 4
aggregationLevel16	n1	AL16	Test 5
}			
}			
searchSpaceType CHOICE {			
common SEQUENCE {			CSS, SISS
ue-Specific SEQUENCE {			USS
dci-Formats	formats0-1-And-1-1	DCI Format 1_1 for tests 2 and 3	Long_DCI
	formats0-0-And-1-0	DCI Format 1_0 for tests 1, 4, 5	
}			
}			
}			

Table 5.3.3.1.1.4.3.1-3: *PDSCH-Config*

Derivation Path: TS 38.508-1 [6], Table 5.4.2-18			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-Config ::= SEQUENCE {			
TCI-State[1]	TCI-StateId 0		
qcl-type1 {		Type 1 QCL information	
Cell	ServCellIndex		
Bwp-id	1	BWP ID	
referenceSignal	Ssb : 0	SSB # 0	
Qcl-Type	Type C		
}			
qcl-type2 {		Type 2 QCL information	
Cell	ServCellIndex		
Bwp-id	1	BWP ID	
referenceSignal	Ssb : 0	SSB # 0	
Qcl-Type	Type D		
}			
TCI-State[2]	TCI-StateId 1	Type 1 QCL information	
qcl-type1 {			
Cell	ServCellIndex		
Bwp-id	1	BWP ID	
referenceSignal	csi-rs : 0	CSI-RS # 0	
Qcl-Type	Type A		
}			
qcl-type2 {		Type 2 QCL information	
Cell	ServCellIndex		
Bwp-id	1	BWP ID	
referenceSignal	csi-rs : 0	SSB # 0	
Qcl-Type	Type D		
}			
}			
}			

Editor's note: duplicated table below was renamed to 3A. Conflict has to be resolved!

Table 5.3.3.1.1.4.3.1-3A: *PDSCH-Config*

Derivation Path: TS 38.508-1 [6], Table 5.4.2-18			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-Config ::= SEQUENCE {			
resourceAllocation	resourceAllocationType1		Test 1, Test 4, Test 5
}			

5.3.3.1.1.4.3.2 Message exceptions for NSA

Same as 5.3.3.1.1.4.3.1.

5.3.3.1.1.5 Test requirement

Table 5.3.3.1.1.5-1 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 5.3.3.1.1.5-1.

Table 5.3.3.1.1.5-1: Test Requirement for 1Tx PDCCH with 15 kHz SCS

Test number	Band width (MHz)	CORE SET RB	CORESET duration	Aggregation level	Reference Channel	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
								Pm-dsg (%)	SNR (dB)
1	10	24	2	2	R.PDCCH. 1-2.1 FDD	TDLA30-10	1x4 Low	1	3.1
2	10	24	2	2	R.PDCCH. 1-2.3 FDD	TDLC300-100	1x4 Low	1	3.6
3	10	48	2	4	R.PDCCH. 1-2.4 FDD	TDLA30-10	1x4 Low	1	1.1
4	10	48	1	4	R.PDCCH. 1-1.1 FDD	TDLA30-10	1x4 Low	1	0.5
5	10	48	2	16	R.PDCCH. 1-2.6 FDD	TDLA30-10	1x4 Medium A	1	-2.3

5.3.3.1.2 4Rx FDD FR1 PDCCH 2 Tx antenna performance for both SA and NSA

5.3.3.1.2.1 Test Purpose

This test verifies the demodulation performance of PDCCH under 4 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 5.3.3.1.2.3-1. The downlink physical setup is in accordance with Annex C.2.1.

5.3.3.1.2.2 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.

5.3.3.1.2.3 Minimum conformance requirements

For the parameters specified in Table 5.3.3.1-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 5.3.3.1.2.3-1. The downlink physical setup is in accordance with Annex C.2.1.

Table 5.3.3.1.2.3-1: Minimum performance for PDCCH with 15 kHz SCS

Test number	Band width (MHz)	CORE SET RB	CORESET duration	Aggregation level	Reference Channel	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
								Pm-dsg (%)	SNR (dB)
1	10	24	2	4	R.PDCCH. 1-2.2 FDD	TDLC300-100	2x4 Low	1	-1.9
2	10	48	2	8	R.PDCCH. 1-2.5 FDD	TDLC300-100	2x4 Low	1	-4.5
3	10	48	1	4	R.PDCCH. 1-1.2 FDD	TDLA30-10	2x4 Low	1	-1.0

The normative reference for this requirement is TS 38.101-4 [5] clause 5.3.3.1.

5.3.3.1.2.4 Test description

5.3.3.1.2.4.1 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 [7].

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 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 sources 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.
2. The parameter settings for the cell are set up according to Table 5.3-1, Table 5.3.3.1-1 and Table 5.3.3.1.2.3-1 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 38.521-1 [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 contents are defined in clause 5.3.3.1.2.4.3.

5.3.3.1.2.4.2 Test procedure

1. SS transmits PDCCH with DCI format as specified in PDCCH Reference Channel for C_RNTI to transmit the DL RMC according to Table 5.3.3.1.2.3-1. The details of PDCCH are specified in Table 5.3-1, Table 5.3.3.1-1 and Table 5.3.3.1.2.3-1 respectively. The SS sends downlink MAC padding bits on the DL RMC.
2. Set the parameters of the propagation condition, antenna configuration, the correlation matrix and the SNR according to Table 5.3.3.1.2.3-1 as appropriate.
3. 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 5.3.3.1.2.5-1, pass the UE. Otherwise fail the UE.
4. Repeat steps from 1 to 3 for each subtest in Table 5.3.3.1.2.3-1 as appropriate.

5.3.3.1.2.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clauses 4.6.1 and 5.4.2.

5.3.3.1.2.4.3.1 Message exceptions for SA

Table 5.3.3.1.2.4.3.1-1: PDCCH-ControlResourceSet

Derivation Path: TS 38.508-1 [6], Table 5.4.2-3			
Information Element	**Value/remark**	**Comment**	**Condition**
ControlResourceSet ::= SEQUENCE {			
controlResourceSetId	ControlResourceSetId		
frequencyDomainResources	11111111 00000000 00000000 00000000 00000000 00000	CORESET to use the least significant 48 RBs of the BWP Test 2, 3	
	11110000 00000000 00000000 00000000 00000000 00000	CORESET to use the least significant 24 RBs of the BWP Test 1	
Duration	2	SearchSpace duration of 2 symbols Test 1, 2	
	1	SearchSpace duration of 1 symbol Test3	
precoderGranularity	sameAsREG-bundle		
tci-StatesPDCCH-ToAddList {	0	TCI State #0	
	1	TCI State #1	
}			
}			

Table 5.3.3.1.2.4.3.1-2: PDCCH *Search Space*

Derivation Path: TS 38.508-1 [6], Table 5.4.2-4			
Information Element	**Value/remark**	**Comment**	**Condition**
SearchSpace ::= SEQUENCE {			
searchSpaceId	2	SearchSpaceId with condition USS	USS
controlResourceSetId	1	ControlResourceSetId	
monitoringSlotPeriodicityAndOffset CHOICE {			
sl1	NULL		
}			
nrofCandidates SEQUENCE {			
aggregationLevel4	n1	AL4	Test 1, Test 3
aggregationLevel8	n1	AL8	Test 2
}			
}			
searchSpaceType CHOICE {			
common SEQUENCE {			CSS, SISS
ue-Specific SEQUENCE {			USS
dci-Formats	formats0-1-And-1-1	DCI Format 1_1 for tests 2 and 3	Long_DCI
	formats0-0-And-1-0	DCI Format 1_0 for test 1	
}			
}			
}			

Table 5.3.3.1.2.4.3.1-3: *PDSCH-Config*

Derivation Path: TS 38.508-1 [6], Table 5.4.2-18			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-Config ::= SEQUENCE {			
TCI-State[1]	TCI-StateId 0		
qcl-type1 {		Type 1 QCL information	
Cell	ServCellIndex		
Bwp-id	1	BWP ID	
referenceSignal	Ssb : 0	SSB # 0	
Qcl-Type	Type C		
}			
qcl-type2 {		Type 2 QCL information	
Cell	ServCellIndex		
Bwp-id	1	BWP ID	
referenceSignal	Ssb : 0	SSB # 0	
Qcl-Type	Type D		
}			
TCI-State[2]	TCI-StateId 1	Type 1 QCL information	
qcl-type1 {			
Cell	ServCellIndex		
Bwp-id	1	BWP ID	
referenceSignal	csi-rs : 0	CSI-RS # 0	
Qcl-Type	Type A		
}			
qcl-type2 {		Type 2 QCL information	
Cell	ServCellIndex		
Bwp-id	1	BWP ID	
referenceSignal	csi-rs : 0	SSB # 0	
Qcl-Type	Type D		
}			
}			
}			

Editor's note: duplicated table below was renamed to 3A. Conflict has to be resolved!

Table 5.3.3.1.2.4.3.1-3A: *PDSCH-Config*

Derivation Path: TS 38.508-1 [6], Table 5.4.2-18			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-Config ::= SEQUENCE {			
resourceAllocation	resourceAllocationType1		Test 1
}			

5.3.3.1.2.4.3.2 Message exceptions for NSA

Same as 5.3.3.1.2.4.3.1.

5.3.3.1.2.5 Test requirement

Table 5.3.3.1.2.5-1 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 5.3.3.1.2.5-1.

Table 5.3.3.1.2.5-1: Test Requirement for 2Tx PDCCH with 15 kHz SCS

Test number	Band width (MHz)	CORE SET RB	CORESET duration	Aggregation level	Reference Channel	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
								Pm-dsg (%)	SNR (dB)
1	10	24	2	4	R.PDCCH. 1-2.2 FDD	TDLC300-100	2x4 Low	1	-0.9
2	10	48	2	8	R.PDCCH. 1-2.5 FDD	TDLC300-100	2x4 Low	1	-3.5
3	10	48	1	4	R.PDCCH. 1-1.2 FDD	TDLA30-10	2x4 Low	1	0

5.3.3.2 TDD

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

Table 5.3.3.2-1: Common Test Parameters

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

5.3.3.2.1 4Rx TDD FR1 PDCCH 1 Tx antenna performance for both SA and NSA

5.3.3.2.1.1 Test Purpose

This test verifies the demodulation performance of PDCCH under 4 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 5.3.3.2.1.3-1. The downlink physical setup is in accordance with Annex C.2.1.

5.3.3.2.1.2 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.

5.3.3.2.1.3 Minimum conformance requirements

For the parameters specified in Table 5.3.3.2-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 5.3.3.2.1.3-1. The downlink physical setup is in accordance with Annex C.2.1.

Table 5.3.3.2.1.3-1: Minimum performance for PDCCH with 30 kHz SCS

Test number	Band width (MHz)	CORE SET RB	CORESET duration	Aggregation level	Reference Channel	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
								Pm-dsg (%)	SNR (dB)

1	40	102	1	2	R.PDCCH. 2-1.1 TDD	TDLA30-10	1x4 Low	1	2.1
2	40	102	1	4	R.PDCCH. 2-1.2 TDD	TDLC300-100	1x4 Low	1	-0.9
3	40	48	2	16	R.PDCCH. 2-2.1 TDD	TDLA30-10	1x4 Medium A	1	-3.6

The normative reference for this requirement is TS 38.101-4 [5] clause 5.3.3.2.

5.3.3.2.1.4 Test description

5.3.3.2.1.4.1 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 5.3.6-2 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 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 sources 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.3.2.5 for UE diagram.

2. The parameter settings for the cell are set up according to Table 5.3-1, Table 5.3.3.2-1 and Table 5.3.3.2.1.3-1 as appropriate.

3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2 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 contents are defined in clause 5.3.3.2.1.4.3.

5.3.3.2.1.4.2 Test procedure

1. SS transmits PDSCH via PDCCH with DCI format as specified in PDCCH Reference Channel for C_RNTI to transmit the DL RMC according to Table 5.3.3.2.1.3-1. The details of PDCCH are specified in Table 5.3-1, Table 5.3.3.2-1 and Table 5.3.3.2.1.3-1 respectively. The details of PDSCH are specified in Table A.3.3.2.2-3. The SS sends downlink MAC padding bits on the DL RMC.

2. Set the parameters of the propagation condition, antenna configuration, the correlation matrix and the SNR according to Table 5.3.3.2.1.3-1 as appropriate.

3. Measure the Pm-dsg for a duration sufficient to achieve statistical significance according to Annex G clause [G.1.x]. 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 5.3.3.2.1.5-1, pass the UE. Otherwise fail the UE.

4. Repeat steps from 1 to 3 for each subtest in Table 5.3.3.2.1.3-1 as appropriate.

5.3.3.2.1.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clauses 4.6.1 and 5.4.2.

5.3.3.2.1.4.3.1 Message exceptions for SA

Table 5.3.3.2.1.4.3.1-1: PDCCH-ControlResourceSet

Derivation Path: TS 38.508-1 [6], Table 5.4.2-3			
Information Element	**Value/remark**	**Comment**	**Condition**
ControlResourceSet ::= SEQUENCE {			
controlResourceSetId	ControlResourceSetId		
frequencyDomainResources	11111111 00000000 00000000 00000000 00000000 00000	CORESET to use the least significant 48 RBs of the BWP Test 3	
	11111111 11111111 10000000 00000000 00000000 00000	CORESET to use the least significant 102 RBs of the BWP Test 1, 2	
Duration	2	SearchSpace duration of 2 symbols Test 3	
	1	SearchSpace duration of 1 symbol Test 1, 2	
cce-REG-MappingType CHOICE {			
Interleaved SEQUENCE {	Null		Test 1, Test 2
reg-BundleSize	n2		1 Tx
interleaverSize	n3		TDD
}			
nonInterleaved	null		Test 3
}			
precoderGranularity	sameAsREG-bundle		
tci-StatesPDCCH-ToAddList {	0	TCI State #0	
	1	TCI State #1	
}			
}			

Table 5.3.3.2.1.4.3.1-2: PDCCH *Search Space*

Derivation Path: TS 38.508-1 [6], Table 5.4.2-4			
Information Element	**Value/remark**	**Comment**	**Condition**
SearchSpace ::= SEQUENCE {			
searchSpaceId	2	SearchSpaceId with condition USS	USS
controlResourceSetId	1	ControlResourceSetId	
monitoringSlotPeriodicityAndOffset CHOICE {			
sl1	NULL		
}			
nrofCandidates SEQUENCE {			
aggregationLevel2	n1	AL2	Test 1
aggregationLevel4	n1	AL4	Test 2
aggregationLevel16	n1	AL16	Test 3
}			
}			
searchSpaceType CHOICE {			
common SEQUENCE {			CSS, SISS
ue-Specific SEQUENCE {			USS
dci-Formats	formats0-1-And-1-1	DCI Format 1_1 for test 2	Long_DCI
	formats0-0-And-1-0	DCI Format 1_0 for test 1 and 3	
}			
}			
}			

Table 5.3.3.2.1.4.3.1-3: *PDSCH-Config*

Derivation Path: TS 38.508-1 [6], Table 5.4.2-18			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-Config ::= SEQUENCE {			
TCI-State[1]	TCI-StateId 0		
qcl-type1 {		Type 1 QCL information	
Cell	ServCellIndex		
Bwp-id	1	BWP ID	
referenceSignal	Ssb : 0	SSB # 0	
Qcl-Type	Type C		
}			
qcl-type2 {		Type 2 QCL information	
Cell	ServCellIndex		
Bwp-id	1	BWP ID	
referenceSignal	Ssb : 0	SSB # 0	
Qcl-Type	Type D		
}			
TCI-State[2]	TCI-StateId 1	Type 1 QCL information	
qcl-type1 {			
Cell	ServCellIndex		
Bwp-id	1	BWP ID	
referenceSignal	csi-rs : 0	CSI-RS # 0	
Qcl-Type	Type A		
}			
qcl-type2 {		Type 2 QCL information	
Cell	ServCellIndex		
Bwp-id	1	BWP ID	
referenceSignal	csi-rs : 0	SSB # 0	
Qcl-Type	Type D		
}			
}			
}			

Editor's note: duplicated table below was renamed to 3A. Conflict has to be resolved!

Table 5.3.3.2.1.4.3.1-3A: *PDSCH-Config*

Derivation Path: TS 38.508-1 [6], Table 5.4.2-18			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-Config ::= SEQUENCE {			
resourceAllocation	resourceAllocationType1		Test 1, Test 3
}			

5.3.3.2.1.4.3.2 Message exceptions for NSA

Same as 5.3.3.2.1.4.3.1.

5.3.3.2.1.5 Test requirement

Table 5.3.3.2.1.5-1 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 5.3.3.2.1.5-1.

Table 5.3.3.2.1.5-1: Test Requirement for 1Tx PDCCH with 30 kHz SCS

Test number	Band width (MHz)	CORE SET RB	CORESET duration	Aggregation level	Reference Channel	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
								Pm-dsg (%)	SNR (dB)
1	40	102	1	2	R.PDCCH. 2-1.1 TDD	TDLA30-10	1x4 Low	1	3
2	40	102	1	4	R.PDCCH. 2-1.2 TDD	TDLC300-100	1x4 Low	1	0
3	40	48	2	16	R.PDCCH. 2-2.1 TDD	TDLA30-10	1x4 Medium A	1	-2.7

5.3.3.2.2 4Rx TDD FR1 PDCCH 2 Tx antenna performance for both SA and NSA

5.3.3.2.2.1 Test Purpose

This test verifies the demodulation performance of PDCCH under 4 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 5.3.3.2.2.3-1. The downlink physical setup is in accordance with Annex C.2.1.

5.3.3.2.2.2 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.

5.3.3.2.2.3 Minimum conformance requirements

For the parameters specified in Table 5.3.3.2-1, the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 5.3.3.2.2.3-1. The downlink physical setup is in accordance with Annex C.2.1.

Table 5.3.3.2.2.3-1: Minimum performance for PDCCH with 30 kHz SCS

Test number	Band width (MHz)	CORE SET RB	CORESET duration	Aggregation level	Reference Channel	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
								Pm-dsg (%)	SNR (dB)
1	40	90	1	8	R.PDCCH. 2-1.3	TDLC300-100	2x4 Low	1	-4.3

The normative reference for this requirement is TS 38.101-4 [5] clause 5.3.3.2.

5.3.3.2.2.4 Test description

5.3.3.2.2.4.1 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 5.3.6-2 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 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 sources 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.

2. The parameter settings for the cell are set up according to Table 5.3-1, Table 5.3.3.2-1 and Table 5.3.3.2.2.3-1 as appropriate.

3. Downlink signals for NR cell are initially set up according to Annexes C.0, C.1, C.2 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 contents are defined in clause 5.3.3.2.2.4.3.

5.3.3.2.2.4.2 Test procedure

1. SS transmits PDSCH via PDCCH with DCI format as specified in PDCCH Reference Channel for C_RNTI to transmit the DL RMC according to Table 5.3.3.2.2.3-1. The details of PDCCH are specified in Table 5.3-1, Table 5.3.3.2-1 and Table 5.3.3.2.2.3-1. The details of PDSCH are specified in Table A.3.3.2.2-3. The SS sends downlink MAC padding bits on the DL RMC.

2. Set the parameters of the propagation condition, antenna configuration, the correlation matrix and the SNR according to Table 5.3.3.2.2.3-1 as appropriate.

3. 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 5.3.3.2.2.5-1, pass the UE. Otherwise fail the UE.

4. Repeat steps from 1 to 3 for each subtest in Table 5.3.3.2.2.3-1 as appropriate.

5.3.3.2.2.4.3 Message contents

Message contents are according to TS 38.508-1 [6] clause 4.6.1 and 5.4.2.

5.3.3.2.2.4.3.1 Message exceptions for SA

Table 5.3.3.2.2.4.3.1-1: PDCCH-ControlResourceSet

Derivation Path: TS 38.508-1 [6], Table 5.4.2-3			
Information Element	**Value/remark**	**Comment**	**Condition**
ControlResourceSet ::= SEQUENCE {			
controlResourceSetId	ControlResourceSetId		
frequencyDomainResources	11111111 11111110 00000000 00000000 00000000 00000	CORESET to use the least significant 90 RBs of the BWP Test 1	
Duration	1	SearchSpace duration of 1 symbols Test 1	
cce-REG-MappingType CHOICE {			
Interleaved SEQUENCE {	Null		
reg-BundleSize	n6		2 Tx
interleaverSize	n3		TDD
}			
}			
precoderGranularity	sameAsREG-bundle		
tci-StatesPDCCH-ToAddList {	0	TCI State #0	
	1	TCI State #1	
}			
}			

Table 5.3.3.2.2.4.3.1-2: PDCCH *Search Space*

Derivation Path: TS 38.508-1 [6], Table 5.4.2-4			
Information Element	**Value/remark**	**Comment**	**Condition**
SearchSpace ::= SEQUENCE {			
searchSpaceId	2	SearchSpaceId with condition USS	USS
controlResourceSetId	1	ControlResourceSetId	
monitoringSlotPeriodicityAndOffset CHOICE {			
sl1	NULL		
}			
nrofCandidates SEQUENCE {			
aggregationLevel8	n1	AL8	Test 1
}			
}			

Table 5.3.3.2.2.4.3.1-3: *PDSCH-Config*

Derivation Path: TS 38.508-1 [6], Table 5.4.2-18			
Information Element	**Value/remark**	**Comment**	**Condition**
PDSCH-Config ::= SEQUENCE {			
TCI-State[1]	TCI-StateId 0		
qcl-type1 {		Type 1 QCL information	
Cell	ServCellIndex		
Bwp-id	1	BWP ID	
referenceSignal	Ssb : 0	SSB # 0	
Qcl-Type	Type C		
}			
qcl-type2 {		Type 2 QCL information	
Cell	ServCellIndex		
Bwp-id	1	BWP ID	
referenceSignal	Ssb : 0	SSB # 0	
Qcl-Type	Type D		
}			
TCI-State[2]	TCI-StateId 1	Type 1 QCL information	
qcl-type1 {			
Cell	ServCellIndex		
Bwp-id	1	BWP ID	
referenceSignal	csi-rs : 0	CSI-RS # 0	
Qcl-Type	Type A		
}			
qcl-type2 {		Type 2 QCL information	
Cell	ServCellIndex		
Bwp-id	1	BWP ID	
referenceSignal	csi-rs : 0	SSB # 0	
Qcl-Type	Type D		
}			
}			
}			

5.3.3.2.2.4.3.2 Message exceptions for NSA

FFS

5.3.3.2.2.5 Test requirement

Table 5.3.3.2.2.5-1 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 5.3.3.2.2.5-1.

Table 5.3.3.2.2.5-1: Test Requirement for 2Tx PDCCH with 30 kHz SCS

Test number	Band width (MHz)	CORE SET RB	CORESET duration	Aggregation level	Reference Channel	Propagation Condition	Antenna configuration and correlation Matrix	Reference value	
								Pm-dsg (%)	SNR (dB)
1	40	90	1	8	R.PDCCH.2-1.3	TDLC300-100	2x4 Low	1	-3.3

5.4 PBCH demodulation requirements

RAN4 will specify the PBCH performance requirements and has recommended that these requirements do not need to be tested.

5.5 Sustained downlink data rate provided by lower layers

5.5.1 FR1 Sustained downlink data rate performance for single carrier

5.5.1.1 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

5.5.1.2 Test Applicability

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

5.5.1.3 Minimum conformance requirements

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

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

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

The common test parameters are specified in Table 5.5.1.3-1. The parameters specified in Table 5.5.1.3-2 are applicable for tests on FDD bands and parameters specified in Table 5.5.1.3-3 are applicable for tests on TDD bands.

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

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

Table 5.5.1.3-1: Common test parameters for FDD and TDD bands

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 5.5.1.3-4
	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
	1 layer CCs			1x2 or 1x4

Antenna configuration	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 5.5.1.3-2: Additional test parameters for 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 5.5.1.3-3: Additional test parameters for 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 5.5.1.3-4: Number of PRBs in CORESET

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

Table 5.5.1.3-5: MCS indexes for indicated UE capabilities

Maximum number of PDSCH MIMO layers	Maximum modulation format	Scaling factor	MCS
1	8	1	26
1	8	0.8	21
1	8	0.75	20
1	8	0.4	11
1	6	1	27
1	6	0.8	23
1	6	0.75	22
1	6	0.4	14
1	4	1	16
1	4	0.8	16
1	4	0.75	16
1	4	0.4	10
1	2	1	9
1	2	0.8	9
1	2	0.75	9
1	2	0.4	4
2	8	1	26
2	8	0.8	21
2	8	0.75	20
2	8	0.4	11
2	6	1	27
2	6	0.8	23
2	6	0.75	22
2	6	0.4	14
2	4	1	16
2	4	0.8	16
2	4	0.75	16
2	4	0.4	10
2	2	1	9
2	2	0.8	9
2	2	0.75	9
2	2	0.4	4
4	8	1	26
4	8	0.8	23
4	8	0.75	22
4	8	0.4	12
4	6	1	27
4	6	0.8	24
4	6	0.75	23
4	6	0.4	14
4	4	1	16
4	4	0.8	16
4	4	0.75	16
4	4	0.4	11
4	2	1	9
4	2	0.8	9
4	2	0.75	9
4	2	0.4	5
Note 1: MCS Index for maximum modulation format 2,4 and 6 is based on MCS index table 1 defined in clause 5.1.3.1 of TS 38.214 [12] Note 2: MCS Index for maximum modulation format 8 is based on MCS index table 2 defined in clause 5.1.3.1 of TS 38.214 [12]			

5.5.1.3.1 Procedure for test parameter selection

Below test parameter selection procedure is from 38.101-4 [5] by replacing CA configuration with operating band, and bandwidth instead of bandwidth combination.

The test parameters are determined by the following procedure:

- Select one operating band among all supported operating bands and set of per band UE capabilities among all supported UE capabilities that provides the largest data rate [TS 38.306 [14, Section 4.1.2]].
- Set of per band UE capabilities includes channel bandwidth, subcarrier spacing, number of PDSCH MIMO layers, modulation format and scaling factor [TS 38.306 [14, Section 4.1.2]].
- When there are multiple sets of bandwidths and UE capabilities (channel bandwidth, subcarrier spacing, number of MIMO layer, modulation format, scaling factor) with same largest data rate, select one among sets with the smallest channel bandwidth.
- For each operating band, use Table 5.5.1.3-5 to determine MCS 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.

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.

The normative reference for this requirement is TS 38.101-4 [5], clause 5.5.1.

5.5.1.4 Test description

5.5.1.4.1 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 5.5.1.3-1 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.0.
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 5.5.1.4.3.
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 5.5.1.3.1 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.

5.5.1.4.2 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 $A \geq$ 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.

5.5.1.4.3 Message contents

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

Table 5.5.1.4.3-0: 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 5.5.1.4.3-1 to -6: Void

Table 5.5.1.4.3-7: 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 5.5.1.4.3-8: *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		
}			

5.5.1.5 Test requirement

The PDCP SDU success rate of greater than 85% shall be sustained during at least 300 frames.

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.

6.1.1.2 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 (void)

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

<table>
<tr><th>UE feature/capability [14]</th><th colspan="2">Test type</th><th>Test list</th><th>Applicability notes</th></tr>
<tr><td rowspan="6">PDSCH MIMO layers (maxNumberMIMO-LayersPDSCH)</td><td rowspan="3">FR1 FDD</td><td>CQI</td><td>Clause 6.2.3.1.1.1</td><td rowspan="6">The requirements apply only in case the PDSCH MIMO rank in the test case does not exceed UE PDSCH MIMO layers capability</td></tr>
<tr><td>PMI</td><td>Clause 6.3.3.1.2</td></tr>
<tr><td>RI</td><td>Clause 6.4.2.1
Clause 6.4.3.1</td></tr>
<tr><td rowspan="3">FR1 TDD</td><td>CQI</td><td>Clause 6.2.3.2.1.1</td></tr>
<tr><td>PMI</td><td>Clause 6.3.3.2.2</td></tr>
<tr><td>RI</td><td>Clause 6.4.2.2
Clause 6.4.3.2</td></tr>
<tr><td rowspan="4">Supported maximum number of ports across all configured NZP-CSI-RS resources per CC (maxConfigNumberPortsAcrossNZP-CSI-RS-PerCC)</td><td rowspan="2">FR1 FDD</td><td>PMI</td><td>Clause 6.3.2.1.1
Clause 6.3.2.1.2
Clause 6.3.3.1.1
Clause 6.3.3.1.2</td><td rowspan="4">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</td></tr>
<tr><td>RI</td><td>Clause 6.4.3.1 (Test 4)</td></tr>
<tr><td rowspan="2">FR1 TDD</td><td>PMI</td><td>Clause 6.3.2.2.1
Clause 6.3.2.2.2
Clause 6.3.3.2.1
Clause 6.3.3.2.2</td></tr>
<tr><td>RI</td><td>Clause 6.4.3.2 (Test 4)</td></tr>
</table>

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
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 an 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
	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
	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
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 38.101-1 [2] for tested channel bandwidth and subcarrier spacing.				

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 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 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 6.2.2.1.1.1.4.4_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 {		Periodic	
periodic SEQUENCE {			
reportSlotConfig	CSI-ReportPeriodicityAndOffset	5/1	
}			
}			
reportFreqConfiguration SEQUENCE {			
csi-ReportingBand CHOICE{			
Subbands7	1111111		
}			
}			
}			

Table 6.2.2.1.1.1.4.4_1-2: *CodebookConfig*

Derivation Path: TS38.508-1 [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		
}			
}			
}			
}			
}			
}			
}			

6.2.2.1.1.1.4.3_2 Message exceptions for NSA

Same as specified in 6.2.2.1.1.1.4.4_1.

6.2.2.1.1.1.4 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.

6.2.2.1.2 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 4.3.1.

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.3.1.7.1 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	5/5			
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 4.3.1.

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.3.1.6.1 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. 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 2000 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)) $\geq$ 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 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 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 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 6.2.2.2.1.1.4.3.

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: 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	10/1	
}			
}			
reportFreqConfiguration SEQUENCE {			
	widebandCQI		
	widebandPMI		
csi-ReportingBand CHOICE{			
Subbands7	1111111		
}			
}			
}			

Table 6.2.2.2.1.1.4.4_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		
}			
}			
}			
}			
}			
}			
}			

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.

6.2.2.2.2 Wideband 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:

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 10 ms and also cases where UE transmits nothing in its CQI timing are also counted as wideband CQI reports.

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

<table>
<tr><th colspan="2">Parameter</th><th>Unit</th><th colspan="2">Test 1</th><th colspan="2">Test 2</th></tr>
<tr><td colspan="2">Bandwidth</td><td>MHz</td><td colspan="4">10</td></tr>
<tr><td colspan="2">Subcarrier spacing</td><td>kHz</td><td colspan="4">15</td></tr>
<tr><td colspan="2">Duplex Mode</td><td></td><td colspan="4">FDD</td></tr>
<tr><td colspan="2">SNR</td><td>dB</td><td>5</td><td>6</td><td>11</td><td>12</td></tr>
<tr><td colspan="2">Propagation channel</td><td></td><td colspan="4">AWGN</td></tr>
<tr><td colspan="2">Antenna configuration</td><td></td><td colspan="4">2×4 with static channel specified in Annex B.1</td></tr>
<tr><td colspan="2">Beamforming Model</td><td></td><td colspan="4">As specified in Annex B.4.1</td></tr>
<tr><td rowspan="7">ZP CSI-RS configuration</td><td>CSI-RS resource Type</td><td></td><td colspan="4">Periodic</td></tr>
<tr><td>Number of CSI-RS ports (X)</td><td></td><td colspan="4">4</td></tr>
<tr><td>CDM Type</td><td></td><td colspan="4">FD-CDM2</td></tr>
<tr><td>Density (ρ)</td><td></td><td colspan="4">1</td></tr>
<tr><td>First subcarrier index in the PRB used for CSI-RS (k_0)</td><td></td><td colspan="4">Row 5,4</td></tr>
<tr><td>First OFDM symbol in the PRB used for CSI-RS (l_0)</td><td></td><td colspan="4">9</td></tr>
<tr><td>CSI-RS
periodicity and offset</td><td>slot</td><td colspan="4">5/1</td></tr>
<tr><td rowspan="2">NZP CSI-RS for CSI acquisition</td><td>CSI-RS resource Type</td><td></td><td colspan="4">Periodic</td></tr>
<tr><td>Number of CSI-RS ports (X)</td><td></td><td colspan="4">2</td></tr>
</table>

	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 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.3.1.7.5 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.

6.2.3.1.1.1.5 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 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 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.3.1.7.5 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.

6.2.3.2.2 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:

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 10 ms and also cases where UE transmits nothing in its CQI timing are also counted as wideband CQI reports.

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			0			
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		

6.3 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 reports compared to the case when the transmitter is using random precoding, respectively. When the transmitter uses random precoding, for each PDSCH allocation a precoder is randomly generated and applied to the PDSCH. A fixed transport format (FRC) is configured for all requirements.

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

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

In the definition of γ, for 4TX and 8TX 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 Type I- 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
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 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.3.1.7.1 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 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 5.2.2.2.1-5 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 Type I – 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
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 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.3.1.7.1 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 to carry the PUSCH CSI 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 $\gamma = \dfrac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. 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, Table 5.4.2-9			
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, Table 5.4.2-13			
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

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

- Connection figure for 16 Tx is missing

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 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-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
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

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 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 TBD 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 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 5.2.2.2.1-5 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 6.3.2.1.3.5-1, 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

6.3.2.2 TDD

6.3.2.2.1 2Rx TDD FR1 Single PMI with 4Tx Type1 - 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,-)

Parameter		Unit	Test 1
	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 (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)
	CodebookSubsetRestriction		11111111
	RI Restriction		00000001

Parameter	Unit	Test 1
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
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 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.3.1.7.1 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 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 5.2.2.2.1-5 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 5.4.2-9			
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, Table 5.4.2-13			
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
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 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.3.1.7.1 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 to carry the PUSCH CSI 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 $\gamma = \dfrac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. 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, Table 5.4.2-9			
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, Table 5.4.2-13			
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 Single PMI with 16Tx Type1 - SinglePanel codebook for both SA and NSA

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

- Connection figure for 16 Tx is missing

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 16 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 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 TBD 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 to carry the PUSCH CSI 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 $\gamma = \dfrac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. 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

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

- Connection figure for 32 Tx is missing

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 16 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
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 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 TBD 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 to carry the PUSCH CSI 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 $\gamma = \dfrac{t_{ue,\, follow1,\, follow2}}{t_{rnd1,\, rnd2}}$. 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

6.3.3 4RX requirements

6.3.3.1 FDD

6.3.3.1.1 Single PMI with 4TX TypeI-SinglePanel Codebook– 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)
	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
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 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.3.1.7.1 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 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 5.2.2.2.1-5 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 $\gamma = \dfrac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. 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 Single PMI with 8TX TypeI-SinglePanel Codebook– 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
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 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.3.1.7.1 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 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 5.2.2.2.1-5 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 $\gamma = \dfrac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. If the ratio ≥ γ 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, Table 5.4.2-9			
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, Table 5.4.2-13			
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

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

- Connection figure for 16 Tx is missing

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-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
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

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 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 TBD 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 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 5.2.2.2.1-5 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 6.3.3.1.3.5-1, 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

6.3.3.2 TDD

6.3.3.2.1 4Rx TDD FR1 Single PMI with 4Tx Type1 - 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
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 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.3.1.7.1 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 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 5.2.2.2.1-5 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 $\gamma = \dfrac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. 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, Table 5.4.2-9			
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, Table 5.4.2-13			
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 Type1 - 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
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 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 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 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 5.2.2.2.1-5 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 $\gamma = \dfrac{t_{ue,\,follow1,\,follow2}}{t_{rnd1,\,rnd2}}$. 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, Table 5.4.2-9			
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, Table 5.4.2-13			
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 Single PMI with 16Tx Type1 - SinglePanel codebook for both SA and NSA

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

- Connection figure for 16 Tx is missing

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 16 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 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 TBD 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 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 5.2.2.2.1-5 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 6.3.3.2.3.5-1, 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

6.4 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, k_1)		Row 5, (4,-)	Row 5, (4,-)	Row 5, (4,-)

	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(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 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 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

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 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.3.1.7.1 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 5.2-1, Table 5.2.2.1.1.0-2 and Table 5.2.2.1.0-3 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, k_1)		Row 5, (4,-)	Row 5, (4,-)	Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(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, 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 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

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 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 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, k_1)		Row 5, (4,-)	Row 5, (4,-)	Row 5, (4,-)	Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(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, k_1)		Row 3 (6,-)	Row 3 (6,-)	Row 3 (6,-)	Row 4 (0,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(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

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 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.3.1.7.4 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
Duplex Mode			TDD	TDD	TDD	TDD
TDD Slot Configuration			FR1.30-1	FR1.30-1	FR1.30-1	FR1.30-1
DL BWP configuration #1	First PRB		0	0	0	0
	Number of contiguous PRB		106	106	106	106
	Subcarrier spacing	kHz	30	30	30	30
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, k_1)		Row 5, (4,-)	Row 5, (4,-)	Row 5, (4,-)	Row 5, (4,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(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, k_1)		Row 3 (6,-)	Row 3 (6,-)	Row 3 (6,-)	Row 4 (0,-)
	First OFDM symbol in the PRB used for CSI-RS (l_0, l_1)		(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

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 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 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 UEfeatures

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

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	

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.			

7.2 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
	Type 1 QCL information: QCL Type		Type C
	Type 2 QCL information: SSB index		SSB #0
	Type 2 QCL information: 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, 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 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, 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

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

Editor's Note: The following aspects are pending further analysis:

- The maximum testable SNR_{BB} for IFF based Test System for n259 is TBD
- Test points 1-3, 2-2, 2-3, 2-4, 2-5, 2-6 are not testable with the current assumption of maximum testable SNR_{BB}

Current assumption of maximum testable SNR_{BB} for IFF based Test System for FR2a: [19.2] dB, FR2b: [7.3 dB], FR2c: TBD.

Test point 1-1, 1-2, 2-1 are fully testable for FR2a, FR2b for 100 MHz CBW.

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 5.3.5-1 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 4.3.1.1.

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.
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 7.2.2.2.1.4.3.

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 Table 7.2.2.2.1_1.3-3 and 7.2.2.2.1_1.3-4. 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_1.4.4-1 and 7.2.2.2.1_1.4.4-2 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 Table 7.2.2.2.1_1.4.4-1 and Table 7.2.2.2.1_1.4.4-2 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 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 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 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 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 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 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 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

Table 7.2.2.2.1-2 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_1.4-1 and Table 7.2.2.21_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

Editor's Note: The following aspects are pending further analysis:

- The maximum testable SNR_{BB} for IFF based Test System for n259 is TBD
- Test points 3-1 is not testable with the current assumption of maximum testable SNR_{BB}

Current assumption of maximum testable SNR_{BB} for IFF based Test System for FR2a: [19.2] dB, FR2b: [7.3 dB], FR2c: TBD.

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 Table 7.2.2.2.1_1.4-1

7.2.2.2.1_2.3.1 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_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 7.2.2.2.1.0-2 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_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

7.2A PDSCH demodulation requirements for CA

The parameters specified in Table 7.2-1 for PDSCH single carrier tests are reused for PDSCH CA test unless otherwise stated.

7.2A.1 1RX requirements (Void)

7.2A.2 2RX requirements

7.2A.2.1_0 Minimum conformance requirements

For CA with different numbers of DL component carriers, the requirements are defined in Table 7.2A.2.1_0-3 based on the single carrier requirements for different bandwidth specified in Table 7.2A.2.1_0-2, with the parameters in Table 7.2A.2.1_0-1 and the downlink physical channel setup according to Annex C.2.2. The performance requirements specified in this sub-cluase do not apply for UE single carrier test.

Table 7.2A.2.1_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.2.1_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.2.1_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.2.1-2
Note 1: The applicability of requirements for different CA duplex modes, SCSs, CA configurations and bandwidth combination sets is defined in 7.1.1.x.		

The normative reference for this requirement is TS 38.101-4 [5] clause 7.2A.2.1

7.2A.2.1_1 2Rx TDD FR2 PDSCH CA Performance

Editor's Note: This clause is incomplete.

7.2A.2.1_1.1 Test Purpose

Verify the PDSCH mapping Type A normal performance with different channel models, MCSs and number of MIMO layers.

7.2A.2.1_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_1.3 Test Description

FFS

7.2A.2.1_1.3.2 Test Procedure

FFS

7.2A.2.1_1.3.3 Message Contents

FFS

7.2A.2.1_1.4 Test Requirements

FFS

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

<table>
<tr><th>Parameter</th><th colspan="2">Unit</th><th>Value</th><th>Parameter</th></tr>
<tr><td>Carrier configuration</td><td colspan="2">Offset between Point A and the lowest usable subcarrier on this carrier (Note 1)</td><td></td><td>0</td></tr>
<tr><td>DL BWP configuration #1</td><td colspan="2">Cyclic prefix</td><td></td><td>Normal</td></tr>
<tr><td rowspan="3">Common serving cell parameters</td><td colspan="2">Physical Cell ID</td><td></td><td>0</td></tr>
<tr><td colspan="2">SSB position in burst</td><td></td><td>1</td></tr>
<tr><td colspan="2">SSB periodicity</td><td>ms</td><td>20</td></tr>
<tr><td rowspan="4">PDCCH configuration</td><td colspan="2">Slots for PDCCH monitoring</td><td></td><td>Each slot</td></tr>
<tr><td colspan="2">Number of PDCCH candidates</td><td></td><td>1</td></tr>
<tr><td colspan="2">Frequency domain resource allocation for CORESET</td><td></td><td>Start from RB = 0 with contiguous RB allocation</td></tr>
<tr><td colspan="2">TCI state</td><td></td><td>TCI state #1</td></tr>
<tr><td rowspan="10">CSI-RS for tracking</td><td colspan="2">First subcarrier index in the PRB used for CSI-RS (k0)</td><td></td><td>0</td></tr>
<tr><td colspan="2">First OFDM symbol in the PRB used for CSI-RS (l0)</td><td></td><td>CSI-RS resource 1: 4
CSI-RS resource 2: 8
CSI-RS resource 3: 4
CSI-RS resource 4: 8</td></tr>
<tr><td colspan="2">Number of CSI-RS ports (X)</td><td></td><td>1</td></tr>
<tr><td colspan="2">CDM Type</td><td></td><td>No CDM</td></tr>
<tr><td colspan="2">Density (ρ)</td><td></td><td>3</td></tr>
<tr><td colspan="2">CSI-RS periodicity</td><td>Slots</td><td>160</td></tr>
<tr><td colspan="2">CSI-RS offset</td><td>Slots</td><td>80 for CSI-RS resource 1 and 2
81 for CSI-RS resource 3 and 4</td></tr>
<tr><td colspan="2">Frequency Occupation</td><td></td><td>Start PRB 0
Number of PRB = BWP size</td></tr>
<tr><td colspan="2">QCL info</td><td></td><td>TCI state #0</td></tr>
<tr><td rowspan="9">NZP CSI-RS for beam management</td><td colspan="2">First subcarrier index in the PRB used for CSI-RS (k0)</td><td></td><td>0</td></tr>
<tr><td colspan="2">First OFDM symbol in the PRB used for CSI-RS (l0)</td><td></td><td>CSI-RS resource 1: 8
CSI-RS resource 2: 9</td></tr>
<tr><td colspan="2">Number of CSI-RS ports (X)</td><td></td><td>1</td></tr>
<tr><td colspan="2">CDM Type</td><td></td><td>No CDM</td></tr>
<tr><td colspan="2">Density (ρ)</td><td></td><td>3</td></tr>
<tr><td colspan="2">CSI-RS periodicity</td><td>Slots</td><td>120 kHz SCS: 160 for CSI-RS resource 1,2</td></tr>
<tr><td colspan="2">CSI-RS offset</td><td>Slots</td><td>0 for CSI-RS resource 1,2</td></tr>
<tr><td colspan="2">Repetition</td><td></td><td>ON</td></tr>
<tr><td colspan="2">QCL info</td><td></td><td>TCI state #1</td></tr>
<tr><td colspan="3">PDCCH & PDCCH DMRS Precoding configuration</td><td></td><td>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</td></tr>
<tr><td rowspan="4">TCI state #0</td><td rowspan="2">Type 1 QCL information</td><td>SSB index</td><td></td><td>SSB #0</td></tr>
<tr><td>QCL Type</td><td></td><td>Type C</td></tr>
<tr><td rowspan="2">Type 2 QCL information</td><td>SSB index</td><td></td><td>SSB #0</td></tr>
<tr><td>QCL Type</td><td></td><td>Type D</td></tr>
</table>

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				OCNG in Annex A.5
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

Editor's Note: The following aspects are pending further analysis:

- The maximum testable SNR_{BB} for IFF based Test System for n259 is TBD.
- Test point 1-1 is not testable for FR2b with the current assumption of maximum testable SNR_{BB}.

Current assumption of maximum testable SNR_{BB} for IFF based Test System for FR2a: [19.2] dB, FR2b: [7.3 dB], FR2c: TBD.

Test points 1-1 and 1-2 are fully testable for FR2a for 100MHz CBW.

Test point 1-2 is fully testable for FR2b for 100MHz CBW.

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 5.3.5-1 and Table 5.3.6-1 of 38.521-1 [7].

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 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.3.3.2 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 7.3.2.2.1.3-1as 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 7.3.2.2.1.4.3.

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 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] clause 4.6.1.

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 4.6.3-28			
Information Element	**Value/remark**	**Comment**	**Condition**
ControlResourceSet ::= SEQUENCE {			
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
}			
}			

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

Editor's Note: The following aspects are either missing or not yet determined:

- The maximum testable SNR_{BB} for IFF based Test System for n259 is TBD. Current assumption of maximum testable SNR_{BB} for IFF based Test System for FR2a: [19.2] dB, FR2b: [7.3 dB], FR2c: TBD.

Test points 2-1 and 2-2 are fully testable for FR2a, FR2b for 100MHz CBW

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 5.3.5-1 and Table 5.3.6-1 of 38.521-1 [7].

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 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.3.3.2 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 7.3.2.2.2.3-1as 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 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] clause 4.6.1.

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 {			
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
}			
}			

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

7.4 PBCH demodulation requirements

RAN4 will 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

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

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

<table>
<tr><th>UE feature/capability [14]</th><th colspan="2">Test type</th><th>Test list</th><th>Applicability notes</th></tr>
<tr><td rowspan="2">Supported maximum number of PDSCH MIMO layers (maxNumberMIMO-LayersPDSCH)</td><td rowspan="2">FR2 TDD</td><td>CQI</td><td>Clause 8.2.2.2.1.1</td><td rowspan="2">The requirements apply only in case the PDSCH MIMO rank in the test case does not exceed UE PDSCH MIMO layers capability</td></tr>
<tr><td>RI</td><td>Clause 8.4.2.2</td></tr>
<tr><td rowspan="3">Support of 1 port PTRS (onePortsPTRS)</td><td rowspan="3">FR2 TDD</td><td>CQI</td><td>Clause 8.2</td><td rowspan="3"></td></tr>
<tr><td>PMI</td><td>Clause 8.3</td></tr>
<tr><td>RI</td><td>Clause 8.4</td></tr>
</table>

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 [7] 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 CQI reporting under AWGN performance for both SA and NSA

Editor's Note: The following aspects are pending further analysis:

- The maximum testable SNR_{BB} for IFF based Test System for n259 is TBD.
- Test 2 is not testable with the current assumption of maximum testable SNR_{BB}
- Test 1 is not testable for FR2b with the current assumption of maximum testable SNR_{BB}

Current assumption of maximum testable SNR_{BB} for IFF based Test System for FR2a: [19.2] dB, FR2b: [7.3 dB], FR2c: TBD.

Test 1 is fully testable for FR2a, FR2b for 100MHz CBW.

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 5.3.5-1 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 4.3.1.1.

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.

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 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 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.

8.2.2.2.1.1.4 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 CQI reporting under fading performance for both SA and NSA

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

- Annex for measurement uncertainty and test tolerance is TBD
- The maximum testable SNRBB for IFF based Test System for n259 is TBD
- Testability of Tests is TBD due to unknown TT

Current assumption of maximum testable SNR_{BB} for IFF based Test System for FR2a: [19.2] dB, FR2b: [7.3 dB], FR2c: TBD.

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 periodic 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 and using the downlink physical channels specified in Annex C.5.1, the minimum requirements are specified by the following:

a) a CQI index not in the set {median CQI -1, median CQI, median CQI +1} shall be reported at least α % of the time, where α% is specified in Table 8.2.2.2.2.1-2;

b) the ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be $\geq \gamma$, where γ is specified in Table 8.2.2.2.2.1-2;

c) when transmitting the transport format indicated by each reported wideband CQI index, the average BLER for the indicated transport formats shall be greater or equal to 0.01.

Table 8.2.2.2.2.1.3-1: 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 8.2.2.2.2.1-2 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 5.3.5-1 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 4.3.1.1.

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.

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 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 6.2.2.1.2.1.5-1.

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 40 (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 6.2.2.1.2.1.5 -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 with the following exceptions:

8.2.2.2.2.1.4.3_1 Message exceptions for SA

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

8.2.2.2.2.1.4 Test Requirements

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+TT	7+TT	12+TT	13+TT
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 = TBD			

Table 8.2.2.2.2.1-2 Test requirements

	Test 1	Test 2
α [%]	2	2
γ	1.05 - TT	1.05 - TT
Note 1: TT = 0.01		

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

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

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

8.3.1 1RX requirements (Void)

8.3.2 2RX requirements

8.3.2.1 FDD

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 5.3.5-1 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 4.3.1.1.

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 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			
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**
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

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

- Annex for measurement uncertainty and test tolerance is TBD
- The maximum testable SNR_{BB} for IFF based Test System for n259 is TBD

Current assumption of maximum testable SNR_{BB} for IFF based Test System for FR2a: [19.2] dB, FR2b: [7.3 dB], FR2c: TBD.

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 8.4.2.2.1-2 is defined as

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

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

For the parameters specified in Table 8.4.2.2-1, and using the downlink physical channels specified in Annex C.2.2, the minimum requirements are specified in Table 8.4.2.2.1-2.

Table 8.4.2.2.1-1: 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			FR1.120-2	FR1.120-2	FR1.120-2
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		Periodic	Periodic	Periodic
	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			7	7	7
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 Configuration contains pointers to NZP CSI-RS and CSI-IM	One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM	One State with one Associated Report Configuration Associated Report Configuration contains pointers to NZP CSI-RS and CSI-IM
Codebook 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

Table 8.4.2.2.1-2: 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 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.

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 8.1.2-1 and Table 8.4.2.2.1-1 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.

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 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 8.4.2.2.1-1 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 8.4.2.2.1-1. 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 8.4.2.2.1-1.

6. The UE shall transmit RRC Connection Reconfiguration Complete message.

7. Propagation conditions are set according to Table 8.4.2.2.1-1.

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 8.4.2.2.1-2 for the other Tests as appropriate. Otherwise, declare a PASS verdict.

8.4.2.2.1.4.3 Message Contents

8.4.2.2.1.4.3_1 Message exceptions for SA

TBD

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	1.05+TT	1.05+TT
γ_2	1.0+TT	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 both SA and NSA,
  - The performance requirements specified in Clause 5 will be verified only for SA except for the sustained downlink data rate test specified in Clause 5.5 and 5.5A.
  - The performance requirements specified in Clause 7 will be verified only for SA except for the sustained downlink data rate test specified in Clause 7.5.
  - The sustained downlink data rate tests specified in Clauses 5.5, 5.5A and 7.5 for SA and in Clause 9.4B for NSA are verified separately.
- The FR1 EN-DC test cases with the NR TDD DL-UL configurations which are not aligned with LTE's can be tested on the corresponding EN-DC band combinations where UE supports simultaneous transmission and reception.
- For UEs supporting NR FR1 CA and/or NR CA including FR1 and FR2, the requirements applicability is specified in Table 9.1.1-1.

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

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

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

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

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

- For UEs supporting NR-DC including FR1 and FR2, if the FR2 requirements in Clause 7.2 and Clause 7.3 are tested, the test coverage can be considered fulfilled without executing requirements in Clause 9.2B.2 and Clause 9.3B.2.

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

9.1.1.1 Applicability of requirements for optional UE features

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
	1 layer CCs			1x2 or 1x4

Antenna configuration	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 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. 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* 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 5.5.1.4.3.
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.1.1.3.1 determine one EN-DC bandwidth combination that would provide the largest aggregated data rate.
9. Setup up the NR CG and E-UTRA CG using these parameters for the test.
10. 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 RRC Reconfiguration message 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 RRC Reconfiguration message 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 $\geq$ 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 (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 -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 -6: Void

Table 9.4B.1.1.4.3-7: 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		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.1.1.4.3-8: *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		
}			

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

- Annex for measurement uncertainty and test tolerance is TBD

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-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 = 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 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, 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 4.3.1.1.

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.

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 both SA and NSA,
  - The performance requirements specified in Clause 6 will be verified only for SA mode.
  - The performance requirements specified in Clause 8 will be verifiedonly for SA 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

Annex A (normative): Measurement channels

A.1 General

A.1.1 Throughput definition

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

A.1.2 TDD UL-DL configurations for FR1

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

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

Parameter		**Unit**	**UL-DL pattern**
			FR1.15-1
TDD Slot Configuration pattern (Note 1)			DDDSU
Special Slot Configuration (Note 2)			10D+2G+2U
referenceSubcarrierSpacing		kHz	15
pattern1	*dl-UL-TransmissionPeriodicity*	ms	5
	nrofDownlinkSlots		3
	nrofDownlinkSymbols		10
	nrofUplinkSlot		1
	nrofUplinkSymbols		2
The number of slots between PDSCH and corresponding HARQ-ACK information (Note 3)			4 if mod(i,5) = 0 3 if mod(i,5) = 1 2 if mod(i,5) = 2 6 if mod(i,5) = 3
Note 1: D denotes a slot with all DL symbols; S denotes a slot with a mix of DL, UL and guard symbols; U denotes a slot with all UL symbols. The field is for information. Note 2: D, G, U denote DL, guard and UL symbols, respectively. The field is for information. Note 3: i is the slot index per frame; i = {0,…,9}.			

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

Parameter		Unit	UL-DL pattern					
			FR1.30-1	**FR1.30-2**	**FR1.30-3**	**FR1.30-4**	**FR1.30-5**	**FR1.30-6**
TDD Slot Configuration pattern (Note 1)			7DS2U	DDDSU	DDDSUDDSUU	DDDSUUDDDD	DSUU	DS_1S_2U
Special Slot Configuration (Note 2)			6D+4G+4U	10D+2G+2U	10D+2G+2U	6D+4G+4U	12D+2G	S1: 10D+2G+2U S2: 12D+2G+0U
referenceSubcarrierSpacing		kHz	30	30	30	30	30	30
pattern1								
	dl-UL-TransmissionPeriodicity	ms	5	2.5	2.5	3	2	1
	nrofDownlinkSlots		7	3	3	3	1	1
	nrofDownlinkSymbols		6	10	10	6	12	10
	nrofUplinkSlot		2	1	1	2	2	0
	nrofUplinkSymbols		4	2	2	4	0	2
pattern2								
	dl-UL-TransmissionPeriodicity	ms	N/A	N/A	2.5	2	N/A	1
	nrofDownlinkSlots		N/A	N/A	2	4	N/A	0
	nrofDownlinkSymbols		N/A	N/A	10	0	N/A	12
	nrofUplinkSlot		N/A	N/A	2	0	N/A	1
	nrofUplinkSymbols		N/A	N/A	2	0	N/A	0
The number of slots between PDSCH and corresponding HARQ-ACK information (Note 3)			8 if mod(i,10) = 0 7 if mod(i,10) = 1 6 if mod(i,10) = 2 5 if mod(i,10) = 3 5 if mod(i,10) = 4 4 if mod(i,10) = 5 3 if mod(i,10) = 6 2 if mod(i,10) = 7	4 if mod(i,5) = 0 3 if mod(i,5) = 1 2 if mod(i,5) = 2 6 if mod(i,5) = 3	4 if mod(i,10) = 0 3 if mod(i,10) = 1 2 if mod(i,10) = 2 5 if mod(i,10) = 3 3 if mod(i,10) = 5 3 if mod(i,10) = 6 2 if mod(i,10) = 7	5 if mod(i,10) = 0 4 if mod(i,10) = 1 3 if mod(i,10) = 2 2 if mod(i,10) = 3 8 if mod(i,10) = 6 7 if mod(i,10) = 7 6 if mod(i,10) = 8 5 if mod(i,10) = 9	3 if mod(i,4) = 0 2 if mod(i,4) = 1	3 if mod(i,4) = 0 2 if mod(i,4) = 1 3 if mod(i,4) = 2

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

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

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

A.1.3 TDD UL-DL configurations for FR2

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

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

Parameter		Unit	UL-DL pattern
			FR2.60-1
TDD Slot Configuration pattern (Note 1)			DDSU
Special Slot Configuration (Note 2)			11D+3G+0U
referenceSubcarrierSpacing		kHz	60
pattern1	*dl-UL-TransmissionPeriodicity*	ms	1
	nrofDownlinkSlots		2
	nrofDownlinkSymbols		11
	nrofUplinkSlot		1
	nrofUplinkSymbols		0

The number of slots between PDSCH and corresponding HARQ-ACK information (Note 3)		3 if mod(i,4) = 0 2 if mod(i,4) = 1 5 if mod(i,4) = 2
Note 1: D denotes a slot with all DL symbols; S denotes a slot with a mix of DL, UL and guard symbols; U denotes a slot with all UL symbols. The field is for information. Note 2: D, G, U denote DL, guard and UL symbols, respectively. The field is for information. Note 3: i is the slot index per frame; i = {0,…,39}		

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

Parameter		Unit	UL-DL pattern	
			FR2.120-1	**FR2.120-2**
TDD Slot Configuration pattern (Note 1)			DDDSU	DDSU
Special Slot Configuration (Note 2)			10D+2G+2U	11D+3G+0U
referenceSubcarrierSpacing		kHz	120	120
pattern1	*dl-UL-TransmissionPeriodicity*	ms	0.625	0.5
	nrofDownlinkSlots		3	2
	nrofDownlinkSymbols		10	11
	nrofUplinkSlot		1	1
	nrofUplinkSymbols		2	0
The number of slots between PDSCH and corresponding HARQ-ACK information(Note 3)			4 if mod(i,5) = 0 3 if mod(i,5) = 1 2 if mod(i,5) = 2 6 if mod(i,5) = 3	3 if mod(i,4) = 0 2 if mod(i,4) = 1 5 if mod(i,4) = 2
Note 1: D denotes a slot with all DL symbols; S denotes a slot with a mix of DL, UL and guard symbols; U denotes a slot with all UL symbols. The field is for information. Note 2: D, G, U denote DL, guard and UL symbols, respectively. The field is for information. Note 3: i is the slot index per frame; i = {0,…,79}				

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

Parameter		Unit	UL-DL pattern
			FR2.120-1A
TDD Slot Configuration pattern (Note 1)			DDDSU
Special Slot Configuration (Note 2)			10D+2G+2U
referenceSubcarrierSpacing		kHz	N/A
pattern1 (Note 4)	*dl-UL-TransmissionPeriodicity*	ms	N/A
	nrofDownlinkSlots		N/A
	nrofDownlinkSymbols		N/A
	nrofUplinkSlot		N/A
	nrofUplinkSymbols		N/A
PDCCH DCI Configuration	DCI Format		1-1 for slot indices with mod(i,5) = 0,1,2,3
	Scheduled Grant		Symbol 1-13 for slot indices with mod(i,5) = 0,1,2 and Symbol 1-9 for slot indices with mod(i,5) = 3
The number of slots between PDSCH and corresponding HARQ-ACK information(Note 3)			4 if mod(i,5) = 0 3 if mod(i,5) = 1 2 if mod(i,5) = 2 6 if mod(i,5) = 3
Note 1: D denotes a slot with all DL symbols; S denotes a slot with a mix of DL, UL and guard symbols; U denotes a slot with all UL symbols. The field is for information. Note 2: D, G and U denote DL, guard and UL symbols, respectively. The field is for information. Note 3: i is the slot index per frame; i = {0,…,79} Note 4: Do not configure *tdd-UL-DL-ConfigurationCommon* using RRC configuration.			

A.2 UL Reference measurement channels

A.2.1 General

The measurement channels in the following subclauses are defined to test the performance requirements where PUSCH is required. The measurement channels represent example configurations of physical channels for different data rates.

A.2.2 Reference measurement channels for FDD

A.2.2.1 RMC for Sustained downlink data rate

A.2.2.1.1 CP-OFDM 64QAM

Table A.2.2.1.1-1: Reference Channels for CP-OFDM 64QAM for 15kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit	MHz	KHz						Bits	Bits			Bits	
	5	15	25	11	64QAM	19	1/2	9992	24	1	2	19800	3300
	10	15	52	11	64QAM	19	1/2	21000	24	1	3	41184	6864
	15	15	79	11	64QAM	19	1/2	31752	24	1	4	62568	10428
	20	15	106	11	64QAM	19	1/2	42016	24	1	5	83952	13992
	25	15	133	11	64QAM	19	1/2	53288	24	1	7	105336	17556
	30	15	160	11	64QAM	19	1/2	63528	24	1	8	126720	21120
	40	15	216	11	64QAM	19	1/2	86040	24	1	11	171072	28512
	50	15	270	11	64QAM	19	1/2	108552	24	1	13	213840	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.2.1.1-2: Reference Channels for CP-OFDM 64QAM for 30kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit	**MHz**	**KHz**						**Bits**	**Bits**			**Bits**	
	5	30	11	11	64QAM	19	1/2	4352	24	1	1	8712	1452
	10	30	24	11	64QAM	19	1/2	9480	24	1	2	19008	3168
	15	30	38	11	64QAM	19	1/2	15112	24	1	2	30096	5016
	20	30	51	11	64QAM	19	1/2	20496	24	1	3	40392	6732
	25	30	65	11	64QAM	19	1/2	26120	24	1	4	51480	8580
	30	30	78	11	64QAM	19	1/2	31240	24	1	4	61776	10296
	40	30	106	11	64QAM	19	1/2	42016	24	1	5	83952	13992
	50	30	133	11	64QAM	19	1/2	53288	24	1	7	105336	17556
	60	30	162	11	64QAM	19	1/2	64552	24	1	8	128304	21384
	80	30	217	11	64QAM	19	1/2	86040	24	1	11	171864	28644
	90	30	245	11	64QAM	19	1/2	98376	24	1	12	194040	32340
	100	30	273	11	64QAM	19	1/2	108552	24	1	13	216216	36036

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

A.2.3 Reference measurement channels for TDD

A.2.3.1 RMC for Sustained downlink data rate

A.2.3.1.1 CP-OFDM 16QAM

Table A.2.3.1.1-1: Reference Channels for CP-OFDM 16QAM for 15kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size for slots 4 and 9	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for slots 4 and 9 (Note 3)	Total number of bits per slot for slots 4 and 9	Total modulated symbols per slot for slots 4 and 9
Unit	MHz	KHz						Bits	Bits			Bits	
	5-50	15	1	11	16QAM	10	1/3	176	16	2	1	528	132
	5	15	13	11	16QAM	10	1/3	2280	16	2	1	6864	1716
	5	15	25	11	16QAM	10	1/3	4352	24	1	1	13200	3300
	10	15	26	11	16QAM	10	1/3	4480	24	1	1	13728	3432
	10	15	52	11	16QAM	10	1/3	9224	24	1	2	27456	6864
	15	15	40	11	16QAM	10	1/3	7040	24	1	1	21120	5280
	15	15	79	11	16QAM	10	1/3	13832	24	1	2	41712	10428
	20	15	53	11	16QAM	10	1/3	9224	24	1	2	27984	6996
	20	15	106	11	16QAM	10	1/3	18432	24	1	3	55968	13992
	25	15	67	11	16QAM	10	1/3	11784	24	1	2	35376	8844
	25	15	133	11	16QAM	10	1/3	23040	24	1	3	70224	17556
	30	15	80	11	16QAM	10	1/3	14088	24	1	2	42240	10560
	30	15	160	11	16QAM	10	1/3	28168	24	1	4	84480	21120
	40	15	108	11	16QAM	10	1/3	18960	24	1	3	57024	14256
	40	15	216	11	16QAM	10	1/3	37896	24	1	5	114048	28512
	50	15	135	11	16QAM	10	1/3	23568	24	1	3	71280	17820
	50	15	270	11	16QAM	10	1/3	47112	24	1	6	142560	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.3.1.1-2: Reference Channels for CP-OFDM 16QAM for 30kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size for slots 8, 9, 18 and 19	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for slots 8, 9, 18 and 19 (Note 3)	Total number of bits per slot for slots 8, 9, 18 and 19	Total modulated symbols per slot for slots 8, 9, 18 and 19
Unit	MHz	KHz						Bits	Bits			Bits	
	5-50	30	1	11	16QAM	10	1/3	176	16	2	1	528	132
	5	30	6	11	16QAM	10	1/3	1064	16	2	1	3168	792
	5	30	11	11	16QAM	10	1/3	1928	16	2	1	5808	1452
	10	30	12	11	16QAM	10	1/3	2088	16	2	1	6336	1584
	10	30	24	11	16QAM	10	1/3	4224	24	1	1	12672	3168
	15	30	19	11	16QAM	10	1/3	3368	16	2	1	10032	2508
	15	30	38	11	16QAM	10	1/3	6656	24	1	1	20064	5016
	20	30	26	11	16QAM	10	1/3	4480	24	1	1	13728	3432
	20	30	51	11	16QAM	10	1/3	8968	24	1	2	26928	6732
	25	30	33	11	16QAM	10	1/3	5760	24	1	1	17424	4356
	25	30	65	11	16QAM	10	1/3	11272	24	1	2	34320	8580
	30	30	39	11	16QAM	10	1/3	6784	24	1	1	20592	5148
	30	30	78	11	16QAM	10	1/3	13576	24	1	2	41184	10296
	40	30	53	11	16QAM	10	1/3	9224	24	1	2	27984	6996
	40	30	106	11	16QAM	10	1/3	18432	24	1	3	55968	13992
	50	30	67	11	16QAM	10	1/3	11784	24	1	2	35376	8844
	50	30	133	11	16QAM	10	1/3	23040	24	1	3	70224	17556
	60	30	81	11	16QAM	10	1/3	14088	24	1	2	42768	10692
	60	30	162	11	16QAM	10	1/3	28168	24	1	4	85536	21384
	80	30	109	11	16QAM	10	1/3	18960	24	1	3	57552	14388
	80	30	217	11	16QAM	10	1/3	37896	24	1	5	114576	28644
	90	30	123	11	16QAM	10	1/3	21504	24	1	3	64944	16236
	90	30	245	11	16QAM	10	1/3	43032	24	1	6	129360	32340
	100	30	137	11	16QAM	10	1/3	24072	24	1	3	72336	18084
	100	30	273	11	16QAM	10	1/3	48168	24	1	6	144144	36036

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

A.3 DL reference measurement channels

A.3.1 General

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

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

A.3.2 Reference measurement channels for PDSCH performance requirements

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

A.3.2.1 FDD

A.3.2.1.1 Reference measurement channels for SCS 15 kHz FR1

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

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

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

Parameter	Unit	Value				
Reference channel		R.PDSCH.1-2.1 FDD	R.PDSCH.1-2.2 FDD	R.PDSCH.1-2.3 FDD	R.PDSCH.1-2.4 FDD	
Channel bandwidth	MHz	10	10	10	10	
Subcarrier spacing	kHz	15	15	15	15	
Number of allocated resource blocks	PRBs	52	52	52	52	
Number of consecutive PDSCH symbols		12	12	12	12	
Allocated slots per 2 frames	Slots	19	19	19	19	
MCS table		64QAM	64QAM	64QAM	64QAM	
MCS index		13	13	13	13	
Modulation		16QAM	16QAM	16QAM	16QAM	
Target Coding Rate		0.48	0.48	0.48	0.48	
Number of MIMO layers		1	2	3	4	
Number of DMRS REs		12	12	24	24	
Overhead for TBS determination		0	0	0	0	
Information Bit Payload per Slot						
For Slot i = 0	Bits	N/A	N/A	N/A	N/A	
For Slots i = 1,…, 19	Bits	13064	26120	35856	48168	
Transport block CRC per Slot						
For Slot i = 0	Bits	N/A	N/A	N/A	N/A	
For Slots i = 1,…, 19	Bits	24	24	24	24	
Number of Code Blocks per Slot						
For Slot i = 0	CBs	N/A	N/A	N/A	N/A	
For Slots i = 1,…, 19	CBs	2	4	5	6	
Binary Channel Bits Per Slot						
For Slot i = 0	Bits	N/A	N/A	N/A	N/A	
For Slots i = 10, 11	Bits	26208	52416	71136	94848	
For Slots i = 1,…, 9, 12, …, 19	Bits	27456	54912	74880	99840	
Max. Throughput averaged over 2 frames	Mbps	12.411	24.814	34.063	45.760	
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms. Note 2: Slot i is slot index per 2 frames.						

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

Parameter	Unit	Value				
Reference channel		R.PDSCH.1-3.1 FDD				
Channel bandwidth	MHz	10				
Subcarrier spacing	kHz	15				
Number of allocated resource blocks	PRBs	52				
Number of consecutive PDSCH symbols		12				
Allocated slots per 2 frames	Slots	19				
MCS table		64QAM				
MCS index		19				
Modulation		64QAM				
Target Coding Rate		0.51				
Number of MIMO layers		2				
Number of DMRS REs		12				
Overhead for TBS determination		0				
Information Bit Payload per Slot						
For Slot i = 0	Bits	N/A				
For Slots i = 1,…, 19	Bits	42016				
Transport block CRC per Slot						
For Slot i = 0	Bits	N/A				
For Slots i = 1,…, 19	Bits	24				
Number of Code Blocks per Slot						
For Slot i = 0	CBs	N/A				
For Slots i = 1,…, 19	CBs	5				
Binary Channel Bits Per Slot						
For Slot i = 0	Bits	N/A				
For Slots i = 10, 11	Bits	78624				
For Slots i = 1,…, 9, 12, …, 19	Bits	82368				
Max. Throughput averaged over 2 frames	Mbps	39.915				
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms. Note 2: Slot i is slot index per 2 frames.						

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

Parameter	Unit	Value				
Reference channel		R.PDSCH.1-4.1 FDD				
Channel bandwidth	MHz	10				
Subcarrier spacing	kHz	15				
Number of allocated resource blocks	PRBs	52				
Number of consecutive PDSCH symbols		12				
Allocated slots per 2 frames	Slots	19				
MCS table		256QAM				
MCS index		24				
Modulation		256QAM				
Target Coding Rate		0.82				
Number of MIMO layers		1				
Number of DMRS REs		12				
Overhead for TBS determination		0				
Information Bit Payload per Slot						
For Slot i = 0	Bits	N/A				
For Slots i = 1,…, 19	Bits	45096				
Transport block CRC per Slot						
For Slot i = 0	Bits	N/A				
For Slots i = 1,…, 19	Bits	24				
Number of Code Blocks per Slot						
For Slot i = 0	CBs	N/A				
For Slots i = 1,…, 19	CBs	6				
Binary Channel Bits Per Slot						
For Slot i = 0	Bits	N/A				
For Slots i = 10, 11	Bits	52416				
For Slots i = 1,…, 9, 12, …, 19	Bits	54912				
Max. Throughput averaged over 2 frames	Mbps	42.841				
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms. Note 2: Slot i is slot index per 2 frames.						

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

Parameter	Unit	Value				
Reference channel		R.PDSCH.1-5.1 FDD				
Channel bandwidth	MHz	10				
Subcarrier spacing	kHz	15				
Number of allocated resource blocks	PRBs	52				
Number of consecutive PDSCH symbols		12				
Allocated slots per 2 frames	Slots	19				
MCS table		64QAM				
MCS index		13				
Modulation		16QAM				
Target Coding Rate		0.48				
Number of MIMO layers		2				
Number of DMRS REs		12				
Overhead for TBS determination		0				
Information Bit Payload per Slot						
For Slot i = 0	Bits	N/A				
For Slots i = 1,…, 19	Bits	26120				
Transport block CRC per Slot						
For Slot i = 0	Bits	N/A				
For Slots i = 1,…, 19	Bits	24				
Number of Code Blocks per Slot						
For Slot i = 0	CBs	N/A				
For Slots i = 1,…, 19	CBs	4				
Binary Channel Bits Per Slot						
For Slot i = 0	Bits	N/A				
For Slots i = 5, 15	Bits	50752				
For Slots i = 10	Bits	48256				
For Slots i = 11	Bits	52416				
For Slots i = 1,…,4,6,…, 9,12,…14,16,…,19	Bits	54912				
Max. Throughput averaged over 2 frames	Mbps	24.814				
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms. Note 2: Slot i is slot index per 2 frames.						

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

Parameter	Unit	Value				
Reference channel		R.PDSCH.1-6.1 FDD	R.PDSCH.1-6.2 FDD			
Channel bandwidth	MHz	10	10			
Subcarrier spacing	kHz	15	15			
Number of allocated resource blocks	PRBs	52	52			
Number of consecutive PDSCH symbols		12	12			
Allocated slots per 2 frames	Slots	15	15			
MCS table		64QAM	64QAM			
MCS index		13	13			
Modulation		16QAM	16QAM			
Target Coding Rate		0.48	0.48			
Number of MIMO layer		1	2			
Number of DMRS REs (Note 3)		24	24			
Overhead for TBS determination		0	0			
Information Bit Payload per Slot						
For Slot i = 0	Bits	N/A	N/A			
For CSI Slots i, if mod (i,5) =1, i={0,…,19}		N/A	N/A			
For Non CSI-RS Slot i, if mod (i,5) ={0,2,3,4}, i={1,..19}	Bits	12040	24072			
Transport block CRC per Slot						
For Slot i = 0	Bits	N/A	N/A			
For CSI Slots i, if mod (i,5) =1, i={0,…,19}		N/A	N/A			
For Non CSI-RS Slot i, if mod (i,5) ={0,2,3,4}, i={1,..19}	Bits	24	24			
Number of Code Blocks per Slot						
For Slot i = 0	CBs	N/A	N/A			
For CSI Slots i, if mod (i,5) =1, i={0,…,19}		N/A	N/A			
For Non CSI-RS Slot i, if mod (i,5) ={0,2,3,4}, i={1,..,19}	CBs	2	3			
Binary Channel Bits Per Slot						
For Slot i = 0	Bits	N/A	N/A			
For CSI Slots i, if mod (i,5) =1, i={0,…,19}		N/A	N/A			
For Slots i = 10	Bits	23712	47424			
For Non CSI-RS Slot i, if mod (i,5) ={0,2,3,4}, i={1,..9,11,…,19}	Bits	24960	49920			
Max. Throughput averaged over 2 frames	Mbps	9.030	18.054			
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms. Note 2: Slot i is slot index per 2 frames. Note 3: Number of DMRS REs includes the overhead of the DM-RS CDM groups without data.						

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

Parameter	Unit	Value				
Reference channel		R.PDSCH.1-7.1 FDD	R.PDSCH.1-7.2 FDD			
Channel bandwidth	MHz	10	10			
Subcarrier spacing	kHz	15	15			
Number of allocated resource blocks	PRBs	52	52			
Number of consecutive PDSCH symbols		9	11			
Allocated slots per 2 frames	Slots	16	16			
MCS table		64QAM	64QAM			
MCS index		4	4			
Modulation		QPSK	QPSK			
Target Coding Rate		0.30	0.30			
Number of MIMO layers		1	1			
Number of DMRS REs		12	12			
Overhead for TBS determination		18	18			
Information Bit Payload per Slot						
For Slots i = 0,5,10,15	Bits	N/A	N/A			
For Slots i, if mod(i, 5) = {1,2,3,4} for i from {0,…,19}	Bits	2472	3240			
Transport block CRC per Slot						
For Slots i = 0,5,10,15	Bits	N/A	N/A			
For Slots i, if mod(i, 5) = {1,2,3,4} for i from {0,…,19}	Bits	16	16			
Number of Code Blocks per Slot						
For Slots i = 0,5,10,15	CBs	N/A	N/A			
For Slots i, if mod(i, 5) = {1,2,3,4} for i from {0,…,19}	CBs	1	1			
Binary Channel Bits Per Slot						
For Slots i = 0,5,10,15	Bits	N/A	N/A			
For Slots i = 11	Bits	7760	10256			
For Slots i, if mod(i, 5) = {1,2,3,4} for i from {1,…, 9, 12, …, 19}	Bits	8384	10880			
Max. Throughput averaged over 2 frames	Mbps	1.978	2.592			
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms Note 2: Slot i is slot index per 2 frames Note 3: No user data is scheduled on slots with LTE PBCH/PSS/SSS						

Table A.3.2.1.1-8: PDSCH Reference Channel for FDD HST scenario

Parameter	Unit	Value				
Reference channel		R.PDSCH.1-8.1 FDD	R.PDSCH.1-8.2 FDD	R.PDSCH.1-8.3 FDD	R.PDSCH.1-8.4 FDD	
Channel bandwidth	MHz	10	10	10	10	
Subcarrier spacing	kHz	15	15	15	15	
Number of allocated resource blocks	PRBs	52	52	52	52	
Number of consecutive PDSCH symbols		12	12	12	12	
Allocated slots per 2 frames	Slots	19	19	19	19	
MCS table		64QAM	64QAM	64QAM	64QAM	
MCS index		13	17	13	17	
Modulation		16QAM	64QAM	16QAM	64QAM	
Target Coding Rate		0.48	0.43	0.48	0.43	
Number of MIMO layers		1	1	2	2	
Number of DMRS REs		18	18	18	18	
Overhead for TBS determination		0	0	0	0	
Information Bit Payload per Slot						
For Slot i = 0	Bits	N/A	N/A	N/A	N/A	
For Slots i = 1,…, 19	Bits	12552	16896	25104	28680	
Transport block CRC per Slot						
For Slot i = 0	Bits	N/A	N/A	N/A	N/A	
For Slots i = 1,…, 19	Bits	24	24	24	24	
Number of Code Blocks per Slot						
For Slot i = 0	CBs	N/A	N/A	N/A	N/A	
For Slots i = 1,…, 19	CBs	2	3	3	4	
Binary Channel Bits Per Slot						
For Slot i = 0	Bits	N/A	N/A	N/A	N/A	
For Slots i = 1,2,11,12	Bits	24960	37440	51168	76752	
For Slots i = 3,…, 10, 13, …, 19	Bits	26208	39312	52416	78624	
Max. Throughput averaged over 2 frames	Mbps	11.924	16.0512	23.8488	27.246	
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms Note 2: Slot i is slot index per 2 frames						

A.3.2.1.2 Reference measurement channels for SCS 30 kHz FR1

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

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

A.3.2.1.3 Reference measurement channels for SCS 60 kHz FR1

A.3.2.1.4 Reference measurement channels for E-UTRA

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

Parameter	Unit	Value			
Reference channel		R.PDSCH.4-1.1 FDD	R.PDSCH.4-1.2 FDD	R.PDSCH.4-1.3 FDD	R.PDSCH.4-1.4 FDD
Channel bandwidth	MHz	5	10	15	20
Allocated resource blocks		Note 6	Note 7	Note 8	Note 9
Allocated subframes per Radio Frame		9	10	10	10
Modulation		64QAM	64QAM	64QAM	64QAM
Coding Rate					
For Sub-Frames 1,2,3,4,6,7,8,9,		0.85	0.85	0.85	0.88
For Sub-Frame 5		N/A	0.89	0.91	0.87
For Sub-Frame 0		0.83	0.90	0.88	0.90
Information Bit Payload (Note 3)					
For Sub-Frames 1,2,3,4,6,7,8,9	Bits	18336	36696	55056	75376
For Sub-Frame 5	Bits	N/A	35160	52752	71112
For Sub-Frame 0	Bits	15840	36696	55056	75376
Number of Code Blocks (Notes 3 and 4)					
For Sub-Frames 1,2,3,4,6,7,8,9	CBs	3	6	9	13
For Sub-Frame 5	CBs	N/A	6	9	12
For Sub-Frame 0	CBs	3	6	9	13
Binary Channel Bits (Note 3)					
For Sub-Frames 1,2,3,4,6,7,8,9	Bits	21600	43200	64800	86400
For Sub-Frame 5	Bits	N/A	39744	60480	82080
For Sub-Frame 0	Bits	19152	40752	62352	83952
Number of layers		2	2	2	2
Max. Throughput averaged over 1 frame (Note 3)	Mbps	16.253	36.542	54.826	74.950

Note 1: 1 symbol allocated to PDCCH for all tests.
Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [17].
Note 3: Given per component carrier per codeword.
Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
Note 5: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
Note 6: Resource blocks n_{PRB} = 0..24 in sub-frames 0,1,2,3,4,6,7,8,9.
Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,1,2,3,4,6,7,8,9.
Note 8: Resource blocks nPRB = 4..74 are allocated for the user data in sub-frame 5, and resource blocks nPRB = 0..74 in sub-frames 0,1,2,3,4,6,7,8,9.
Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0,1,2,3,4,6,7,8,9.

Table A.3.2.1.4-2: PDSCH Reference Channel for sustained data-rate test (64QAM, 4 MIMO layers)

Parameter	Unit	Value			
Reference channel		R.PDSCH.4-2.1 FDD	R.PDSCH.4-2.2 FDD	R.PDSCH.4-2.3 FDD	R.PDSCH.4-2.4 FDD
Channel bandwidth	MHz	5	10	15	20
Allocated resource blocks		Note 6	Note 7	Note 8	Note 9
Allocated subframes per Radio Frame		9	10	10	10
Modulation		64QAM	64QAM	64QAM	64QAM
Coding Rate					
For Sub-Frames 1,2,3,4,6,7,8,9,		0.78	0.78	0.77	0.79
For Sub-Frame 5		N/A	0.80	0.79	0.81
For Sub-Frame 0		0.85	0.83	0.8	0.81
Information Bit Payload (Note 3)					
For Sub-Frames 1,2,3,4,6,7,8,9	Bits	31704	63776	93800	128496
For Sub-Frame 5	Bits	N/A	59256	90816	124464
For Sub-Frame 0	Bits	30576	63776	93800	128496
Number of Code Blocks (Notes 3 and 4)					
For Sub-Frames 1,2,3,4,6,7,8,9	CBs	6	11	16	21
For Sub-Frame 5	CBs	N/A	10	15	21
For Sub-Frame 0	CBs	5	11	16	21
Binary Channel Bits (Note 3)					
For Sub-Frames 1,2,3,4,6,7,8,9	Bits	40800	81600	122400	163200
For Sub-Frame 5	Bits	N/A	74976	114144	154944
For Sub-Frame 0	Bits	36192	76992	117792	158592
Number of layers		4	4	4	4
Max. Throughput averaged over 1 frame (Note 3)	Mbps	28.421	63.324	93.502	128.093

Note 1: 1 symbol allocated to PDCCH for all tests.
Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [17].
Note 3: Given per component carrier per codeword.
Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
Note 5: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
Note 6: Resource blocks n_{PRB} = 0..24 in sub-frames 0,1,2,3,4,6,7,8,9.
Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,1,2,3,4,6,7,8,9.
Note 8: Resource blocks nPRB = 4..74 are allocated for the user data in sub-frame 5, and resource blocks nPRB = 0..74 in sub-frames 0,1,2,3,4,6,7,8,9.
Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0,1,2,3,4,6,7,8,9.

Table A.3.2.1.4-3: PDSCH Reference Channel for sustained data-rate test (256QAM, 2 MIMO layers)

Parameter	Unit	Value			
Reference channel		R.PDSCH.4-3.1 FDD	R.PDSCH.4-3.2 FDD	R.PDSCH.4-3.3 FDD	R.PDSCH.4-3.4 FDD
Channel bandwidth	MHz	5	10	15	20
Allocated resource blocks		Note 6	Note 7	Note 8	Note 9
Allocated subframes per Radio Frame		10	10	10	10
Modulation		256QAM	256QAM	256QAM	256QAM
Coding Rate					
For Sub-Frames 3,4,8,9		0.85	0.85	0.88	0.85
For Sub-Frames 1,2,6,7		0.77	0.74	0.74	0.74
For Sub-Frame 5		0.79	0.77	0.77	0.75
For Sub-Frame 0		0.84	0.78	0.77	0.76
Information Bit Payload (Note 3)					
For Sub-Frames 3,4,8,9	Bits	24496	48936	75376	97896
For Sub-Frames 1,2,6,7	Bits	21384	42368	63776	84760
For Sub-Frame 5	Bits	19848	40576	61664	81176
For Sub-Frame 0	Bits	21384	42368	63776	84760
Number of Code Blocks (Notes 3 and 4)					
For Sub-Frames 3,4,8,9	CBs	4	8	13	16
For Sub-Frames 1,2,6,7	CBs	4	7	11	14
For Sub-Frame 5	CBs	4	7	11	14
For Sub-Frame 0	CBs	4	7	11	14
Binary Channel Bits (Note 3)					
For Sub-Frames 3,4,8,9	Bits	28800	57600	86400	115200
For Sub-Frames 1,2,6,7	Bits	28800	57600	86400	115200
For Sub-Frame 5	Bits	25344	52992	80640	109440
For Sub-Frame 0	Bits	25536	54336	83136	111936
Number of layers		2	2	2	2
Max. Throughput averaged over 1 frame (Note 3)	Mbps	22.475	44.816	68.205	89.656
Note 1: 1 symbol allocated to PDCCH for all tests. Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [17]. Note 3: Given per component carrier per codeword. Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). Note 5: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths. Note 6: Resource blocks n_{PRB} = 2..24 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..24 in sub-frames 0,1,2,3,4,6,7,8,9. Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,1,2,3,4,6,7,8,9. Note 8: Resource blocks nPRB = 4..74 are allocated for the user data in sub-frame 5, and resource blocks nPRB = 0..74 in sub-frames 0,1,2,3,4,6,7,8,9. Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0,1,2,3,4,6,7,8,9.					

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

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

Note 1: 1 symbol allocated to PDCCH for all tests.
Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [17].
Note 3: Given per component carrier per codeword.
Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
Note 5: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
Note 6: Resource blocks n_{PRB} = 2..24 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..24 in sub-frames 0,1,2,3,4,6,7,8,9.
Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,1,2,3,4,6,7,8,9.
Note 8: Resource blocks nPRB = 4..74 are allocated for the user data in sub-frame 5, and resource blocks nPRB = 0..74 in sub-frames 0,1,2,3,4,6,7,8,9.
Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0,1,2,3,4,6,7,8,9.

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

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

Note 1: 1 symbol allocated to PDCCH for all tests.
Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [17].
Note 3: Given per component carrier per codeword.
Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
Note 5: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
Note 6: Resource blocks n_{PRB} = 2..24 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..24 in sub-frames 0,1,2,3,4,6,7,8,9.
Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,1,2,3,4,6,7,8,9.
Note 8: Resource blocks nPRB = 4..74 are allocated for the user data in sub-frame 5, and resource blocks nPRB = 0..74 in sub-frames 0,1,2,3,4,6,7,8,9.
Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0,1,2,3,4,6,7,8,9.

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

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

Note 1: 1 symbol allocated to PDCCH for all tests.
Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [17].
Note 3: Given per component carrier per codeword.
Note 4: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
Note 5: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
Note 6: Resource blocks n_{PRB} = 2..24 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..24 in sub-frames 0,1,2,3,4,6,7,8,9.
Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,1,2,3,4,6,7,8,9.
Note 8: Resource blocks nPRB = 4..74 are allocated for the user data in sub-frame 5, and resource blocks nPRB = 0..74 in sub-frames 0,1,2,3,4,6,7,8,9.
Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0,1,2,3,4,6,7,8,9.

A.3.2.2 TDD

A.3.2.2.1 Reference measurement channels for SCS 15 kHz FR1

A.3.2.2.2 Reference measurement channels for SCS 30 kHz FR1

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

Parameter	Unit	Value				
Reference channel		R.PDSCH. 2-1.1 TDD	R.PDSCH. 2-1.2 TDD	R.PDSCH. 2-1.3 TDD		
Channel bandwidth	MHz	40	40	40		
Subcarrier spacing	kHz	30	30	30		
Allocated resource blocks	PRBs	106	6	106		
Number of consecutive PDSCH symbols						
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}		4	4	N/A		
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39}		12	12	7		
Allocated slots per 2 frames		31	31	27		
MCS table		64QAM	64QAM	64QAM		
MCS index		4	4	4		
Modulation		QPSK	QPSK	QPSK		
Target Coding Rate		0.30	0.30	0.30		
Number of MIMO layers		1	1	1		
Number of DMRS REs						
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}		6	6	N/A		
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39}		18	12	12		
Overhead for TBS determination		0	0	0		
Information Bit Payload per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39}	Bits	N/A	N/A	N/A		
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}	Bits	2664	144	N/A		
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39}	Bits	8064	480	4608		
Transport block CRC per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39}	Bits	N/A	N/A	N/A		
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}	Bits	16	16	N/A		
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39}	Bits	24	16	24		
Number of Code Blocks per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39}	CBs	N/A	N/A	N/A		
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}	CBs	1	1	N/A		
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39}	CBs	1	1	1		
Binary Channel Bits Per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39}	Bits	N/A	N/A	N/A		
For Slots i = 20, 21	Bits	25440	1512	13992		
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}	Bits	8904	504	N/A		
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,19,22,…,39}	Bits	26712	1584	15264		
Max. Throughput averaged over 2 frames	Mbps	11.419	0.677	6.221		
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms. Note 2: Slot i is slot index per 2 frames.						

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

Parameter	Unit	Value				
Reference channel		R.PDSCH. 2-2.1 TDD	R.PDSCH. 2-2.2 TDD	R.PDSCH. 2-2.3 TDD	R.PDSCH. 2-2.4 TDD	
Channel bandwidth	MHz	40	40	40	40	
Subcarrier spacing	kHz	30	30	30	30	
Allocated resource blocks	PRBs	106	106	106	106	
Number of consecutive PDSCH symbols						
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}		4	4	4	4	
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39}		12	12	12	12	
Allocated slots per 2 frames		31	31	31	31	
MCS table		64QAM	64QAM	64QAM	64QAM	
MCS index		13	13	13	13	
Modulation		16QAM	16QAM	16QAM	16QAM	
Target Coding Rate		0.48	0.48	0.48	0.48	
Number of MIMO layers		1	2	3	4	
Number of DMRS REs						
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}		6	6	12	12	
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39}		12	12	24	24	
Overhead for TBS determination		0	0	0	0	
Information Bit Payload per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39}	Bits	N/A	N/A	N/A	N/A	
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}	Bits	8456	16896	22032	29192	
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39}	Bits	26632	53288	73776	98376	
Transport block CRC per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39}	Bits	N/A	N/A	N/A	N/A	
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}	Bits	24	24	24	24	
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39}	Bits	24	24	24	24	
Number of Code Blocks per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39}	CBs	N/A	N/A	N/A	N/A	
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}	CBs	2	3	3	4	
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39}	CBs	4	7	9	12	
Binary Channel Bits Per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39}	Bits	N/A	N/A	N/A	N/A	
For Slots i = 20, 21	Bits	53424	106848	144008	193344	
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}	Bits	17808	35616	45792	61056	
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,19,22,…,39}	Bits	55968	111936	152640	203520	
Max. Throughput averaged over 2 frames	Mbps	37.644	75.318	104.004	138.646	
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms. Note 2: Slot i is slot index per 2 frames.						

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

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

Table A.3.2.2.2-4: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-1 (256QAM)

Parameter	Unit	Value				
Reference channel		R.PDSCH. 2-4.1 TDD				
Channel bandwidth	MHz	40				
Subcarrier spacing	kHz	30				
Allocated resource blocks	PRBs	106				
Number of consecutive PDSCH symbols						
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}		4				
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39}		12				
Allocated slots per 2 frames		31				
MCS table		256QAM				
MCS index		24				
Modulation		256QAM				
Target Coding Rate		0.82				
Number of MIMO layers		1				
Number of DMRS REs						
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}		6				
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39}		12				
Overhead for TBS determination		0				
Information Bit Payload per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39}	Bits	N/A				
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}	Bits	29192				
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39}	Bits	92200				
Transport block CRC per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39}	Bits	N/A				
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}	Bits	24				
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39}	Bits	24				
Number of Code Blocks per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39}	CBs	N/A				
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}	CBs	4				
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39}	CBs	11				
Binary Channel Bits Per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39}	Bits	N/A				
For Slots i = 20, 21	Bits	106848				
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}	Bits	35616				
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,19,22,…,39}	Bits	111936				
Max. Throughput averaged over 2 frames	Mbps	130.308				
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms. Note 2: Slot i is slot index per 2 frames.						

Table A.3.2.2.2-5: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-2

Parameter	Unit	Value				
Reference channel		R.PDSCH. 2-5.1 TDD				
Channel bandwidth	MHz	40				
Subcarrier spacing	kHz	30				
Allocated resource blocks	PRBs	106				
Number of consecutive PDSCH symbols						
For Slot i, if mod(i, 5) = 3 for i from {0,…,39}		8				
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,39}		12				
Allocated slots per 2 frames		31				
MCS table		64QAM				
MCS index		4				
Modulation		QPSK				
Target Coding Rate		0.30				
Number of MIMO layers		1				
Number of DMRS REs						
For Slot i, if mod(i, 5) = 3 for i from {0,…,39}		12				
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,39}		12				
Overhead for TBS determination		0				
Information Bit Payload per Slot						
For Slot 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,39}	Bits	N/A				
For Slot i, if mod(i, 5) = 3 for i from {0,…,39}	Bits	5376				
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,39}	Bits	8456				
Transport block CRC per Slot						
For Slot 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,39}	Bits	N/A				
For Slot i, if mod(i, 5) = 3 for i from {0,…,39}	Bits	24				
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,39}	Bits	24				
Number of Code Blocks per Slot						
For Slot 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,39}	CBs	N/A				
For Slot i, if mod(i, 5) = 3 for i from {0,…,39}	CBs	1				
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,39}	CBs	2				
Binary Channel Bits Per Slot						
For Slot 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,39}	Bits	N/A				
For Slot i = 20, 21	Bits	26712				
For Slot i, if mod(i, 5) = 3 for i from {0,…,39}	Bits	17808				
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,19,22,…,39}	Bits	27984				
Max. Throughput averaged over 2 frames	Mbps	11.875				
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms. Note 2: Slot i is slot index per 2 frames.						

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

Parameter	Unit	Value				
Reference channel		R.PDSCH. 2-6.1 TDD				
Channel bandwidth	MHz	40				
Subcarrier spacing	kHz	30				
Allocated resource blocks	PRBs	106				
Number of consecutive PDSCH symbols						
For Slot i, if mod(i, 10) = {3,7} for i from {0,…,39}		8				
For Slot i, if mod(i, 10) = {0,1,2,5,6} for i from {1,…,39}		12				
Allocated slots per 2 frames		27				
MCS table		64QAM				
MCS index		4				
Modulation		QPSK				
Target Coding Rate		0.30				
Number of MIMO layers		1				
Number of DMRS REs						
For Slot i, if mod(i, 10) = {3,7} for i from {0,…,39}		12				
For Slot i, if mod(i, 10) = {0,1,2,5,6} for i from {1,…,39}		12				
Overhead for TBS determination		0				
Information Bit Payload per Slot						
For Slot 0 and Slot i, if mod(i, 10) = {4,8,9} for i from {0,…,39}	Bits	N/A				
For Slot i, if mod(i, 10) = {3,7} for i from {0,…,39}	Bits	5376				
For Slot i, if mod(i, 10) = {0,1,2,5,6} for i from {1,…,39}	Bits	8456				
Transport block CRC per Slot						
For Slot 0 and Slot i, if mod(i, 10) = {4,8,9} for i from {0,…,39}	Bits	N/A				
For Slot i, if mod(i, 10) = {3,7} for i from {0,…,39}	Bits	24				
For Slot i, if mod(i, 10) = {0,1,2,5,6} for i from {1,…,39}	Bits	24				
Number of Code Blocks per Slot						
For Slot 0 and Slot i, if mod(i, 10) = {4,8,9} for i from {0,…,39}	CBs	N/A				
For Slot i, if mod(i, 10) = {3,7} for i from {0,…,39}	CBs	1				
For Slot i, if mod(i, 10) = {0,1,2,5,6} for i from {1,…,39}	CBs	2				
Binary Channel Bits Per Slot						
For Slot 0 and Slot i, if mod(i, 10) = {4,8,9} for i from {0,…,39}	Bits	N/A				
For Slot i = 20, 21	Bits	26712				
For Slot i, if mod(i, 10) = {3,7} for i from {0,…,39}	Bits	17808				
For Slot i, if mod(i, 10) = {0,1,2,5,6} for i from {1,…,19,22,…,39}	Bits	27984				
Max. Throughput averaged over 2 frames	Mbps	10.184				
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms. Note 2: Slot i is slot index per 2 frames.						

Table A.3.2.2.2-7: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-1 and CSI-RS overlapped with PDSCH

Parameter	Unit	Value				
Reference channel		R.PDSCH. 2-7.1 TDD				
Channel bandwidth	MHz	40				
Subcarrier spacing	kHz	30				
Allocated resource blocks	PRBs	106				
Number of consecutive PDSCH symbols						
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}		4				
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39}		12				
Allocated slots per 2 frames		31				
MCS table		64QAM				
MCS index		13				
Modulation		16QAM				
Target Coding Rate		0.48				
Number of MIMO layers		2				
Number of DMRS REs						
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}		6				
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39}		12				
Overhead for TBS determination		0				
Information Bit Payload per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39}	Bits	N/A				
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}	Bits	16896				
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39}	Bits	53288				
Transport block CRC per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39}	Bits	N/A				
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}	Bits	24				
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39}	Bits	24				
Number of Code Blocks per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39}	CBs	N/A				
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}	CBs	3				
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39}	CBs	7				
Binary Channel Bits Per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39}	Bits	N/A				
For Slot i, if mod(i, 10) = {0,5} for i from {1,…,19,22,…,39}	Bits	103456				
For Slots i = 20	Bits	98368				
For Slots i = 21	Bits	106848				
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}	Bits	35616				
For Slot i, if mod(i, 10) = {1,2,3,4,6} for i from {1,…,19,22,…,39}	Bits	111936				
Max. Throughput averaged over 2 frames	Mbps	75.318				
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms. Note 2: Slot i is slot index per 2 frames.						

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

Parameter	Unit	Value				
Reference channel		R.PDSCH. 2-8.1 TDD	R.PDSCH. 2-8.2 TDD			
Channel bandwidth	MHz	40	40			
Subcarrier spacing	kHz	30	30			
Allocated resource blocks	PRBs	106	106			
Number of consecutive PDSCH symbols		12	12			
Allocated slots per 2 frames		23	23			
MCS table		64QAM	64QAM			
MCS index		13	13			
Modulation		16QAM	16QAM			
Target Coding Rate		0.48	0.48			
Number of MIMO layers		1	2			
Number of DMRS REs (Note 3)		24	24			
Overhead for TBS determination		0	0			
Information Bit Payload per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,…,39}	Bits	N/A	N/A			
For CSI-RS Slot i, if mod(i,10) =1 for i from {0,…,39}	Bits	N/A	N/A			
For Slot i = 20	Bits	24576	49176			
For Slot i, if mod(i, 10) = {0,2,3,4,5,6} for i from {1,…,19,22,…,39}	Bits	24576	49176			
Transport block CRC per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,…,39}	Bits	N/A	N/A			
For CSI-RS Slot i, if mod(i,10) =1 for i from {0,…,39}	Bits	N/A	N/A			
For Slot i = 20	Bits	24	24			
For Slot i, if mod(i, 10) = {0,2,3,4,5,6} for i from {1,…,19,22,…,39}	Bits	24	24			
Number of Code Blocks per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,…,39}	CBs	N/A	N/A			
For CSI-RS Slot i, if mod(i,10) =1 for i from {0,…,39}	CBs	N/A	N/A			
For Slot i = 20	CBs	3	6			
For Slot i, if mod(i, 10) = {0,2,3,4,5,6} for i from {1,…,19,22,…,39}	CBs	3	6			
Binary Channel Bits Per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,…,39}	Bits	N/A	N/A			
For CSI-RS Slot i, if mod(i,10) =1 for i from {0,…,39}	Bits	N/A	N/A			
For Slot i = 20	Bits	48336	96672			
For Slot i, if mod(i, 10) = {0,2,3,4,5,6} for i from {1,…,19,22,…,39}	Bits	50880	101760			
Max. Throughput averaged over 2 frames	Mbps	28.2624	56.5524			
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms. Note 2: Slot i is slot index per 2 frames. Note 3: Number of DMRS REs includes the overhead of the DM-RS CDM groups without data.						

Table A.3.2.2.2-9: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-4 (64QAM)

Parameter	Unit	Value				
Reference channel		R.PDSCH.2-9.1 TDD				
Channel bandwidth	MHz	20				
Subcarrier spacing	kHz	30				
Allocated resource blocks	PRBs	51				
Number of consecutive PDSCH symbols						
For Slot i, if mod(i, 10) = 3 for i from {0,…,39}		4				
For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,…,39}		12				
Allocated slots per 2 frames		31				
MCS table		64QAM				
MCS index		19				
Modulation		64QAM				
Target Coding Rate		0.51				
Number of MIMO layers		2				
Number of DMRS REs						
For Slot i, if mod(i, 10) = 3 for i from {0,…,39}		6				
For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,…,39}		12				
Overhead for TBS determination		0				
Information Bit Payload per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,…,39}	Bits	N/A				
For Slot i, if mod(i, 10) = 3 for i from {0,…,39}	Bits	13064				
For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,…,39}	Bits	40976				
Transport block CRC per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,…,39}	Bits	N/A				
For Slot i, if mod(i, 10) = 3 for i from {0,…,39}	Bits	24				
For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,…,39}	Bits	24				
Number of Code Blocks per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,…,39}	CBs	N/A				
For Slot i, if mod(i, 10) = 3 for i from {0,…,39}	CBs	2				
For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,…,39}	CBs	5				
Binary Channel Bits Per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {4,5} for i from {0,…,39}	Bits	N/A				
For Slots i = 20, 21	Bits	77112				
For Slot i, if mod(i, 10) = 3 for i from {0,…,39}	Bits	25704				
For Slot i, if mod(i, 10) = {0,1,2,6,7,8,9} for i from {1,…,19,22,…,39}	Bits	80784				
Max. Throughput averaged over 2 frames	Mbps	57.930				
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms Note 2: Slot i is slot index per 2 frames						

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

Parameter	Unit	Value				
Reference channel		R.PDSCH.2-10.1 TDD	R.PDSCH.2-10.2 TDD	R.PDSCH.2-10.3 TDD	R.PDSCH.2-10.4 TDD	R.PDSCH.2-10.5 TDD
Channel bandwidth	MHz	40	40	40	40	40
Subcarrier spacing	kHz	30	30	30	30	30
Allocated resource blocks	PRBs	106	106	106	106	106
Number of consecutive PDSCH symbols						
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}		4	N/A	4	N/A	4
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39}		12	12	12	12	12
Allocated slots per 2 frames		31	27	31	27	31
MCS table		64QAM	64QAM	64QAM	64QAM	64QAM
MCS index		13	13	17	13	17
Modulation		16QAM	16QAM	64QAM	16QAM	64QAM
Target Coding Rate		0.48	0.48	0.43	0.48	0.43
Number of MIMO layers		1	1	1	2	2
Number of DMRS REs						
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}		6	N/A	6	N/A	6
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39}		18	18	18	18	18
Overhead for TBS determination		0	0	0	0	0
Information Bit Payload per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39}	Bits	N/A	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}	Bits	8456	N/A	11528	N/A	19464
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39}	Bits	25608	25608	33816	51216	58384
Transport block CRC per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39}	Bits	N/A	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}	Bits	24	N/A	24	N/A	24
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39}	Bits	24	24	24	24	24
Number of Code Blocks per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39}	CBs	N/A	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}	CBs	2	N/A	2	N/A	3
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39}	CBs	4	4	5	7	7
Binary Channel Bits Per Slot						
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39}	Bits	N/A	N/A	N/A	N/A	N/A
For Slots i = 1,2,21,22	Bits	52176	50880	76320	104304	156456
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}	Bits	17808	N/A	26712	N/A	53424
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {3,…,20,23,…,39}	Bits	53424	53424	80136	106848	160272
Max. Throughput averaged over 2 frames	Mbps	36.262	34.5708	47.9572	69.1416	82.7112
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms Note 2: Slot i is slot index per 2 frames						

Table A.3.2.2.2-11: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-5

Parameter	Unit	Value				
Reference channel		R.PDSCH.2-11.1 TDD				
Channel bandwidth	MHz	40				
Subcarrier spacing	kHz	30				
Allocated resource blocks	PRBs	106				
Number of consecutive PDSCH symbols						
For Slot i, if mod(i, 4) = 0 for i from {1,…,39}		12				
For Slot i, if mod(i, 4) = 1 for i from {0,…,39}		10				
Allocated slots per 2 frames		31				
MCS table		64QAM				
MCS index		4				
Modulation		QPSK				
Target Coding Rate		0.30				
Number of MIMO layers		1				
Number of DMRS REs						
For Slot i, if mod(i, 4) = 0 for i from {1,…,39}		18				
For Slot i, if mod(i, 4) = 1 for i from {0,…,39}		18				
Overhead for TBS determination		0				
Information Bit Payload per Slot						
For Slot 0 and Slot i, if mod(i, 4) = {2,3} for i from {0,…,39}	Bits	N/A				
For Slot i, if mod(i, 4) = 0 for i from {1,…,39}	Bits	8064				
For Slot i, if mod(i, 4) = 1 for i from {0,…,39}	Bits	6528				
Transport block CRC per Slot						
For Slot 0 and Slot i, if mod(i, 4) = {2,3} for i from {0,…,39}	Bits	N/A				
For Slot i, if mod(i, 4) = 0 for i from {1,…,39}	Bits	24				
For Slot i, if mod(i, 4) = 1 for i from {0,…,39}	Bits	24				
Number of Code Blocks per Slot						
For Slot 0 and Slot i, if mod(i, 4) = {2,3} for i from {0,…,39}	CBs	N/A				
For Slot i, if mod(i, 4) = 0 for i from {1,…,39}	CBs	1				
For Slot i, if mod(i, 4) = 1 for i from {0,…,39}	CBs	1				
Binary Channel Bits Per Slot						
For Slot 0 and Slot i, if mod(i, 4) = {2,3} for i from {0,…,39}	Bits	N/A				
For Slot i = 20	Bits	25440				
For Slot i = 21	Bits	20352				
For Slot i, if mod(i, 4) = 0 for i from {1,…,19,22,…,39}	Bits	26712				
For Slot i, if mod(i, 4) = 1 for i from {0,…,19,22,…,39}	Bits	21624				
Max. Throughput averaged over 2 frames	Mbps	6.893				
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms Note 2: Slot i is slot index per 2 frames						

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

Parameter	Unit	Value				
Reference channel		R.PDSCH.2-12.1 TDD				
Channel bandwidth	MHz	40				
Subcarrier spacing	kHz	30				
Allocated resource blocks	PRBs	106				
Number of consecutive PDSCH symbols						
For Slot i, if mod(i, 4) = 0 for i from {1,…,39}		12				
For Slot i, if mod(i, 4) = 1 for i from {0,…,39}		8				
For Slot i, if mod(i, 4) = 2 for i from {0,…,39}		10				
Allocated slots per 2 frames		31				
MCS table		64QAM				
MCS index		4				
Modulation		QPSK				
Target Coding Rate		0.30				
Number of MIMO layers		1				
Number of DMRS REs						
For Slot i, if mod(i, 4) = 0 for i from {1,…,39}		18				
For Slot i, if mod(i, 4) = 1 for i from {0,…,39}		18				
For Slot i, if mod(i, 4) = 2 for i from {0,…,39}		18				
Overhead for TBS determination		0				
Information Bit Payload per Slot						
For Slot 0 and Slot i, if mod(i, 4) = 3 for i from {0,…,39}	Bits	N/A				
For Slot i, if mod(i, 4) = 0 for i from {1,…,39}	Bits	8064				
For Slot i, if mod(i, 4) = 1 for i from {0,…,39}	Bits	4992				
For Slot i, if mod(i, 4) = 2 for i from {0,…,39}	Bits	6528				
Transport block CRC per Slot						
For Slot 0 and Slot i, if mod(i, 4) = 3 for i from {0,…,39}	Bits	N/A				
For Slot i, if mod(i, 4) = 0 for i from {1,…,39}	Bits	24				
For Slot i, if mod(i, 4) = 1 for i from {0,…,39}	Bits	24				
For Slot i, if mod(i, 4) = 2 for i from {0,…,39}	Bits	24				
Number of Code Blocks per Slot						
For Slot 0 and Slot i, if mod(i, 4) = 3 for i from {0,…,39}	CBs	N/A				
For Slot i, if mod(i, 4) = 0 for i from {1,…,39}	CBs	1				
For Slot i, if mod(i, 4) = 1 for i from {0,…,39}	CBs	1				
For Slot i, if mod(i, 4) = 2 for i from {0,…,39}	CBs	1				
Binary Channel Bits Per Slot						
For Slot 0 and Slot i, if mod(i, 4) = 3 for i from {0,…,39}	Bits	N/A				
For Slot i = 20	Bits	25440				
For Slot i = 21	Bits	15264				
For Slot i, if mod(i, 4) = 0 for i from {1,…,19,22,…,39}	Bits	26712				
For Slot i, if mod(i, 4) = 1 for i from {1,…,19,22,…,39}	Bits	16536				
For Slot i, if mod(i, 4) = 2 for i from {0,…,39}	Bits	21624				

Max. Throughput averaged over 2 frames	Mbps	9.389				
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms Note 2: Slot i is slot index per 2 frames						

A.3.2.2.3 Reference measurement channels for SCS 60 kHz FR1

A.3.2.2.4 Reference measurement channels for SCS 60 kHz FR2

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

Parameter	Unit	Value				
Reference channel		R.PDSCH.4-1.1 TDD				
Channel bandwidth	MHz	50				
Subcarrier spacing	kHz	60				
Allocated resource blocks	PRBs	66				
Number of consecutive PDSCH symbols						
For Slot i, if mod(i, 4) = 2 for i from {1,…, 79}		10				
For Slot i, if mod(i, 4) = {0,1} for i from {1,…,79}		13				
Allocated slots per 2 frames		59				
MCS table		64QAM				
MCS index		13				
Modulation		16QAM				
Target Coding Rate		0.48				
Number of MIMO layers		2				
Number of DMRS REs						
For Slot i, if mod(i, 4) = 2 for i from {1,…, 79}		12				
For Slot i, if mod(i, 4) = {0,1} for i from {1,…,79}		12				
Overhead for TBS determination		6				
Information Bit Payload per Slot						
For Slots 0 and Slot i, if mod(i, 4) = 3 for i from {0,…,79}	Bits	N/A				
For Slot i, if mod(i, 4) = 2 for i from {1,…, 79}	Bits	25608				
For Slot i, if mod(i, 4) = {0,1} for i from {1,…,79}	Bits	34816				
Transport block CRC per Slot						
For Slots 0 and Slot i, if mod(i, 4) = 3 for i from {0,…,79}	Bits	N/A				
For Slot i, if mod(i, 4) = 2 for i from {1,…, 79}	Bits	24				
For Slot i, if mod(i, 4) = {0,1} for i from {1,…,79}	Bits	24				
Number of Code Blocks per Slot						
For Slots 0 and Slot i, if mod(i, 4) = 3 for i from {0,…,79}	CBs	N/A				
For Slot i, if mod(i, 4) = 2 for i from {1,…, 79}	CBs	4				
For Slot i, if mod(i, 4) = {0,1} for i from {1,…,79}	CBs	5				
Binary Channel Bits Per Slot						
For Slots 0 and Slot i, if mod(i, 4) = 3 for i from {0,…,79}	Bits	N/A				
For Slot i = 40, 41	Bits	69960				
For Slot i, if mod(i, 4) = 2 for i from {4,…, 79}	Bits	54912				
For Slot i, if mod(i, 4) = {0,1} for i from {1,…,39,42,…,79}	Bits	73128				
Max. Throughput averaged over 2 frames	Mbps	93.499				
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms. Note 2: Slot i is slot index per 2 frames.						

A.3.2.2.5 Reference measurement channels for SCS 120 kHz FR2

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

Parameter	Unit	Value				
Reference channel		R.PDSCH.5-1.1 TDD				
Channel bandwidth	MHz	100				
Subcarrier spacing	kHz	120				
Allocated resource blocks	PRBs	66				
Number of consecutive PDSCH symbols						
For Slot i, if mod(i, 5) = 3 for i from {0,…, 159}		9				
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159}		13				
Allocated slots per 2 frames		127				
MCS table		64QAM				
MCS index		4				
Modulation		QPSK				
Target Coding Rate		0.30				
Number of MIMO layers		1				
Number of DMRS REs						
For Slot i, if mod(i, 5) = 3 for i from {0,…, 159}		12				
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159}		12				
Overhead for TBS determination		6				
Information Bit Payload per Slot						
For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159}	Bits	N/A				
For Slot i, if mod(i, 5) = 3 for i from {0,…, 159}	Bits	3624				
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159}	Bits	5504				
Transport block CRC per Slot						
For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159}	Bits	N/A				
For Slot i, if mod(i, 5) = 3 for i from {0,…, 159}	Bits	16				
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159}	Bits	24				
Number of Code Blocks per Slot						
For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159}	CBs	N/A				
For Slot i, if mod(i, 5) = 3 for i from {0,…, 159}	CBs	1				
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159}	CBs	1				
Binary Channel Bits Per Slot						
For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159}	Bits	N/A				
For Slots i = 80, 81	Bits	17490				
For Slot i, if mod(i, 5) = 3 for i from {0,…, 159}	Bits	12210				
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,79,82,…,159}	Bits	18282				
Max. Throughput averaged over 2 frames	Mbps	31.942				
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms. Note 2: Slot i is slot index per 2 frames.						

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

Parameter	Unit	Value				
Reference channel		R.PDSCH.5-2.1 TDD	R.PDSCH.5-2.2 TDD	R.PDSCH.5-2.3 TDD		
Channel bandwidth	MHz	100	100	200		
Subcarrier spacing	kHz	120	120	120		
Allocated resource blocks	PRBs	66	66	132		
Number of consecutive PDSCH symbols						
For Slot i, if mod(i, 5) = 3 for i from {0,…, 159}		9	9	9		
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159}		13	13	13		
Allocated slots per 2 frames		127	127	127		
MCS table		64QAM	64QAM	64QAM		
MCS index		13	13	13		
Modulation		16QAM	16QAM	16QAM		
Target Coding Rate		0.48	0.48	0.48		
Number of MIMO layers		1	2	2		
Number of DMRS REs						
For Slot i, if mod(i, 5) = 3 for i from {0,…, 159}		12	12	12		
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159}		12	12	12		
Overhead for TBS determination		6	6	6		
Information Bit Payload per Slot						
For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159}	Bits	N/A	N/A	N/A		
For Slot i, if mod(i, 5) = 3 for i from {0,…, 159}	Bits	11272	22536	45096		
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159}	Bits	17424	34816	69672		
Transport block CRC per Slot						
For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159}	Bits	N/A	N/A	N/A		
For Slot i, if mod(i, 5) = 3 for i from {0,…, 159}	Bits	24	24	24		
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159}	Bits	24	24	24		
Number of Code Blocks per Slot						
For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159}	CBs	N/A	N/A	N/A		
For Slot i, if mod(i, 5) = 3 for i from {0,…, 159}	CBs	2	3	6		
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159}	CBs	3	5	9		
Binary Channel Bits Per Slot						
For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159}	Bits	N/A	N/A	N/A		
For Slots i = 80, 81	Bits	36564	69960	139920		
For Slots i = 82, 83	Bits	34980	73128	146256		
For Slot i, if mod(i, 5) = 3 for i from {0,…, 159}	Bits	24420	48840	97680		
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,79,84,…,159}	Bits	36564	73128	146256		
Max. Throughput averaged over 2 frames	Mbps	100.799	201.434	403.096		
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms. Note 2: Slot i is slot index per 2 frames.						

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

Parameter	Unit	Value				
Reference channel		R.PDSCH.5-3.1 TDD				
Channel bandwidth	MHz	100				
Subcarrier spacing	kHz	120				
Allocated resource blocks	PRBs	66				
Number of consecutive PDSCH symbols						
For Slot i, if mod(i, 5) = 3 for i from {0,…, 159}		9				
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159}		13				
Allocated slots per 2 frames		127				
MCS table		64QAM				
MCS index		18				
Modulation		64QAM				
Target Coding Rate		0.46				
Number of MIMO layers		1				
Number of DMRS REs						
For Slot i, if mod(i, 5) = 3 for i from {0,…, 159}		12				
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159}		12				
Overhead for TBS determination		6				
Information Bit Payload per Slot						
For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159}	Bits	N/A				
For Slot i, if mod(i, 5) = 3 for i from {0,…, 159}	Bits	16136				
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159}	Bits	25104				
Transport block CRC per Slot						
For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159}	Bits	N/A				
For Slot i, if mod(i, 5) = 3 for i from {0,…, 159}	Bits	24				
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159}	Bits	24				
Number of Code Blocks per Slot						
For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159}	CBs	N/A				
For Slot i, if mod(i, 5) = 3 for i from {0,…, 159}	CBs	2				
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,159}	CBs	3				
Binary Channel Bits Per Slot						
For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159}	Bits	N/A				
For Slots i = 80, 81	Bits	52470				
For Slot i, if mod(i, 5) = 3 for i from {0,…, 159}	Bits	36630				
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,79,82,…,159}	Bits	54846				
Max. Throughput averaged over 2 frames	Mbps	145.062				
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms. Note 2: Slot i is slot index per 2 frames.						

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

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

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

Parameter	Unit	Value				
Reference channel		R.PDSCH.5-5.1 TDD	R.PDSCH.5-5.2 TDD			
Channel bandwidth	MHz	100	50			
Subcarrier spacing	kHz	120	120			
Allocated resource blocks	PRBs	66	32			
Number of consecutive PDSCH symbols						
For Slot i, if mod(i, 4) = 2 for i from {1,…, 159}		10	10			
For Slot i, if mod(i, 4) = {0,1} for i from {1,…,159}		13	13			
Allocated slots per 2 frames		119	119			
MCS table		64QAM	64QAM			
MCS index		13	13			
Modulation		16QAM	16QAM			
Target Coding Rate		0.48	0.48			
Number of MIMO layers		2	2			
Number of DMRS REs						
For Slot i, if mod(i, 4) = 2 for i from {1,…, 159}		12	12			
For Slot i, if mod(i, 4) = {0,1} for i from {1,…,159}		12	12			
Overhead for TBS determination		6	6			
Information Bit Payload per Slot						
For Slots 0 and Slot i, if mod(i, 4) = 3 for i from {0,…,159}	Bits	N/A	N/A			
For Slot i, if mod(i, 4) = 2 for i from {1,…, 159}	Bits	25608	12552			
For Slot i, if mod(i, 4) = {0,1} for i from {1,…,159}	Bits	34816	16896			
Transport block CRC per Slot						
For Slots 0 and Slot i, if mod(i, 4) = 3 for i from {0,…,159}	Bits	N/A	N/A			
For Slot i, if mod(i, 4) = 2 for i from {1,…, 159}	Bits	24	24			
For Slot i, if mod(i, 4) = {0,1} for i from {1,…,159}	Bits	24	24			
Number of Code Blocks per Slot						
For Slots 0 and Slot i, if mod(i, 4) = 3 for i from {0,…,159}	CBs	N/A	N/A			
For Slot i, if mod(i, 4) = 2 for i from {1,…, 159}	CBs	4	2			
For Slot i, if mod(i, 4) = {0,1} for i from {1,…,159}	CBs	5	3			
Binary Channel Bits Per Slot						
For Slots 0 and Slot i, if mod(i, 4) = 3 for i from {0,…,159}	Bits	N/A	N/A			
For Slot i = 80, 81	Bits	69960	33920			
For Slot i, if mod(i, 4) = 2 for i from {4,…, 159}	Bits	54912	26624			
For Slot i, if mod(i, 4) = {0,1} for i from {1,…,79,82,…,159}	Bits	73128	35456			
Max. Throughput averaged over 2 frames	Mbps	188.739	91.843			
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms. Note 2: Slot i is slot index per 2 frames.						

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

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

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

Parameter	Unit	Value				
Reference channel		R.PDSCH.5-7.1 TDD				
Channel bandwidth	MHz	100				
Subcarrier spacing	kHz	120				
Allocated resource blocks	PRBs	66				
Number of consecutive PDSCH symbols		12				
Allocated slots per 2 frames		63				
MCS table		64QAM				
MCS index		13				
Modulation		16QAM				
Target Coding Rate		0.48				
Number of MIMO layers		1				
Number of DMRS REs (Note 3)		24				
Overhead for TBS determination		6				
Information Bit Payload per Slot						
For Slots 0 and Slot i, if mod(i, 5) = {3,4} for i from {0,…,159}	Bits	N/A				
For CSI-RS Slot i, if mod(i,5) =1 for i from {0,…,159}	Bits	N/A				
For Slot i = 80	Bits	14344				
For Slot i, if mod(i, 5) = {0,2} for i from {1,…, 79,82,…,159}	Bits	14344				
Transport block CRC per Slot						
For Slots 0 and Slot i, if mod(i, 5) = {3,4} for i from {0,…,159}	Bits	N/A				
For CSI-RS Slot i, if mod(i, 5) =1 for i from {0,…,159}	Bits	N/A				
For Slot i = 80	Bits	24				
For Slot i, if mod(i, 5) = {0,2} for i from {1,…,79,82,…,159}	Bits	24				
Number of Code Blocks per Slot						
For Slots 0 and Slot i, if mod(i, 5) = {3,4} for i from {0,…,159}	CBs	N/A				
For CSI-RS Slot i, if mod(i, 5) =1 for i from {0,…,159}	CBs	N/A				
For Slot i = 80	CBs	2				
For Slot i, if mod(i, 5) = {0,2} for i from {1,…,79,82,…,159}	CBs	2				
Binary Channel Bits Per Slot						
For Slots 0 and Slot i, if mod(i, 5) = {3,4} for i from {0,…,159}	Bits	N/A				
For CSI-RS Slot i, if mod(i, 5) =1 for i from {0,…,159}	Bits	N/A				
For Slot i = 80	Bits	28776				
For Slot i, if mod(i, 5) = {0,2} for i from {1,…,79,82,…,159}	Bits	30360				
Max. Throughput averaged over 2 frames	Mbps	45.1836				
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms. Note 2: Slot i is slot index per 2 frames. Note 3: Number of DMRS REs includes the overhead of the DM-RS CDM groups without data.						

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

Parameter	Unit	Value				
Reference channel		R.PDSCH.5-8.1 TDD				
Channel bandwidth	MHz	100				
Subcarrier spacing	kHz	120				
Allocated resource blocks	PRBs	66				
Number of consecutive PDSCH symbols		12				
Allocated slots per 2 frames		59				
MCS table		64QAM				
MCS index		13				
Modulation		16QAM				
Target Coding Rate		0.48				
Number of MIMO layers		1				
Number of DMRS REs (Note 3)		24				
Overhead for TBS determination		6				
Information Bit Payload per Slot						
For Slots 0 and Slot i, if mod(i, 4) = {2,3} for i from {0,…,159}	Bits	N/A				
For CSI-RS Slot i, if mod(i, 8) =1 for i from {0,…,159}	Bits	N/A				
For Slot i = 80	Bits	14344				
For Slot i, if mod(i, 8) = {0,4,5} for i from {1,…,79,82,…,159}	Bits	14344				
Transport block CRC per Slot						
For Slots 0 and Slot i, if mod(i, 4) = {2,3} for i from {0,…,159}	Bits	N/A				
For CSI-RS Slot i, if mod(i, 8) =1 for i from {0,…,159}	Bits	N/A				
For Slot i = 80	Bits	24				
For Slot i, if mod(i, 8) = {0,4,5,} for i from {1,…,79,82,…,159}	Bits	24				
Number of Code Blocks per Slot						
For Slots 0 and Slot i, if mod(i, 4) = {2,3} for i from {0,…,159}	CBs	N/A				
For CSI-RS Slot i, if mod(i, 8) =1 for i from {0,…,159}	CBs	N/A				
For Slot i = 80	CBs	2				
For Slot i, if mod(i, 8) = {0,4,5} for i from {1,…,79,82,…,159}	CBs	2				
Binary Channel Bits Per Slot						
For Slots 0 and Slot i, if mod(i, 4) = {2,3} for i from {0,…,159}	Bits	N/A				
For CSI-RS Slot i, if mod(i, 8) =1 for i from {0,…,159}	Bits	N/A				
For Slot i = 80	Bits	28776				
For Slot i, if mod(i, 8) = {0,4,5}for i from {1,…,79,82,…,159}	Bits	30360				
Max. Throughput averaged over 2 frames	Mbps	42.3148				
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms. Note 2: Slot i is slot index per 2 frames. Note 3: Number of DMRS REs includes the overhead of the DM-RS CDM groups without data.						

A.3.2.2.6 Reference measurement channels for E-UTRA

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

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

Note 1: 1 symbol allocated to PDCCH for all tests.
Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [17].
Note 3: As per Table 4.2-2 in TS 36.211 [15].
Note 4: Given per component carrier per codeword.
Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
Note 6: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,3,4,8,9.
Note 8: Resource blocks n_{PRB} = 4..74 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..74 in sub-frames 0,3,4,8,9.
Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0,3,4,8,9.

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

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

Note 1: 1 symbol allocated to PDCCH for all tests.
Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [17].
Note 3: As per Table 4.2-2 in TS 36.211 [15].
Note 4: Given per component carrier per codeword.
Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
Note 6: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,3,4,8,9.
Note 8: Resource blocks n_{PRB} = 4..74 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..74 in sub-frames 0,3,4,8,9.
Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0,3,4,8,9.

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

Parameter	Unit	Value			
Reference channel		R.PDSCH.6-3.1 TDD	R.PDSCH.6-3.2 TDD	R.PDSCH.6-3.3 TDD	
Channel bandwidth	MHz	10	15	20	
Allocated resource blocks		Note 7	Note 8	Note 9	
Uplink-Downlink Configuration (Note 3)		2	2	2	
Number of HARQ Processes per component carrier		10	10	10	
Allocated subframes per Radio Frame (D+S)		6	6	6	
Modulation		256QAM	256QAM	256QAM	
Coding Rate					
For Sub-Frames 1,2,6,7		N/A	N/A	N/A	
For Sub-Frames 3,4		0.74	0.79	0.74	
For Sub-Frames 8,9		0.85	0.88	0.85	
For Sub-Frame 5		0.76	0.76	0.74	
For Sub-Frame 0		0.78	0.77	0.76	
Information Bit Payload (Note 4)					
For Sub-Frames 1,2,6,7	Bits	N/A	N/A	N/A	
For Sub-Frames 3,4	Bits	42368	63776	84760	
For Sub-Frames 8,9	Bits	48936	75376	97896	
For Sub-Frame 5	Bits	40576	61664	81176	
For Sub-Frame 0	Bits	42368	63776	84760	
Number of Code Blocks (Notes 4 and 5)					
For Sub-Frames 1,2,6,7	CBs	N/A	N/A	N/A	
For Sub-Frames 3,4	CBs	7	11	14	
For Sub-Frames 8,9	CBs	8	13	16	
For Sub-Frame 5	CBs	7	11	14	
For Sub-Frame 0	CBs	7	11	14	
Binary Channel Bits (Note 4)					
For Sub-Frames 1,2,6,7	Bits	N/A	N/A	N/A	
For Sub-Frames 3,4	Bits	57600	86400	115200	
For Sub-Frames 8,9	Bits	57600	86400	115200	
For Sub-Frame 5	Bits	53568	81216	110016	
For Sub-Frame 0	Bits	54912	83712	112512	
Number of layers		2	2	2	
Max. Throughput averaged over 1 frame (Note 4)	Mbps	26.555	40.374	53.125	

Note 1: 1 symbol allocated to PDCCH for all tests.
Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [17].
Note 3: As per Table 4.2-2 in TS 36.211 [15].
Note 4: Given per component carrier per codeword.
Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
Note 6: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,3,4,8,9.
Note 8: Resource blocks n_{PRB} = 4..74 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..74 in sub-frames 0,3,4,8,9.
Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0,3,4,8,9.

Table A.3.2.2.6-4: PDSCH Reference Channel for sustained data-rate test (256QAM, 4 MIMO layers)

Parameter	Unit	Value			
Reference channel		R.PDSCH.6-4.1 TDD	R.PDSCH.6-4.2 TDD	R.PDSCH.6-4.3 TDD	
Channel bandwidth	MHz	10	15	20	
Allocated resource blocks		Note 7	Note 8	Note 9	
Uplink-Downlink Configuration (Note 3)		2	2	2	
Number of HARQ Processes per component carrier		10	10	10	
Allocated subframes per Radio Frame (D+S)		6	6	6	
Modulation		256QAM	256QAM	256QAM	
Coding Rate					
For Sub-Frames 1,2,6,7		N/A	N/A	N/A	
For Sub-Frames 3,4		0.78	0.79	0.78	
For Sub-Frames 8,9		0.78	0.79	0.78	
For Sub-Frame 5		0.81	0.82	0.78	
For Sub-Frame 0		0.82	0.82	0.80	
Information Bit Payload (Note 4)					
For Sub-Frames 1,2,6,7	Bits	N/A	N/A	N/A	
For Sub-Frames 3,4	Bits	84760	128496	169544	
For Sub-Frames 8,9	Bits	84760	128496	169544	
For Sub-Frame 5	Bits	81176	124464	161760	
For Sub-Frame 0	Bits	84760	128496	169544	
Number of Code Blocks (Notes 4 and 5)					
For Sub-Frames 1,2,6,7	CBs	N/A	N/A	N/A	
For Sub-Frames 3,4	CBs	14	21	28	
For Sub-Frames 8,9	CBs	14	21	28	
For Sub-Frame 5	CBs	14	21	27	
For Sub-Frame 0	CBs	14	21	28	
Binary Channel Bits (Note 4)					
For Sub-Frames 1,2,6,7	Bits	N/A	N/A	N/A	
For Sub-Frames 3,4	Bits	108800	163200	217600	
For Sub-Frames 8,9	Bits	108800	163200	217600	
For Sub-Frame 5	Bits	101120	153344	207744	
For Sub-Frame 0	Bits	103808	158208	212608	
Number of layers		4	4	4	
Max. Throughput averaged over 1 frame (Note 4)	Mbps	50.498	76.694	100.948	

Note 1: 1 symbol allocated to PDCCH for all tests.
Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [17].
Note 3: As per Table 4.2-2 in TS 36.211 [15].
Note 4: Given per component carrier per codeword.
Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
Note 6: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,3,4,8,9.
Note 8: Resource blocks n_{PRB} = 4..74 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..74 in sub-frames 0,3,4,8,9.
Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0,3,4,8,9.

Table A.3.2.2.6-5: PDSCH Reference Channel for sustained data-rate test (1024QAM, 2 MIMO layers)

Parameter	Unit	Value			
Reference channel		R.PDSCH.6-5.1 TDD	R.PDSCH.6-5.2 TDD	R.PDSCH.6-5.3 TDD	
Channel bandwidth	MHz	10	15	20	
Allocated resource blocks		Note 7	Note 8	Note 9	
Uplink-Downlink Configuration (Note 3)		2	2	2	
Number of HARQ Processes per component carrier		10	10	10	
Allocated subframes per Radio Frame (D+S)		6	6	6	
Modulation		1024QAM	1024QAM	1024QAM	
Coding Rate					
For Sub-Frames 1,2,6,7		N/A	N/A	N/A	
For Sub-Frames 3,4		0.76	0.75	0.76	
For Sub-Frames 8,9		0.76	0.75	0.76	
For Sub-Frame 5		0.76	0.78	0.77	
For Sub-Frame 0		0.80	0.78	0.78	
Information Bit Payload (Note 4)					
For Sub-Frames 1,2,6,7	Bits	N/A	N/A	N/A	
For Sub-Frames 3,4	Bits	55056	81176	110136	
For Sub-Frames 8,9	Bits	55056	81176	110136	
For Sub-Frame 5	Bits	51024	78704	105528	
For Sub-Frame 0	Bits	55056	81176	110136	
Number of Code Blocks (Notes 4 and 5)					
For Sub-Frames 1,2,6,7	CBs	N/A	N/A	N/A	
For Sub-Frames 3,4	CBs	9	14	18	
For Sub-Frames 8,9	CBs	9	14	18	
For Sub-Frame 5	CBs	9	13	18	
For Sub-Frame 0	CBs	9	14	18	
Binary Channel Bits (Note 4)					
For Sub-Frames 1,2,6,7	Bits	N/A	N/A	N/A	
For Sub-Frames 3,4	Bits	72000	108000	144000	
For Sub-Frames 8,9	Bits	72000	108000	144000	
For Sub-Frame 5	Bits	66960	101520	137520	
For Sub-Frame 0	Bits	68640	104640	140640	
Number of layers		2	2	2	
Max. Throughput averaged over 1 frame (Note 4)	Mbps	32.630	48.458	65.621	

Note 1: 1 symbol allocated to PDCCH for all tests.
Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [17].
Note 3: As per Table 4.2-2 in TS 36.211 [15].
Note 4: Given per component carrier per codeword.
Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
Note 6: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,3,4,8,9.
Note 8: Resource blocks n_{PRB} = 4..74 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..74 in sub-frames 0,3,4,8,9.
Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0,3,4,8,9.

Table A.3.2.2.6-6: PDSCH Reference Channel for sustained data-rate test (1024QAM, 4 MIMO layers)

Parameter	Unit	Value			
Reference channel		R.PDSCH.6-6.1 TDD	R.PDSCH.6-6.2 TDD	R.PDSCH.6-6.3 TDD	
Channel bandwidth	MHz	10	15	20	
Allocated resource blocks		Note 7	Note 8	Note 9	
Uplink-Downlink Configuration (Note 3)		2	2	2	
Number of HARQ Processes per component carrier		10	10	10	
Allocated subframes per Radio Frame (D+S)		6	6	6	
Modulation		1024QAM	1024QAM	1024QAM	
Coding Rate					
For Sub-Frames 1,2,6,7		N/A	N/A	N/A	
For Sub-Frames 3,4		0.81	0.79	0.81	
For Sub-Frames 8,9		0.81	0.79	0.81	
For Sub-Frame 5		0.81	0.82	0.82	
For Sub-Frame 0		0.85	0.82	0.83	
Information Bit Payload (Note 4)					
For Sub-Frames 1,2,6,7	Bits	N/A	N/A	N/A	
For Sub-Frames 3,4	Bits	110136	161760	220296	
For Sub-Frames 8,9	Bits	110136	161760	220296	
For Sub-Frame 5	Bits	101840	157432	211936	
For Sub-Frame 0	Bits	110136	161760	220296	
Number of Code Blocks (Notes 4 and 5)					
For Sub-Frames 1,2,6,7	CBs	N/A	N/A	N/A	
For Sub-Frames 3,4	CBs	18	27	36	
For Sub-Frames 8,9	CBs	18	27	36	
For Sub-Frame 5	CBs	17	26	35	
For Sub-Frame 0	CBs	18	27	36	
Binary Channel Bits (Note 4)					
For Sub-Frames 1,2,6,7	Bits	N/A	N/A	N/A	
For Sub-Frames 3,4	Bits	136000	204000	272000	
For Sub-Frames 8,9	Bits	136000	204000	272000	
For Sub-Frame 5	Bits	126400	191680	259680	
For Sub-Frame 0	Bits	129760	197760	265760	
Number of layers		2	2	2	
Max. Throughput averaged over 1 frame (Note 4)	Mbps	65.252	96.623	131.342	

Note 1: 1 symbol allocated to PDCCH for all tests.
Note 2: Reference signal, synchronization signals and PBCH allocated as per TS 36.211 [17].
Note 3: As per Table 4.2-2 in TS 36.211 [15].
Note 4: Given per component carrier per codeword.
Note 5: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
Note 6: Resource blocks n_{PRB} = 0..2 are allocated for SIB transmissions in sub-frame 5 for all bandwidths.
Note 7: Resource blocks n_{PRB} = 3..49 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..49 in sub-frames 0,3,4,8,9.
Note 8: Resource blocks n_{PRB} = 4..74 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..74 in sub-frames 0,3,4,8,9.
Note 9: Resource blocks n_{PRB} = 4..99 are allocated for the user data in sub-frame 5, and resource blocks n_{PRB} = 0..99 in sub-frames 0,3,4,8,9.

A.3.2_1 Reference measurement channels for Sustained downlink data rate performance requirements

A.3.2_1.1 FDD

A.3.2_1.1.1 Reference measurement channels for SCS 15 kHz FR1

Table A.3.2_1.1.1-1: Sustained Downlink Data Rate Reference Channel for FDD 15kHz SCS FR1 (64QAM)

Parameter	Channel bandwidth	Subcarrier spacing	Allocated resource blocks	Number of consecutive PDSCH symbols for allocated full DL slots (Note 1)	MCS Index (Note 2)	Modulation	Target Coding Rate	Number of MIMO layers	LDPC Base Graph	Information Bit Payload per Slot for allocated full DL slots (Note 1)	Transport block CRC per Slot for allocated full DL slots (Note 1)	Number of Code Blocks per Slot for allocated full DL slots (Note 1, 6)	Binary Channel Bits per Slot for allocated full DL slots (Note 1)	Max. Throughput averaged over 2 frames
	MHz	kHz	PRBs	Symbols						Bits	Bits	CBs	Bits	Mbps
	10	15	52	13	18	64QAM	0.46	1	1	20496	24	3	44928	17.422
	20	15	106	13	18	64QAM	0.46	1	1	42016	24	5	91584	35.714
	10	15	52	13	22	64QAM	0.65	1	1	29192	24	4	44928	24.813
	20	15	106	13	22	64QAM	0.65	1	1	59432	24	8	91584	50.517
	10	15	52	13	23	64QAM	0.7	1	1	31752	24	4	44928	26.989
	20	15	106	13	23	64QAM	0.7	1	1	64552	24	8	91584	54.869
	10	15	52	13	27	64QAM	0.89	1	1	39936	24	5	44928	33.946
	20	15	106	13	27	64QAM	0.89	1	1	81976	24	10	91584	69.68
	10	15	52	13	18	64QAM	0.46	2	1	40976	24	5	89856	34.83
	20	15	106	13	18	64QAM	0.46	2	1	83976	24	10	183168	71.38
	10	15	52	13	22	64QAM	0.65	2	1	58384	24	7	89856	49.626
	20	15	106	13	22	64QAM	0.65	2	1	118896	24	15	183168	101.062
	10	15	52	13	23	64QAM	0.7	2	1	63528	24	8	89856	53.999
	20	15	106	13	23	64QAM	0.7	2	1	129128	24	16	183168	109.759
	10	15	52	13	27	64QAM	0.89	2	1	79896	24	10	89856	67.912
	20	15	106	13	27	64QAM	0.89	2	1	163976	24	20	183168	139.38
	10	15	52	13	19	64QAM	0.5	4	1	83976	24	10	164736	71.38
	20	15	106	13	19	64QAM	0.5	4	1	167976	24	20	335808	142.78
	10	15	52	13	23	64QAM	0.7	4	1	114776	24	14	164736	97.56
	20	15	106	13	23	64QAM	0.7	4	1	237776	24	29	335808	202.11
	10	15	52	13	24	64QAM	0.75	4	1	125016	24	15	164736	106.264

	20	15	106	13	24	64QAM	0.75	4	1	254176	24	31	335808	216.05
	10	15	52	13	27	64QAM	0.89	4	1	147576	24	18	164736	125.44
	20	15	106	13	27	64QAM	0.89	4	1	295176	24	36	335808	250.9

Note 1: Allocated full DL slots are with slot index i, if i is not in {0,10,11} for i = 0,1,...,19. So total number of allocated slots per 2 frames is 17.
Note 2: MCS Index is based on MCS Table defined in TS38.214 when 256QAM is not enabled. MCS 18 and 19 are equivalent to MCS 11 and 12 in 256QAM table, respectively.
Note 3: Number of DMRS REs per RB = 12,12,24,24 for number of MIMO layers = 1,2,3,4, respectively
Note 4: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms.
Note 5: Overhead parameter for TBS determination is 0.
Note 6: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.3.2_1.1.1-2: Sustained Downlink Data Rate Reference Channel for FDD 15kHz SCS FR1 (256QAM)

Parameter	Channel bandwidth	Subcarrier spacing	Allocated resource blocks	Number of consecutive PDSCH symbols for allocated full DL slots (Note 1)	MCS Index (Note 2)	Modulation	Target Coding Rate	Number of MIMO layers	LDPC Base Graph	Information Bit Payload per Slot for allocated full DL slots (Note 1)	Transport block CRC per Slot for allocated full DL slots (Note 1)	Number of Code Blocks per Slot for allocated full DL slots (Note 1, 6)	Binary Channel Bits per Slot for allocated full DL slots (Note 1)	Max. Throughput averaged over 2 frames
	MHz	kHz	PRBs	Symbols						Bits	Bits	CBs	Bits	Mbps
	10	15	52	13	20	256QAM	0.67	1	1	39936	24	5	59904	33.946
	20	15	106	13	20	256QAM	0.67	1	1	81976	24	10	122112	69.68
	10	15	52	13	21	256QAM	0.69	1	1	42016	24	5	59904	35.714
	20	15	106	13	21	256QAM	0.69	1	1	83976	24	10	122112	71.38
	10	15	52	13	26	256QAM	0.9	1	1	53288	24	7	59904	45.295
	20	15	106	13	26	256QAM	0.9	1	1	108552	24	13	122112	92.269
	10	15	52	13	20	256QAM	0.67	2	1	79896	24	10	119808	67.912
	20	15	106	13	20	256QAM	0.67	2	1	163976	24	20	244224	139.38
	10	15	52	13	21	256QAM	0.69	2	1	83976	24	10	119808	71.38
	20	15	106	13	21	256QAM	0.69	2	1	167976	24	20	244224	142.78
	25	15	133	13	21	256QAM	0.69	2	1	213176	24	26	306432	181.2

	10	15	52	13	26	256QAM	0.9	2	1	106576	24	13	119808	90.59
	20	15	106	13	26	256QAM	0.9	2	1	217128	24	26	244224	184.559
	10	15	52	13	22	256QAM	0.74	4	1	159880	24	19	219648	135.898
	20	15	106	13	22	256QAM	0.74	4	1	327888	24	39	447744	278.705
	10	15	52	13	23	256QAM	0.78	4	1	172176	24	21	219648	146.35
	20	15	106	13	23	256QAM	0.78	4	1	352440	24	42	447744	299.574
	25	15	133	13	23	256QAM	0.78	4	1	434280	24	52	561792	369.138
	10	15	52	13	26	256QAM	0.9	4	1	196776	24	24	219648	167.26
	20	15	106	13	26	256QAM	0.9	4	1	401640	24	48	447744	341.394
Note 1: Allocated full DL slots are with slot index i, if i is not in {0,10,11} for i = 0,1,...,19. So total number of allocated slots per 2 frames is 17. Note 2: MCS Index is based on MCS Table defined in TS38.214 when 256QAM is enabled. Note 3: Number of DMRS REs per RB = 12,12,24,24 for number of MIMO layers = 1,2,3,4, respectively Note 4: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms. Note 5: Overhead parameter for TBS determination is 0. Note 6: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)														

A.3.2_1.2 TDD

A.3.2_1.2.1 Reference measurement channels for SCS 30 kHz FR1

Table A.3.2_1.2.1-1: Sustained Downlink Data Rate Reference Channel for TDD 30kHz SCS FR1 (64QAM)

Parameter	Channel bandwidth	Subcarrier spacing	Allocated resource blocks	Number of consecutive PDSCH symbols for allocated full DL slots (Note 1)	MCS Index (Note 2)	Modulation	Target Coding Rate	Number of MIMO layers	LDPC Base Graph	Information Bit Payload per Slot for allocated full DL slots (Note 1)	Transport block CRC per Slot for allocated full DL slots (Note 1)	Number of Code Blocks per Slot for allocated full DL slots (Note 1, 6)	Binary Channel Bits per Slot for allocated full DL slots (Note 1)	Max. Throughput averaged over 2 frames
	MHz	kHz	PRBs	Symbols						Bits	Bits	CBs	Bits	Mbps
	20	30	51	13	18	64QAM	0.46	1	1	19968	24	3	44064	24.96
	100	30	273	13	18	64QAM	0.46	1	1	106576	24	13	235872	133.22
	20	30	51	13	22	64QAM	0.65	1	1	28680	24	4	44064	35.85
	100	30	273	13	22	64QAM	0.65	1	1	151608	24	18	235872	189.51
	20	30	51	13	23	64QAM	0.7	1	1	30728	24	4	44064	38.41
	100	30	273	13	23	64QAM	0.7	1	1	163976	24	20	235872	204.97
	20	30	51	13	27	64QAM	0.89	1	1	38936	24	5	44064	48.67

	100	30	273	13	27	64QAM	0.89	1	1	208976	24	25	235872	261.22
	20	30	51	13	18	64QAM	0.46	2	1	39936	24	5	88128	49.92
	100	30	273	13	18	64QAM	0.46	2	1	213176	24	26	471744	266.47
	20	30	51	13	22	64QAM	0.65	2	1	57376	24	7	88128	71.72
	100	30	273	13	22	64QAM	0.65	2	1	303240	24	36	471744	379.05
	20	30	51	13	23	64QAM	0.7	2	1	61480	24	8	88128	76.85
	100	30	273	13	23	64QAM	0.7	2	1	327888	24	39	471744	409.86
	20	30	51	13	27	64QAM	0.89	2	1	77896	24	10	88128	97.37
	100	30	273	13	27	64QAM	0.89	2	1	417976	24	50	471744	522.47
	20	30	51	13	19	64QAM	0.5	4	1	81976	24	10	161568	102.47
	100	30	273	13	19	64QAM	0.5	4	1	434280	24	52	864864	542.85
	20	30	51	13	23	64QAM	0.7	4	1	112648	24	14	161568	140.81
	100	30	273	13	23	64QAM	0.7	4	1	606504	24	72	864864	758.13
	20	30	51	13	24	64QAM	0.75	4	1	120936	24	15	161568	151.17
	100	30	273	13	24	64QAM	0.75	4	1	655800	24	78	864864	819.75
	20	30	51	13	27	64QAM	0.89	4	1	143400	24	18	161568	179.25
	100	30	273	13	27	64QAM	0.89	4	1	770568	24	92	864864	963.21

Note 1: Allocated full DL slots are with slot index i, if mod(i,10) = 0,1,2,3,4,5,6 and i is not in {0,20,21} for i = 0,1,...,39. So total number of allocated slots per 2 frames is 25.
Note 2: MCS Index is based on MCS Table defined in TS38.214 when 256QAM is not enabled. MCS 18 and 19 are equivalent to MCS 11 and 12 in 256QAM table, respectively.
Note 3: Number of DMRS REs per RB = 12,12,24,24 for number of MIMO layers = 1,2,3,4, respectively
Note 4: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms.
Note 5: Overhead parameter for TBS determination is 0.
Note 6: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.3.2_1.2.1-2: Sustained Downlink Data Rate Reference Channel for TDD 30kHz SCS FR1(256QAM)

Parameter	Channel bandwidth	Subcarrier spacing	Allocated resource blocks	Number of consecutive PDSCH symbols for allocated full DL slots (Note 1)	MCS Index (Note 2)	Modulation	Target Coding Rate	Number of MIMO layers	LDPC Base Graph	Information Bit Payload per Slot for allocated full DL slots (Note 1)	Transport block CRC per Slot for allocated full DL slots (Note 1)	Number of Code Blocks per Slot for allocated full DL slots (Note 1, 6)	Binary Channel Bits per Slot for allocated full DL slots (Note 1)	Max. Throughput averaged over 2 frames
	MHz	kHz	PRBs	Symbols						Bits	Bits	CBs	Bits	Mbps
	20	30	51	13	20	256QAM	0.67	1	1	38936	24	5	58752	48.67

	100	30	273	13	20	256QAM	0.67	1	1	208976	24	25	314496	261.22
	20	30	51	13	21	256QAM	0.69	1	1	40976	24	5	58752	51.22
	100	30	273	13	21	256QAM	0.69	1	1	217128	24	26	314496	271.41
	20	30	51	13	26	256QAM	0.9	1	1	52224	24	7	58752	65.28
	100	30	273	13	26	256QAM	0.9	1	1	278776	24	34	314496	348.47
	20	30	51	13	20	256QAM	0.67	2	1	77896	24	10	117504	97.37
	100	30	273	13	20	256QAM	0.67	2	1	417976	24	50	628992	522.47
	20	30	51	13	21	256QAM	0.69	2	1	81976	24	10	117504	102.47
	100	30	273	13	21	256QAM	0.69	2	1	434280	24	52	628992	542.85
	20	30	51	13	26	256QAM	0.9	2	1	104496	24	13	117504	130.62
	100	30	273	13	26	256QAM	0.9	2	1	557416	24	67	628992	696.77
	20	30	51	13	22	256QAM	0.74	4	1	159880	24	19	215424	199.85
	100	30	273	13	22	256QAM	0.74	4	1	852696	24	102	1153152	1065.87
	20	30	51	13	23	256QAM	0.78	4	1	167976	24	20	215424	209.97
	100	30	273	13	23	256QAM	0.78	4	1	901344	24	107	1153152	1126.68
	20	30	51	13	26	256QAM	0.9	4	1	192624	24	23	215424	240.78
	100	30	273	13	26	256QAM	0.9	4	1	1032192	24	123	1153152	1290.24

Note 1: Allocated full DL slots are with slot index i, if mod(i,10) = 0,1,2,3,4,5,6 and i is not in {0,20,21} for i = 0,1,...,39. So total number of allocated slots per 2 frames is 25.
Note 2: MCS Index is based on MCS Table defined in TS38.214 when 256QAM is enabled.
Note 3: Number of DMRS REs per RB = 12,12,24,24 for number of MIMO layers = 1,2,3,4, respectively
Note 4: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms.
Note 5: Overhead parameter for TBS determination is 0.
Note 6: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

A.3.3 Reference measurement channels for PDCCH performance requirements

A.3.3.1 FDD

A.3.3.1.1 Reference measurement channels for SCS 15 kHz FR1

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

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

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

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

A.3.3.1.2 Reference measurement channels for SCS 30 kHz FR1

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

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

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

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

A.3.3.2 TDD

A.3.3.2.1 Reference measurement channels for SCS 15 kHz FR1

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

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

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

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

A.3.3.2.2 Reference measurement channels for SCS 30 kHz FR1

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

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

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

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

Table A.3.3.2.2-3: Additional PDSCH Reference Channel TDD

Parameter	Unit	Value	
DCI Format		1-0	1-1
TDD UL/DL pattern		FR1.30-1	FR1.30-1
Channel bandwidth	MHz	40	40
Subcarrier spacing	kHz	30	30
Allocated resource blocks	PRBs	106	106
Number of consecutive PDSCH symbols			
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}		4	4
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6) for i from {1,…,39}		12	12
Allocated slots per 2 frames		31	31
MCS table		64QAM	64QAM
MCS index		4	4
Modulation		QPSK	QPSK
Target Coding Rate		0.30	0.3
Number of MIMO layers		1	1
Number of DMRS rEs			
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}		6	6
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6) for i from {1,…,39}		12	12
Overhead for TBS determination		0	0
Information Bit Payload per Slot			
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39}	Bits	N/A	N/A
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}	Bits	2280	2664
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6) for i from {1,…,39}	Bits	6912	8456
Transport block CRC per Slot			
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39}	Bits	N/A	N/A
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}	Bits	16	16
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6) for i from {1,…,39}	Bits	24	24
Number of Code Blocks per Slot			
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39}	CBs	N/A	N/A
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}	CBs	1	1
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6) for i from {1,…,39}	CBs	1	2
Binary Channel Bits Per Slot			
For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39}	Bits	N/A	N/A
For Slot i, if mod(i, 10) = 7 for i from {0,…,39}	Bits	7488	8904
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6) for i from {1,…,39}	Bits	22896	27984
Max. Throughput averaged over 2 frames	Mbps	9.78	11.94

A.3.3.2.3 Reference measurement channels for SCS 60 kHz FR1

A.3.3.2.4 Reference measurement channels for SCS 60 kHz FR2

A.3.3.2.5 Reference measurement channels for SCS 120 kHz FR2

Table A.3.3.2.5-1: PDCCH Reference Channels (Time domain allocation 1 symbol)

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

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

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

A.3.4 Reference measurement channels for PBCH demodulation requirements

A.3.4.1 Reference measurement channels for FR1

Table A.3.4.1-1: PBCH Reference Channel

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

A.3.4.2 Reference measurement channels for FR2

Table A.3.4.2-1: PBCH Reference Channel

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

A.4 CSI reference measurement channels

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

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

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

TBS Scheme				TBS.1-1	TBS.1-2				
MCS table				64QAM					
Number of allocated PDSCH resource blocks				66	66				
Number of consecutive PDSCH symbols				12	12				
Number of PDSCH MIMO layers				1	2				
Number of DMRS REs (Note 1)				24	24				
Overhead for TBS determination				6	6				
Available RE-s				7920	7920				
CQI index	Spectral efficiency	MCS index	Modulation	Information Bit Payload per Slot					
0	OOR	OOR	OOR	N/A	N/A				
1	0.1523	0	QPSK	1800	3624				
2	0.2344	0		1800	3624				
3	0.3770	2		2856	5640				
4	0.6016	4		4480	8968				
5	0.8770	6		6528	13064				
6	1.1758	8		8712	17928				
7	1.4766	11	16QAM	11016	22032				
8	1.9141	13		14343	28680				
9	2.4063	15		17928	35856				
10	2.7305	18	64QAM	20496	40976				
11	3.3223	20		25104	50184				
12	3.9023	22		29192	58384				
13	4.5234	24		33816	67584				
14	5.1152	26		38936	77896				
15	5.5547	28		42016	83976				
Note 1: Number of DMRS REs includes the overhead of the DM-RS CDM groups without data Note 2: PDSCH is not scheduled on slots containing CSI-RS or slots which are not full DL Note 3: PDSCH is not scheduled on slots containing PBCH, i.e. slot#0 per 20ms periodicity									

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

TBS Scheme				TBS.2-1	TBS.2-2	TBS.2-3	TBS.2-4	TBS.2-5	TBS.2-6
MCS table				256QAM					
Number of allocated PDSCH resource blocks				52	52	106	106	8	16
Number of consecutive PDSCH symbols				12	12	12	12	12	12
Number of PDSCH MIMO layers				1	2	1	2	1	1
Number of DMRS REs (Note 1)				24	24	24	24	24	24
Overhead for TBS determination				0	0	0	0	0	0
Available RE-s for PDSCH				6240	6240	12720	12720	960	1920
CQI index	Spectral efficiency	MCS index	Modulation	Information Bit Payload per Slot					
0	OOR	OOR	OOR	N/A	N/A	N/A	N/A	N/A	N/A
1	0.1523	0	QPSK	1480	2976	2976	5896	224	456
2	0.3770	1		2408	4744	4744	9480	368	736
3	0.8770	3		5504	11016	11016	22536	848	1736
4	1.4766	5	16QAM	9224	18432	18960	37896	1416	2856
5	1.9141	7		12040	24072	24576	49176	1864	3752
6	2.4063	9		15112	30216	30728	61480	2408	4608
7	2.7305	11	64QAM	16896	33816	34816	69672	2600	5248
8	3.3223	13		20496	40976	42016	83976	3240	6400
9	3.9023	15		24576	49176	49176	98376	3752	7424
10	4.5234	17		28168	56368	57376	114776	4352	8712
11	5.1152	19		31752	63528	65576	131176	4864	9736
12	5.5547	21	256QAM	34816	69672	69672	139376	5248	10760
13	6.2266	23		38936	77896	79896	159880	6016	12040
14	6.9141	25		43032	86040	88064	176208	6656	13320
15	7.4063	27		46104	92200	94248	188576	7040	14088
Note 1: Number of DMRS REs includes the overhead of the DM-RS CDM groups without data Note 2: PDSCH is not scheduled on slots containing CSI-RS or slots which are not full DL Note 3: PDSCH is not scheduled on slots containing PBCH, i.e. slot#0 per 20ms periodicity									

A.5 OFDMA Channel Noise Generator (OCNG)

A.5.1 OCNG Patterns for FDD

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

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

OCNG Appliance / OCNG Parameters	Control Region (CORESET)	Data Region
Resources allocated	All unused REs (Note 1)	All unused REs (Note 2)
Structure	PDCCH	PDSCH
Content	Uncorrelated pseudo random QPSK modulated data	Uncorrelated pseudo random QPSK modulated data
Transmission scheme for multiple antennas ports transmission	Single Tx port transmission	Spatial multiplexing using any precoding matrix with dimensions same as the precoding matrix for PDSCH
Subcarrier Spacing	Same as for RMC PDCCH in the active BWP	Same as for RMC PDSCH in the active BWP
Power Level	Same as for RMC PDCCH	Same as for RMC PDSCH
Note 1: All unused REs in the active CORESETS appointed by the search spaces in use. Note 2: Unused available REs refer to REs in PRBs not allocated for any physical channels, CORESETs, synchronization signals or reference signals, and excluding REs in all the available PDSCH DMRS CDM groups, in channel bandwidth.		

A.5.2 OCNG Patterns for TDD

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

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

OCNG Appliance / OCNG Parameters	Control Region (CORESET)	Data Region
Resources allocated	All unused REs (Note 1)	All unused REs (Note 2)
Structure	PDCCH	PDSCH
Content	Uncorrelated pseudo random QPSK modulated data	Uncorrelated pseudo random QPSK modulated data
Transmission scheme for multiple antennas ports transmission	Single Tx port transmission	Spatial multiplexing using any precoding matrix with dimensions same as the precoding matrix for PDSCH
Subcarrier Spacing	Same as for RMC PDCCH in the active BWP	Same as for RMC PDSCH in the active BWP
Power Level	Same as for RMC PDCCH	Same as for RMC PDSCH
Note 1: All unused REs in the active CORESETS appointed by the search spaces in use. Note 2: Unused available REs refer to REs in PRBs not allocated for any physical channels, CORESETs, synchronization signals or reference signals, and excluding REs in all the available PDSCH DMRS CDM groups, in channel bandwidth.		

Annex B (normative): Propagation conditions

B.0 No interference

The downlink connection between the System Simulator and the UE is without Additive White Gaussian Noise, and has no fading or multipath effects.

B.1 Static propagation condition

B.1.1 UE Receiver with 2Rx

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

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

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

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

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

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

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

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

B.1.2 UE Receiver with 4Rx

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

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

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

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

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

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

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

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

B.2 Multi-path fading propagation conditions

The multipath propagation conditions consist of several parts:

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

B.2.1 Delay profiles

The delay profiles are simplified from the TR 38.901 [15] TDL models. The simplification steps are shown below for information. These steps are only used when new delay profiles are created. Otherwise, the delay profiles specified in B.2.1.1 and B.2.1.2 can be used as such.

Step 1: Use the original TDL model from TR38.901 [15].

Step 2: Re-order the taps in ascending delays

Step 3: Perform delay scaling according to the procedure described in subclause 7.7.3 in TR 38.901 [15].

Step 4: Apply the quantization to the delay resolution 5 ns. This is done simply by rounding the tap delays to the nearest multiple of the delay resolution.

Step 5: If multiple taps are rounded to the same delay bin, merge them by calculating their linear power sum.

Step 6: If there are more than 12 taps in the quantized model, merge the taps as follows:

- Find the weakest tap from all taps (both merged and unmerged taps are considered)
  - If there are two or more taps having the same value and are the weakest, select the tap with the smallest delay as the weakest tap.
- When the weakest tap is the first delay tap, merge taps as follows:
  - Update the power of the first delay tap as the linear power sum of the weakest tap and the second delay tap.
  - Remove the second delay tap.
- When the weakest tap is the last delay tap, merge taps as follows:
  - Update the power of the last delay tap as the linear power sum of the second-to-last tap and the last tap.

        - Remove the second-to-last tap.

    - Otherwise

        - For each side of the weakest tap, identify the neighbour tap that has the smaller delay difference to the weakest tap.

            - When the delay difference between the weakest tap and the identified neighbour tap on one side equals the delay difference between the weakest tap and the identified neighbour tap on the other side.

                - Select the neighbour tap that is weaker in power for merging.

            - Otherwise, select the neighbour tap that has smaller delay difference for merging.

        - To merge, the power of the merged tap is the linear sum of the power of the weakest tap and the selected tap.

        - When the selected tap is the first tap, the location of the merged tap is the location of the first tap. The weakest tap is removed.

        - When the selected tap is the last tap, the location of the merged tap is the location of the last tap. The weakest tap is removed.

        - Otherwise, the location of the merged tap is based on the average delay of the weakest tap and selected tap. If the average delay is on the sampling grid, the location of the merged tap is the average delay. Merge two parallel taps with different delays (average delay, sum power) starting from the weakest ones. Otherwise, the location of the merged tap is rounded towards the direction of the selected tap (e.g. 10 ns & 20 ns → 15 ns, 10 ns & 25 ns → 20 ns, if 25 ns had higher or equal power; 15 ns, if 10 ns had higher power). The weakest tap and the selected tap are removed.

    - Repeat step 6 until the final number of taps is 12.

Step 7: Round the amplitudes of taps to one decimal (e.g. -8.78 dB → -8.8 dB)

Step 8: If the delay spread has slightly changed due to the tap merge, adjust the final delay spread by increasing or decreasing the power of the last tap so that the delay spread is corrected.

Step 9: Re-normalize tap powers such that the strongest tap is at 0dB.

Note 1: Some values of the delay profile created by the simplification steps may differ from the values in tables B.2.1.1-2, B.2.1.1-3, B.2.1.1-4, B.2.1.2-2, and B.2.1.1-3 for the corresponding model.

Note 2: For Step 5 and Step 6, the power values are expressed in the linear domain using 6 digits of precision. The operations are in the linear domain.

B.2.1.1 Delay profiles for FR1

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

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

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

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

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

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

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

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

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

B.2.1.2 Delay profiles for FR2

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

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

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

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

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

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

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

B.2.2 Combinations of channel model parameters

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

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

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

Combination name	Model	Maximum Doppler frequency
TDLA30-5	TDLA30	5 Hz
TDLA30-10	TDLA30	10 Hz
TDLB100-400	TDLB100	400 Hz
TDLC300-100	TDLC300	100 Hz
TDLC300-600	TDLC300	600 Hz
TDLC300-1200	TDLC300	1200 Hz

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

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

B.2.3 MIMO Channel Correlation Matrices

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

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

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

B.2.3.1.1 Definition of MIMO Correlation Matrices

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

Table B.2.3.1.1-1: gNB correlation matrix

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

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

Table B.2.3.1.1-2 UE correlation matrix

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

1x2 case	N/A
2x1 case	N/A
2x2 case	$R_{medium} = \left(\begin{array}{cccc} 1 & 0.9 & 0.3 & 0.27 \\ 0.9 & 1 & 0.27 & 0.3 \\ 0.3 & 0.27 & 1 & 0.9 \\ 0.27 & 0.3 & 0.9 & 1 \end{array}\right)$
2x4 case	$R_{medium} = \left(\begin{array}{cccccccc} 1.0000 & 0.9882 & 0.9541 & 0.8999 & 0.3000 & 0.2965 & 0.2862 & 0.2700 \\ 0.9882 & 1.0000 & 0.9882 & 0.9541 & 0.2965 & 0.3000 & 0.2965 & 0.2862 \\ 0.9541 & 0.9882 & 1.0000 & 0.9882 & 0.2862 & 0.2965 & 0.3000 & 0.2965 \\ 0.8999 & 0.9541 & 0.9882 & 1.0000 & 0.2700 & 0.2862 & 0.2965 & 0.3000 \\ 0.3000 & 0.2965 & 0.2862 & 0.2700 & 1.0000 & 0.9882 & 0.9541 & 0.8999 \\ 0.2965 & 0.3000 & 0.2965 & 0.2862 & 0.9882 & 1.0000 & 0.9882 & 0.9541 \\ 0.2862 & 0.2965 & 0.3000 & 0.2965 & 0.9541 & 0.9882 & 1.0000 & 0.9882 \\ 0.2700 & 0.2862 & 0.2965 & 0.3000 & 0.8999 & 0.9541 & 0.9882 & 1.0000 \end{array}\right)$
4x2 case	$R_{medium} = \left(\begin{array}{cccccccc} 1.0000 & 0.9000 & 0.8748 & 0.7873 & 0.5856 & 0.5271 & 0.3000 & 0.2700 \\ 0.9000 & 1.0000 & 0.7873 & 0.8748 & 0.5271 & 0.5856 & 0.2700 & 0.3000 \\ 0.8748 & 0.7873 & 1.0000 & 0.9000 & 0.8748 & 0.7873 & 0.5856 & 0.5271 \\ 0.7873 & 0.8748 & 0.9000 & 1.0000 & 0.7873 & 0.8748 & 0.5271 & 0.5856 \\ 0.5856 & 0.5271 & 0.8748 & 0.7873 & 1.0000 & 0.9000 & 0.8748 & 0.7873 \\ 0.5271 & 0.5856 & 0.7873 & 0.8748 & 0.9000 & 1.0000 & 0.7873 & 0.8748 \\ 0.3000 & 0.2700 & 0.5856 & 0.5271 & 0.8748 & 0.7873 & 1.0000 & 0.9000 \\ 0.2700 & 0.3000 & 0.5271 & 0.5856 & 0.7873 & 0.8748 & 0.9000 & 1.0000 \end{array}\right)$
4x4 case	$R_{medium} = \left(\begin{array}{cccccccccccccccc} 1.0000 & 0.9882 & 0.9541 & 0.8999 & 0.8747 & 0.8645 & 0.8347 & 0.7872 & 0.5855 & 0.5787 & 0.5588 & 0.5270 & 0.3000 & 0.2965 & 0.2862 & 0.2700 \\ 0.9882 & 1.0000 & 0.9882 & 0.9541 & 0.8645 & 0.8747 & 0.8645 & 0.8347 & 0.5787 & 0.5855 & 0.5787 & 0.5588 & 0.2965 & 0.3000 & 0.2965 & 0.2862 \\ 0.9541 & 0.9882 & 1.0000 & 0.9882 & 0.8347 & 0.8645 & 0.8747 & 0.8645 & 0.5588 & 0.5787 & 0.5855 & 0.5787 & 0.2862 & 0.2965 & 0.3000 & 0.2965 \\ 0.8999 & 0.9541 & 0.9882 & 1.0000 & 0.7872 & 0.8347 & 0.8645 & 0.8747 & 0.5270 & 0.5588 & 0.5787 & 0.5855 & 0.2700 & 0.2862 & 0.2965 & 0.3000 \\ 0.8747 & 0.8645 & 0.8347 & 0.7872 & 1.0000 & 0.9882 & 0.9541 & 0.8999 & 0.8747 & 0.8645 & 0.8347 & 0.7872 & 0.5855 & 0.5787 & 0.5588 & 0.5270 \\ 0.8645 & 0.8747 & 0.8645 & 0.8347 & 0.9882 & 1.0000 & 0.9882 & 0.9541 & 0.8645 & 0.8747 & 0.8645 & 0.8347 & 0.5787 & 0.5855 & 0.5787 & 0.5588 \\ 0.8347 & 0.8645 & 0.8747 & 0.8645 & 0.9541 & 0.9882 & 1.0000 & 0.9882 & 0.8347 & 0.8645 & 0.8747 & 0.8645 & 0.5588 & 0.5787 & 0.5855 & 0.5787 \\ 0.7872 & 0.8347 & 0.8645 & 0.8747 & 0.8999 & 0.9541 & 0.9882 & 1.0000 & 0.7872 & 0.8347 & 0.8645 & 0.8747 & 0.5270 & 0.5588 & 0.5787 & 0.5855 \\ 0.5855 & 0.5787 & 0.5588 & 0.5270 & 0.8747 & 0.8645 & 0.8347 & 0.7872 & 1.0000 & 0.9882 & 0.9541 & 0.8999 & 0.8747 & 0.8645 & 0.8347 & 0.7872 \\ 0.5787 & 0.5855 & 0.5787 & 0.5588 & 0.8645 & 0.8747 & 0.8645 & 0.8347 & 0.9882 & 1.0000 & 0.9882 & 0.9541 & 0.8645 & 0.8747 & 0.8645 & 0.8347 \\ 0.5588 & 0.5787 & 0.5855 & 0.5787 & 0.8347 & 0.8645 & 0.8747 & 0.8645 & 0.9541 & 0.9882 & 1.0000 & 0.9882 & 0.8347 & 0.8645 & 0.8747 & 0.8645 \\ 0.5270 & 0.5588 & 0.5787 & 0.5855 & 0.7872 & 0.8347 & 0.8645 & 0.8747 & 0.8999 & 0.9541 & 0.9882 & 1.0000 & 0.7872 & 0.8347 & 0.8645 & 0.8747 \\ 0.3000 & 0.2965 & 0.2862 & 0.2700 & 0.5855 & 0.5787 & 0.5588 & 0.5270 & 0.8747 & 0.8645 & 0.8347 & 0.7872 & 1.0000 & 0.9882 & 0.9541 & 0.8999 \\ 0.2965 & 0.3000 & 0.2965 & 0.2862 & 0.5787 & 0.5855 & 0.5787 & 0.5588 & 0.8645 & 0.8747 & 0.8645 & 0.8347 & 0.9882 & 1.0000 & 0.9882 & 0.9541 \\ 0.2862 & 0.2965 & 0.3000 & 0.2965 & 0.5588 & 0.5787 & 0.5855 & 0.5787 & 0.8347 & 0.8645 & 0.8747 & 0.8645 & 0.9541 & 0.9882 & 1.0000 & 0.9882 \\ 0.2700 & 0.2862 & 0.2965 & 0.3000 & 0.5270 & 0.5588 & 0.5787 & 0.5855 & 0.7872 & 0.8347 & 0.8645 & 0.8747 & 0.8999 & 0.9541 & 0.9882 & 1.0000 \end{array}\right)$

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

2x4 case	$R_{medium\ A} = \begin{pmatrix} 1.0000 & 0.9000 & 0.6561 & 0.3874 & 0.3000 & 0.2700 & 0.1968 & 0.1162 \\ 0.9000 & 1.0000 & 0.9000 & 0.6561 & 0.2700 & 0.3000 & 0.2700 & 0.1968 \\ 0.6561 & 0.9000 & 1.0000 & 0.9000 & 0.1968 & 0.2700 & 0.3000 & 0.2700 \\ 0.3874 & 0.6561 & 0.9000 & 1.0000 & 0.1162 & 0.1968 & 0.2700 & 0.3000 \\ 0.3000 & 0.2700 & 0.1968 & 0.1162 & 1.0000 & 0.9000 & 0.6561 & 0.3874 \\ 0.2700 & 0.3000 & 0.2700 & 0.1968 & 0.9000 & 1.0000 & 0.9000 & 0.6561 \\ 0.1968 & 0.2700 & 0.3000 & 0.2700 & 0.6561 & 0.9000 & 1.0000 & 0.9000 \\ 0.1162 & 0.1968 & 0.2700 & 0.3000 & 0.3874 & 0.6561 & 0.9000 & 1.0000 \end{pmatrix}$
4x4 case	$R_{medium\ A} = \begin{pmatrix} 1.0000 & 0.9000 & 0.6561 & 0.3874 & 0.8748 & 0.7873 & 0.5739 & 0.3389 & 0.5856 & 0.5270 & 0.3842 & 0.2269 & 0.3000 & 0.2700 & 0.1968 & 0.1162 \\ 0.9000 & 1.0000 & 0.9000 & 0.6561 & 0.7873 & 0.8748 & 0.7873 & 0.5739 & 0.5270 & 0.5856 & 0.5270 & 0.3842 & 0.2700 & 0.3000 & 0.2700 & 0.1968 \\ 0.6561 & 0.9000 & 1.0000 & 0.9000 & 0.5739 & 0.7873 & 0.8748 & 0.7873 & 0.3842 & 0.5270 & 0.5856 & 0.5270 & 0.1968 & 0.2700 & 0.3000 & 0.2700 \\ 0.3874 & 0.6561 & 0.9000 & 1.0000 & 0.3389 & 0.5739 & 0.7873 & 0.8748 & 0.2269 & 0.3842 & 0.5270 & 0.5856 & 0.1162 & 0.1968 & 0.2700 & 0.3000 \\ 0.8748 & 0.7873 & 0.5739 & 0.3389 & 1.0000 & 0.9000 & 0.6561 & 0.3874 & 0.8748 & 0.7873 & 0.5739 & 0.3389 & 0.5856 & 0.5270 & 0.3842 & 0.2269 \\ 0.7873 & 0.8748 & 0.7873 & 0.5739 & 0.9000 & 1.0000 & 0.9000 & 0.6561 & 0.7873 & 0.8748 & 0.7873 & 0.5739 & 0.5270 & 0.5856 & 0.5270 & 0.3842 \\ 0.5739 & 0.7873 & 0.8748 & 0.7873 & 0.6561 & 0.9000 & 1.0000 & 0.9000 & 0.5739 & 0.7873 & 0.8748 & 0.7873 & 0.3842 & 0.5270 & 0.5856 & 0.5270 \\ 0.3389 & 0.5739 & 0.7873 & 0.8748 & 0.3874 & 0.6561 & 0.9000 & 1.0000 & 0.3389 & 0.5739 & 0.7873 & 0.8748 & 0.2269 & 0.3842 & 0.5270 & 0.5856 \\ 0.5856 & 0.5270 & 0.3842 & 0.2269 & 0.8748 & 0.7873 & 0.5739 & 0.3389 & 1.0000 & 0.9000 & 0.6561 & 0.3874 & 0.8748 & 0.7873 & 0.5739 & 0.3389 \\ 0.5270 & 0.5856 & 0.5270 & 0.3842 & 0.7873 & 0.8748 & 0.7873 & 0.5739 & 0.9000 & 1.0000 & 0.9000 & 0.6561 & 0.7873 & 0.8748 & 0.7873 & 0.5739 \\ 0.3842 & 0.5270 & 0.5856 & 0.5270 & 0.5739 & 0.7873 & 0.8748 & 0.7873 & 0.6561 & 0.9000 & 1.0000 & 0.9000 & 0.5739 & 0.7873 & 0.8748 & 0.7873 \\ 0.2269 & 0.3842 & 0.5270 & 0.5856 & 0.3389 & 0.5739 & 0.7873 & 0.8748 & 0.3874 & 0.6561 & 0.9000 & 1.0000 & 0.3389 & 0.5739 & 0.7873 & 0.8748 \\ 0.3000 & 0.2700 & 0.1968 & 0.1162 & 0.5856 & 0.5270 & 0.3842 & 0.2269 & 0.8748 & 0.7873 & 0.5739 & 0.3389 & 1.0000 & 0.9000 & 0.6561 & 0.3874 \\ 0.2700 & 0.3000 & 0.2700 & 0.1968 & 0.5270 & 0.5856 & 0.5270 & 0.3842 & 0.7873 & 0.8748 & 0.7873 & 0.5739 & 0.9000 & 1.0000 & 0.9000 & 0.6561 \\ 0.1968 & 0.2700 & 0.3000 & 0.2700 & 0.3842 & 0.5270 & 0.5856 & 0.5270 & 0.5739 & 0.7873 & 0.8748 & 0.7873 & 0.6561 & 0.9000 & 1.0000 & 0.9000 \\ 0.1162 & 0.1968 & 0.2700 & 0.3000 & 0.2269 & 0.3842 & 0.5270 & 0.5856 & 0.3389 & 0.5739 & 0.7873 & 0.8748 & 0.3874 & 0.6561 & 0.9000 & 1.0000 \end{pmatrix}$

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

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

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

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

The MIMO channel correlation matrices defined in B.2.3.2 apply for the antenna configuration using cross polarized (XP/X-pol) antennas at both gNB and UE. The cross-polarized antenna elements with +/-45 degrees polarization slant angles are deployed at gNB and cross-polarized antenna elements with +90/0 degrees polarization slant angles are deployed at UE.

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

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

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

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

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

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

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

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

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

where

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

The matrix Γ is defined as:

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

A permutation matrix P elements are defined as:

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

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

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

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

where

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

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

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

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

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

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

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

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

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

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

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

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

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

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

The spatial correlation matrices at UE side are as follows:

- For 1 antenna element with the same polarization,

$$R_{UE} = 1 .$$

- For 2 antenna elements with the same polarization,

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

B.2.3.2.2 MIMO Correlation Matrices using cross polarized antennas

The values for parameters α_1, α_2. β and γ for the cross polarized antenna models are given in Table B.2.3.2.2-1.

Table B.2.3.2.2-1: The α and β parameters for cross-polarized MIMO correlation matrices

Correlation Model	α_1	α_2	β	γ
Medium Correlation	0.3	0.3	0.6	0.2
High Correlation	0.9	0.9	0.9	0.3
NOTE 1: Value of α_1 applies when more than one pair of cross-polarized antenna elements in first dimension at gNB side. NOTE 2: Value of α_2 applies when more than one pair of cross-polarized antenna elements in second dimension at gNB side. NOTE 3: Value of β applies when more than one pair of cross-polarized antenna elements at UE side.				

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

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

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

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

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

4(2,1,2)x 2 case	$R_{high} = \begin{bmatrix} 1.0000 & 0.0000 & 0.9000 & 0.0000 & -0.3000 & 0.0000 & -0.2700 & 0.0000 \\ 0.0000 & 1.0000 & 0.0000 & 0.9000 & 0.0000 & 0.3000 & 0.0000 & 0.2700 \\ 0.9000 & 0.0000 & 1.0000 & 0.0000 & -0.2700 & 0.0000 & -0.3000 & 0.0000 \\ 0.0000 & 0.9000 & 0.0000 & 1.0000 & 0.0000 & 0.2700 & 0.0000 & 0.3000 \\ -0.3000 & 0.0000 & -0.2700 & 0.0000 & 1.0000 & 0.0000 & 0.9000 & 0.0000 \\ 0.0000 & 0.3000 & 0.0000 & 0.2700 & 0.0000 & 1.0000 & 0.0000 & 0.9000 \\ -0.2700 & 0.0000 & -0.3000 & 0.0000 & 0.9000 & 0.0000 & 1.0000 & 0.0000 \\ 0.0000 & 0.2700 & 0.0000 & 0.3000 & 0.0000 & 0.9000 & 0.0000 & 1.0000 \end{bmatrix}$
2(1,1,2)x 4 case	$R_{high} = \begin{bmatrix} 1.0000 & 0.9000 & 0.0000 & 0.0000 & -0.3000 & -0.2700 & 0.0000 & 0.0000 \\ 0.9000 & 1.0000 & 0.0000 & 0.0000 & -0.2700 & -0.3000 & 0.0000 & 0.0000 \\ 0.0000 & 0.0000 & 1.0000 & 0.9000 & 0.0000 & 0.0000 & 0.3000 & 0.2700 \\ 0.0000 & 0.0000 & 0.9000 & 1.0000 & 0.0000 & 0.0000 & 0.2700 & 0.3000 \\ -0.3000 & -0.2700 & 0.0000 & 0.0000 & 1.0000 & 0.9000 & 0.0000 & 0.0000 \\ -0.2700 & -0.3000 & 0.0000 & 0.0000 & 0.9000 & 1.0000 & 0.0000 & 0.0000 \\ 0.0000 & 0.0000 & 0.3000 & 0.2700 & 0.0000 & 0.0000 & 1.0000 & 0.9000 \\ 0.0000 & 0.0000 & 0.2700 & 0.3000 & 0.0000 & 0.0000 & 0.9000 & 1.0000 \end{bmatrix}$
4(2,1,2)x 4 case	$R_{high} = \begin{bmatrix} 1.0000 & 0.9000 & 0.0000 & 0.0000 & 0.9000 & 0.8100 & 0.0000 & 0.0000 & -0.3000 & -0.2700 & 0.0000 & 0.0000 & -0.2700 & -0.2430 & 0.0000 & 0.0000 \\ 0.9000 & 1.0000 & 0.0000 & 0.0000 & 0.8100 & 0.9000 & 0.0000 & 0.0000 & -0.2700 & -0.3000 & 0.0000 & 0.0000 & -0.2430 & -0.2700 & 0.0000 & 0.0000 \\ 0.0000 & 0.0000 & 1.0000 & 0.9000 & 0.0000 & 0.0000 & 0.9000 & 0.8100 & 0.0000 & 0.0000 & 0.3000 & 0.2700 & 0.0000 & 0.0000 & 0.2700 & 0.2430 \\ 0.0000 & 0.0000 & 0.9000 & 1.0000 & 0.0000 & 0.0000 & 0.8100 & 0.9000 & 0.0000 & 0.0000 & 0.2700 & 0.3000 & 0.0000 & 0.0000 & 0.2430 & 0.2700 \\ 0.9000 & 0.8100 & 0.0000 & 0.0000 & 1.0000 & 0.9000 & 0.0000 & 0.0000 & -0.2700 & -0.2430 & 0.0000 & 0.0000 & -0.3000 & -0.2700 & 0.0000 & 0.0000 \\ 0.8100 & 0.9000 & 0.0000 & 0.0000 & 0.9000 & 1.0000 & 0.0000 & 0.0000 & -0.2430 & -0.2700 & 0.0000 & 0.0000 & -0.2700 & -0.3000 & 0.0000 & 0.0000 \\ 0.0000 & 0.0000 & 0.9000 & 0.8100 & 0.0000 & 0.0000 & 1.0000 & 0.9000 & 0.0000 & 0.0000 & 0.2700 & 0.2430 & 0.0000 & 0.0000 & 0.3000 & 0.2700 \\ 0.0000 & 0.0000 & 0.8100 & 0.9000 & 0.0000 & 0.0000 & 0.9000 & 1.0000 & 0.0000 & 0.0000 & 0.2430 & 0.2700 & 0.0000 & 0.0000 & 0.2700 & 0.3000 \\ -0.3000 & -0.2700 & 0.0000 & 0.0000 & -0.2700 & -0.2430 & 0.0000 & 0.0000 & 1.0000 & 0.9000 & 0.0000 & 0.0000 & 0.9000 & 0.8100 & 0.0000 & 0.0000 \\ -0.2700 & -0.3000 & 0.0000 & 0.0000 & -0.2430 & -0.2700 & 0.0000 & 0.0000 & 0.9000 & 1.0000 & 0.0000 & 0.0000 & 0.8100 & 0.9000 & 0.0000 & 0.0000 \\ 0.0000 & 0.0000 & 0.3000 & 0.2700 & 0.0000 & 0.0000 & 0.2700 & 0.2430 & 0.0000 & 0.0000 & 1.0000 & 0.9000 & 0.0000 & 0.0000 & 0.9000 & 0.8100 \\ 0.0000 & 0.0000 & 0.2700 & 0.3000 & 0.0000 & 0.0000 & 0.2430 & 0.2700 & 0.0000 & 0.0000 & 0.9000 & 1.0000 & 0.0000 & 0.0000 & 0.8100 & 0.9000 \\ -0.2700 & -0.2430 & 0.0000 & 0.0000 & -0.3000 & -0.2700 & 0.0000 & 0.0000 & 0.9000 & 0.8100 & 0.0000 & 0.0000 & 1.0000 & 0.9000 & 0.0000 & 0.0000 \\ -0.2430 & -0.2700 & 0.0000 & 0.0000 & -0.2700 & -0.3000 & 0.0000 & 0.0000 & 0.8100 & 0.9000 & 0.0000 & 0.0000 & 0.9000 & 1.0000 & 0.0000 & 0.0000 \\ 0.0000 & 0.0000 & 0.2700 & 0.2430 & 0.0000 & 0.0000 & 0.3000 & 0.2700 & 0.0000 & 0.0000 & 0.9000 & 0.8100 & 0.0000 & 0.0000 & 1.0000 & 0.9000 \\ 0.0000 & 0.0000 & 0.2430 & 0.2700 & 0.0000 & 0.0000 & 0.2700 & 0.3000 & 0.0000 & 0.0000 & 0.8100 & 0.9000 & 0.0000 & 0.0000 & 0.9000 & 1.0000 \end{bmatrix}$
8(4,1,2)x 2 case	$R_{high} = \begin{bmatrix} 1.0000 & 0.0000 & 0.9883 & 0.0000 & 0.9542 & 0.0000 & 0.8999 & 0.0000 & -0.3000 & 0.0000 & -0.2965 & 0.0000 & -0.2862 & 0.0000 & -0.2700 & 0.0000 \\ 0.0000 & 1.0000 & 0.0000 & 0.9883 & 0.0000 & 0.9542 & 0.0000 & 0.8999 & 0.0000 & 0.3000 & 0.0000 & 0.2965 & 0.0000 & 0.2862 & 0.0000 & 0.2700 \\ 0.9883 & 0.0000 & 1.0000 & 0.0000 & 0.9883 & 0.0000 & 0.9542 & 0.0000 & -0.2965 & 0.0000 & -0.3000 & 0.0000 & -0.2965 & 0.0000 & -0.2862 & 0.0000 \\ 0.0000 & 0.9883 & 0.0000 & 1.0000 & 0.0000 & 0.9883 & 0.0000 & 0.9542 & 0.0000 & 0.2965 & 0.0000 & 0.3000 & 0.0000 & 0.2965 & 0.0000 & 0.2862 \\ 0.9542 & 0.0000 & 0.9883 & 0.0000 & 1.0000 & 0.0000 & 0.9883 & 0.0000 & -0.2862 & 0.0000 & -0.2965 & 0.0000 & -0.3000 & 0.0000 & -0.2965 & 0.0000 \\ 0.0000 & 0.9542 & 0.0000 & 0.9883 & 0.0000 & 1.0000 & 0.0000 & 0.9883 & 0.0000 & 0.2862 & 0.0000 & 0.2965 & 0.0000 & 0.3000 & 0.0000 & 0.2965 \\ 0.8999 & 0.0000 & 0.9542 & 0.0000 & 0.9883 & 0.0000 & 1.0000 & 0.0000 & -0.2700 & 0.0000 & -0.2862 & 0.0000 & -0.2965 & 0.0000 & -0.3000 & 0.0000 \\ 0.0000 & 0.8999 & 0.0000 & 0.9542 & 0.0000 & 0.9883 & 0.0000 & 1.0000 & 0.0000 & 0.2700 & 0.0000 & 0.2862 & 0.0000 & 0.2965 & 0.0000 & 0.3000 \\ -0.3000 & 0.0000 & -0.2965 & 0.0000 & -0.2862 & 0.0000 & -0.2700 & 0.0000 & 1.0000 & 0.0000 & 0.9883 & 0.0000 & 0.9542 & 0.0000 & 0.8999 & 0.0000 \\ 0.0000 & 0.3000 & 0.0000 & 0.2965 & 0.0000 & 0.2862 & 0.0000 & 0.2700 & 0.0000 & 1.0000 & 0.0000 & 0.9883 & 0.0000 & 0.9542 & 0.0000 & 0.8999 \\ -0.2965 & 0.0000 & -0.3000 & 0.0000 & -0.2965 & 0.0000 & -0.2862 & 0.0000 & 0.9883 & 0.0000 & 1.0000 & 0.0000 & 0.9883 & 0.0000 & 0.9542 & 0.0000 \\ 0.0000 & 0.2965 & 0.0000 & 0.3000 & 0.0000 & 0.2965 & 0.0000 & 0.2862 & 0.0000 & 0.9883 & 0.0000 & 1.0000 & 0.0000 & 0.9883 & 0.0000 & 0.9542 \\ -0.2862 & 0.0000 & -0.2965 & 0.0000 & -0.3000 & 0.0000 & -0.2965 & 0.0000 & 0.9542 & 0.0000 & 0.9883 & 0.0000 & 1.0000 & 0.0000 & 0.9883 & 0.0000 \\ 0.0000 & 0.2862 & 0.0000 & 0.2965 & 0.0000 & 0.3000 & 0.0000 & 0.2965 & 0.0000 & 0.9542 & 0.0000 & 0.9883 & 0.0000 & 1.0000 & 0.0000 & 0.9883 \\ -0.2700 & 0.0000 & -0.2862 & 0.0000 & -0.2965 & 0.0000 & -0.3000 & 0.0000 & 0.8999 & 0.0000 & 0.9542 & 0.0000 & 0.9883 & 0.0000 & 1.0000 & 0.0000 \\ 0.0000 & 0.2700 & 0.0000 & 0.2862 & 0.0000 & 0.2965 & 0.0000 & 0.3000 & 0.0000 & 0.8999 & 0.0000 & 0.9542 & 0.0000 & 0.9883 & 0.0000 & 1.0000 \end{bmatrix}$

Table B.2.3.2.2-3: MIMO correlation matrices for medium spatial correlation

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

B.2.3.2.3 Beam steering approach

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

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

And the steering matrix is further expressed as following:

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

Where:

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

For antenna array with only one direction, number of antenna element in second direction N_2 equals 1.

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

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

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

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

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

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

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

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

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

$\theta_{k,i}$ controls the phase variation in first dimension and second dimension respectively, and the phase for k-th subframe is denoted by $\theta_{k,i} = \theta_{0,i} + \Delta\theta \cdot k$, where $\theta_{0,i}$ is the random start value with the uniform distribution, i.e. $\theta_{0,i} \in [0, 2\pi]$, $\Delta\theta$ is the step of phase variation, which is defined in Table B.2.3.2.3-1, and k is the linear increment of $2^{-\mu}$ for every slot throughout the simulation, the index $i = 1,2$ stands for first dimension and second dimension respectively.

- W is the precoding matrix for Nt transmission antennas,
- y is the received signal, x is the transmitted signal, and n is AWGN.
- μ corresponds to subcarrier spacing configuration, $\Delta f = 2^{\mu} \cdot 15[\text{kHz}]$

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

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

Table B.2.3.2.3-1: The step of phase variation

Variation Step	Value (rad/ms)
$\Delta\theta$	1.2566×10^{-3}

B.2.4 Two-tap propagation conditions for CQI tests

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

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

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

B.3 High Speed Train Scenario

B.3.1 Single Tap Channel Profile

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

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

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

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

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

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

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

Doppler shift and cosine angle are given by equation B.3.1.1 and B.3.1.2-B.3.1.4 respectively, where the required input parameters listed in table B.3.1-1 and the resulting Doppler shift shown in Figures B.3.1-1, B.3.1-2, B.3.1-3, B.3.1-4 are applied for all frequency bands.

Table B.3.1-1: High speed train scenario

Parameter	Value			
	HST-750	HST-972	HST-1000	HST-1667
D_s	300 m	300 m	300 m	300 m
D_{min}	2 m	2 m	2 m	2 m
v	300 km/h	500 km/h	300 km/h	500 km/h
f_d	750 Hz for 15 kHz SCS test	972 Hz for 15 kHz SCS test	1000 Hz for 30 kHz SCS test	1667 Hz for 30 kHz SCS test

Note 1: Parameters for HST conditions in table B.3.1-1 including f_d and Doppler shift trajectories presented on figures B.3.1-1 for 750 Hz and B.3.1-3 for 972 Hz for 15 kHz SCS and figures B.3.1-2 for 1000 Hz and B.3.1-4 for 1667 Hz for 30 kHz SCS are applied for performance verification in all frequency bands.

Note 2: The propagation conditions used for the performance requirements under high speed train condition are indicated as a combination of “HST” and Doppler shift f_d , i.e. HST-<Doppler shift>, where ‘<Dopper shift>‘indicates the maximum Doppler shift (Hz).

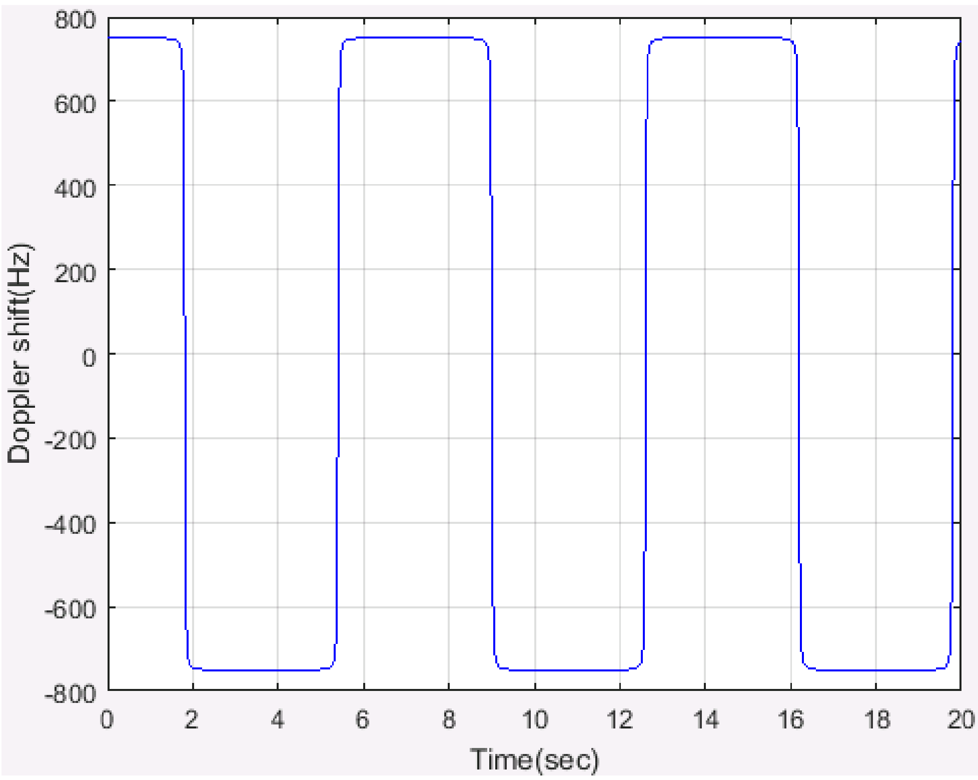

Figure B.3.1-1: Doppler shift trajectory (f_d = 750 Hz)

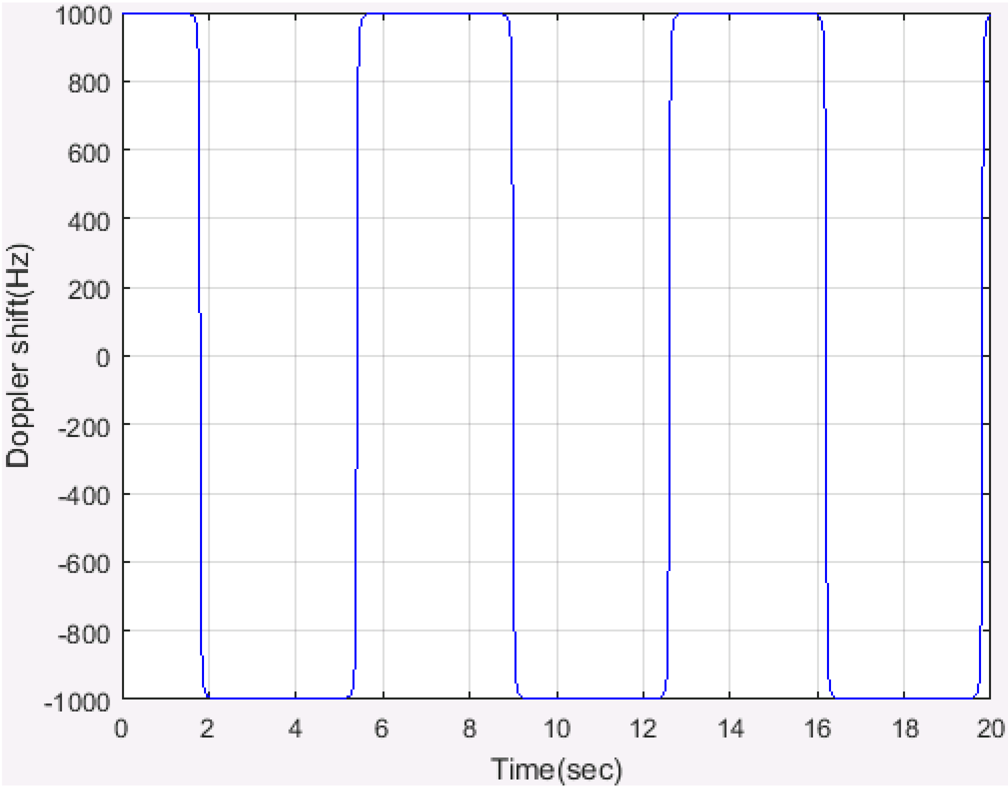

Figure B.3.1-2: Doppler shift trajectory (f_d = 1000 Hz)

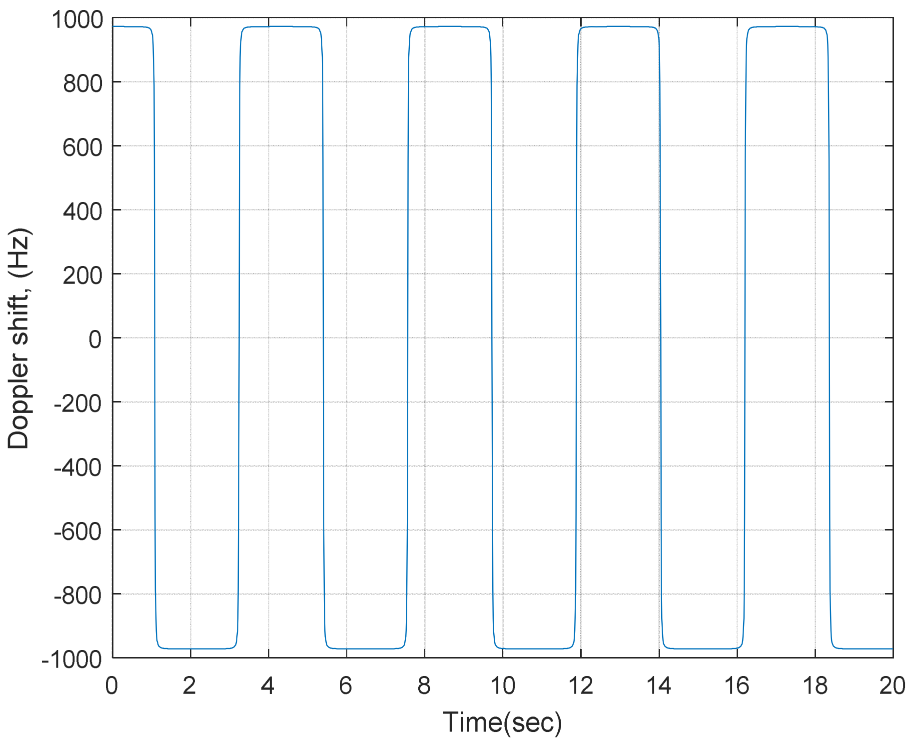

Figure B.3.1-3: Doppler shift trajectory (f_d = 972 Hz)

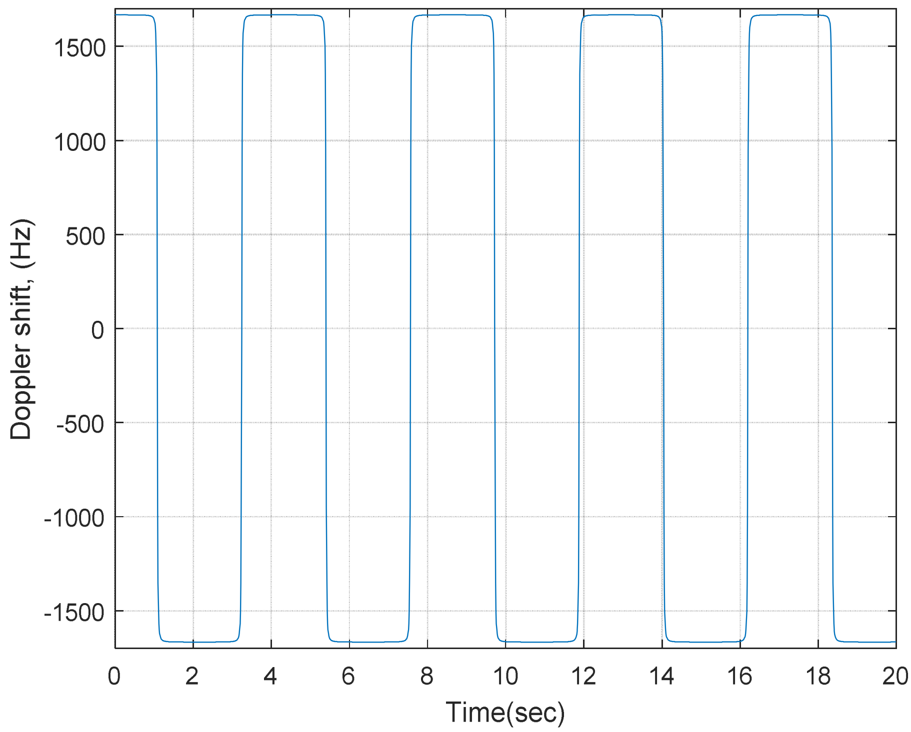

Figure B.3.1-4: Doppler shift trajectory (f_d = 1667 Hz)

For 1x2 antenna configuration, the same $h(t,\tau)$ is used to describe the channel between every pair of Tx and Rx.

For 1x4 antenna configuration, the same $h(t,\tau)$ is used to describe the channel between every pair of Tx and Rx.

B.3.2 HST-SFN Channel Profile

There is an infinite number of RRHs distributed equidistantly along the track with the same Cell ID as depicted in figure B.3.2-1.

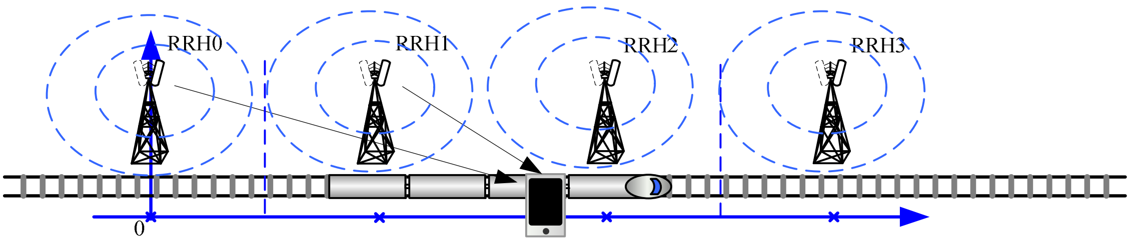

Figure B.3.2-1: Deployment of HST-SFN

The location of RRH k is given as:

$$x_k = k * D_s + j * D_{\min} \quad \text{(B.3.2.1)}$$

where: $k \in [-\infty, \infty]$, $j = sqrt(-1)$ and $D_{\min}$ is the distance between the RRHs and railway track, while D_s is the distance of two RRHs, both in meters.

The train location is denoted as:

$$y = a + j * 0 \quad \text{(B.3.2.2)}$$

where: $a \in [0, \infty]$ and a means distance in meters, which means the train is right on the track.

The HST-SFN scenario for the test of the baseband performance is a non fading propagation channel with four taps, namely the four nearest RRHs. Thus, RRH k is visible for the train only in the range:

$$k * D_s - 2 * D_s \le a < k * D_s + 2 * D_s \quad \text{(B.3.2.3)}$$

Power level P_k (dB) for the signal from k^{th} RRH, normalized to the total power received from all visible RRHs, is given by:

$$P_k = -20\lg\left(\left|y - x_k\right|\right) - 10\lg\left(\sum_{i \in \{i | i * D_S - 2 * D_S \le a < i * D_S + 2 * D_S\}} \frac{1}{\left|y - x_i\right|^2}\right) \text{ for } k * D_s - 2 * D_s \le a < k * D_s + 2 * D_s$$

(B.3.2.4)

Doppler shift $F_{D,k}$ (Hz) from k^{th} RRH is given by:

$$F_{D,k} = f_C \times real\left[-v \times \frac{y - x_k}{\left|y - x_k\right| \times C}\right] \text{ for } k * D_s - 2 * D_s \le a < k * D_s + 2 * D_s \quad \text{(B.3.2.5)}$$

The relative delay T_k (s) for the signal from k^{th} RRH can be derived as:

$$T_k = \frac{\left|y - x_k\right|}{C} \text{ for } k * D_s - 2 * D_s \le a < k * D_s + 2 * D_s \quad \text{(B.3.2.6)}$$

In the above v (m/s) is the moving speed of the train, f_C (Hz) is the center frequency, and C (m/s) is the velocity of light.

Power level, Doppler shift and relative delay are given by equations B.3.2.4 ~ B.3.2.6 respectively, where the required input parameters listed in table B.3.2-1 and the resulting Doppler shift shown in Figures B.3.2-3 and B.3.2-4 are applied for all requency bands.

Table B.3.2-1: HST-SFN scenario

Parameter	Value
D_s	700 m
$D_{\min}$	150 m
v	500 km/h
f_d	870 Hz for 15 kHz SCS test; 1667 Hz for 30 kHz SCS test

NOTE 1: The trajectories of ralative power, Doppler shifts and absolute delays presented in Figures B.3.2-2, B.3.2-3, B.3.2-4 and B.3.2-5 are derived from the equations B.3.2.4 ~ B.3.2.6 respectively.

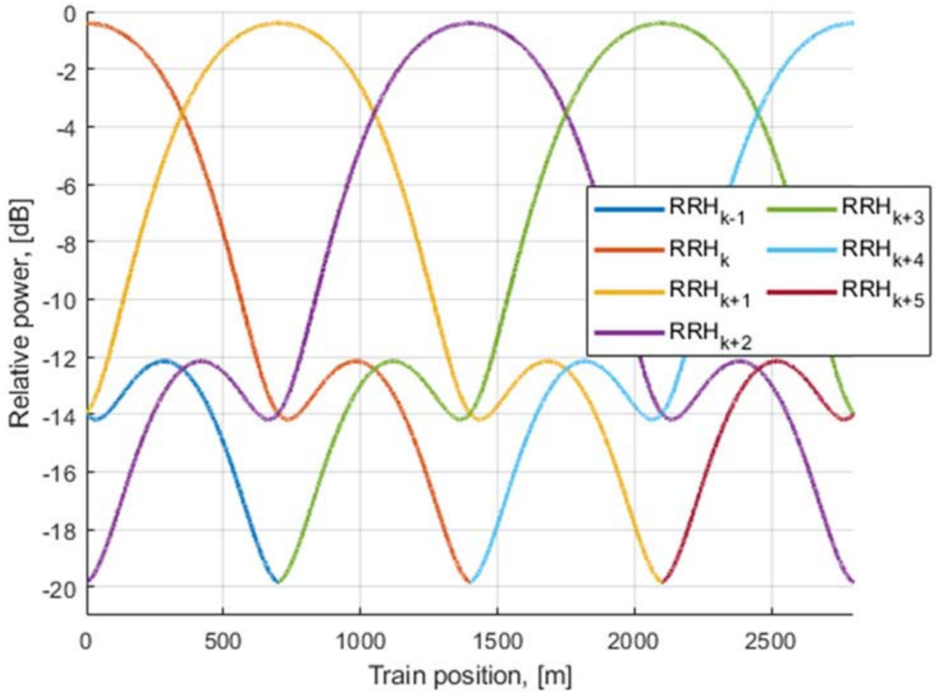

Figure B.3.2-2 Relative power level trajectories

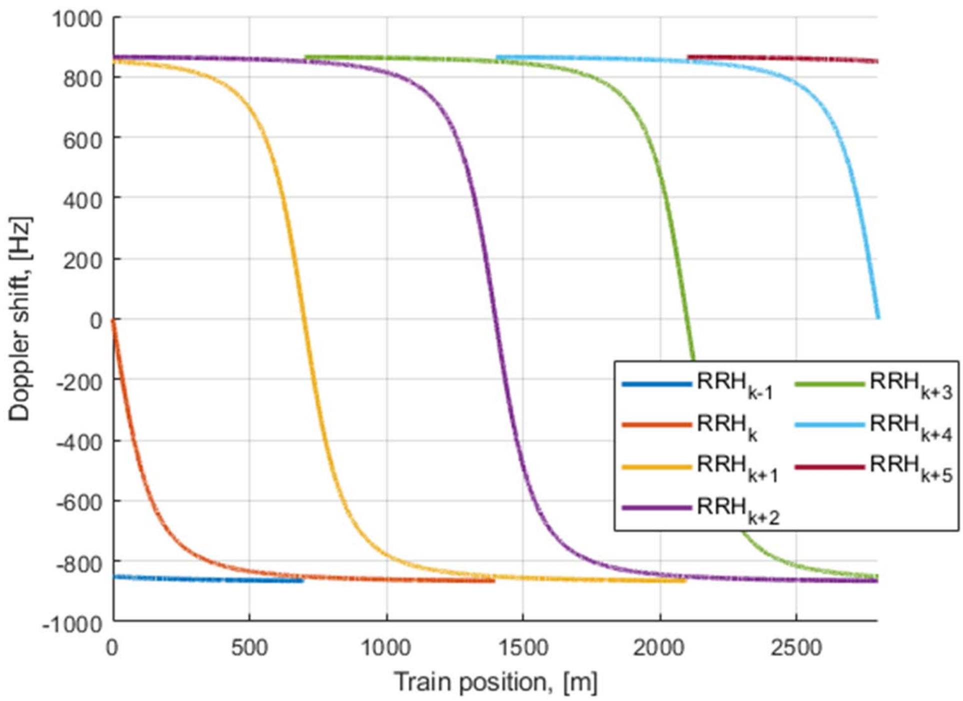

Figure B.3.2-3 Doppler shift trajectories (f_d = 870 Hz)

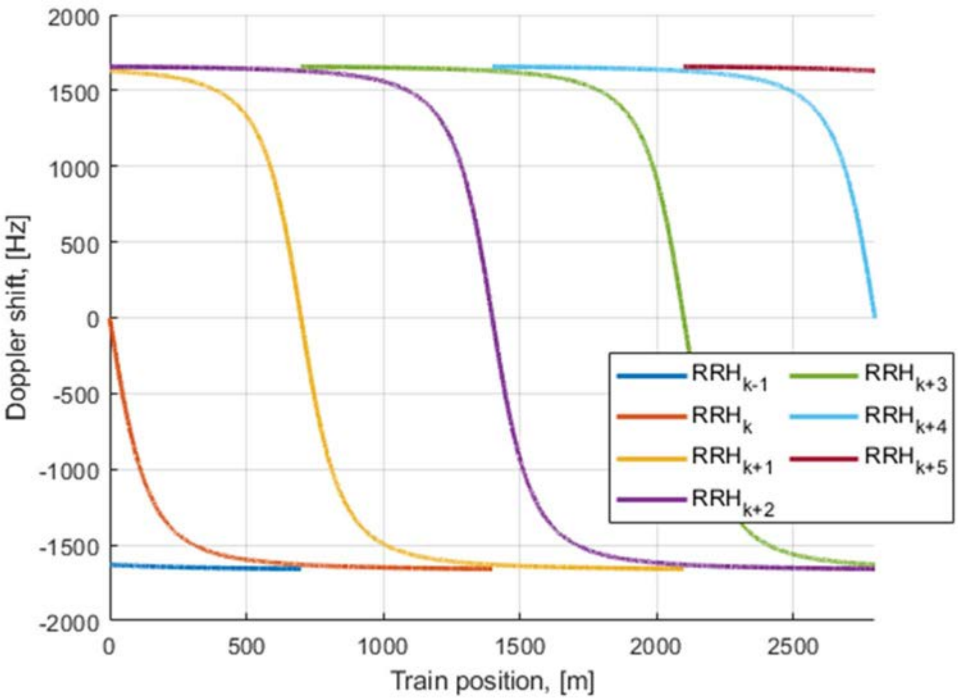

Figure B.3.2-4 Doppler shift trajectories (f_d = 1667 Hz)

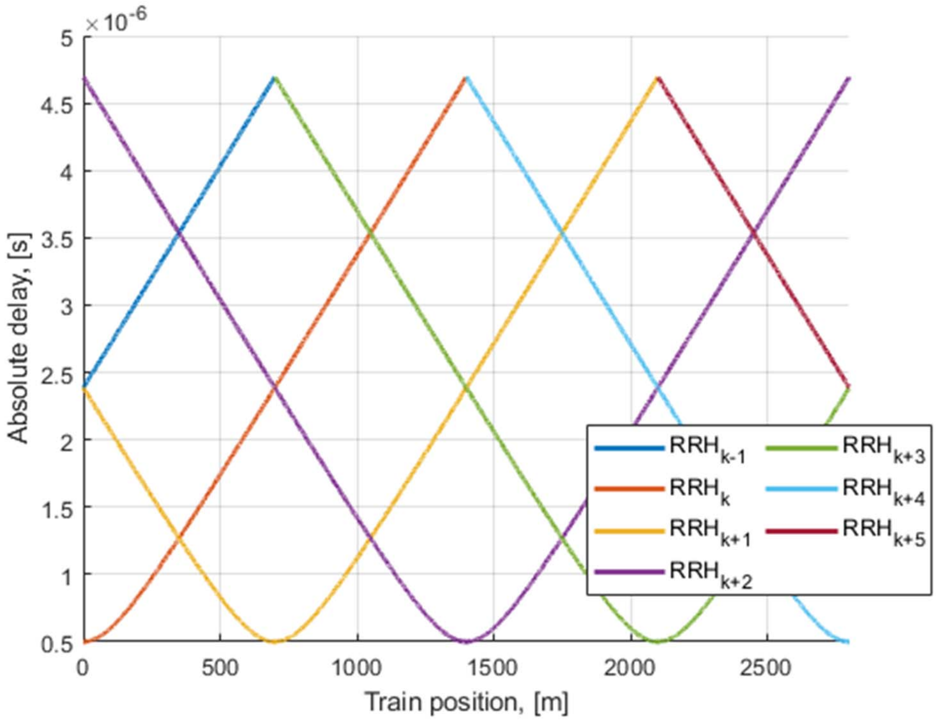

Figure B.3.2-5 Absolute delay trajectories

Static channel matrix will be used as defined in Annex B.1.

B.3.3 HST-DPS Channel Profile

There is an infinite number of RRHs distributed equidistantly along the railway track with the same Cell ID as illustrated in Figure B.3.3-1.

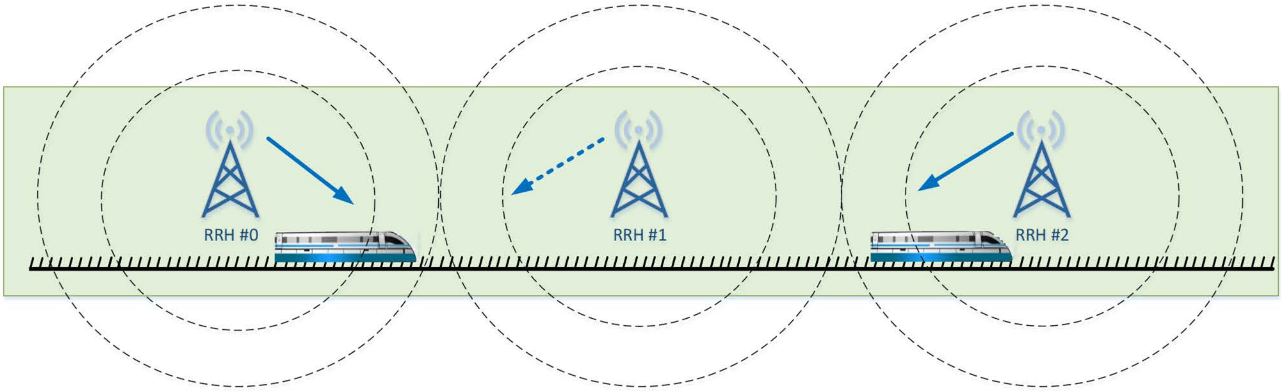

Figure B.3.3-1: Deployment of HST-DPS

The location of RRH *k* is given as:

$$x_k = k * D_s + j * D_{\min} \qquad \text{(B.3.3.1)}$$

where: $k \in [-\infty, \infty]$, $j = sqrt(-1)$ and $D_{\min}$ is the distance between the RRHs and railway track, while D_s is the distance of two RRHs, both in meters.

The train location is denoted as:

$$y = a + j * 0 \qquad \text{(B.3.3.2)}$$

where: $a \in [0, \infty]$ and *a* means distance in meters, which means the train is right on the track.

The HST DPS multi-RRH scenario for the test of the baseband performance is a single tap propagation channel at each time with switching of transmission point in the middle point between two RRHs. Thus, RRH *k* is visible for the train only in the range:

$$k * D_s - \frac{D_s}{2} \le a < k * D_s + \frac{D_s}{2} \qquad \text{(B.3.3.3)}$$

Power level P_k (dB) for the signal from k^{th} RRH equals to 0. Doppler shift $F_{D,k}$ (Hz) from k^{th} RRH is given by:

$$F_{D,k} = f_C \times real\left[-v \times \frac{y - x_k}{|y - x_k| \times C} \right] \text{ for } k * D_s - \frac{D_s}{2} \le a < k * D_s + \frac{D_s}{2} \qquad \text{(B.3.3.4)}$$

In the above v (m/s) is the moving speed of the train, f_C (Hz) is the centre frequency, and C (m/s) is the velocity of light.

Doppler shift is given by equation B.3.3.4, where the required input parameters listed in table B.3.3-1 and the resulting Doppler shift shown in Figures B.3.3-2 and B.3.3-3 are applied for all frequency bands.

Table B.3.3-1: HST-DPS scenario

Parameter	Value
D_s	700 m
$D_{\min}$	150 m
v	500 km/h
f_d	870 Hz for 15 kHz SCS test; 1667 Hz for 30 kHz SCS test

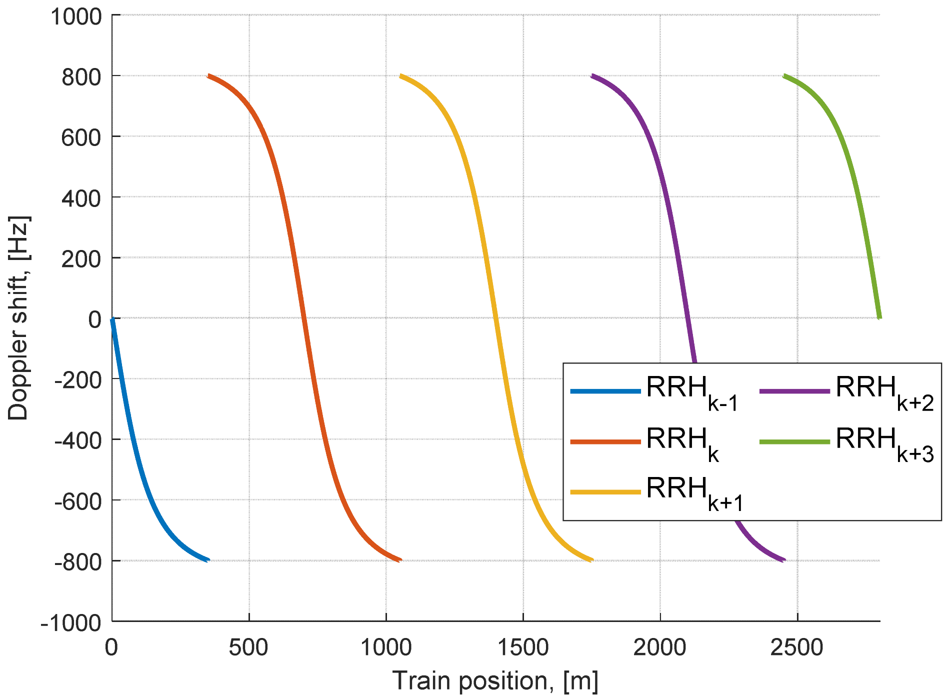

Figure B.3.3-2 Doppler shift trajectory (f_d = 870 Hz)

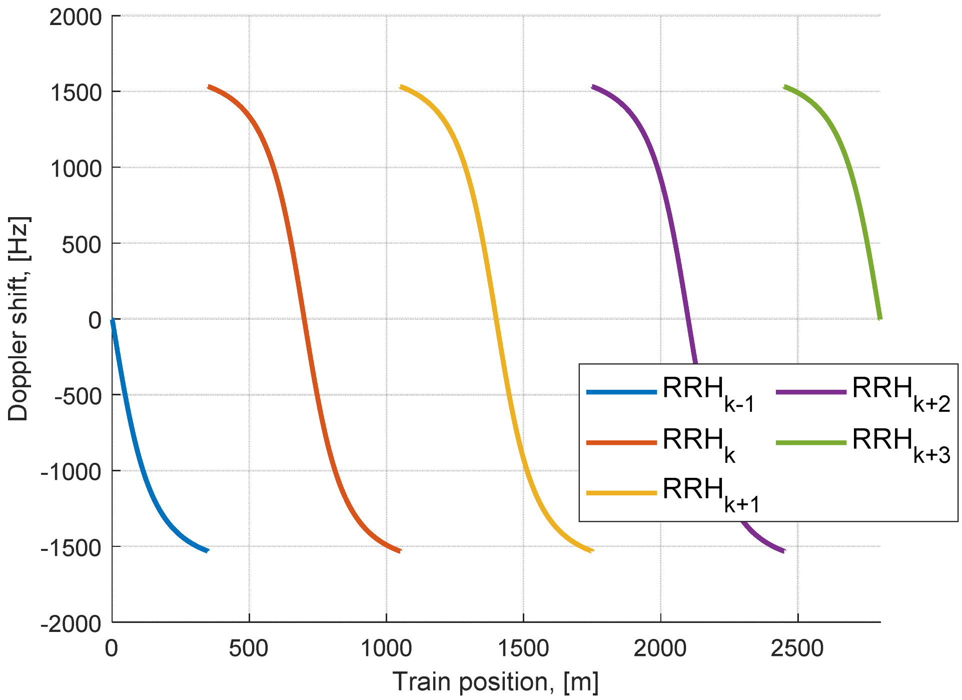

Figure B.3.3-3 Doppler shift trajectory (f_d = 1667 Hz)

Static channel matrix will be used as defined in Annex B.1.

B.4 Physical signals, channels mapping and precoding

B.4.1 General

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

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

For Clause 6 and 8, the transmission of PDCCH and PDCCH DMRS on antenna port $p = p_0$ is defined by using a precoder matrix $W(i)$ of size 2x1. This precoder takes as an input a block of signals for antenna port(s) $p = p_0$, $y^{(p)}(i) = y^{(p_0)}(i)$ and generates a block of signals $y_{bf}^{(q)}(i) = \left[y_{bf}^{(0)}(i)\ \ y_{bf}^{\left(\frac{N_{ANT}}{2}\right)}(i)\right]^T$ the elements of which are to be mapped onto the frequency-time index pair (k, l) as per the test configuration but transmitted on different physical antenna elements:

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

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

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

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

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

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

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

Modulation symbols $a_{k,l}^{(p)}$ for NZP CSI-RS which configured for CSI acquisition with $p \in \{p_0, p_0 + 1, \ldots, p_0 + N_{CSI} - 1\}$ are mapped to the physical antenna index $j = p - p_0$ where N_{CSI} is the number of NZP CSI-RS ports configured per test.

Annex C (normative): Downlink physical channels

C.0 Downlink signal levels

Downlink power settings to be configured for connection setup has been defined in this clause covering both FR1 and FR2.

C.0.1 FR1 Downlink Signal Levels (Conducted)

The downlink power settings in Table C.0.1-1 is used for FR1 conducted unless otherwise specified in a test case.

If the UE has more than one Rx antenna, the downlink signal is applied to each one. All UE Rx antennas shall be connected.

Table C.0.1-1: Default Downlink power levels for NR FR1

SCS (kHz)		**Unit**	**Channel bandwidth**											
			5 MHz	**10 MHz**	**15 MHz**	**20 MHz**	**25 MHz**	**30 MHz**	**40 MHz**	**50 MHz**	**60 MHz**	**80 MHz**	**90 MHz**	**100 MHz**
15	Number of RBs		25	50	75	100	128	160	215	270	N/A	N/A	N/A	N/A
	Channel BW power	dBm	-60	-57	-55	-54	-53	-52	-51	-50	N/A	N/A	N/A	N/A
30	Number of RBs		10	24	36	50	64	75	100	128	162	216	243	270
	Channel BW power	dBm	-61	-57	-55	-54	-53	-52	-51	-50	-49	-48	-47	-47
60	Number of RBs		N/A	10	18	24	30	36	50	64	75	100	120	135
	Channel BW power	dBm	N/A	-58	-56	-54	-53	-52	-51	-50	-49	-48	-47	-47
	SSS EPRE	dBm/ 15 kHz	-85	-85	-85	-85	-85	-85	-85	-85	-85	-85	-85	-85
	NOTE 1: The channel bandwidth powers are informative, based on -85dBm/15kHz SS/PBCH SSS EPRE, then scaled according to the number of RBs and rounded to the nearest integer dBm value. Full RE allocation with no boost or deboost is assumed. NOTE 2: The power level is specified at each UE Rx antenna. NOTE 3: DL level is applied for any of the Subcarrier Spacing configuration ( ) with the same power spectrum density of -85 dBm/15 kHz.													

The default signal level uncertainty is [+/-3] dB at each test port, for any level specified. If the uncertainty value is critical for the test purpose, a tighter uncertainty is specified for the related test case in [Annex F]

C.0.2 FR2 Downlink Signal Levels (Radiated)

The downlink power settings in Table C.0.2-1 is used unless otherwise specified in a test case.

Table C.0.2-1: Default Downlink power levels for NR FR2

SCS (kHz)		Unit	Channel Bandwidth			
			50 MHz	**100 MHz**	**200 MHz**	**400 MHz**
60	Number of RBs		66	132	264	N/A
	Channel BW power	dBm	-70	-67	-64	N/A
120	Number of RBs		32	66	132	264
	Channel BW power	dBm	-70	-67	-64	-61
	SS/PBCH SSS EPRE	dBm/60 kHz	[-99]	[-99]	[-99]	[-99]
NOTE 1: The channel bandwidth powers are informative, based on [-99] dBm/60 kHz SS/PBCH SSS EPRE, then scaled according to the number of RBs and rounded to the nearest integer dBm value. Full RE allocation with no boost or deboost is assumed. NOTE 2: The power level is specified at the centre of quiet zone. NOTE 3: DL level is applied for any of the Subcarrier Spacing configuration (μ) with the same power spectrum density of [-99]dBm/60kHz.						

The default downlink signal level uncertainty is +/- TBD dB, for any level specified. If the uncertainty value is critical for the test purpose, a tighter uncertainty is specified for the related test case in Annex F.

C.1 Setup

The following clause describes the downlink Physical Channels that are transmitted during connection setup.

C.1.1 FR1 Setup

Table C.1.1-1 describes the downlink Physical Channels that are required for FR1 connection set up.

Table C.1.1-1: Downlink Physical Channels required for FR1 connection setup

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

The following common PDSCH and PDCCH configuration parameters shall be used to bring up the connection setup for FR1 NR cell.

Table C.1.1-2: Common reference channel parameters for FR1

Parameter	Unit	Value
CORESET frequency domain allocation		Full BW,number of RB's to be in multiple of 6
CORESET time domain allocation		2 OFDM symbols at the begin of each slot
PDSCH mapping type		Type A
PDSCH start symbol index (S)		2
Number of consecutive PDSCH symbols (L)		12
PDSCH PRB bundling	PRBs	2
Dynamic PRB bundling		false
Overhead value for TBS determination		0
First DMRS position for Type A PDSCH mapping		2
DMRS type		Type 1
Number of additional DMRS		1
FDM between DMRS and PDSCH		Enable
TRS configuration		2 slots, periodicity 20 ms, offset 10
PTRS configuration		PTRS is not configured
Num of HARQ processes		8 (TDD)

Table C.1.1-3: Additional reference channels parameters for FDD

Parameter	Unit	Value
Number of HARQ Processes		4
K1 value		2 for all slots

Table C.1.1-4: TDD UL-DL pattern for SCS 15 KHz

<table>
<tr><th colspan="2" rowspan="2">Parameter</th><th rowspan="2">Unit</th><th>UL-DL pattern</th></tr>
<tr><th>FR1.15-1</th></tr>
<tr><td colspan="2">TDD Slot Configuration pattern (Note 1)</td><td></td><td>DDDSU</td></tr>
<tr><td colspan="2">Special Slot Configuration (Note 2)</td><td></td><td>10D+2G+2U</td></tr>
<tr><td rowspan="6">UL-DL configuration (tdd-UL-DL-ConfigurationCommon)</td><td>referenceSubcarrierSpacing</td><td>kHz</td><td>15</td></tr>
<tr><td>dl-UL-TransmissionPeriodicity</td><td>ms</td><td>5</td></tr>
<tr><td>nrofDownlinkSlots</td><td></td><td>3</td></tr>
<tr><td>nrofDownlinkSymbols</td><td></td><td>10</td></tr>
<tr><td>nrofUplinkSlot</td><td></td><td>1</td></tr>
<tr><td>nrofUplinkSymbols</td><td></td><td>2</td></tr>
<tr><td colspan="2">K1 value
(PDSCH-to-HARQ-timing-indicator)</td><td></td><td>[4] if mod(I,5) = 0
[3] if mod(i,5) = 1
[2] if mod(i,5) = 2
[6] if mod(i,5) = 3</td></tr>
<tr><td colspan="4">Note 1: D denotes a slot with all DL symbols; S denotes a slot with a mix of DL, UL and guard symbols; U denotes a slot with all UL symbols. The field is for information.
Note 2: D, G, U denote DL, guard and UL symbols, respectively. The field is for information.
Note 3: i is the slot index per frame; i = {0,…,9}</td></tr>
</table>

Table C.1.1-5: TDD UL-DL pattern for SCS 30 KHz

Parameter		Unit	UL-DL Pattern
TDD Slot Configuration pattern (Note 1)			7DS2U
Special Slot Configuration (Note 2)			6D+4G+4U
UL-DL configuration (*tdd-UL-DL-ConfigurationCommon*)	*referenceSubcarrierSpacing*	30	kHz
	dl-UL-TransmissionPeriodicity	5	
	nrofDownlinkSlots	7	
	nrofDownlinkSymbols	6	
	nrofUplinkSlot	2	
	nrofUplinkSymbols	4	
UL-DL configuration2 (*tdd-UL-DL-ConfigurationCommon2*)	*referenceSubcarrierSpacing*	N/A	
	dl-UL-TransmissionPeriodicity	N/A	
	nrofDownlinkSlots	N/A	
	nrofDownlinkSymbols	N/A	
	nrofUplinkSlot	N/A	
	nrofUplinkSymbols	N/A	
K1 value (PDSCH-to-HARQ-timing-indicator)			8 if mod(i,10) = 0 7 if mod(i,10) = 1 6 if mod(i,10) = 2 5 if mod(i,10) = 3 5 if mod(i,10) = 4 4 if mod(i,10) = 5 3 if mod(i,10) = 6 2 if mod(i,10) = 7
Note 1: D denotes a slot with all DL symbols; S denotes a slot with a mix of DL, UL and guard symbols; U denotes a slot with all UL symbols. The field is for information. Note 2: D, G, U denote DL, guard and UL symbols, respectively. The field is for information. Note 3: i is the slot index per frame; i = {0,…,19}			

C.1.2 FR2 Setup

Table C.1.2-1 describes the downlink Physical Channels that are required for FR2 connection set up.

Table C.1.2-1: Downlink Physical Channels required for FR2 connection set-up

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

The following common PDSCH and PDCCH configuration parameters shall be used to bring up the connection setup for FR2 NR cell.

Table C.1.2-2: Common reference channel parameters for FR2

Parameter	Unit	Value
CORESET frequency domain allocation		Full BW, number of RB's to be in multiple of 6
CORESET time domain allocation		1 OFDM symbols at the begin of each slot
PDSCH mapping type		Type A
PDSCH start symbol index (S)		1
Number of consecutive PDSCH symbols (L)		13
PDSCH PRB bundling	PRBs	2
Dynamic PRB bundling		false
MCS table for TBS determination		64QAM
Overhead value for TBS determination		0
First DMRS position for Type A PDSCH mapping		2
DMRS type		Type 1
Number of additional DMRS		1
FDM between DMRS and PDSCH		Enable
TRS configuration		2 slots, periodicity 20 ms, offset 10
PTRS configuration		Single port, every other RB, every symbol (K=2, L=1)
Num of HARQ processes		8

Table C.1.2-3: Additional test parameters for TDD for SCS 60 KHz

Parameter		Unit	UL-DL pattern
TDD Slot Configuration pattern (Note 1)			DDSU
Special Slot Configuration (Note 2)			11D+3G+0U
UL-DL configuration (*tdd-UL-DL-ConfigurationCommon*)	*referenceSubcarrierSpacing*	kHz	60
	dl-UL-TransmissionPeriodicity	ms	1
	nrofDownlinkSlots		2
	nrofDownlinkSymbols		11
	nrofUplinkSlot		1
	nrofUplinkSymbols		0
K1 value (PDSCH-to-HARQ-timing-indicator)			K1 = 3 if mod(i,4) = 0 K1 = 2 if mod(i,4) = 1 K1 = 5 if mod(i,4) = 2
Note 1: D denotes a slot with all DL symbols; S denotes a slot with a mix of DL, UL and guard symbols; U denotes a slot with all UL symbols. The field is for information. Note 2: D, G, U denote DL, guard and UL symbols, respectively. The field is for information. Note 3: i is the slot index per frame; i = {0,…,39}			

Table C.1.2-4: Additional test parameters for TDD for SCS 120 KHz

Parameter		Unit	UL-DL pattern
TDD Slot Configuration pattern (Note 1)			DDDSU
Special Slot Configuration (Note 2)			10D+2G+2U
UL-DL configuration (*tdd-UL-DL-ConfigurationCommon*)	*referenceSubcarrierSpacing*	kHz	120
	dl-UL-TransmissionPeriodicity	ms	0.625
	nrofDownlinkSlots		3
	nrofDownlinkSymbols		10
	nrofUplinkSlot		1
	nrofUplinkSymbols		2
K1 value (PDSCH-to-HARQ-timing-indicator)			K1 = [4] if mod(i,5) = 0 K1 = [3] if mod(i,5) = 1 K1 = [2] if mod(i,5) = 2 K1 = [6] if mod(i,5) = 3
Note 1: D denotes a slot with all DL symbols; S denotes a slot with a mix of DL, UL and guard symbols; U denotes a slot with all UL symbols. The field is for information. Note 2: D, G, U denote DL, guard and UL symbols, respectively. The field is for information. Note 3: i is the slot index per frame; i = {0,…,79}			

C.2 Connection

C.2.1 FR1 Measurement of Performance Characteristics

Unless otherwise stated, Table C.2.1-1 is applicable for measurements in which uniform RS-to-EPRE boosting for all downlink physical channels is used.

Table C.2.1-1: Downlink Physical Channels transmitted during a connection (FDD and TDD) for FR1

Parameter	Unit	Value (NOTE 2)
SSS transmit power	W	Test specific
EPRE ratio of PSS to SSS	dB	0
EPRE ratio of PBCH to SSS	dB	0
EPRE ratio of PBCH to PBCH DMRS	dB	0
EPRE ratio of PDCCH to SSS	dB	0
EPRE ratio of PDCCH to PDCCH DMRS	dB	0
EPRE ratio of PDSCH to SSS	dB	0
EPRE ratio of PDSCH to PDSCH DMRS	dB	Test specific (Note 1)
EPRE ratio of NZP CSI-RS to SSS	dB	-10*log10(L) (Note 3)
EPRE ratio of PDSCH OCNG to SSS	dB	0
EPRE ratio of PDCCH OCNG to SSS	dB	0
EPRE ratio of LTE CRS to NR SSS	dB	0 (Note 4)
NOTE 1: Value is derived from Table 4.1-1 in TS 38.214 [X] based on “Number of DM-RS CDM groups without data” and “DMRS Type” parameters specified for each test. NOTE 2: The value is the energy of per RE for a single antenna port before pre-coding. NOTE 3: $L \in \{1,2,4,8\}$ is the CDM group size of NZP CSI-RS specified for each test. NOTE 4: It is only applicable to LTE-NR coexistence tests.		

C.2.2 FR2 Measurement of Performance Characteristics

Unless otherwise stated, Table C.2.2-1 is applicable for measurements on the Performance Characteristics.

Table C.2.2-1: Downlink Physical Channels transmitted during a connection (TDD) for FR2

Parameter	Unit	Value (Note 2)
SSS transmit power	W	Test specific
EPRE ratio of PSS to SSS	dB	0
EPRE ratio of PBCH to SSS	dB	0
EPRE ratio of PBCH to PBCH DMRS	dB	0
EPRE ratio of PDCCH to SSS	dB	0
EPRE ratio of PDCCH to PDCCH DMRS	dB	0
EPRE ratio of PDSCH to SSS	dB	0
EPRE ratio of PDSCH to PDSCH DMRS	dB	Test specific (Note 1)
EPRE ratio of NZP CSI-RS to SSS	dB	-10*log10(L) (Note 3)
EPRE ratio of PTRS to PDSCH	dB	Test specific (Note 4)
EPRE ratio of PDSCH OCNG to SSS	dB	0
EPRE ratio of PDCCH OCNG to SSS	dB	0
Note 1: Value is derived from Table 4.1-1 in TS 38.214 [12] based on "Number of DM-RS CDM groups without data" and "DMRS Type" parameters specified for each test Note 2: The value is the energy of per RE for a single antenna port before pre-coding. Note 3: $L \in \{1,2,4,8\}$ is the CDM group size of NZP CSI-RS specified for each test. Note 4: Value is derived from Table 4.1-2 in TS 38.214 [12] based on “The number of PDSCH layers” and “*epre-Ratio*” parameters specified for each test.		

Annex D (normative): E-UTRA link setup config for NSA testing

D.0 General

Below clauses define the E-UTRA link setup config for NSA Demodulation and CSI tests cases unless otherwise specified within the main test case.

D.1 E-UTRA test parameters

Below are the common test parameters to be configured for E-UTRA link.

Table D.1-1: Common Test Parameters (FDD)

Parameter	Unit	Value	Comments
Inter-TTI Distance		1	
Number of HARQ processes	Processes	8	For FDD, 8 HARQ processes in the DL, as specified in TS 36.213 [10] clause 7. All 8 HARQ processes are used.
Scheduling of retransmissions			1. Retransmissions use the same Transport Block Size (TBS) as the initial transmission. 2. HARQ processes are scheduled consecutively, independent of the fact, whether retransmissions (for negatively acknowledged HARQ processes) or new transmissions (for positively acknowledged HARQ processes) occur.
Maximum number of HARQ transmission		4	It is always 4 for FDD, as specified in TS 36.213 [10] clause 8
Redundancy version coding sequence		{0,1,2,3} for QPSK	
Number of OFDM symbols for PDCCH	OFDM symbols	3 for 5 MHz bandwidths, 2 for 10 MHz, 20MHz	The PCFICH carries information about the number of OFDM symbols used for transmission of PDCCHs in a subframe, as specified in TS 36.211 [8] clause 6.7
Cyclic Prefix		Normal	CP consist of the following physical resource blocks (RBs) parameters: 12 consecutive subcarriers at a 15 kHz spacing and 7 OFDM symbols, as specified in TS 36.211 [8] clause 6.2.3
Cell ID		0 (Note 1)	The Cell ID is uniquely defined by a number in the range of 0 to 503, representing the physical-layer cell identity, as specified in TS 36.211 [8] clause 6.11.
DCI format for PDSCH	Format 1A		
DCI format for PUSCH	Format 0		

Table D.1-2: Common Test Parameters (TDD)

Parameter	Unit	Value	Comments
Uplink downlink configuration (Note 1)		1	
Special subframe configuration (Note 2)		4	
Inter-TTI Distance		1	
Number of HARQ processes	Processes	7	For TDD, 7 HARQ processes in the DL, as specified in TS 36.213 [10] clause 7. All 7 HARQ processes are used.
Scheduling of retransmissions			1. Retransmissions use the same Transport Block Size (TBS) as the initial transmission. 2. HARQ processes are scheduled consecutively, independent of the fact, whether retransmissions (for negatively acknowledged HARQ processes) or new transmissions (for positively acknowledged HARQ processes) occur. 3. In case when the initial transmission and the retransmissions are scheduled in subframes with a different N_{PRB} (in terms of TS 36.213 [10] subclause 7.1.7) $29 \le I_{MCS} \le 31$ according to TS 36.213 [10] subclause 7.1.7.2 and the appropriate modulation is used.
Maximum number of HARQ transmission		4	It is always 4 for TDD, as specified in TS 36.213 [10] clause 8
Redundancy version coding sequence		{0,1,2,3} for QPSK	
Number of OFDM symbols for PDCCH	OFDM symbols	3 for 5 MHz bandwidths, 2 for 10 MHz	The PCFICH carries information about the number of OFDM symbols used for transmission of PDCCHs in a subframe, as specified in TS 36.211 [8] clause 6.7
Cyclic Prefix		Normal	CP consist of the following physical resource blocks (RBs) parameters: 12 consecutive subcarriers at a 15 kHz spacing and 7 OFDM symbols, as specified in TS 36.211 [8] clause 6.2.3
Cell ID		0 (Note 3)	The Cell ID is uniquely defined by a number in the range of 0 to 503, representing the physical-layer cell identity, as specified in TS 36.211 [8] clause 6.11.
DCI format for PDSCH	Format 1A		
DCI format for PUSCH	Format 0		

NOTE 1: as specified in Table 4.2-2 in TS 36.211 [8].
NOTE 2: as specified in Table 4.2-1 in TS 36.211 [8].
NOTE 3: For CA tests, Cell ID = 0 applies only to P-Cell. For (n)*th* S-Cell, Cell ID = n is used.

D.2 E-UTRA configuration

This clause defines the E-UTRA link settings for the test cases defined in clauses 5 and 6. The LTE link is supposed to be a functional link. The configuration defined in this clause ensures establishment of LTE link. Unless otherwise stated, ensure the UE is in state 3A-RF on the E-UTRA cell as defined in TS 36.508 [19].

Table D.2-1: E-UTRA configuration for EN-DC tests

Parameter	Value	Comments
Test Frequency during and after connection setup	Mid	As defined in TS 36.508 [19] for inter band test cases and as defined in TS 38.508-1 [6] clause 4.3.1 for intra band test cases, with NR SCS as per the test case for the LTE band under test
Bandwidth during and after connection setup	5 MHz (Note 1)	Supported by all LTE bands
PDSCH transmission mode and antenna config	TM1 1x2	
OCNG pattern	OP.1 for FDD OP.1 for TDD	These physical resource blocks are assigned to an arbitrary number of virtual UE′ s with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated.
DL RMC	According to table A.3.2-1 in TS 36.521-1 [16] for FDD According to table A.3.1.1-1 in TS 38.521-3 [21] for TDD	Note 1
DL RB allocation	25	Full RB allocation assuming 5 MHz ChBW. 100 RB for 20 MHz ChBW as applicable
UL Signal levels during connection setup	PUSCH Power	Attained by enabling open loop power control and setting up UL signal levels according to Annexes H.0, H.2 and H.3 of TS 36.521-1 [16]
TA adjustments	*TimeAlignmentTimerDedicated* IE to be set to infinity	*TimeAlignmentTimerDedicated* IE to be set to infinity to ensure UE doesn't look for TA adjustments (See Table D.2-4)
CQI reports and SRS after connection setup	Disabled (See Table D.2-2 and D.2-3)	Disable periodic and aperiodic CQI reports to ensure none of these transmissions occur on the LTE uplink.
NOTE 1: If none of the UE supported EN-DC band combos support 5MHz E-UTRA carrier, configure 20 MHz channel BW.		

Table D.2-2: *CQI-ReportConfig-DEFAULT:* Additional E-UTRA Anchor Configuration

Derivation Path: TS 36.508 [7] clause 4.6.3, Table 4.6.3-2 CQI-ReportConfig-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
CQI-ReportConfig-DEFAULT ::= SEQUENCE {			
cqi-ReportModeAperiodic	NOT PRESENT		
cqi-ReportPeriodic	NOT PRESENT		
}			

Table D.2-3: *PhysicalConfigDedicated-DEFAULT:* Additional E-UTRA Anchor Configuration

Derivation Path: TS 36.508 [7] clause 4.8.2, Table 4.8.2.1.6-1 PhysicalConfigDedicated-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
PhysicalConfigDedicated-DEFAULT ::= SEQUENCE {			
soundingRS-UL-ConfigDedicated	Not present		RBC
}			

Table D.2-4: *MAC-MainConfig-RBC*: Additional E-UTRA Anchor Configuration

Derivation Path: TS 36.508 [7] clause 4.8.2.1.5, Table 4.8.2.1.5-1 MAC-MainConfig-RBC			
Information Element	**Value/remark**	**Comment**	**Condition**
timeAlignmentTimerDedicated	Infinity		

D.3 E-UTRA link common physical channel setup

Table D.3-1 describes the downlink Physical Channels that are required for E-UTRA connection set up.

Table D.3-1: Downlink Physical Channels required for E-UTRA connection set-up

Physical Channel	EPRE Ratio	Note
PBCH	PBCH_RA = 0 dB	
	PBCH_RB = 0 dB	
PSS	PSS_RA = 0 dB	
SSS	SSS_RA = 0 dB	
PCFICH	PCFICH_RB = 0 dB	
PDCCH	PDCCH_RA = 0 dB	
	PDCCH_RB = 0 dB	
PDSCH	PDSCH_RA = 0 dB	
	PDSCH_RB = 0 dB	
PHICH	PHICH_RA = 0 dB	
	PHICH_RB = 0 dB	
NOTE 1: $P_B = 0$. NOTE 2: PHICH group power, i.e. the total power of all active PHICH sequences within a PHICH group.		

D.4 E-UTRA power level

D.4.1 E-UTRA power level (conducted)

Table D.4.1-1: DL power level for E-UTRA (conducted)

Parameter	Value	Comments
DL signal level	RS EPRE -85.0 dBm/15 kHz	The power level is specified at each UE Rx antenna

D.4.2 E-UTRA power level (radiated)

Table D.4.2-1: Downlink power levels for E-UTRA (radiated)

Parameter	Value	Comments
DL signal level	RS EPRE -100 dBm/15 kHz	The power level is specified at each UE Rx antenna

Annex E (normative): Environmental conditions

FFS

Annex F (normative): Measurement uncertainties and test tolerances

The requirements of this clause apply to all tests in the present document.

F.1 Measurement uncertainties and test tolerances for FR1

F.1.1 Acceptable uncertainty of test system (normative)

The maximum acceptable uncertainty of the Test System is specified below for each test, where appropriate. The Test System shall enable the stimulus signals in the test case to be adjusted to within the specified range, and the equipment under test to be measured with an uncertainty not exceeding the specified values. All ranges and uncertainties are absolute values, and are valid for a confidence level of 95 %, unless otherwise stated.

A confidence level of 95 % is the measurement uncertainty tolerance interval for a specific measurement that contains 95 % of the performance of a population of test equipment.

For RF tests it should be noted that the uncertainties in clause F.1 apply to the Test System operating into a nominal 50 ohm load and do not include system effects due to mismatch between the DUT and the Test System.

The downlink signal uncertainties apply at each receiver antenna connector.

F.1.1.1 Measurement of test environments

The measurement accuracy of the UE test environments defined in TS 38.508-1 [5] subclause 4.1, Test environments shall be

- Pressure ±5 kPa.
- Temperature ±2 degrees.
- Relative Humidity ±5 %.
- DC Voltage ±1,0 %.
- AC Voltage ±1,5 %.
- Vibration 10 %.
- Vibration frequency 0,1 Hz.

The above values shall apply unless the test environment is otherwise controlled and the specification for the control of the test environment specifies the uncertainty for the parameter.

F.1.1.2 Measurement of Demod Performance requirements

This clause defines the maximum test system uncertainty for Demod Performance requirements. The maximum test system uncertainty allowed for the measurement uncertainty contributors are defined in Table F.1.1.2-1.

Table F.1.1.2-1: Maximum measurement uncertainty values for the test system for FR1 (up to 6 GHz) and Channel BW ≤ 40 MHz

MU contributor	Unit	Value	Comment
AWGN flatness and signal flatness, max deviation for any Resource Block, relative to average over BW_{config}	dB	±2.0	Same as in LTE

MU contributor	Unit	Value	Comment
Signal to noise ratio uncertainty	dB	±0.3	Same as in LTE
Signal to noise ratio variation	dB	±0.5	Same as in LTE
Fading profile power uncertainty for 1Tx	dB	±0.5	Same as in LTE
Fading profile power uncertainty for 2Tx	dB	±0.7	Same as in LTE

The maximum test system uncertainty for test cases defined in section 5 is defined in Table F.1.1.2-2.

Table F.1.1.2-2: Maximum test system uncertainty for FR1 demodulation performance test cases

Subclause	Maximum Test System Uncertainty	Derivation of Test System Uncertainty
5.2.2.1.1_1 2Rx FDD FR1 PDSCH mapping Type A performance - 2x2 MIMO with baseline receiver for both SA and NSA	± 0.9 dB for > 10Hz doppler ± 1 dB for 10Hz doppler	Overall system uncertainty for fading conditions comprises four quantities: 1. Signal-to-noise ratio uncertainty 2. Fading profile power uncertainty 3. Effect of AWGN flatness and signal flatness 4. SNR uncertainty due to finite test time Items 1, 2, 3 and 4 are assumed to be uncorrelated so can be root sum squared: AWGN flatness and signal flatness has x 0.25 effect on the required SNR, so use sensitivity factor of x 0.25 for the uncertainty contribution. Test System uncertainty = SQRT (Signal-to-noise ratio uncertainty ^{2} + Fading profile power uncertainty ^{2} + (0.25 x AWGN flatness and signal flatness) ^{2}) + SNR uncertainty due to finite test time^2 Signal-to-noise ratio uncertainty ±0.3 dB Fading profile power uncertainty ±0.7 dB for 2Tx AWGN flatness and signal flatness ±2.0 dB SNR uncertainty due to finite test time ±0.3 dB for 10Hz Doppler, otherwise ±0.0 dB
5.2.2.1.1_2 2Rx FDD FR1 PDSCH Mapping Type A performance - 2x2 MIMO with enhanced receiver type X for both SA and NSA	Same as 5.2.2.1.1_1	Same as 5.2.2.1.1_1
5.2.2.1.2_1 2Rx FDD FR1 PDSCH mapping Type A and CSI-RS overlapped with PDSCH performance - 2x2 MIMO with baseline receiver for both SA and NSA	Same as 5.2.2.1.1_1	Same as 5.2.2.1.1_1
5.2.2.1.3_1 2Rx FDD FR1 PDSCH mapping Type B performance - 2x2 MIMO with baseline receiver for both SA and NSA	Same as 5.2.2.1.1_1	Same as 5.2.2.1.1_1
5.2.2.1.4_1 2Rx FDD FR1 PDSCH Mapping Type A and LTE-NR coexistence performance - 4x2 MIMO with baseline receiver for both SA and NSA	Same as 5.2.2.1.1_1	Same as 5.2.2.1.1_1
5.2.2.2.1_1 2Rx TDD FR1 PDSCH mapping Type A performance - 2x2 MIMO with baseline receiver for both SA and NSA	Same as 5.2.2.1.1_1	Same as 5.2.2.1.1_1
5.2.2.2.1_2 2Rx TDD FR1 PDSCH Mapping Type A performance - 2x2 MIMO with enhanced receiver type X for both SA and NSA	Same as 5.2.2.1.1_1	Same as 5.2.2.1.1_1
5.2.2.2.2_1 2Rx TDD FR1 PDSCH mapping Type A and CSI-RS overlapped with PDSCH performance - 2x2 MIMO with baseline receiver for both SA and NSA	Same as 5.2.2.1.1_1	Same as 5.2.2.1.1_1
5.2.2.2.3_1 2Rx TDD FR1 PDSCH mapping Type B performance - 2x2 MIMO with baseline receiver for both SA and NSA	Same as 5.2.2.1.1_1	Same as 5.2.2.1.1_1
5.2.2.2.4_1 2Rx TDD FR1 PDSCH Mapping Type A and LTE-NR coexistence performance - 4x2 MIMO with baseline receiver for both SA and NSA	Same as 5.2.2.1.1_1	Same as 5.2.2.1.1_1

5.2.3.1.1_1 4Rx FDD FR1 PDSCH mapping Type A performance - 2x4 MIMO with baseline receiver for both SA and NSA	± 0.9 dB for > 10Hz doppler ± 1.0 dB for 10Hz doppler	Overall system uncertainty for fading conditions comprises four quantities: 1. Signal-to-noise ratio uncertainty 2. Fading profile power uncertainty 3. Effect of AWGN flatness and signal flatness 4. SNR uncertainty due to finite test time Items 1, 2, 3 and 4 are assumed to be uncorrelated so can be root sum squared: AWGN flatness and signal flatness has x 0.25 effect on the required SNR, so use sensitivity factor of x 0.25 for the uncertainty contribution. Test System uncertainty = SQRT (Signal-to-noise ratio uncertainty ^{2} + Fading profile power uncertainty ^{2} + (0.25 x AWGN flatness and signal flatness) ^{2} + SNR uncertainty due to finite test time ^{2}) Signal-to-noise ratio uncertainty ±0.3 dB Fading profile power uncertainty ±0.7 dB for 2Tx AWGN flatness and signal flatness ±2.0 dB SNR uncertainty due to finite test time ±0.3 dB for 10Hz Doppler, otherwise ±0.0 dB
5.2.3.1.1_2 4Rx FDD FR1 PDSCH mapping Type A performance - 4x4 MIMO with baseline receiver for both SA and NSA	Same as 5.2.3.1.1_1	Same as 5.2.3.1.1_1
5.2.3.1.1_4 4Rx FDD FR1 PDSCH mapping Type A performance - 4x4 MIMO with enhanced receiver type 1 for both SA and NSA	Same as 5.2.3.1.1_1	Same as 5.2.3.1.1_1
5.2.3.1.2_1 4Rx FDD FR1 PDSCH mapping Type A and CSI-RS overlapped with PDSCH performance - 4x4 MIMO with baseline receiver for both SA and NSA	Same as 5.2.3.1.1_1	Same as 5.2.3.1.1_1
5.2.3.1.3_1 4Rx FDD FR1 PDSCH mapping Type B performance - 2x4 MIMO with baseline receiver for both SA and NSA	Same as 5.2.3.1.1_1	Same as 5.2.3.1.1_1
5.2.3.1.4_1 4Rx FDD FR1 PDSCH Mapping Type A and LTE-NR coexistence performance - 4x4 MIMO with baseline receiver for both SA and NSA	Same as 5.2.3.1.1_1	Same as 5.2.3.1.1_1
5.2.3.2.1_1 4Rx TDD FR1 PDSCH mapping Type A performance - 2x4 MIMO with baseline receiver for both SA and NSA	Same as 5.2.3.1.1_1	Same as 5.2.3.1.1_1
5.2.3.2.1_2 4Rx TDD FR1 PDSCH mapping Type A performance - 4x4 MIMO with baseline receiver for both SA and NSA	Same as 5.2.3.1.1_1	Same as 5.2.3.1.1_1
5.2.3.2.1_4 4Rx TDD FR1 PDSCH mapping Type A performance - 4x4 MIMO with enhanced receiver type 1 for both SA and NSA	Same as 5.2.3.1.1_1	Same as 5.2.3.1.1_1
5.2.3.2.2_1 4Rx TDD FR1 PDSCH mapping Type A and CSI-RS overlapped with PDSCH performance - 2x4 MIMO with baseline receiver for both SA and NSA	Same as 5.2.3.1.1_1	Same as 5.2.3.1.1_1
5.2.3.2.3_1 4Rx TDD FR1 PDSCH mapping Type B performance - 2x4 MIMO with baseline receiver for both SA and NSA	Same as 5.2.3.1.1_1	Same as 5.2.3.1.1_1

5.3.2.1.1 2Rx FDD FR1 PDCCH 1 Tx antenna performance for both SA and NSA	± 0.9 dB	Overall system uncertainty for fading conditions comprises four quantities: 1. Signal-to-noise ratio uncertainty 2. Fading profile power uncertainty 3. Effect of AWGN flatness and signal flatness 4. SNR uncertainty due to finite test time Items 1, 2, 3 and 4 are assumed to be uncorrelated so can be root sum squared: AWGN flatness and signal flatness has x 0.25 effect on the required SNR, so use sensitivity factor of x 0.25 for the uncertainty contribution. Test System uncertainty = SQRT (Signal-to-noise ratio uncertainty ^{2} + Fading profile power uncertainty ^{2} + (0.25 x AWGN flatness and signal flatness) ^{2}+ SNR uncertainty due to finite test time^2) Signal-to-noise ratio uncertainty ±0.3 dB Fading profile power uncertainty ±0.5 dB for 1Tx AWGN flatness and signal flatness ±2.0 dB SNR uncertainty due to finite test time ±0.4 dB
5.3.2.1.2 2Rx FDD FR1 PDCCH 2 Tx antenna performance for both SA and NSA	± 1.0 dB	Overall system uncertainty for fading conditions comprises four quantities: 1. Signal-to-noise ratio uncertainty 2. Fading profile power uncertainty 3. Effect of AWGN flatness and signal flatness 4. SNR uncertainty due to finite test time Items 1, 2, 3 and 4 are assumed to be uncorrelated so can be root sum squared: AWGN flatness and signal flatness has x 0.25 effect on the required SNR, so use sensitivity factor of x 0.25 for the uncertainty contribution. Test System uncertainty = SQRT (Signal-to-noise ratio uncertainty ^{2} + Fading profile power uncertainty ^{2} + (0.25 x AWGN flatness and signal flatness) ^{2}+ SNR uncertainty due to finite test time^2) Signal-to-noise ratio uncertainty ±0.3 dB Fading profile power uncertainty ±0.7 dB for 2 Tx AWGN flatness and signal flatness ±2.0 dB SNR uncertainty due to finite test time ±0.4 dB
5.3.2.2.1 2Rx TDD FR1 PDCCH 1 Tx antenna performance for both SA and NSA	Same as 5.3.2.1.1	Same as 5.3.2.1.1
5.3.2.2.2 2Rx TDD FR1 PDCCH 2 Tx antenna performance for both SA and NSA	Same as 5.3.2.1.2	Same as 5.3.2.1.2
5.3.3.1.1 4Rx FDD FR1 PDCCH 1 Tx antenna performance for both SA and NSA	Same as 5.3.2.1.1	Same as 5.3.2.1.1
5.3.3.1.2 4Rx FDD FR1 PDCCH 2 Tx antenna performance for both SA and NSA	Same as 5.3.2.1.2	Same as 5.3.2.1.2
5.3.3.2.1 4Rx TDD FR1 PDCCH 1 Tx antenna performance for both SA and NSA	Same as 5.3.2.1.1	Same as 5.3.2.1.1
5.3.3.2.2 4Rx TDD FR1 PDCCH 2 Tx antenna performance for both SA and NSA	Same as 5.3.2.1.2	Same as 5.3.2.1.2

5.5.1 FR1 Sustained downlink data rate performance for single carrier	±0.7 dB, f ≤ 3.0GHz ±1.0 dB, 3.0GHz < f ≤ 4.2GHz ±1.5 dB, 4.2GHz < f ≤ 6GHz Downlink EVM ≤ 3%	3% EVM is equivalent to a Test system downlink SNR of 30.5dB. The noise from the Test system is then sufficiently below that required for the UE to demodulate the signal with the required % success rate. Under these conditions the UE throughput is limited by the Reference measurement channel and the UE capability, and not by the Test system EVM.
9.4B.1.1 Sustained downlink data rate performance for EN-DC within FR1	E-UTRA CC: ±0.7 dB, f ≤ 3.0GHz ±1.0 dB, 3.0GHz < f ≤ 4.2GHz NR CC: Same as 5.5.1	Same as 5.5.1

F.1.1.3 Measurement of Channel State Information reporting

This clause defines the maximum test system uncertainty for channel state information reporting requirements. The maximum test system uncertainty allowed for the measurement uncertainty contributors are defined in Table F.1.1.3-1.

Table F.1.1.3-1: Maximum measurement uncertainty values for the test system for FR1 (up to 6 GHz) and Channel BW ≤ 40 MHz

MU contributor	Unit	Value	Comment
AWGN flatness and signal flatness, max deviation for any Resource Block, relative to average over BW_{config}	dB	Same as in table F.1.1.2-1	
Signal to noise ratio uncertainty	dB	Same as in table F.1.1.2-1	
Signal to noise ratio variation	dB	Same as in table F.1.1.2-1	
Fading profile power uncertainty for 1Tx	dB	Same as in table F.1.1.2-1	
Fading profile power uncertainty for 2Tx	dB	Same as in table F.1.1.2-1	

The maximum test system uncertainty for test cases defined in section 6 is defined in Table F.1.1.3-2.

Table F.1.1.3-2: Maximum test system uncertainty for FR1 channel state information reporting test cases

Subclause	Maximum Test System Uncertainty	Derivation of Test System Uncertainty
6.2.2.1.1.1 2Rx FDD FR1 periodic CQI reporting under AWGN conditions for both SA and NSA	+/- 0.3 dB	Overall system uncertainty for AWGN conditions comprises: Signal-to-noise ratio uncertainty ±0.3 dB *AWGN flatness and signal flatness ±2.0 dB not expected to have any significant effect*
6.2.2.1.2.12Rx FDD FR1 periodic wideband CQI reporting under fading conditions for both SA and NSA	+/- 0.8 dB	Overall system uncertainty for fading conditions comprises two quantities: 1. Signal-to-noise ratio uncertainty ±0.3 dB 2. Fading profile power uncertainty for 2Tx ±0.7 dB Items 1 and 2 are assumed to be uncorrelated so can be root sum squared: Test System uncertainty = SQRT (Signal-to-noise ratio uncertainty ^{2} + Fading profile power uncertainty ^{2}) *AWGN flatness and signal flatness ±2.0 dB not expected to have any significant effect*
6.2.2.1.2.22Rx FDD FR1 aperiodic subband CQI reporting under fading conditions for both SA and NSA	Same as 6.2.2.1.2.1	Same as 6.2.2.1.2.1
6.2.2.2.1.1 2Rx TDD FR1 periodic CQI reporting under AWGN conditions for both SA and NSA	Same as 6.2.2.1.1.1	Same as 6.2.2.1.1.1
6.2.2.2.2.12Rx TDD FR1 periodic wideband CQI reporting under fading conditions for both SA and NSA	Same as 6.2.2.1.2.1	Same as 6.2.2.1.2.1
6.2.2.2.2.22Rx TDD FR1 aperiodic subband CQI reporting under fading conditions for both SA and NSA	Same as 6.2.2.1.2.1	Same as 6.2.2.1.2.1
6.2.3.1.2.14Rx FDD FR1 periodic wideband CQI reporting under fading conditions for both SA and NSA	Same as 6.2.2.1.2.1	Same as 6.2.2.1.2.1
6.2.3.1.2.24Rx FDD FR1 aperiodic subband CQI reporting under fading conditions for both SA and NSA	Same as 6.2.2.1.2.1	Same as 6.2.2.1.2.1
6.2.3.2.2.14Rx TDD FR1 periodic wideband CQI reporting under fading conditions for both SA and NSA	Same as 6.2.2.1.2.1	Same as 6.2.2.1.2.1
6.2.3.2.2.24Rx TDD FR1 aperiodic subband CQI reporting under fading conditions for both SA and NSA	Same as 6.2.2.1.2.1	Same as 6.2.2.1.2.1
6.3.2.1.1 2Rx FDD FR1 Single PMI with 4Tx Type I- SinglePanel codebook for both SA and NSA	Same as 6.2.2.1.2.1	Same as 6.2.2.1.2.1
6.3.2.1.2 2Rx FDD FR1 Single PMI with 8Tx Type I – SinglePanel codebook for both SA and NSA	Same as 6.2.2.1.2.1	Same as 6.2.2.1.2.1
6.3.2.1.3 2Rx FDD FR1 Multiple PMI with 16Tx Type I – SinglePanel Codebook for both SA and NSA	Same as 6.2.2.1.2.1	Same as 6.2.2.1.2.1
6.2.3.1.1.1 4Rx FDD FR1 periodic CQI reporting under AWGN conditions for both SA and NSA	Same as 6.2.2.1.1.1	Same as 6.2.2.1.1.1
6.2.3.1.2.1 4Rx FDD FR1 periodic wideband CQI reporting under fading conditions for both SA and NSA	Same as 6.2.2.1.2.1	Same as 6.2.2.1.2.1
6.2.3.1.2.2 4Rx FDD FR1 aperiodic subband CQI reporting under fading conditions for both SA and NSA	Same as 6.2.2.1.2.1	Same as 6.2.2.1.2.1

6.2.3.2.1.1 4Rx TDD FR1 periodic CQI reporting under AWGN conditions for both SA and NSA	Same as 6.2.2.1.1.1	Same as 6.2.2.1.1.1
6.2.3.2.2.1 4Rx TDD FR1 periodic wideband CQI reporting under fading conditions for both SA and NSA	Same as 6.2.2.1.2.1	Same as 6.2.2.1.2.1
6.2.3.2.2.2 4Rx TDD FR1 aperiodic subband CQI reporting under fading conditions for both SA and NSA	Same as 6.2.2.1.2.1	Same as 6.2.2.1.2.1
6.3.3.1.1 Single PMI with 4TX TypeI-SinglePanel Codebook– SinglePanel codebook for both SA and NSA	Same as 6.2.2.1.2.1	Same as 6.2.2.1.2.1
6.3.3.1.2 Single PMI with 8TX TypeI-SinglePanel Codebook– SinglePanel codebook for both SA and NSA	Same as 6.2.2.1.2.1	Same as 6.2.2.1.2.1
6.3.3.1.3 4Rx FDD FR1 Multiple PMI with 16Tx Type I – SinglePanel Codebook for both SA and NSA	Same as 6.2.2.1.2.1	Same as 6.2.2.1.2.1
6.3.3.2.1 4Rx TDD FR1 Single PMI with 4Tx Type1 - SinglePanel codebook for both SA and NSA	Same as 6.2.2.1.2.1	Same as 6.2.2.1.2.1
6.3.2.2.1 2Rx TDD FR1 Single PMI with 4Tx TypeI - SinglePanel codebook for both SA and NSA	Same as 6.2.2.1.2.1	Same as 6.2.2.1.2.1
6.3.2.2.2 2Rx TDD FR1 Single PMI with 8Tx TypeI - SinglePanel codebook for both SA and NSA	Same as 6.2.2.1.2.1	Same as 6.2.2.1.2.1
6.3.2.2.3 2Rx TDD FR1 Single PMI with 16Tx Type1 - SinglePanel codebook for both SA and NSA	Same as 6.2.2.1.2.1	Same as 6.2.2.1.2.1
6.3.2.2.4 2Rx TDD FR1 Single PMI with 32Tx Type1 - SinglePanel codebook for both SA and NSA	Same as 6.2.2.1.2.1	Same as 6.2.2.1.2.1
6.3.3.2.2 4Rx TDD FR1 Single PMI with 8Tx Type1 - SinglePanel codebook for both SA and NSA	Same as 6.2.2.1.2.1	Same as 6.2.2.1.2.1
6.3.3.2.3 4Rx TDD FR1 Single PMI with 16Tx Type1 - SinglePanel codebook for both SA and NSA	Same as 6.2.2.1.2.1	Same as 6.2.2.1.2.1
6.4.2.1_1 2Rx FDD FR1 RI reporting for both SA and NSA	Same as 6.2.2.1.2.1	Same as 6.2.2.1.2.1
6.4.2.2_1 2Rx TDD FR1 RI reporting for both SA and NSA	Same as 6.2.2.1.2.1	Same as 6.2.2.1.2.1
6.4.3.1_1 4Rx FDD FR1 RI reporting for both SA and NSA	Same as 6.2.2.1.2.1	Same as 6.2.2.1.2.1
6.4.3.2_1 4Rx TDD FR1 RI reporting for both SA and NSA	Same as 6.2.2.1.2.1	Same as 6.2.2.1.2.1

F.1.2 Interpretation of measurement results (normative)

The measurement results returned by the Test System are compared – without any modification – against the Test Requirements as defined by the shared risk principle.

The Shared Risk principle is defined in ETR 273-1-2 clause 6.5.

The actual measurement uncertainty of the Test System for the measurement of each parameter shall be included in the test report.

The recorded value for the Test System uncertainty shall be, for each measurement, equal to or lower than the appropriate figure in clause F.1 of the present document.

If the Test System for a test is known to have a measurement uncertainty greater than that specified in clause F.1, it is still permitted to use this apparatus provided that an adjustment is made value as follows:

Any additional uncertainty in the Test System over and above that specified in clause F.1 shall be used to tighten the Test Requirement, making the test harder to pass. For some tests, for example receiver tests, this may require modification of stimulus signals. This procedure will ensure that a Test System not compliant with clause F.1does not increase the chance of passing a device under test where that device would otherwise have failed the test if a Test System compliant with clause F.1 had been used.

F.1.3 Test Tolerance and Derivation of Test Requirements (informative)

The Test Requirements in the present document have been calculated by relaxing the Minimum Requirements of the core specification using the Test Tolerances defined in this clause. When the Test Tolerance is zero, the Test Requirement will be the same as the Minimum Requirement. When the Test Tolerance is non-zero, the Test Requirements will differ from the Minimum Requirements, and the formula used for the relaxation is given in this clause.

The Test Tolerances are derived from Test System uncertainties, regulatory requirements and criticality to system performance. As a result, the Test Tolerances may sometimes be set to zero.

The test tolerances should not be modified for any reason e.g. to take account of commonly known test system errors (such as mismatch, cable loss, etc.).

The downlink Test Tolerances apply at each receiver antenna connector.

F.1.3.1 Measurement of test environments

The UE test environments are set to the values defined in TS 36.508 subclause 4.1, without any relaxation. The applied Test Tolerance is therefore zero.

F.1.3.2 Measurement of Demod Performance requirements

The derivation of the test requirements for the test cases in section 5 is defined in Table F.1.3.2-1.

Table F.1.3.2-1: Derivation of Test Requirements (FR1 demodulation performance tests)

Test	Minimum Requirement in TS 38.101-4	Test Tolerance (TT)	Test Requirement in TS 38.521-4
5.2.2.1.1_1 2Rx FDD FR1 PDSCH mapping Type A performance - 2x2 MIMO with baseline receiver for both SA and NSA	SNRs as specified	0.9 dB for > 10 Hz doppler 1.0 dB for 10Hz doppler	Formula: SNR + TT T-put limit unchanged
5.2.2.1.1_2 2Rx FDD FR1 PDSCH Mapping Type A performance - 2x2 MIMO with enhanced receiver type X for both SA and NSA	SNRs as specified	0.9 dB for > 10 Hz doppler 1.0 dB for 10Hz doppler	Formula: SNR + TT T-put limit unchanged
5.2.2.1.2_1 2Rx FDD FR1 PDSCH mapping Type A and CSI-RS overlapped with PDSCH performance - 2x2 MIMO with baseline receiver for both SA and NSA	SNRs as specified	0.9 dB for > 10 Hz doppler 1.0 dB for 10Hz doppler	Formula: SNR + TT T-put limit unchanged
5.2.2.1.3_1 2Rx FDD FR1 PDSCH mapping Type B performance - 2x2 MIMO with baseline receiver for both SA and NSA	SNRs as specified	0.9 dB for > 10 Hz doppler 1.0 dB for 10Hz doppler	Formula: SNR + TT T-put limit unchanged
5.2.2.1.4_1 2Rx FDD FR1 PDSCH Mapping Type A and LTE-NR coexistence performance - 4x2 MIMO with baseline receiver for both SA and NSA	SNRs as specified	0.9 dB for > 10 Hz doppler 1.0 dB for 10Hz doppler	Formula: SNR + TT T-put limit unchanged
5.2.2.2.1_1 2Rx TDD FR1 PDSCH mapping Type A performance - 2x2 MIMO with baseline receiver for both SA and NSA	SNRs as specified	0.9 dB for > 10 Hz doppler 1.0 dB for 10Hz doppler	Formula: SNR + TT T-put limit unchanged
5.2.2.2.1_2 2Rx TDD FR1 PDSCH Mapping Type A performance - 2x2 MIMO with enhanced receiver type X for both SA and NSA	SNRs as specified	0.9 dB for > 10 Hz doppler 1.0 dB for 10Hz doppler	Formula: SNR + TT T-put limit unchanged
5.2.2.2.2_1 2Rx TDD FR1 PDSCH mapping Type A and CSI-RS overlapped with PDSCH performance - 2x2 MIMO with baseline receiver for both SA and NSA	SNRs as specified	0.9 dB for > 10 Hz doppler 1.0 dB for 10Hz doppler	Formula: SNR + TT T-put limit unchanged
5.2.2.2.3_1 2Rx TDD FR1 PDSCH mapping Type B performance - 2x2 MIMO with baseline receiver for both SA and NSA	SNRs as specified	0.9 dB for > 10 Hz doppler 1.0 dB for 10Hz doppler	Formula: SNR + TT T-put limit unchanged
5.2.2.2.4_1 2Rx TDD FR1 PDSCH Mapping Type A and LTE-NR coexistence performance - 4x2 MIMO with baseline receiver for both SA and NSA	SNRs as specified	0.9 dB for > 10 Hz doppler 1.0 dB for 10Hz doppler	Formula: SNR + TT T-put limit unchanged
5.3.2.1.2 2Rx FDD FR1 PDCCH 2 Tx antenna performance for both SA and NSA	SNRs as specified	1.0 dB	Formula: SNR + TT T-put limit unchanged
5.3.2.1.1 2Rx FDD FR1 PDCCH 1 Tx antenna performance for both SA and NSA	SNRs as specified	0.9 dB	Formula: SNR + TT T-put limit unchanged
5.3.2.2.1 2Rx TDD FR1 PDCCH 1 Tx antenna performance for both SA and NSA	SNRs as specified	0.9 dB	Formula: SNR + TT T-put limit unchanged

5.3.2.2.2 2Rx TDD FR1 PDCCH 2 Tx antenna performance for both SA and NSA	SNRs as specified	1.0 dB	Formula: SNR + TT T-put limit unchanged
5.3.3.1.1 4Rx FDD FR1 PDCCH 1 Tx antenna performance for both SA and NSA	SNRs as specified	0.9 dB	Formula: SNR + TT T-put limit unchanged
5.3.3.1.2 4Rx FDD FR1 PDCCH 2 Tx antenna performance for both SA and NSA	SNRs as specified	1.0 dB	Formula: SNR + TT T-put limit unchanged
5.3.3.2.1 4Rx TDD FR1 PDCCH 1 Tx antenna performance for both SA and NSA	SNRs as specified	0.9 dB	Formula: SNR + TT T-put limit unchanged
5.3.3.2.2 4Rx TDD FR1 PDCCH 2 Tx antenna performance for both SA and NSA	SNRs as specified	1.0 dB	Formula: SNR + TT T-put limit unchanged
5.2.3.1.1_1 4Rx FDD FR1 PDSCH mapping Type A performance - 2x4 MIMO baseline receiver for both SA and NSA	SNRs as specified	0.9 dB for > 10Hz doppler 1.0 dB for 10Hz doppler	Formula: SNR + TT T-put limit unchanged
5.2.3.1.1_2 4Rx FDD FR1 PDSCH mapping Type A performance - 4x4 MIMO baseline receiver for both SA and NSA	SNRs as specified	0.9 dB for > 10Hz doppler 1.0 dB for 10Hz doppler	Formula: SNR + TT T-put limit unchanged
5.2.3.1.2_1 4Rx FDD FR1 PDSCH mapping Type A and CSI-RS overlapped with PDSCH performance - 4x4 MIMO with baseline receiver for both SA and NSA	SNRs as specified	0.9 dB	Formula: SNR + TT T-put limit unchanged
5.2.3.1.3_1 4Rx FDD FR1 PDSCH mapping Type B performance - 2x4 MIMO with baseline receiver for both SA and NSA	SNRs as specified	1.0 dB	Formula: SNR + TT T-put limit unchanged
5.2.3.1.1_4 4Rx FDD FR1 PDSCH mapping Type A performance - 4x4 MIMO with enhanced receiver type 1 for both SA and NSA	SNRs as specified	0.9 dB for > 10Hz doppler 1.0 dB for 10Hz doppler	Formula: SNR + TT T-put limit unchanged
5.2.3.1.4_1 4Rx FDD FR1 PDSCH Mapping Type A and LTE-NR coexistence performance - 4x4 MIMO with baseline receiver for both SA and NSA	SNRs as specified	0.9 dB for > 10 Hz doppler 1.0 dB for 10Hz doppler	Formula: SNR + TT T-put limit unchanged
5.2.3.2.2_1 4Rx TDD FR1 PDSCH mapping Type A and CSI-RS overlapped with PDSCH performance - 2x4 MIMO with baseline receiver for both SA and NSA	SNRs as specified	0.9 dB	Formula: SNR + TT T-put limit unchanged
5.2.3.2.3_1 4Rx TDD FR1 PDSCH mapping Type B performance - 2x4 MIMO with baseline receiver for both SA and NSA	SNRs as specified	1.0 dB	Formula: SNR + TT T-put limit unchanged

F.1.3.3 Measurement of Channel State Information reporting

The derivation of the test requirements for the test cases in section 6 is defined in Table F.1.3.3-1.

Table F.1.3.3-1: Derivation of Test Requirements (FR1 channel state information reporting tests)

Test	Minimum Requirement in TS 38.101-4	Test Tolerance (TT)	Test Requirement in TS 38.521-4
6.2.2.1.1.1 2Rx FDD FR1 periodic CQI reporting under AWGN conditions for both SA and NSA	SNRs as specified Limits as in the Test Procedure	No test tolerances applied	SNR unchanged
6.2.2.1.2.12Rx FDD FR1 periodic wideband CQI reporting under fading conditions for both SA and NSA	SNRs as specified α 20% γ 1.05 BLER 0.02	SNR 0 dB α 0% γ *0.01* BLER 0	SNR unchanged α unchanged γ 1.04 BLER limit unchanged
6.2.2.1.2.22Rx FDD FR1 periodic subband CQI reporting under fading conditions for both SA and NSA	SNRs as specified α 2% β 55% γ 1.05 BLER 0.02	SNR 0 dB α 0% β 0% γ 0.01 BLER 0	SNR unchanged α limit unchanged β limit unchanged γ1.04 BLER limit unchanged
6.2.2.2.1.1 2Rx TDD FR1 periodic CQI reporting under AWGN conditions for both SA and NSA	SNRs as specified Limits as in the Test Procedure	No test tolerances applied	SNR unchanged
6.2.2.2.2.12Rx TDD FR1 periodic wideband CQI reporting under fading conditions for both SA and NSA	SNRs as specified α 20% γ 1.05 BLER 0.02	SNR 0 dB α 0% γ *0.01* BLER 0	SNR unchanged α unchanged γ1.04 BLER limit unchanged
6.2.2.2.2.22Rx TDD FR1 periodic subband CQI reporting under fading conditions for both SA and NSA	SNRs as specified α 2% β 55% γ 1.05 BLER 0.02	SNR 0 dB α 0% β 0% γ *0.01* BLER 0	SNR unchanged α limit unchanged β limit unchanged γ1.04 BLER limit unchanged
6.2.3.1.1.1 4Rx FDD FR1 periodic CQI reporting under AWGN conditions for both SA and NSA	SNRs as specified Limits as in the Test Procedure	No test tolerances applied	SNR unchanged
6.2.3.1.2.1 4Rx FDD FR1 periodic wideband CQI reporting under fading conditions for both SA and NSA	SNRs as specified α 5% γ 1.05 BLER 0.02	SNR 0 dB α 0% γ *0.01* BLER 0	SNR unchanged α unchanged γ 1.04 BLER limit unchanged
6.2.3.1.2.2 4Rx FDD FR1 aperiodic subband CQI reporting under fading conditions for both SA and NSA	SNRs as specified α 2% β 55% γ 1.05 BLER 0.02	SNR 0 dB α 0% β 0% γ 0.01 BLER 0	SNR unchanged α limit unchanged β limit unchanged γ1.04 BLER limit unchanged
6.2.3.2.1.1 4Rx TDD FR1 periodic CQI reporting under AWGN conditions for both SA and NSA	SNRs as specified Limits as in the Test Procedure	No test tolerances applied	SNR unchanged
6.2.3.2.2.1 4Rx TDD FR1 periodic wideband CQI reporting under fading conditions for both SA and NSA	SNRs as specified α 5% γ 1.05 BLER 0.02	SNR 0 dB α 0% γ *0.01* BLER 0	SNR unchanged α unchanged γ1.04 BLER limit unchanged
6.2.3.2.2.2 4Rx TDD FR1 aperiodic subband CQI reporting under fading conditions for both SA and NSA	SNRs as specified α 2% β 55% γ 1.05 BLER 0.02	SNR 0 dB α 0% β 0% γ *0.01* BLER 0	SNR unchanged α limit unchanged β limit unchanged γ1.04 BLER limit unchanged
6.3.2.1.1 2Rx FDD FR1 Single PMI with 4Tx Type I- SinglePanel codebook for both SA and NSA	SNRs as specified γ 1.30	SNR 0 dB γ *0.01*	SNR unchanged γ1.29
6.3.2.1.2 2Rx FDD FR1 Single PMI with 8Tx Type I – SinglePanel codebook for both SA and NSA	SNRs as specified γ 1.50	SNR 0 dB γ *0.01*	SNR unchanged γ1.49
6.3.2.1.3 2Rx FDD FR1 Multiple PMI with 16Tx Type I – SinglePanel Codebook for both SA and NSA	SNRs as specified γ 2.50	SNR 0 dB γ *0.01*	SNR unchanged γ2.49

6.3.2.2.1 2Rx TDD FR1 Single PMI with 4Tx TypeI - SinglePanel codebook for both SA and NSA	SNRs as specified γ 1.30	SNR 0 dB γ *0.01*	SNR unchanged γ1.29
6.3.2.2.2 2Rx TDD FR1 Single PMI with 8Tx TypeI - SinglePanel codebook for both SA and NSA	SNRs as specified γ 1.50	SNR 0 dB γ *0.01*	SNR unchanged γ1.49
6.3.2.2.3 2Rx TDD FR1 Single PMI with 16Tx Type1 - SinglePanel codebook for both SA and NSA	SNRs as specified γ *2*.50	SNR 0 dB γ *0.01*	SNR unchanged γ2.49
6.3.2.2.4 2Rx TDD FR1 Single PMI with 32Tx Type1 - SinglePanel codebook for both SA and NSA	SNRs as specified γ *5*.0	SNR 0 dB γ *0.01*	SNR unchanged γ4.99
6.3.3.1.1 Single PMI with 4TX TypeI-SinglePanel Codebook– SinglePanel codebook for both SA and NSA	SNRs as specified γ 1.30	SNR 0 dB γ *0.01*	SNR unchanged γ1.29
6.3.3.1.2 Single PMI with 8TX TypeI-SinglePanel Codebook– SinglePanel codebook for both SA and NSA	SNRs as specified γ 1.50	SNR 0 dB γ *0.01*	SNR unchanged γ1.49
6.3.3.1.3 4Rx FDD FR1 Multiple PMI with 16Tx Type I – SinglePanel Codebook for both SA and NSA	SNRs as specified γ 3.00	SNR 0 dB γ *0.01*	SNR unchanged γ2.99
6.3.3.2.1 4Rx TDD FR1 Single PMI with 4Tx Type1 - SinglePanel codebook for both SA and NSA	SNRs as specified γ 1.30	SNR 0 dB γ *0.01*	SNR unchanged γ1.29
6.3.3.2.2 4Rx TDD FR1 Single PMI with 8Tx Type1 - SinglePanel codebook for both SA and NSA	SNRs as specified γ 1.50	SNR 0 dB γ *0.01*	SNR unchanged γ1.49
6.3.3.2.3 4Rx TDD FR1 Single PMI with 16Tx Type1 - SinglePanel codebook for both SA and NSA	SNRs as specified γ *3*.0	SNR 0 dB γ *0.01*	SNR unchanged γ2.99
6.4.2.1_1 2Rx FDD FR1 RI reporting for both SA and NSA	SNRs as specified γ_2 1.00 for Test 1 γ_1 1.05 for Test 2 γ_1 0.90 for Test 3	SNR 0 dB γ_2 *0.01 for Test 1* γ_1 *0.01 for Test 2* γ_1 *0.01 for Test 3*	SNR unchanged γ_2 0.99 for Test 1 γ_1 1.04 for Test 2 γ_1 0.89 for Test 3
6.4.2.2_1 2Rx TDD FR1 RI reporting for both SA and NSA	SNRs as specified γ_2 1.00 for Test 1 γ_1 1.05 for Test 2 γ_1 0.90 for Test 3	SNR 0 dB γ_2 *0.01 for Test 1* γ_1 *0.01 for Test 2* γ_1 *0.01 for Test 3*	SNR unchanged γ_2 0.99 for Test 1 γ_1 1.04 for Test 2 γ_1 0.89 for Test 3
6.4.3.1_1 4Rx FDD FR1 RI reporting for both SA and NSA	SNRs as specified γ_2 0.90 for Test 1 γ_1 1.05 for Test 2 γ_1 0.90 for Test 3 γ_2 0.90 for Test 4	SNR 0 dB γ_2 *0.01 for Test 1* γ_1 *0.01 for Test 2* γ_1 *0.01 for Test 3* γ_2 *0.01 for Test 4*	SNR unchanged γ_2 0.89 for Test 1 γ_1 1.04 for Test 2 γ_1 0.89 for Test 3 γ_2 0.89 for Test 4
6.4.3.2_1 4Rx TDD FR1 RI reporting for both SA and NSA	SNRs as specified γ_2 0.90 for Test 1 γ_1 1.05 for Test 2 γ_1 0.90 for Test 3 γ_2 0.90 for Test 4	SNR 0 dB γ_2 *0.01 for Test 1* γ_1 *0.01 for Test 2* γ_1 *0.01 for Test 3* γ_2 *0.01 for Test 4*	SNR unchanged γ_2 0.89 for Test 1 as per Table G.3.4 γ_1 1.04 for Test 2 as per Table G.3.4 γ_1 0.89 for Test 3 as per Table G.3.4 γ_2 0.89 for Test 4 as per Table G.3.4

F.2 Measurement uncertainties and test tolerances for FR2

F.2.1 Acceptable uncertainty of test system (normative)

The maximum acceptable uncertainty of the Test System is specified below for each test, where appropriate. The Test System shall enable the stimulus signals in the test case to be adjusted to within the specified range, and the equipment under test to be measured with an uncertainty not exceeding the specified values. Care should be taken to ensure that each conformance test implementation including the OTA chamber aspects meets the specified measurement uncertainty for each test case by requiring the test laboratory to maintain a detailed measurement uncertainty test report showing compliance to all the measurement uncertainty requirements. The detailed measurement uncertainty report would contain the justification for each measurement uncertainty component and its value and distribution. The derivation of these values is based on the minimum conformance requirements plus relaxation, i.e., test tolerance is not to be considered. All ranges and uncertainties are absolute values, and are valid for a confidence level of 95 %, unless otherwise stated.

A confidence level of 95 % is the measurement uncertainty tolerance interval for a specific measurement that contains 95 % of the performance of a population of test equipment.

The downlink signal uncertainties apply at the defined quiet zone with the UE properly positioned in the quiet zone. The uplink signal uncertainties apply at the measurement equipment with the UE positioned properly in the quiet zone.

F.2.1.1 Measurement of test environments

TBD

F.2.1.2 Measurement of Demod Performance requirements

This clause defines the maximum test system uncertainty for Demod Performance requirements. The maximum test system uncertainty allowed for the measurement uncertainty contributors are defined in Table F.2.1.2-1.

Table F.2.1.2-1: Maximum measurement uncertainty values for the test system for FR2 (up to 40 GHz) and Channel BW ≤ 400 MHz

MU contributor	Unit	Value	Comment
AWGN flatness and signal flatness, max deviation for any Resource Block, relative to average over BW_{config}	dB	±3.6	
gNB emulator Signal to noise ratio uncertainty	dB	±0.3	
Impact on non-ideal isolation between branches for the wireless cable mode	dB	0.60 for Rank1 0.45 for Rank2	Systematic uncertainty
Fading profile power uncertainty	dB	±0.5 for 1Tx ±0.7 for 2Tx	
SNR uncertainty due to finite test time	dB	±0.3 for PDSCH and doppler < 100Hz 0.0 for PDSCH and doppler ≥ ±0.4 for PDCCH	

The maximum test system uncertainty for test cases defined in section 7 is defined in Table F.2.1.2-2.

Table F.2.1.2-2: Maximum test system uncertainty for FR2 demodulation performance test cases

Subclause	Maximum Test System Uncertainty	Derivation of Test System Uncertainty
7.2.2.2.1_1 2Rx TDD FR2 PDSCH mapping Type A performance - 2x2 MIMO with baseline receiver for SA and NSA	2Tx, Rank 1: ± 1.82 dB for Doppler < 100 Hz ± 1.78 dB for Doppler ≥100 Hz 2Tx, Rank 2: ± 1.67 dB for Doppler < 100Hz ± 1.63 dB for Doppler ≥100 Hz	Overall system uncertainty for fading conditions comprises four quantities: 1. gNB emulator Signal-to-noise ratio uncertainty 2. Fading profile power uncertainty 3. Effect of AWGN flatness and signal flatness 4. SNR uncertainty due to finite test time 5. Impact on non-ideal isolation between branches for the wireless cable mode gNB emulator SNR Items 1, 2, 3 and 4 are assumed to be uncorrelated so can be root sum squared: AWGN flatness and signal flatness has x 0.25 effect on the required SNR, so use sensitivity factor of x 0.25 for the uncertainty contribution. Test System uncertainty = SQRT (gNB emulator Signal-to-noise ratio uncertainty ^{2} + Fading profile power uncertainty ^{2} + (0.25 x AWGN flatness and signal flatness) ^{2} + SNR uncertainty due to finite test time^{2}) + Impact on non-ideal isolation between branches for the wireless cable mode gNB emulator Signal-to-noise ratio uncertainty ±0.3 dB Fading profile power uncertainty ±0.7 dB AWGN flatness and signal flatness ±3.6 dB SNR uncertainty due to finite test time ±0.3 dB for doppler < 100Hz, otherwise 0 dB Impact on non-ideal isolation between branches for the wireless cable mode 0.60 dB for Rank1, 0.45 dB for Rank2
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	2Tx, Rank 2: ± 1.67 dB for Doppler < 100Hz ± 1.63 dB for Doppler ≥ 100Hz	Same as 7.2.2.2.1_1

7.3.2.2.1 2Rx TDD FR2 PDCCH 1 Tx antenna performance for both SA and NSA	1Tx, rank1: ± 1.74 dB	Overall system uncertainty for fading conditions comprises four quantities: 1. gNB emulator Signal-to-noise ratio uncertainty 2. Fading profile power uncertainty 3. Effect of AWGN flatness and signal flatness 4. SNR uncertainty due to finite test time 5. Impact on non-ideal isolation between branches for the wireless cable mode gNB emulator SNR Items 1, 2, 3 and 4 are assumed to be uncorrelated so can be root sum squared: AWGN flatness and signal flatness has x 0.25 effect on the required SNR, so use sensitivity factor of x 0.25 for the uncertainty contribution. Test System uncertainty = SQRT (gNB emulator Signal-to-noise ratio uncertainty 2 + Fading profile power uncertainty 2 + (0.25 x AWGN flatness and signal flatness) 2 + SNR uncertainty due to finite test time2) + Impact on non-ideal isolation between branches for the wireless cable mode gNB emulator Signal-to-noise ratio uncertainty ±0.3 dB Fading profile power uncertainty ±0.5 dB for 1Tx, ±0.7 dB for 2Tx AWGN flatness and signal flatness ±3.6 dB SNR uncertainty due to finite test time ±0.4 dB Impact on non-ideal isolation between branches for the wireless cable mode 0.6 for Rank1 and 0.45 for rank2
7.3.2.2.2 2Rx TDD FR2 PDCCH 2 Tx antenna performance for both SA and NSA	2Tx, rank1: ± 1.84 dB	Same as 7.3.2.2.1

F.2.1.3 Measurement of Channel State Information reporting

This clause defines the maximum test system uncertainty for channel state information reporting requirements. The maximum test system uncertainty allowed for the measurement uncertainty contributors are defined in Table F.2.1.3-1.

Table F.2.1.3-1: Maximum measurement uncertainty values for the test system for FR2 (up to 40 GHz) and Channel BW ≤ 400 MHz

MU contributor	Unit	Value	Comment
AWGN flatness and signal flatness, max deviation for any Resource Block, relative to average over BW_{config}	dB	Same as in table F.2.1.2-1	
Signal to noise ratio uncertainty	dB	Same as in table F.2.1.2-1	
Impact on non-ideal isolation between branches for the wireless cable mode	dB	Same as in table F.2.1.2-1	
Fading profile power uncertainty	dB	Same as in table F.2.1.2-1	

The maximum test system uncertainty for test cases defined in section 8 is defined in Table F.2.1.3-2.

Table F.2.1.3-2: Maximum test system uncertainty for FR2 channel state information reporting test cases

Subclause	Maximum Test System Uncertainty	Derivation of Test System Uncertainty
8.2.2.2.1.12Rx TDD FR2 periodic CQI reporting under AWGN performance for both SA and NSA	± 1.40 dB	Overall system uncertainty under AWGN conditions comprises three quantities: 1. gNB emulator Signal-to-noise ratio uncertainty 2. Effect of AWGN flatness and signal flatness 3. Impact on non-ideal isolation between branches for the wireless cable mode gNB emulator SNR Items 1 and 2 are assumed to be uncorrelated so can be root sum squared: AWGN flatness and signal flatness has x [0.25] effect on the required SNR, so use sensitivity factor of x [0.25] for the uncertainty contribution. Test System uncertainty = SQRT (gNB emulator Signal-to-noise ratio uncertainty ^{2} + (0.25 x AWGN flatness and signal flatness) ^{2}) + Impact on non-ideal isolation between branches for the wireless cable mode gNB emulator Signal-to-noise ratio uncertainty ±0.3 dB AWGN flatness and signal flatness ±3.6 dB Impact on non-ideal isolation between branches for the wireless cable mode 0.45 dB for Rank2 and 0.6 for Rank1
8.2.2.2.2.12Rx TDD FR2 aperiodic CQI reporting under fading performance for both SA and NSA	± 1.82 dB for Doppler < 100Hz	Overall system uncertainty for fading conditions comprises five quantities: 1. gNB emulator Signal-to-noise ratio uncertainty 2. Fading profile power uncertainty 3. Effect of AWGN flatness and signal flatness 4. SNR uncertainty due to finite test time 5. Impact on non-ideal isolation between branches for the wireless cable mode gNB emulator SNR Items 1, 2, 3 and 4 are assumed to be uncorrelated so can be root sum squared: AWGN flatness and signal flatness has x 0.25 effect on the required SNR, so use sensitivity factor of x 0.25 for the uncertainty contribution. Test System uncertainty = SQRT (gNB emulator Signal-to-noise ratio uncertainty 2 + Fading profile power uncertainty 2 + (0.25 x AWGN flatness and signal flatness) 2 + SNR uncertainty due to finite test time2) + Impact on non-ideal isolation between branches for the wireless cable mode gNB emulator Signal-to-noise ratio uncertainty ±0.3 dB Fading profile power uncertainty ±0.7 dB for 2Tx AWGN flatness and signal flatness ±3.6 dB SNR uncertainty due to finite test time ±0.3 dB Impact on non-ideal isolation between branches for the wireless cable mode 0.6 for Rank1 and 0.45 for Rank2

8.3.2.2.1 2Rx TDD FR2 Single PMI with 2TX TypeI-SinglePanel Codebook for both SA and NSA	Same as 8.2.2.2.2.1	Same as 8.2.2.2.2.1

F.2.2 Interpretation of measurement results (normative)

The actual measurement uncertainty of the Test System for the measurement of each parameter shall be included in the test report.

The recorded value for the Test System uncertainty shall be, for each measurement, equal to or lower than the appropriate figure in clause F.1 of the present document.

If the Test System using one of the permitted test methods defined in TR38.903 [20] for a test is known to have a measurement uncertainty greater than that specified in clause F.1, it is still permitted to use this apparatus provided that an adjustment is made value as follows:

Any additional uncertainty in the Test System over and above that specified in clause F.1 shall be used to tighten the Test Requirement, making the test harder to pass. For some tests, for example receiver tests, this may require modification of stimulus signals. This procedure will ensure that a Test System not compliant with clause F.1does not increase the chance of passing a device under test where that device would otherwise have failed the test if a Test System compliant with clause F.1 had been used.

F.2.3 Test Tolerance and Derivation of Test Requirements (informative)

TBD

F.2.3.1 Measurement of test environments

TBD

F.2.3.2 Measurement of Demod Performance requirements

The derivation of the test requirements for the test cases in section 7 is defined in Table F.2.3.2-1.

Table F.2.3.2-1: Derivation of Test Requirements (FR2 demodulation performance tests)

Test	Minimum Requirement in TS 38.101-4	Test Tolerance (TT)	Test Requirement in TS 38.521-4
7.2.2.2.1_1 2Rx TDD FR2 PDSCH mapping Type A performance - 2x2 MIMO with baseline receiver for SA and NSA	SNRs as specified	2Tx, Rank 1: 1.8 dB 2Tx, Rank 2: 1.7 dB for doppler < 100Hz 1.6 dB otherwise	Formula: SNR + TT T-put limit unchanged
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	SNRs as specified	2Tx, Rank 2: 1.7 dB for doppler < 100Hz 1.6 dB otherwise	Formula: SNR + TT T-put limit unchanged
7.3.2.2.1 2Rx TDD FR2 PDCCH 1 Tx antenna performance for both SA and NSA	SNRs as specified	1Tx, rank1: 1.7 dB	Formula: SNR + TT T-put limit unchanged
7.3.2.2.2 2Rx TDD FR2 PDCCH 2 Tx antenna performance for both SA and NSA	SNRs as specified	2Tx, rank1: 1.8 dB	Formula: SNR + TT T-put limit unchanged

F.2.3.3 Measurement of Channel State Information reporting

The derivation of the test requirements for the test cases in section 8 is defined in Table F.2.3.3-1.

Table F.2.3.3-1: Derivation of Test Requirements (FR2 channel state information reporting tests)

Test	Minimum Requirement in TS 38.101-4	Test Tolerance (TT)	Test Requirement in TS 38.521-4
8.2.2.2.1.12Rx TDD FR2 periodic CQI reporting under AWGN performance for both SA and NSA	SNRs as specified Limits as in the Test Procedure	No test tolerances applied	SNR unchanged
8.2.2.2.2.12Rx TDD FR2 aperiodic CQI reporting under fading performance for both SA and NSA	TBD	TBD	TBD
8.3.2.2.1 2Rx TDD FR2 Single PMI with 2TX TypeI-SinglePanel Codebook for both SA and NSA	SNRs as specified γ 1.05 for Test 1 γ 1.05 for Test 2	SNR 0 dB γ *0.01 for Test 1* γ *0.01 for Test 2*	SNR unchanged γ1.04 for Test 1 γ1.04 for Test 2

Annex G (normative): Statistical Testing

G.1 Statistical testing of Performance Requirements with throughput

G.1.1 General

The test of receiver performance characteristics is twofold.

1. A signal or a combination of signals is offered to the RX port(s) of the receiver.

2. The ability of the receiver to demodulate /decode this signal is verified by measuring the throughput.

In (2) is the statistical aspect of the test and is treated here.

The minimum requirement for all receiver performance tests is either 70 % or 30 % of the maximum throughput.

All receiver performance tests are performed in fading conditions. In addition to the statistical considerations, this requires the definition of a minimum test time.

G.1.2 Mapping throughput to error ratio

a) The measured information bit throughput R is defined as the sum (in kilobits) of the information bit payloads successfully received during the test interval, divided by the duration of the test interval (in seconds).

b) In measurement practice the UE indicates successfully received information bit payload by signalling an ACK to the SS.
If payload is received, but damaged and cannot be decoded, the UE signals a NACK.

c) Only the ACK and NACK signals, not the data bits received, are accessible to the SS.
The number of bits is known in the SS from knowledge of what payload was sent.

d) For the reference measurement channel, applied for testing, the number of bits is different in different subframes, however in a radio frame it is fixed during one test.

e) The time in the measurement interval is composed of successfully received subframes (ACK), unsuccessfully received subframes (NACK) and no reception at all (DTX-subframes).

f) DTX-subframes may occur regularly according the applicable reference measurement channel (regDTX).
In real live networks this is the time when other UEs are served. In TDD these are the UL and special subframes.
regDTX vary from test to test but are fixed within the test.

g) Additional DTX-subframes occur statistically when the UE is not responding ACK or NACK where it should. (statDTX)
This may happen when the UE was not expecting data or decided that the data were not intended for it.

The pass / fail decision is done by observing the:

- number of NACKs

- number of ACKs and

- number of statDTXs (regDTX is implicitly known to the SS)

The ratio `(NACK + statDTX)/(NACK+ statDTX + ACK)`is the Error Ratio (ER). Taking into account the time consumed by the ACK, NACK, and DTX-TTIs (regular and statistical), ER can be mapped unambiguously to throughput for any single reference measurement channel test.

G.1.3 Design of the test

The test is defined by the following design principles (see clause G.2, Theory):

1. The standard concept is applied. (not the early decision concept)
2. A second limit is introduced: The second limit is different, whether 30 % or 70 % throughput is tested.
3. To decide the test pass:

   Supplier risk is applied based on the Bad DUT quality

   To decide the test fail:

   Customer Risk is applied based on the specified DUT quality

The test is defined by the following parameters:

1a) Limit Error Ratio = 0.3 (in case 70 % Throughput is tested) or

1b) Limit Throughput = 0.3 (in case 30 % Throughput is tested)

2a) Bad DUT factor M=1.378 (selectivity)

2b) Bad DUT factor m=0.692 (selectivity)

justification see: TS 34.121 Clause F.6.3.3

3) Confidence level CL = 95 % (for specified DUT and Bad DUT-quality)

G.1.4 Pass Fail limit

Testing Throughput = 30 %, then the test limit is

Number of successes (ACK) / number of samples ≥ 59 / 233

Testing Throughput = 70 % then the test limit is

Number of fails (NACK and statDTX) / number of samples ≤ 66 / 184

There are 3 distinct cases:

a) The duration for the number of samples (233 or 184) is greater than the minimum test time:

Then the number of samples (233 or 184) is predefined and the decision is done according to the number of events (59 successes or 66 fails)

b) Since subframe 0 and 5 contain less bits than the remaining subframes, it is allowed to predefine a number of samples contained in an integer number of frames. In this case test-limit-ratio applies.

c) The minimum test time is greater than the duration for the number of samples:

The minimum test time is predefined and the decision is done comparing the measured ratio at that instant against the test-limit-ratio.

NOTE: The test time for most of the tests is governed by the Minimum Test Time.

G.1.5 Minimum Test time

Editor's Note: Simulation method to derive minimum test time for FR2 needs to be evaluated.

If a pass fail decision in clause G.1.4 can be achieved earlier than the minimum test time, then the test shall not be decided, but continued until the minimum test time is elapsed.

The tables below contain the minimum number of slots for FDD and TDD.

By simulations the minimum number of active subframes (carrying DL payload) was derived (MNAS), then adding inactive subframes to the active ones. For TDD additional subframes contain no DL payload) then rounding up to full thousand.

Simulation method to derive minimum test time:

With a level, corresponding a throughput at the test limit (here 30 % or 70 % of the max. throughput) the preliminary throughput versus time converges towards the final throughput. The allowance of ± 0.2 dB around the above mentioned level is predefined by RAN5 to find the minimum test time. The allowance of ±0.2 dB maps through the function "final throughput versus level" into a throughput corridor. The minimum test time is achieved when the preliminary throughput escapes the corridor the last time. The two functions "final throughput versus level" and "preliminary throughput versus time" are simulation results, which are done individual for each demodulation scenario.

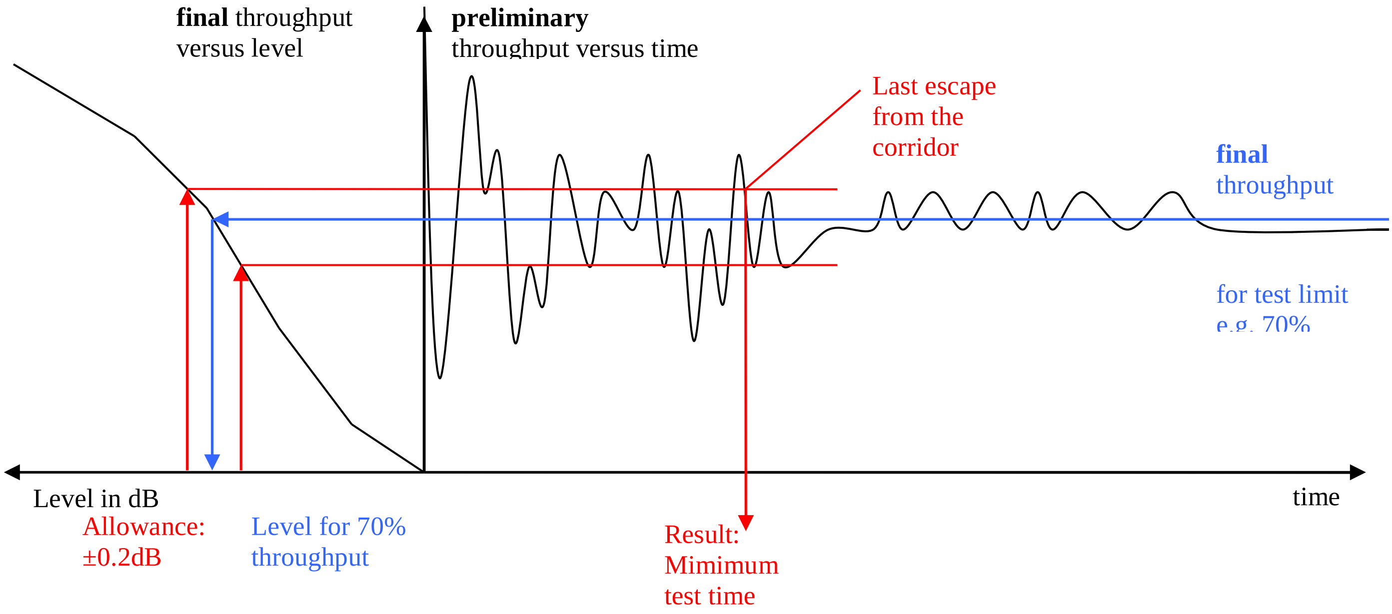

Figure G.1.5-1: Simulation method to derive minimum test time

Table G.1.5-1: Minimum Test time for PDSCH demodulation

TDD UL-DL pattern	Reference Channel	Demodulation scenario (doppler speed)	Minimum number of active subframes (MNAS)	MNAS to MNS Scaling factor (Note 3)	Minimum Number of Subframes (MNS) after rounding up to nearest thousand MNS= $1000*\left\lceil \frac{MNS}{1000} \right\rceil$
NA	R.PDSCH.1-8.1 FDD	750 Hz	FFS	1.0526	FFS
NA	R.PDSCH.1-1.1 FDD	400 Hz	10000 (Note 1)	1.0526	11000
NA	R.PDSCH.1-1.2 FDD, R.PDSCH.1-2.1 FDD, R.PDSCH.1-5.1 FDD,	100 Hz	20000 (Note 1)	1.0526	22000
NA	R.PDSCH.1-1.3 FDD R.PDSCH.1-2.2 FDD, R.PDSCH.1-2.3 FDD, R.PDSCH.1-2.4 FDD, R.PDSCH.1-3.1 FDD, R.PDSCH.1-4.1 FDD, R.PDSCH.1-7.1 FDD, R.PDSCH.1-7.2 FDD, R.PDSCH.2-1.1 FDD,	10 Hz	75000 (Note 1)	1.0526	79000
FR1.30-1A	R.PDSCH.2-1.1 TDD	400 Hz	10000 (Note 1)	1.2903	13000
FR1.30-5	R.PDSCH.2-11.1 TDD	400Hz	10000 (Note 1)	1.2903	13000
FR1.30-6	R.PDSCH.2-12.1 TDD	400Hz	10000 (Note 1)	1.2903	13000
FR1.30-1	R.PDSCH.2-1.2 TDD, R.PDSCH.2-2.1 TDD, R.PDSCH.2-7.1 TDD	100 Hz	20000 (Note 1)	1.2903	26000
FR1.30-1	R.PDSCH.2-4.1 TDD, R.PDSCH.2-3.1 TDD, R.PDSCH.2-2.2 TDD R.PDSCH.2-1.3 TDD R.PDSCH.2-2.3 TDD R.PDSCH.2-2.4 TDD	10 Hz	75000 (Note 1)	1.2903	97000
FR1.30-2	R.PDSCH.2-5.1 TDD	10 Hz	75000 (Note 1)	1.2903	97000
FR1.30-3	R.PDSCH.2-6.1 TDD	10 Hz	75000 (Note 1)	1.4815	112000
FR1.30-4	R.PDSCH.2-9.1 TDD	10 Hz	75000 (Note 1)	1.2903	97000
FR2.60-1	R.PDSCH.4-1.1 TDD	75 Hz	20000 (Note 2)	1.33	27000
FR2.120-1	R.PDSCH.5-1.1 TDD R.PDSCH.5-2.1 TDD R.PDSCH.5-3.1 TDD R.PDSCH.5-2.2 TDD R.PDSCH.5-2.3 TDD	300 Hz	10000 (Note 2)	1.25	13000
FR2.120-2	R.PDSCH.5-4.1 TDD R.PDSCH.5-5.1 TDD R.PDSCH.5-5.2 TDD R.PDSCH.5-6.1 TDD	75 Hz	20000 (Note 2)	1.33	27000

Note 1: MNAS determined by simulations.
Note 2: For cases where MNS is not determined by simulations, use same MNAS as the similar case simulated (same doppler speed)
Note 3: MNS/MNAS ratio decided by scheduling pattern (how much time is required to collect required number of active DL SFs)

Table G.1.5-2: Minimum Test time for PDCCH demodulation

Reference Channel	Demodulation scenario (doppler speed)	Minimum number of active subframes (MNAS)	MNAS to MNS Scaling factor (Note 3)	Minimum Number of Subframes (MNS) after rounding up to nearest thousand MNS= $1000*\left\lceil \frac{MNS}{1000} \right\rceil$
R.PDCCH 1-1.1 FDD, R.PDCCH.1-1.3 FDD, R.PDCCH.1-2.1 FDD, R.PDCCH.1-2.2 FDD, R.PDCCH.1-2.3 FDD, R.PDCCH.1-2.4 FDD, R.PDCCH.1-2.5 FDD, R.PDCCH.1-2.6 FDD	10, 100, 400 Hz	100000 (Note 1)	1.0526	106000
R.PDCCH.2-1.1 TDD, R.PDCCH.2-1.2 TDD, R.PDCCH.2-2.1 TDD, R.PDCCH.2-1.3 TDD	10, 100, 400 Hz	100000 (Note 1)	1.2903	130000
R.PDCCH.5-1.1 TDD R.PDCCH.5-1.2 TDD R.PDCCH.5-1.3 TDD R.PDCCH.5-2.1 TDD	75, 300 Hz	100000 (Note 2)	1.25	130000
Note 1: MNAS determined by simulations. Note 2: For cases where MNS is not determined by simulations, use same MNAS as the similar case simulated (same doppler speed) Note 3: MNS/MNAS ratio decided by scheduling pattern (how much time is required to collect required number of active DL SFs)				

G.2 Theory to derive the numbers for statistical testing (informative)

Editor's note: This clause of the Annex G is for information only and it described the background theory and information for statistical testing.

G.2.1 Error Ratio (ER)

The Error Ratio (ER) is defined as the ratio of number of errors (ne) to all results, number of samples (ns).

(1-ER is the success ratio).

G.2.2 Test Design

A statistical test is characterized by:

Test-time, Selectivity and Confidence level.

G.2.3 Confidence level

The outcome of a statistical test is a decision. This decision may be correct or in-correct. The Confidence Level CL describes the probability that the decision is a correct one. The complement is the wrong decision probability (risk) D = 1-CL.

G.2.4 Introduction: Supplier Risk versus Customer Risk

There are two targets of decision:

(a) A measurement on the pass-limit shows, that the DUT has the specified quality or is better with probability CL (CL e.g.95 %). This shall lead to a "pass decision".

The pass-limit is on the good side of the specified DUT-quality. A more stringent CL (CL e.g.99 %) shifts the pass-limit farer into the good direction. Given the quality of the DUTs is distributed, a greater CL passes less and better DUTs.

A measurement on the bad side of the pass-limit is simply "not pass" (undecided or artificial fail).

(aa) Complementary:

A measurement on the fail-limit shows, that the DUT is worse than the specified quality with probability CL.

The fail-limit is on the bad side of the specified DUT-quality. A more stringent CL shifts the fail-limit farer into the bad direction. Given the quality of the DUTs is distributed, a greater CL fails less and worse DUTs.

A measurement on the good side of the fail-limit is simply "not fail".

(b) A DUT, known to have the specified quality, shall be measured and decided pass with probability CL. This leads to the test limit.

For CL e.g. 95 %, the test limit is on the bad side of the specified DUT-quality. CL e.g.99 % shifts the pass-limit farer into the bad direction. Given the DUT-quality is distributed, a greater CL passes more and worse DUTs.

(bb) A DUT, known to be an ($\varepsilon \rightarrow 0$) beyond the specified quality, shall be measured and decided fail with probability CL.

For CL e.g.95 %, the test limit is on the good side of the specified DUT-quality.

NOTE 1: The different sense for CL in (a), (aa) versus (b), (bb).

NOTE 2: For constant CL in all 4 bullets (a) is equivalent to (bb) and (aa) is equivalent to (b).

G.2.5 Supplier Risk versus Customer Risk

The table below summarizes the different targets of decision.

Table G.2.5-1: Equivalent statements

	Equivalent statements, using different cause-to-effect-directions, and assuming CL = constant >1/2	
cause-to-effect-directions	Known measurement result → estimation of the DUT's quality	Known DUT's quality → estimation of the measurement's outcome
Supplier Risk	A measurement on the pass-limit shows, that the DUT has the specified quality or is better (a)	A DUT, known to have an ($\varepsilon \rightarrow 0$) beyond the specified DUT-quality, shall be measured and decided fail (bb)
Customer Risk	A measurement on the fail-limit shall shows, that the DUT is worse than the specified quality (aa)	A DUT, known to have the specified quality, shall be measured and decided pass (b)

The shaded area shown the direct interpretation of Supplier Risk and Customer Risk.

The same statements can be based on other DUT-quality-definitions.

G.2.6 Introduction: Standard test versus early decision concept

In standard statistical tests, a certain number of results (ns) is predefined in advance to the test. After ns results the number of bad results (ne) is counted and the error ratio (ER) is calculated by ne/ns.

Applying statistical theory, a decision limit can be designed, against which the calculated ER is compared to derive the decision. Such a limit is one decision point and is characterized by:

- D: the wrong decision probability (a predefined parameter)
- ns: the number of results (a fixed predefined parameter)
- ne: the number of bad results (the limit based on just ns)

In the formula for the limit, D and ns can be understood as variable parameter and variable. However the standard test execution requires fixed ns and D. The property of such a test is: It discriminates between two states only, depending on the test design:

- pass (with CL) / undecided (undecided in the sense: finally undecided)
- fail (with CL) / undecided (undecided in the sense: finally undecided)
- pass(with CL) / fail (with CL) (however against two limits).

In contrast to the standard statistical tests, the early decision concept predefines a set of (ne,ns) co-ordinates, representing the limit-curve for decision. After each result a preliminary ER is calculated and compared against the limit-curve. After each result one may make the decision or not (undecided for later decision). The parameters and variables in the limit-curve for the early decision concept have a similar but not equal meaning:

- D: the wrong decision probability (a predefined parameter)
- ns: the number of results (a variable parameter)
- ne: the number of bad results (the limit. It varies together with ns)

To avoid a "final undecided" in the standard test, a second limit shall be introduced and the single decision co-ordinate (ne,ns) needs a high ne, leading to a fixed (high) test time. In the early decision concept, having the same selectivity and the same confidence level an "undecided" need not to be avoided, as it can be decided later. A perfect DUT will hit the decision coordinate (ne,ns) with ne=0. This test time is short.

G.2.7 Standard test versus early decision concept

For Supplier Risk:

The wrong decision probability D in the standard test is the probability, to decide a DUT in-correct in the single decision point. In the early decision concept there is a probability of in-correct decisions d at each point of the limit-curve. The sum of all those wrong decision probabilities accumulate to D. Hence d<D.

For Customer Risk:

The correct decision probability CL in the standard test is the probability, to decide a DUT correct in the single decision point. In the early decision concept there is a probability of correct decisions cl at each point of the limit-curve. The sum of all those correct decision probabilities accumulate to CL. Hence cl<CL or d>D.

G.2.8 Selectivity

There is no statistical test which can discriminate between a limit DUT and a DUT which is an ($\varepsilon \rightarrow 0$) apart from the limit in finite time and high confidence level CL. Either the test discriminates against one limit with the results pass (with CL)/undecided or fail (with CL)/undecided, or the test ends in a result pass (with CL)/fail (with CL) but this requires a second limit.

For CL>1/2, a (measurement-result = specified-DUT-quality), generates undecided in test "supplier risk against pass limit" (a, from above) and also in the test "customer risk against the fail limit " (aa)

For CL>1/2, a DUT, known to be on the limit, will be decided pass for the test "customer risk against pass limit" (b) and also "supplier risk against fail limit" (bb).

This overlap or undecided area is not a fault or a contradiction, however it can be avoided by introducing a Bad or a Good DUT quality according to:

- Bad DUT quality: specified DUT-quality * M (M>1)
- Good DUT quality: specified DUT-quality * m (m<1)

Using e.g. M>1 and CL=95 % the test for different DUT qualities yield different pass probabilities:

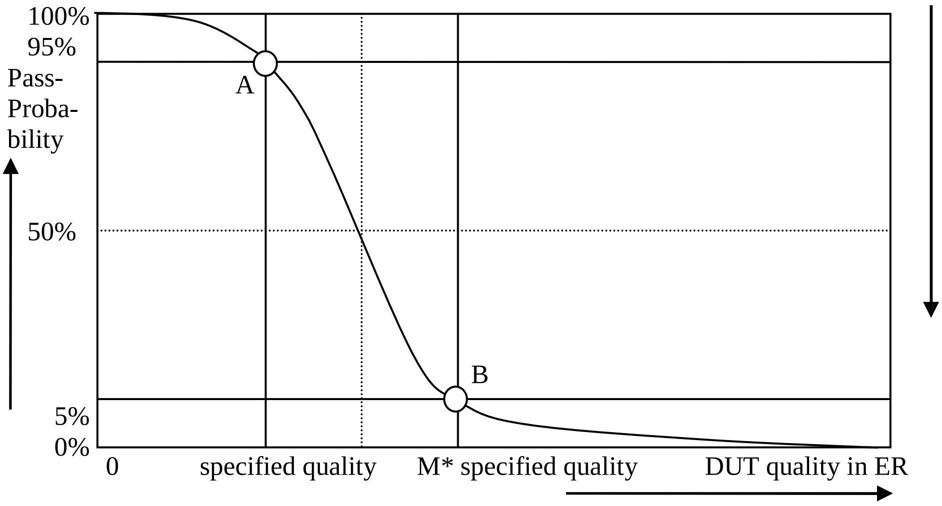

Figure G.2.8-1: Pass probability versus DUT quality

G.2.9 Design of the test

The receiver characteristic test are defined by the following design principles:

1. The early decision concept is applied.
2. A second limit is introduced: Bad DUT factor M>1
3. To decide the test pass:

   Supplier risk is applied based on the Bad DUT quality

   To decide the test fail

   Customer Risk is applied based on the specified DUT quality

The receiver characteristic test are defined by the following parameters:

1. Limit ER = 0.05
2. Bad DUT factor M=1.5 (selectivity)
3. Confidence level CL = 95 % (for specified DUT and Bad DUT-quality)

This has the following consequences:

1. A measurement on the fail limit is connected with 2 equivalent statements:

A measurement on the fail-limit shows, that the DUT is worse than the specified DUT-quality	A DUT, known have the specified quality, shall be measured and decided pass

2. A measurement on the pass limit is connected with the complementary statements:

A measurement on the pass limit shows, that the DUT is better than the Bad DUT-quality.	A DUT, known to have the Bad DUT quality, shall be measured and decided fail

   The left column is used to decide the measurement.

   The right column is used to verify the design of the test by simulation.

   The simulation is based on the two fulcrums A and B only in Figure G.2.8-1

3. Test time

   The minimum and maximum test time is fixed.

   The average test time is a function of the DUT's quality.

   The individual test time is not predictable.

4. The number of decision co-ordinates (ne,ns) in the early decision concept is responsible for the selectivity of the test and the maximum test time. Having fixed the number of decision co-ordinates there is still freedom to select the individual decision co-ordinates in many combinations, all leading to the same confidence level.

G.2.10 Simulation to derive the pass fail limits

There is freedom to design the decision co-ordinates (ne,ns).

The binomial distribution and its inverse is used to design the pass and fail limits. Note that this method is not unique and that other methods exist.

$$\mathrm{fail}(ne, d_f) := \frac{ne}{(ne + \mathrm{qnbinom}(d_f, ne, ER))}$$

$$\mathrm{pass}(ne, cl_p, M) := \frac{ne}{(ne + \mathrm{qnbinom}(cl_p, ne, ER \cdot M))}$$

Where

- fail(..) is the error ratio for the fail limit
- pass(..) is the error ratio for the pass limit
- ER is the specified error ratio 0.05
- ne is the number of bad results. This is the variable in both equations
- M is the Bad DUT factor M=1.5
- d_f is the wrong decision probability of a single (ne,ns) co-ordinate for the fail limit.
  It is found by simulation to be $d_f = 0.004$
- cl_p is the confidence level of a single (ne,ns) co-ordinate for the pass limit.
  It is found by simulation to be $cl_p = 0.9975$
- qnbinom(..): The inverse cumulative function of the negative binomial distribution

The simulation works as follows:

- A large population of limit DUTs with true ER = 0.05 is decided against the pass and fail limits.

- cl_p and d_f are tuned such that CL (95 %) of the population passes and D (5 %) of the population fails.
- A population of Bad DUTs with true ER = M*0.05 is decided against the same pass and fail limits.
- cl_p and d_f are tuned such that CL (95 %) of the population fails and D (5 %) of the population passes.
- This procedure and the relationship to the measurement is justified in clause G.2.9. The number of DUTs decrease during the simulation, as the decided DUTs leave the population. That number decreases with an approximately exponential characteristics. After 169 bad results all DUTs of the population are decided.

NOTE: The exponential decrease of the population is an optimal design goal for the decision co-ordinates (ne,ns), which can be achieved with other formulas or methods as well.

G.3 Measuring throughput ratio

G.3.1 General

Annex G.3 is applicable for clauses 6.2, 6,3 and 6.4. Common to those clauses is, that a throughput ratio γ of the form $\gamma = \frac{t_{Numerator}}{t_{Denominator}}$ is measured. These clauses are tested exclusively with “slow” multipath fading profiles. Hence the test time is governed by test time due to fading, and number of samples due to statistical significance is not applicable.

The test requirement in clause 6.3 is a ratio of 2 throughput tests γ. In either numerator or denominator (depending on test case) a target throughput is desired, which is established by an approach resulting in the throughput and the reference SNR that is defined in G.3.2. This SNR is then reused when measuring the throughput of the other factor of the formula. The formulas for calculation of γ are defined directly under sections 6.3.

The test requirements in clauses 6.2 and 6.4 are a ratio of 2 throughput tests γ, where numerator and denominator are ordinary throughput tests. The formulas for calculation of γ are defined in sections 6.2 and 6.4 respectively

G.3.2 Establishing SNR

Adjust SNR such that the measured throughput is within 2% of target value (TBD% depending on test case). The approach, leading to target throughput and reference SNR is not specified.

The resulting SNR is the reference SNR to use when measuring throughput in the other factor (numerator or denominator) of γ.

To achieve statistical significance the final throughput measurement must be done with MNS samples, given table G.3.4-1

G.3.3 Measuring T-put

To achieve statistical significance the final throughput measurement must be done with MNS samples, given in table G.3.4 -1. Number of samples due to statistical significance is not applicable.

For measuring $t_{ue,follow1,follow2}$ and $t_{ue,rnd1,rnd2}$, the SS collects ACK, NACK and statDTX from the UE and records the time, elapsed from the beginning of the test. The payload size, received by the UE and acknowledged towards the SS, is constant. Throughput can be calculated in the SS by multiplying the payload size with the number of ACKs and dividing the accumulated payload in kilobits by the time in seconds, elapsed from the beginning of the test, being associated to the following ratio: ACK/ (ACK+NACK + DTX).

G.3.4 Number of samples for throughput ratios

Table G.3.4-1: Test time for testing throughput ratios

Demodulation scenario (doppler speed)	Minimum number of active subframes (MNAS)	Scheduling pattern	MNAS to MNS Scaling factor (Note 2)	Minimum Number of Subframes (MNS) after rounding up to nearest thousand MNS= $1000*\left\lceil \frac{MNS}{1000} \right\rceil$
5Hz	100000	FDD	1.0526	106000
5Hz	100000	TDD FR1.30-1	1.2903	130000
Note 1: MNAS determined by theoretical estimations inherited from LTE based on R5-106393. Note 2: MNS/MNAS ratio decided by scheduling pattern (how much time is required to collect required number of active DL SFs) Note 3: MNS apply for both denominator and numerator measurement				

Annex H: Approach for finding UE direction for FR2 Demod and CSI Testing

H.0 Normative criteria for determining UE direction for Demod and CSI

Following 3 criteria shall be satisfied for a given UE direction. Procedure for finding the UE direction is captured in Annex H.1

1. UE shall pass the REFSENS test as per TC 7.3.2 of TS 38.521-2 [8].
2. Minimum isolation requirement of 12 dB between the 2 TE polarization branches shall be met.
3. UE reported rank shall be higher or same as intended rank for a given test.

H.1 Procedure for finding UE direction

This section provides example approaches for finding the UE direction for Demod and CSI tests. Other approaches satisfiying the normative criteria listed in H.0 are not precluded.

Default approach is as defined in H.1.2.

H.1.1 Using Rx beam peak direction search

1. For Rx beam peak direction search, please refer to procedure defined in Annex K.1.2/K.3.2 of TS 38.521-2 [8].
2. Run wireless cable mode isolation procedure as defined in H.2.
3. Ensure UE reported rank is higher or same as intended rank for a given test.

H.1.2 RSRPB based scan with fallback option to Rx beam peak direction search

1. Enable periodic RSRPB reporting from the UE.
2. Set of grid points for the UE scan can be user defined set or entire sphere.
3. For each grid point, record RSRPB first by connecting SS to the DUT through the measurement antenna with $Pol_{Link}= \theta$ polarization to form the Rx beam towards the measurement antenna and similarly for $Pol_{Link}= \phi$ polarization.
4. Wait for BEAM_SELECT_WAIT_TIME before recording the RSRPB reports.
5. Once the grid points scan is completed, sort the grid points based on the linear sum of 4 RSRPB values (2 each for θ and ϕ polarization).
6. For the top [10] grid points, run the REFSENS throughput test as per the test condition defined in 38.521-2 clause 7.3.2
7. Grid points that pass the REFSENS throughput test are the potential UE direction to be used for running the tests.
8. If no grid points found in step 7, fall back to using H.1.1.
9. For running rank1 tests,
    a. Pick any of the grid points obtained in step 7.

b. Run the wireless cable isolation procedure defined in H.2.

c. Exit the procedure.

10. For running rank2 tests,

a. Pick a grid point obtained in step 7.

b. Run the wireless cable mode isolation procedure defined in H.2.

c. If the grid point satisfies the minimum isolation, proceed to RI check.

Enable RI reporting from UE. If the UE reported rank = 2, exit the procedure.

If UE reported rank is not equal to 2, move to the next grid from step 7 and run step 10.

d. If no grid point meets the criteria in step 7 and step 10c, fallback to using H.1.1.

H.2 Wireless cable mode isolation procedure

The following procedure shall be used to verify the wireless cable mode has been established and that the minimum isolation has been achieved

1. Select any of the three Alignment Options (1, 2, or 3) to mount the DUT inside the QZ.
2. If the re-positioning concept is applied to demodulation test cases, position the DUT in DUT Orientation 1 if the RX beam peak is within $0^{o} \leq \theta \leq 90^{o}$. Otherwise, position the DUT in DUT Orientation 2 (Option 1 or 2). If the re-positioning concept is not applied to demodulation test cases, position the DUT in DUT Orientation 1
3. Connect the SS (System Simulator) using static propagation conditions with the DUT through the measurement antenna with $Pol_{Link}=\theta$ polarization to form the RX beam towards the desired test direction. Allow at least BEAM_SELECT_WAIT_TIME for the UE RX beam selection to complete.
4. Adjust the DL power of the SS to obtain P_{DL} defined in Table C.0.2-1 at the centre of QZ
5. Perform the isolation of the branches to achieve the wireless cable mode. The inverse channel matrix approach in [4] is one suitable approach. Alternate approaches are not precluded.
6. To verify the wireless cable mode and thus the min. isolation between branches

   a) Query SS-RSRPB($Pol_{Meas}=Pol_{Link}=\theta$) from the DUT for the θ-polarization and convert the two measurements in dBm, i.e., $SS\text{-}RSRPB_{B1}$ and $SS\text{-}RSRPB_{B2}$

   b) Calculate the isolation from θ-polarization into Branch 1, i.e., $ISO_{\theta,B1} = SS\text{-}RSRPB_{B1} - SS\text{-}RSRPB_{B2}$ and the isolation into Branch 2, i.e., $ISO_{\theta,B2} = SS\text{-}RSRPB_{B2} - SS\text{-}RSRPB_{B1}$

   c) Connect the SS (System Simulator) using static propagation conditions with the DUT through the measurement antenna with $Pol_{Link}=\phi$ polarization to form the RX beam towards desired test direction. Allow at least BEAM_SELECT_WAIT_TIME for the UE RX beam selection to complete.

   d) Adjust the DL power of the SS to obtain P_{DL} defined in Table C.0.2-1 at the centre of QZ

   e) Query SS-RSRPB($Pol_{Meas}=Pol_{Link}=\phi$) from the DUT for ϕ-polarization and convert the two measurements in dBm, i.e., $SS\text{-}RSRPB_{B1}$ and $SS\text{-}RSRPB_{B2}$

   f) Calculate the isolation from ϕ-polarization into Branch 2, i.e., $ISO_{\phi,B2} = SS\text{-}RSRPB_{B2} - SS\text{-}RSRPB_{B1}$ and the isolation into Branch 1, i.e., $ISO_{\phi,B1} = SS\text{-}RSRPB_{B1} - SS\text{-}RSRPB_{B2}$

If either of the isolations pairs, $ISO_{\theta,B1}$ and $ISO_{\phi,B2}$ or $ISO_{\theta,B2}$ and $ISO_{\phi,B1}$ exceed 12dB, the wireless cable mode has been achieved.

Annex I (informative): Change history

Change history							
Date	Meeting	Tdoc	CR	Rev	Cat	Subject/Comment	New version
2018-01		R5-180064				Skeleton for NR Demod spec	0.0.1
2018-04-13		R5-182036				Added the test procedure for FR2 Demod testing in Annex	0.1.0
2018-10-12		R5-185903				Added the demod spec test case section titles to be in line with RAN4 approved skeleton for 38.101-4	0.1.1
2018-11-20	RAN5 #81	R5-188006				new TC for PDSCH FR1 demod	0.2.0
2018-11-20	RAN5 #81	R5-188008				new TC for PDSCH FR2 demod	0.2.0
2018-11-20	RAN5 #81	R5-187573				section 3 of 38.521-4 spec	0.2.0
2018-11-20	RAN5 #81	R5-187845				section 4 of 38.521-4 spec	0.2.0
2018-11-20	RAN5 #81	R5-188009				pCR for new TC addition for FR1 FDD PDSCH Demod	0.2.0
2018-11-20	RAN5 #81	R5-188010				pCR for new TC addition for FR1 FDD PDCCH Demod	0.2.0
2019-01-25	RAN5 5G-NR AH#4	R5-190054				update to 2Rx TDD FR1 PDSCH mapping Type A performance test case	0.3.0
2019-01-25	RAN5 5G-NR AH#4	R5-190926				pCR for new TC addition for FR1 4Rx FDD PDSCH Demodulation performance (2x4)	0.3.0
2019-01-25	RAN5 5G-NR AH#4	R5-190927				pCR for new TC addition for FR1 4Rx FDD PDSCH Demodulation performance (4x4)	0.3.0
2019-01-25	RAN5 5G-NR AH#4	R5-190928				pCR for new TC addition for FR1 4Rx FDD PDSCH Demodulation performance with enhanced receiver type X (4x4)	0.3.0
2019-01-25	RAN5 5G-NR AH#4	R5-190291				Updated to Annex A Measurement Channels for Performance tests	0.3.0
2019-01-25	RAN5 5G-NR AH#4	R5-190292				Updated to Annex B Propagation conditions for Performance tests	0.3.0
2019-01-25	RAN5 5G-NR AH#4	R5-190458				update to 2Rx TDD FR2 PDSCH mapping Type A performance test case	0.3.0
2019-01-25	RAN5 5G-NR AH#4	R5-190461				2Rx TDD FR2 PDCCH performance test case	0.3.0
2019-01-25	RAN5 5G-NR AH#4	R5-190929				LTE link setup details for demod test cases	0.3.0
2019-01-25	RAN5 5G-NR AH#4	R5-190930				Annex for statistical tput calculation for demod test cases	0.3.0
2019-01-25	RAN5 5G-NR AH#4	R5-190931				pCR for TC addition of FR1 TDD 4Rx PDSCH	0.3.0
2019-01-25	RAN5 5G-NR AH#4	R5-190932				pCR for modification of FDD 2Rx FR1 PDSCH Demod	0.3.0
2019-01-25	RAN5 5G-NR AH#4	R5-190933				Annex for DL and UL Signal Setup	0.3.0
2019-01-25	RAN5 5G-NR AH#4	R5-190934				pCR for modification of FDD FR1 PDCCH Demod	0.3.0
2019-01-25	RAN5 5G-NR AH#4	R5-190935				PDSCH and PDCCH Config before measurement	0.3.0
2019-01-25	RAN5 5G-NR AH#4	R5-190986				38.521-4 Common Section updates to clarify leverage across architecture options	0.3.0
2019-01-25	RAN5 5G-NR AH#4	R5-190552				Addition of 2Rx TDD FR1 Single PMI tests for both SA and NSA	0.3.0
2019-01-25	RAN5 5G-NR AH#4	R5-190553				Addition of 2Rx TDD FR1 RI reporting for both SA and NSA	0.3.0
2019-03-01	RAN5 #82	R5-191183				Adding relevant references to 38.521-4	0.4.0
2019-03-01	RAN5 #82	R5-192461				Adding of test case 6.2.2.1.2.1.2, Rx FDD FR1 periodic wideband CQI reporting under fading conditions for both SA and NSA	0.4.0
2019-03-01	RAN5 #82	R5-192672				Introduction of New test case 5.3.2.2.1 2Rx TDD FR1 PDCCH 1 Tx antenna performance for both SA and NSA	0.4.0
2019-03-01	RAN5 #82	R5-192463				Introduction of New test case 5.3.2.2.2 2Rx TDD FR1 PDCCH 2 Tx antenna performance for both SA and NSA	0.4.0
2019-03-01	RAN5 #82	R5-192462				Introduction of New test case 5.3.3.1.1 4Rx FDD FR1 PDCCH 1 Tx antenna performance for both SA and NSA	0.4.0
2019-03-01	RAN5 #82	R5-192464				Introduction of New test case 5.3.3.1.2 4Rx FDD FR1 PDCCH 2 Tx antenna performance for both SA and NSA	0.4.0
2019-03-01	RAN5 #82	R5-192465				Introduction of New test case 5.3.3.2.1 4Rx TDD FR1 PDCCH 1 Tx antenna performance for both SA and NSA	0.4.0
2019-03-01	RAN5 #82	R5-192465				Introduction of New test case 5.3.3.2.2 4Rx TDD FR1 PDCCH 2 Tx antenna performance for both SA and NSA	0.4.0
2019-03-01	RAN5 #82	R5-192474				Introduction of TS 38.521-4 test case 6.3.2.1.1	0.4.0
2019-03-01	RAN5 #82	R5-192475				Introduction of TS 38.521-4 test case 6.3.2.1.2	0.4.0
2019-03-01	RAN5 #82	R5-192467				Introduction of test case 5.2.2.1.2_1, 2Rx FDD FR1 PDSCH mapping Type A and CSI-RS overlapped with PDSCH performance - 2x2 MIMO with baseline receiver for both SA and NSA	0.4.0
2019-03-01	RAN5 #82	R5-192840				Demod spec section 4 update	0.4.0

2019-03-01	RAN5 #82	R5-192673				Update to TDD FR1 2Rx PDSCH Type A test case	0.4.0
2019-03-01	RAN5 #82	R5-192103				addition of 2Rx TDD FR1 periodic CQI reporting test case	0.4.0
2019-03-01	RAN5 #82	R5-192468				pCR for addition of 2Rx TDD FR1 TypeA and CSI-RS overlapped TC	0.4.0
2019-03-01	RAN5 #82	R5-192866				pCR for modification of PDSCH and PDCCH Config before measurement	0.4.0
2019-03-01	RAN5 #82	R5-192470				pCR for modification of FDD FR1 PDCCH Demod	0.4.0
2019-03-01	RAN5 #82	R5-192471				pCR for modification of FDD 2Rx FR1 PDSCH Demod	0.4.0
2019-03-01	RAN5 #82	R5-192472				Update to 2Rx TDD FR1 RI reporting for both SA and NSA	0.4.0
2019-03-01	RAN5 #82	R5-192460				Minimum test time update for FR1 Demod test case	0.4.0
2019-03-01	RAN5 #82	R5-192473				Addition of Annex F for Demod spec	0.4.0
2019-03	RAN#83	RP-190222	-	-	-	Presented to the RAN#83 plenary for 1-step approval	1.0.0
2019-03	RAN#83	-	-	-	-	raised to v15.0.0 with editorial changes only	15.0.0
2019-06	RAN5#83	R5-193544	0030	-	F	Updates to test case 6.2.2.1.2.1, 2Rx FDD FR1 periodic wideband CQI reporting under fading conditions for both SA and NSA	15.1.0
2019-06	RAN5#83	R5-193943	0035	-	F	Adding test case 6.2.2.2.2.2, 2Rx TDD FR1 periodic subband CQI reporting under fading conditions for both SA and NSA	15.1.0
2019-06	RAN5#83	R5-194159	0048	-	F	Alignment of Annex C with core specification	15.1.0
2019-06	RAN5#83	R5-194466	0056	-	F	Introduction of FR1 CQI test case 6.2.2.2.2.1	15.1.0
2019-06	RAN5#83	R5-194622	0057	-	F	Corrections TDD UL-DL configurations	15.1.0
2019-06	RAN5#83	R5-194680	0066	-	F	Demod section 5 general update	15.1.0
2019-06	RAN5#83	R5-194689	0073	-	F	Addition of text for FR1 PBCH demodulation test case	15.1.0
2019-06	RAN5#83	R5-194690	0074	-	F	Update to 2Rx TDD FR2 PDSCH Type A test case	15.1.0
2019-06	RAN5#83	R5-194691	0075	-	F	Update to FR2 PDCCH config param	15.1.0
2019-06	RAN5#83	R5-194692	0076	-	F	Addition of text for FR2 PBCH demodulation test case	15.1.0
2019-06	RAN5#83	R5-194693	0077	-	F	Update to section 8 CSI reporting	15.1.0
2019-06	RAN5#83	R5-194979	0063	1	F	Further updates to 2Rx TDD FR1 PDSCH mapping Type A test case	15.1.0
2019-06	RAN5#83	R5-194980	0032	1	F	Introduction of TC 6.4.3.2_1 4Rx TDD FR1 RI reporting for both SA and NSA	15.1.0
2019-06	RAN5#83	R5-194981	0034	1	F	Adding test case 6.2.2.1.2.2, 2Rx FDD FR1 periodic subband CQI reporting under fading conditions for both SA and NSA	15.1.0
2019-06	RAN5#83	R5-194982	0053	1	F	Update to 4Rx FDD FR1 PDSCH mapping Type A performance 4x4 MIMO with baseline Rx	15.1.0
2019-06	RAN5#83	R5-194983	0054	1	F	Update to 4Rx FDD FR1 PDSCH mapping Type A performance 4x4 MIMO with enhanced Rx	15.1.0
2019-06	RAN5#83	R5-194984	0037	1	F	Editorial changes to TS 38.521-4 test case 6.3.2.1.2	15.1.0
2019-06	RAN5#83	R5-194985	0038	1	F	Introduction to TS 38.521-4 test case 6.3.3.1.1	15.1.0
2019-06	RAN5#83	R5-194986	0039	1	F	Introduction to TS 38.521-4 test case 6.3.3.1.2	15.1.0
2019-06	RAN5#83	R5-194987	0040	1	F	Introduction to TS 38.521-4 test case 6.3.3.2.1	15.1.0
2019-06	RAN5#83	R5-194988	0041	1	F	Introduction to TS 38.521-4 test case 6.3.3.2.2	15.1.0
2019-06	RAN5#83	R5-194989	0059	1	F	Modification of 2Rx FDD FR1 PDSCH mapping Type A performance - enhanced Rx	15.1.0
2019-06	RAN5#83	R5-194990	0060	1	F	Modification of 2Rx TDD FR1 PDSCH mapping Type A and CSI-RS overlapped with PDSCH performance - baseline Rx	15.1.0
2019-06	RAN5#83	R5-194991	0061	1	F	Modification of 2Rx FDD FR1 PDCCH 1 Tx	15.1.0
2019-06	RAN5#83	R5-194992	0062	1	F	Modification of 2Rx FDD FR1 PDCCH 2 Tx	15.1.0
2019-06	RAN5#83	R5-194993	0042	1	F	Update to test case 5.3.2.2.1 2Rx TDD FR1 PDCCH 1 Tx antenna performance for both SA and NSA	15.1.0
2019-06	RAN5#83	R5-194994	0043	1	F	Update to test case 5.3.2.2.2 2Rx TDD FR1 PDCCH 2 Tx antenna performance for both SA and NSA	15.1.0
2019-06	RAN5#83	R5-194995	0044	1	F	Update to test case 5.3.3.1.1 4Rx FDD FR1 PDCCH 1 Tx antenna performance for both SA and NSA	15.1.0
2019-06	RAN5#83	R5-194996	0045	1	F	Update to test case 5.3.3.1.2 4Rx FDD FR1 PDCCH 2 Tx antenna performance for both SA and NSA	15.1.0
2019-06	RAN5#83	R5-194997	0046	1	F	Update to test case 5.3.3.2.1 4Rx TDD FR1 PDCCH 1 Tx antenna performance for both SA and NSA	15.1.0
2019-06	RAN5#83	R5-194998	0047	1	F	Update to test case 5.3.3.2.2 4Rx TDD FR1 PDCCH 2 Tx antenna performance for both SA and NSA	15.1.0
2019-06	RAN5#83	R5-194999	0055	1	F	Update to FR1 demod test case 5.2.2.1.2_1	15.1.0
2019-06	RAN5#83	R5-195000	0078	1	F	Update to RI Reporting Accuracy test	15.1.0
2019-06	RAN5#83	R5-195001	0049	1	F	Updated to Annexes for performance tests	15.1.0
2019-06	RAN5#83	R5-195002	0068	1	F	Demod section 2-4 update	15.1.0
2019-06	RAN5#83	R5-195003	0058	1	F	Modification of 2Rx FDD FR1 PDSCH mapping Type A performance - baseline Rx	15.1.0
2019-06	RAN5#83	R5-195088	0029	1	F	Editorial Aligning CSI common test parameters with core specification	15.1.0
2019-06	RAN5#83	R5-195089	0031	1	F	Updating of E-UTRA test frequency for DEMOD test cases	15.1.0
2019-06	RAN5#83	R5-195098	0079	-	F	Performance implementation of FR2 UL demod OTA tests using single pol Rx TE	15.1.0

2019-06	RAN5#83	R5-195170	0052	1	F	Update to 4Rx FDD FR1 PDSCH mapping Type A performance 2x4 MIMO with baseline Rx	15.1.0
2019-06	RAN5#83	R5-195171	0033	1	F	Introducing MU and TT clauses in annex F for Channel State Information reporting test cases	15.1.0
2019-06	RAN5#83	R5-195172	0069	1	F	Annex update for PDSCH PDCCH minimum test time	15.1.0
2019-06	RAN5#83	R5-195413	0067	1	F	Update to section 9 and 10 of Demod spec	15.1.0
2019-06	RAN5#83	R5-195438	0050	2	F	Introducing 5.2.2.1.4_1 2Rx FDD FR1 PDSCH Mapping Type A and LTE-NR coexistence performance	15.1.0
2019-06	RAN5#83	R5-195439	0051	2	F	Introducing 5.2.3.1.4_1 4Rx FDD FR1 PDSCH Mapping Type A and LTE-NR coexistence performance	15.1.0
2019-06	RAN5#83	R5-195440	0064	1	F	Addition of new test case for 2Rx FDD FR1 periodic CQI reporting under AWGN	15.1.0
2019-06	RAN5#83	R5-195441	0065	1	F	Update to 2Rx TDD FR1 periodic CQI reporting under AWGN	15.1.0
2019-06	RAN5#83	R5-195442	0070	1	F	Addition of SDR test case for single carrier in SA mode	15.1.0
2019-06	RAN5#83	R5-195443	0072	1	F	Addition of FR1 SDR test case for CA in NSA mode	15.1.0
2019-06	RAN#84	-	-	-	-	Administrative release upgrade to match the release of 3GPP TS 38.508-1 and TS 38.521-1 which were upgraded at RAN#84 to Rel-16 due to Rel-16 relevant CR(s)	16.0.0
2019-09	RAN#85	R5-195558	0080	-	F	Correction to 5.2.2.1.4_1 2Rx FR1 PDSCH LTE-NR coexistence performance	16.1.0
2019-09	RAN#85	R5-196245	0090	-	F	Correction to 2Rx TDD FR1 periodic CQI reporting under AWGN conditions for both SA and NSA	16.1.0
2019-09	RAN#85	R5-196247	0092	-	F	Correction to 5.3.2.2.1 and 5.3.3.2.1 TDD FR1 PDCCH 1Tx performance	16.1.0
2019-09	RAN#85	R5-196495	0097	-	F	Updated to Annex A for performance tests	16.1.0
2019-09	RAN#85	R5-196496	0098	-	F	Updated to Annex B for performance tests	16.1.0
2019-09	RAN#85	R5-196498	0100	-	F	Updated to General clauses for Demod and CSI requirements	16.1.0
2019-09	RAN#85	R5-196857	0119	-	F	Corrections to PDSCH demod TCs	16.1.0
2019-09	RAN#85	R5-197370	0086	1	F	Updates to 6.2.2.1.2.1, 2Rx FDD FR1 periodic wideband CQI reporting under fading conditions for both SA and NSA	16.1.0
2019-09	RAN#85	R5-197371	0087	1	F	Updates to 6.2.2.2.2.1, 2Rx TDD FR1 periodic wideband CQI reporting under fading conditions for both SA and NSA	16.1.0
2019-09	RAN#85	R5-197372	0125	1	F	Modification of 4Rx FDD FR1 PDSCH mapping Type A performance - 2x4 MIMO with baseline receiver for both SA and NSA	16.1.0
2019-09	RAN#85	R5-197373	0084	1	F	Clean up test cases 5.3.3.1.1, 5.3.3.1.2, 5.3.3.2.1 and 5.3.3.2.2 for 4Rx PDCCH	16.1.0
2019-09	RAN#85	R5-197374	0099	1	F	Updated to General clauses for performance tests	16.1.0
2019-09	RAN#85	R5-197375	0123	1	F	Modification of FDD FR1 2Rx TypeA baseline and TypeX Rxvr	16.1.0
2019-09	RAN#85	R5-197376	0083	1	F	Clean up test cases 5.3.2.2.1 and 5.3.2.2.2 for 2Rx PDCCH	16.1.0
2019-09	RAN#85	R5-197377	0093	1	F	Correction to FR1 FDD PDSCH mapping Type A performance test cases	16.1.0
2019-09	RAN#85	R5-197378	0095	1	F	Correction to MU and TT for FR1 demodulation test cases	16.1.0
2019-09	RAN#85	R5-197379	0096	1	F	Update to 4Rx FDD FR1 PDSCH mapping Type A performance	16.1.0
2019-09	RAN#85	R5-197380	0117	1	F	Update of Annex F to add new CSI test cases	16.1.0
2019-09	RAN#85	R5-197512	0101	1	F	Update to SA SDR test case	16.1.0
2019-09	RAN#85	R5-197513	0102	1	F	Update to NSA SDR test case	16.1.0
2019-09	RAN#85	R5-197566	0127	1	F	Modification on 2Rx TDD FR1 Single PMI with 4Tx Type1 - SinglePanel codebook for both SA and NSA	16.1.0
2019-09	RAN#85	R5-197567	0128	1	F	Introduce 2Rx TDD FR1 Single PMI with 8Tx Type1 - SinglePanel codebook for both SA and NSA	16.1.0
2019-09	RAN#85	R5-197572	0126	1	F	Modification of 4Rx FDD FR1 PDSCH mapping Type A performance - 4x4 MIMO with baseline receiver for both SA and NSA	16.1.0
2019-09	RAN#85	R5-197573	0091	1	F	Correction to 2Rx TDD FR1 PDSCH mapping Type A performance	16.1.0
2019-09	RAN#85	R5-197574	0105	1	F	Update to TDD FR1 2Rx TypeA Baseline and Type X receiver Demod test cases	16.1.0
2019-09	RAN#85	R5-197575	0107	1	F	Editorial and updates to TS 38.521-4 test case 6.3.2.1.1	16.1.0
2019-09	RAN#85	R5-197576	0108	1	F	Updates to TS 38.521-4 test case 6.3.2.1.2	16.1.0
2019-09	RAN#85	R5-197577	0109	1	F	Updates to TS 38.521-4 test case 6.3.3.1.1	16.1.0
2019-09	RAN#85	R5-197578	0110	1	F	Update to TS 38.521-4 test case 6.3.3.1.2	16.1.0
2019-09	RAN#85	R5-197579	0111	1	F	Editorial and update to TS 38.521-4 test case 6.3.3.2.1	16.1.0
2019-09	RAN#85	R5-197580	0112	1	F	Editorial and update to TS 38.521-4 test case 6.3.3.2.2	16.1.0
2019-09	RAN#85	R5-197581	0120	1	F	Correction of PRACH-ConfigurationIndex for TC 5.2.2.2.1_1	16.1.0
2019-09	RAN#85	R5-197582	0122	1	F	Update to RI Reporting Accuracy test	16.1.0
2019-09	RAN#85	R5-197615	0088	1	F	Updates to 6.2.2.1.2.2, 2Rx FDD FR1 periodic subband CQI reporting under fading conditions for both SA and NSA	16.1.0
2019-09	RAN#85	R5-197616	0089	1	F	Updates to 6.2.2.2.2.2, 2Rx TDD FR1 periodic subband CQI reporting under fading conditions for both SA and NSA	16.1.0
2019-09	RAN#85	R5-197648	0115	2	F	Update to Annex G to restructure minimum test time tables for Demodulation test cases	16.1.0
2019-09	RAN#85	R5-197649	0116	2	F	Update to Annex G to add minimum test time for CSI test cases	16.1.0

2019-12	RAN#86	R5-198248	0141	-	F	Updates to Annex F	16.2.0
2019-12	RAN#86	R5-198281	0142	-	F	Update to FR1 4Rx FDD PDSCH Type A Demodulation performance	16.2.0
2019-12	RAN#86	R5-198395	0151	-	F	Corrections to E-UTRA configurations for EN-DC test cases	16.2.0
2019-12	RAN#86	R5-198407	0152	-	F	Correction to 2Rx FDD FR1 periodic CQI reporting under AWGN conditions for both SA and NSA	16.2.0
2019-12	RAN#86	R5-198408	0153	-	F	Correction to 2Rx and 4Rx TDD FR1 Single PMI with 4Tx Type1 - SinglePanel codebook for both SA and NSA	16.2.0
2019-12	RAN#86	R5-198409	0154	-	F	Correction to Sections 5.2 and 5.3	16.2.0
2019-12	RAN#86	R5-198560	0157	-	F	Updated to Annex A and B for performance tests	16.2.0
2019-12	RAN#86	R5-198679	0161	-	F	Correction of SchedulingRequestResourceConfig periodicityAndOffset for TC 7.2.2.2.1_1	16.2.0
2019-12	RAN#86	R5-198680	0162	-	F	Include PDSCH RMC for PDCCH demod FR1 test cases	16.2.0
2019-12	RAN#86	R5-199079	0137	2	F	Adding new test case 6.2.3.1.2.1, 4Rx FDD FR1 periodic wideband CQI reporting under fading conditions for both SA and NSA	16.2.0
2019-12	RAN#86	R5-199382	0129	1	F	Addition of 5.2.2.1.3_1 2Rx FDD PDSCH mapping Type B	16.2.0
2019-12	RAN#86	R5-199383	0130	1	F	Addition of NR test case 5.2.3.1.2_1-FDD type A CSI-RS overlap 4x4 MIMO	16.2.0
2019-12	RAN#86	R5-199384	0134	1	F	Addition of NR test case 6.2.3.1.1.1-FDD periodical CQI	16.2.0
2019-12	RAN#86	R5-199385	0136	1	F	Addition of NR test case 6.4.2.1_1-FDD RI reporting	16.2.0
2019-12	RAN#86	R5-199387	0149	1	F	Update to starting MCS index for CQI reporting test cases	16.2.0
2019-12	RAN#86	R5-199388	0145	1	F	Update to Annex G for minimum test time for FR2 Demod test cases	16.2.0
2019-12	RAN#86	R5-199414	0131	1	F	Addition of NR test case 5.2.3.1.3_1-FDD type B 2x4 MIMO	16.2.0
2019-12	RAN#86	R5-199415	0132	1	F	Addition of NR test case 5.2.3.2.2_1-TDD type A CSI-RS overlap 2x4 MIMO	16.2.0
2019-12	RAN#86	R5-199416	0133	1	F	Addition of NR test case 5.2.3.2.3_1-TDD type B 2x4 MIMO	16.2.0
2019-12	RAN#86	R5-199417	0135	1	F	Addition of NR test case 6.2.3.2.1.1-TDD periodical CQI	16.2.0
2019-12	RAN#86	R5-199418	0138	1	F	Adding new test case 6.2.3.1.2.2, 4Rx FDD FR1 aperiodic subband CQI reporting under fading conditions for both SA and NSA	16.2.0
2019-12	RAN#86	R5-199419	0139	1	F	Adding new test case 6.2.3.2.2.1, 4Rx TDD FR1 periodic wideband CQI reporting under fading conditions for both SA and NSA	16.2.0
2019-12	RAN#86	R5-199420	0140	1	F	Adding new test case 6.2.3.2.2.2, 4Rx TDD FR1 aperiodic subband CQI reporting under fading conditions for both SA and NSA	16.2.0
2019-12	RAN#86	R5-199421	0155	1	F	Correction to chapter 5 and 6 to be aligned with core spec	16.2.0
2019-12	RAN#86	R5-199422	0156	1	F	Editorial correction to CSI reporting tests	16.2.0
2019-12	RAN#86	R5-199425	0146	1	F	Update to FR2 2Rx PDSCH Type A enhanced type X receiver test case	16.2.0
2019-12	RAN#86	R5-199516	0160	1	F	Update PrachConfigIndex in 5.2.3.2.1_1 test case	16.2.0
2019-12	RAN#86	R5-199525	0148	1	F	Clarification on PDCP SDU size for SDR SA Demod test case	16.2.0
2019-12	RAN#86	R5-199526	0147	1	F	Clarification on PDCP SDU size for SDR NSA Demod test case	16.2.0
2019-12	RAN#86	R5-199527	0143	1	F	Update to FR2 2Rx PDSCH Type A baseline receiver test case	16.2.0
2019-12	RAN#86	R5-199531	0144	1	F	Annex update for UE positioning procedure for Demod test cases	16.2.0
2019-12	RAN#86	R5-199532	0150	1	F	Update to FR2 PDCCH Demod test case	16.2.0
2019-12	RAN#86	R5-199570	0158	1	F	Introduction of FR2 CQI test cases	16.2.0
2020-03	RAN#87	R5-200271	0165	-	F	Update to Demod TC 5.2.3.2.1_1	16.3.0
2020-03	RAN#87	R5-200322	0166	-	F	CR to 38.521-4 to introduce isolation procedure	16.3.0
2020-03	RAN#87	R5-200450	0168	-	F	Addition of message exceptions for Type2 QCL information	16.3.0
2020-03	RAN#87	R5-201245	0170	1	F	Core alignment to 4Rx PDCCH Demod Test Cases	16.3.0
2020-03	RAN#87	R5-200453	0171	-	F	Correction to FR1 2Rx PDSCH demodulation test cases	16.3.0
2020-03	RAN#87	R5-200454	0172	-	F	Correction to FR1 4Rx PDSCH demodulation test cases	16.3.0
2020-03	RAN#87	R5-200455	0173	-	F	Correction to measurement uncertainty and test tolerance for CQI test cases	16.3.0
2020-03	RAN#87	R5-200456	0174	-	F	Correction to PDCCH demod TCs	16.3.0
2020-03	RAN#87	R5-200660	0175	-	F	Correcting CQI value in test procedure	16.3.0
2020-03	RAN#87	R5-200672	0178	-	F	Updated to Annex A and B for performance tests	16.3.0
2020-03	RAN#87	R5-200682	0179	-	F	Correction to Applicability rules for Performance tests	16.3.0
2020-03	RAN#87	R5-200710	0180	-	F	Update of TC 5.2.2.1.3_1 2Rx FDD PDSCH mapping Type B	16.3.0
2020-03	RAN#87	R5-200711	0181	-	F	Update of TC 5.2.3.1.2_1 4Rx FDD PDSCH mapping Type A and CSI-RS overlapped	16.3.0
2020-03	RAN#87	R5-200712	0182	-	F	Update of TC 5.2.3.1.3_1 4Rx FDD PDSCH mapping Type B	16.3.0
2020-03	RAN#87	R5-200713	0183	-	F	Update of TC 5.2.3.2.2_1 4Rx TDD PDSCH mapping Type A and CSI-RS overlapped	16.3.0
2020-03	RAN#87	R5-200714	0184	-	F	Update of TC 5.2.3.2.3_1 4Rx TDD PDSCH mapping Type B	16.3.0
2020-03	RAN#87	R5-200718	0188	-	F	Update of Test Tolerance in Annex F	16.3.0
2020-03	RAN#87	R5-200729	0189	-	F	Core spec alignment for FR1 4Rx FDD PDSCH Type A Demodulation performance	16.3.0

2020-03	RAN#87	R5-200914	0176	1	F	Correction to test case 8.2.2.2.1.1 2 Rx, TDD FR2 periodic CQI reporting under AWGN performance for both SA and NSA	16.3.0
2020-03	RAN#87	R5-200915	0164	1	F	Update of Clause 4 in TS 38.521-4	16.3.0
2020-03	RAN#87	R5-200985	0169	1	F	Core alignment for FR2 demod test case	16.3.0
2020-03	RAN#87	R5-201068	0187	1	F	Update of TC 6.4.2.1_1 2Rx FDD RI reporting	16.3.0
2020-03	RAN#87	R5-201090	0177	1	F	Replacing derivation paths to 38.331	16.3.0
2020-03	RAN#87	R5-201180	0167	1	F	Addition of FR2 Demod sustained data rate test case	16.3.0
2020-06	RAN#88	R5-201816	0190	-	F	Correction to TC 5.2.3.1.1_4 4Rx FDD FR1 PDSCH mapping Type A performance	16.4.0
2020-06	RAN#88	R5-201945	0191	-	F	Updated to Annex A and B for performance tests	16.4.0
2020-06	RAN#88	R5-202242	0195	-	F	Clarification of propagation condition for Demod test cases during call setup	16.4.0
2020-06	RAN#88	R5-202297	0198	-	F	Correction to 4Rx FDD FR1 periodic CQI reporting under AWGN conditions for both SA and NSA	16.4.0
2020-06	RAN#88	R5-202980	0201	1	F	Correction to CSI reporting test cases missing MIMO correlation matrixes	16.4.0
2020-06	RAN#88	R5-202304	0205	-	F	Correction to FR2 PDCCH demodulation tests	16.4.0
2020-06	RAN#88	R5-202307	0208	-	F	Editorial correction on the table numbers for Minimum Test Time	16.4.0
2020-06	RAN#88	R5-202308	0209	-	F	Editorial correction to 4x4 MIMO PDSCH demodulation tests	16.4.0
2020-06	RAN#88	R5-202736	0197	1	F	Message exception correction for Demod test cases	16.4.0
2020-06	RAN#88	R5-202737	0202	1	F	Correction to FR1 aperiodic subband CQI reporting under fading conditions	16.4.0
2020-06	RAN#88	R5-202738	0203	1	F	Correction to FR1 Single PMI with 8Tx TypeI - SinglePanel codebook for both SA and NSA	16.4.0
2020-06	RAN#88	R5-202739	0207	1	F	Correction to message exception and test description in RI tests	16.4.0
2020-06	RAN#88	R5-202740	0196	1	F	Update to FR2 PDSCH Demod test case	16.4.0
2020-06	RAN#88	R5-202741	0211	1	F	Introduction of 8.4.2.2.1 2Rx TDD FR2 RI reporting for both SA and NSA	16.4.0
2020-06	RAN#88	R5-202742	0210	1	F	Editorial correction to Annex C.2	16.4.0
2020-06	RAN#88	R5-202743	0213	1	F	Update Wireless isolation procedure	16.4.0
2020-06	RAN#88	R5-202766	0212	1	F	Updates of FR2 MU and TT in TS 38.521-4	16.4.0
2020-06	RAN#88	R5-202832	0214	1	F	Addition of message exceptions for PDSCH test cases	16.4.0
2020-06	RAN#88	R5-202908	0193	1	F	Clarification of disabling Tx diversity for FR2 UE for FR2 Demod testing	16.4.0
2020-06	RAN#88	R5-202979	0199	2	F	Correction to 4Rx TDD FR1 RI reporting	16.4.0
2020-06	RAN#88	R5-202981	0204	1	F	Correction to FR2 CQI reporting tests	16.4.0
2020-06	RAN#88	R5-202989	0192	1	F	Updates to 8.2.2.2.2.1, 2Rx TDD FR2 aperiodic CQI reporting under fading performance for both SA and NSA	16.4.0
2020-09	RAN#89	R5-203298	0215	-	F	Activate Test Mode in NSA Demod Test Cases	16.5.0
2020-09	RAN#89	R5-203670	0217	-	F	message contents correction for TC 5.2.3.1.2_1	16.5.0
2020-09	RAN#89	R5-203717	0219	-	F	Correction to TC 5.2.3.1.1_1 4Rx FDD FR1 PDSCH mapping Type A performance	16.5.0
2020-09	RAN#89	R5-203756	0220	-	F	Removing unnecessary IE rbg-Size from message exceptions	16.5.0
2020-09	RAN#89	R5-203902	0221	-	F	Correction to Annex G minimum test time table	16.5.0
2020-09	RAN#89	R5-204062	0226	-	F	Correction to PDSCH reference channel	16.5.0
2020-09	RAN#89	R5-204063	0227	-	F	Correction to 2Rx FDD FR1 periodic wideband CQI reporting under fading conditions	16.5.0
2020-09	RAN#89	R5-204064	0228	-	F	Correction to LTE-NR coexistence performance	16.5.0
2020-09	RAN#89	R5-204100	0232	-	F	Update to common test parameters and channel mappings	16.5.0
2020-09	RAN#89	R5-204101	0233	-	F	Update E-UTRA cell configuration for NSA	16.5.0
2020-09	RAN#89	R5-204261	0235	-	F	Editorial correction of message exceptions	16.5.0
2020-09	RAN#89	R5-204774	0223	1	F	Test applicability update for all PDSCH mapping type B test cases	16.5.0
2020-09	RAN#89	R5-204870	0222	1	F	Addition of FR1 2Rx TDD PDSCH mapping type B test case	16.5.0
2020-09	RAN#89	R5-204871	0224	1	F	Addition of 4Rx FDD FR1 RI reporting test case	16.5.0
2020-09	RAN#89	R5-204933	0229	1	F	CR to update MU and TT in 38.521-4	16.5.0
2020-09	RAN#89	R5-204934	0225	1	F	Correction to frequencyDomainAllocation	16.5.0
2020-09	RAN#89	R5-204935	0230	1	F	Correction to MU and TT for FR1 PMI and RI tests	16.5.0
2020-09	RAN#89	R5-204936	0218	1	F	Update to FR2 PDSCH test case	16.5.0
2020-09	RAN#89	R5-204937	0216	1	F	Annex F Update of MU and TT for FR2 PDSCH and PDCCH Demodulation scenario	16.5.0
2020-09	RAN#89	R5-204938	0236	1	F	Update of AWGN flatness in TS 38.521-4	16.5.0
2020-12	RAN#90	R5-205920	0243	-	F	Introduction of new test case for FR2 CA PDSCH Demodulation	16.6.0
2020-12	RAN#90	R5-205925	0247	-	F	Update to FDD LTE-NR coexistence test case	16.6.0
2020-12	RAN#90	R5-206090	0248	-	F	Correction to 5.2.2.1.4_1 LTE NR coexistence performance	16.6.0
2020-12	RAN#90	R5-206091	0249	-	F	Correction to 9.4B.1.1 Sustained downlink data rate performance for EN-DC within FR1	16.6.0
2020-12	RAN#90	R5-206092	0250	-	F	Core alignment to FR1 and FR2 CSI test cases	16.6.0
2020-12	RAN#90	R5-206093	0251	-	F	Clean up on FR2 CQI and RI test cases	16.6.0
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2020-12	RAN#90	R5-206097	0255	-	F	Correction to incorrect parameter settings for subband CQI tests	16.6.0

2020-12	RAN#90	R5-206098	0256	-	F	Correction to Message contents for Sustained downlink data rate tests	16.6.0
2020-12	RAN#90	R5-206163	0259	-	F	Correction in message content of 5.2.2.2.1_1, 5.2.3.2.1_1 test cases	16.6.0
2020-12	RAN#90	R5-206165	0260	-	F	Update on TB success rate definition in Sustain data rate test cases	16.6.0
2020-12	RAN#90	R5-206208	0262	-	F	Editorial update of uplink signals	16.6.0
2020-12	RAN#90	R5-206666	0237	1	F	Update of LTE-NR coexistence performance test case 5.2.2.1.4	16.6.0
2020-12	RAN#90	R5-206667	0238	1	F	Update of LTE-NR coexistence performance test case 5.2.3.1.4	16.6.0
2020-12	RAN#90	R5-206668	0253	1	F	Correction to number of CQI and HARQ in CQI TCs under fading	16.6.0
2020-12	RAN#90	R5-206669	0254	1	F	Correction to FR1 periodic wideband CQI reporting under fading conditions	16.6.0
2020-12	RAN#90	R5-206670	0258	1	F	Correction of CSI-IM periodicity and offset in 4RX FDD wideband CQI under fading condition	16.6.0
2020-12	RAN#90	R5-206671	0240	1	F	Update to OCNG definition in DEMOD spec	16.6.0
2020-12	RAN#90	R5-206775	0239	1	F	Addition of test case 5.2.2.2.4_1 2Rx TDD FR1 PDSCH Mapping Type A and LTE-NR coexistence performance - 4x2 MIMO with baseline receiver for both SA and NSA	16.6.0
2020-12	RAN#90	R5-206776	0241	1	F	Applicability rules for section 5 CA Demodulation requirements	16.6.0
2020-12	RAN#90	R5-206777	0242	1	F	Applicability rules for section 7 CA Demodulation requirements	16.6.0
2020-12	RAN#90	R5-206829	0263	1	F	Update of Annex F	16.6.0
2020-12	RAN#90	R5-206830	0244	1	F	Update to FR2 PDSCH Demodulation test case	16.6.0
2020-12	RAN#90	R5-206831	0245	1	F	Update to FR2 PDCCH Demodulation test case	16.6.0
2020-12	RAN#90	R5-206832	0246	1	F	Update to FR2 CQI reporting under AWGN test case	16.6.0
2020-12	RAN#90	R5-206833	0261	1	F	CR on MU and testability limit for FR2 demod test case	16.6.0
2021-03	RAN#91	R5-210520	0275	-	F	Correction to SR config for TDD PDSCH Type A performance test cases	16.7.0
2021-03	RAN#91	R5-210521	0276	-	F	Correction to test applicability for LTE-NR coexistence performance test cases	16.7.0
2021-03	RAN#91	R5-210522	0277	-	F	Correction to wideband CQI reporting under fading test cases	16.7.0
2021-03	RAN#91	R5-210523	0278	-	F	Addition of 8.3.2.2.1 2Rx TDD FR2 Single PMI with 2TX TypeI-SinglePanel Codebook	16.7.0
2021-03	RAN#91	R5-210770	0282	-	F	Update message content in test case 7.3.2.2.2	16.7.0
2021-03	RAN#91	R5-210773	0283	-	F	Correction in 6.4.2.1_1 test requirements	16.7.0
2021-03	RAN#91	R5-210868	0284	-	F	Correction to Table F.1.1.2-2 for FR1 test cases	16.7.0
2021-03	RAN#91	R5-210869	0285	-	F	Correction to Test Purpose of PDCCH test cases	16.7.0
2021-03	RAN#91	R5-210993	0288	-	F	Editorial, cleanup of some references in 38.521-4	16.7.0
2021-03	RAN#91	R5-211050	0289	-	F	Updating applicability in test case 5.2.2.2.4_1	16.7.0
2021-03	RAN#91	R5-211081	0293	-	F	Update to downlink physical channel EPRE level for LTE-NR coex scenario	16.7.0
2021-03	RAN#91	R5-211086	0296	-	F	Adding new CSI test cases to annex F	16.7.0
2021-03	RAN#91	R5-211658	0297	1	F	Addition of new test case 6.3.2.1.3 2Rx FDD FR1 Multiple PMI with 16Tx Type1 - SinglePanel codebook for both SA and NSA	16.7.0
2021-03	RAN#91	R5-211659	0298	1	F	Addition of new test case 6.3.3.1.3 4Rx FDD FR1 Multiple PMI with 16Tx Type1 - SinglePanel codebook for both SA and NSA	16.7.0
2021-03	RAN#91	R5-211716	0280	1	F	Correction to DCI bit size for PDSCH Type B performance and LTE coexistence tests	16.7.0
2021-03	RAN#91	R5-211717	0281	1	F	Correction to LB setup DRB in CLOSE UE TEST LOOP message	16.7.0
2021-03	RAN#91	R5-211718	0286	1	F	Correction to NR test case 6.2.2.1.2.1	16.7.0
2021-03	RAN#91	R5-211719	0273	1	F	Correction to E-UTRA link setup for NSA testing	16.7.0
2021-03	RAN#91	R5-211813	0290	1	F	Adding new test case 6.3.2.2.3, 2Rx TDD FR1 Single PMI with 16Tx Type1 - SinglePanel codebook for both SA and NSA	16.7.0
2021-03	RAN#91	R5-211814	0292	1	F	Adding new test case 6.3.3.2.3, 4Rx TDD FR1 Single PMI with 16Tx Type1 - SinglePanel codebook for both SA and NSA	16.7.0
2021-03	RAN#91	R5-211816	0274	1	F	Update of minimum conformance requirements for 4Rx FDD FR1 PDSCH in TC 5.2.3.1.1_1	16.7.0
2021-03	RAN#91	R5-211817	0265	1	F	Addition of Applicability of different requirements for R16 NR HST in 5.1.1.7	16.7.0
2021-03	RAN#91	R5-211818	0268	1	F	Update of Applicability of requirements for mandatory UE features with capability signalling for R16 NR HST in 5.1.1.4	16.7.0
2021-03	RAN#91	R5-211819	0269	1	F	Update of Applicability of requirements for optional UE features for R16 NR HST in 5.1.1.3	16.7.0
2021-03	RAN#91	R5-211820	0264	1	F	Addition of Abbreviations and References for R16 NR HST in 3.3 and References	16.7.0
2021-03	RAN#91	R5-211821	0266	1	F	Addition of HST-DPS Channel Profile in B.3.3	16.7.0
2021-03	RAN#91	R5-211822	0267	1	F	Addition of HST-SFN Channel Profile in B.3.2	16.7.0
2021-03	RAN#91	R5-211823	0270	1	F	Update of Combinations of channel model parameters for R16 NR HST in B.2.2	16.7.0
2021-03	RAN#91	R5-211824	0271	1	F	Update of Reference measurement channels for PDSCH performance requirements for R16 NR HST in A.3.2	16.7.0
2021-03	RAN#91	R5-211825	0272	1	F	Update of Single Tap Channel Profile for R16 NR HST in B.3.1	16.7.0

2021-03	RAN#91	R5-211916	0291	1	F	Adding new test case 6.3.2.2.4, 2Rx TDD FR1 Single PMI with 32Tx Type1 - SinglePanel codebook for both SA and NSA	16.7.0
2021-03	RAN#91	R5-211929	0299	1	F	Update of FR2 demod test cases	16.7.0

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