**3GPP TSG-RAN4 Meeting #94-e *R4-2002446\_00076***

**Online, , 24th Feb 2020 - 6th Mar 2020**

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| *CR-Form-v12.0* |
| **CHANGE REQUEST** |
|  |
|  | **38.101-4** | **CR** | **0031** | **rev** | **-** | **Current version:** | **15.4.0** |  |
|  |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network |  | Core Network |  |

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|  |
| ***Title:***  |  |
|  |  |
| ***Source to WG:*** | ANRITSU LTD, Mediatek |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_newRAT-Perf |  | ***Date:*** | 2020-02-10 |
|  |  |  |  |  |
| ***Category:*** | **F** |  | ***Release:*** | Rel-15 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)Rel-12 (Release 12)**Rel-13 (Release 13)Rel-14 (Release 14)Rel-15 (Release 15)Rel-16 (Release 16)* |
|  |  |
| ***Reason for change:*** | The use of random PMI when testing PDSCH demodulation and PMI requirements is not clear enough to implement the test cases as intended.  |
|  |  |
| ***Summary of change:*** | a) Clarify “Precoding configuration” in Table 5.2-1 for PDSCH requirements.b) Clarify “Precoding configuration” in Table 5.3-1 for PDCCH requirements.c) In the PMI general description 6.3, clarify PDSCH random precoding.d) In each PMI scenario, clarify Note 1 on Precoding configuration in Tables 6.3.2.x and 6.3.3.x. |
|  |  |
| ***Consequences if not approved:*** | It would not be clear how to implement the necessary precoding functionality to ensure the test cases in RAN5 work as intended. |
|  |  |
| ***Clauses affected:*** | Table 5.2-1, Table 5.3-1, 6.3, Table 6.3.2.1.1-1, Table 6.3.2.1.2-1, Table 6.3.2.2.1-1, Table 6.3.2.2.2-1, Table 6.3.3.1.1-1, Table 6.3.3.1.2-1, Table 6.3.3.2.1-1, Table 6.3.3.2.2-1.  |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  |  |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** | **Y** |  |  Test specifications | TS 38.533 |
| ***(show related CRs)*** |  |  |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

<< Start of changes >>

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 [6] 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 |
| Precoding configuration |  | Single Panel Type I, Random per slot gwith equal probability of each applicable i1, i2 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  |  | k0=0 for CSI-RS resource 1,2,3,4 |
| First OFDM symbol in the PRB used for CSI-RS  |  |  l0 = 6 for CSI-RS resource 1 and 3l0 = 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 1,2,3,430 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 211 for CSI-RS resource 3 and 430 kHz SCS:20 for CSI-RS resource 1 and 221 for CSI-RS resource 3 and 4 |
| Frequency Occupation |  | Start PRB 0Number 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  |  | k0 = 0 |
| First OFDM symbol in the PRB used for CSI-RS  |  | l0 = 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: 2030 kHz SCS: 40 |
| CSI-RS offset | Slots | 0 |
| Frequency Occupation |  | Start PRB 0Number 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  |  | k0 = 4 |
| First OFDM symbol in the PRB used for CSI-RS  |  | l0 = 12 |
| Number of CSI-RS ports (X) |  | 4 |
| CDM Type |  | 'FD-CDM2' |
| Density (ρ) |  | 1 |
| CSI-RS periodicity | Slots | 15 kHz SCS: 2030 kHz SCS: 40 |
| CSI-RS offset | Slots | 0 |
| Frequency Occupation |  | Start PRB 0Number 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 tests2 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 Precoding configuration |  | Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i1, i2 combination, and with PRB bundling granularity |
| Symbols for all unused REs |  | OCNG Annex A.5 |
| Note 1: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH transmission.Note 2: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-1 [6] for tested channel bandwidth and subcarrier spacing. |

**Table 5.2-2: Number of PRBs in CORESET**

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

<< clauses skipped >>

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 (*k0*) |  | 0 |
| First OFDM symbol in the PRB used for CSI-RS (*l0*) |  | CSI-RS resource 1: 4CSI-RS resource 2: 8CSI-RS resource 3: 4CSI-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: 2030 kHz SCS: 40 |
| CSI-RS offset | Slots | 15 kHz SCS:10 for CSI-RS resource 1 and 211 for CSI-RS resource 3 and 430 kHz SCS:20 for CSI-RS resource 1 and 221 for CSI-RS resource 3 and 4 |
| Frequency Occupation |  | Start PRB 0Number 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 Precoding configuration ~~for PDSCH~~ |  | Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i1, i2 combination with REG bundling granularity for number of Tx larger than 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 [6] for tested channel bandwidth and subcarrier spacing. |

<< clauses skipped >>

## 6.3 Reporting of Precoding Matrix Indicator (PMI)

The minimum performance requirements of PMI reporting are defined based on the precoding gain, expressed as the relative increase in throughput when the transmitter is configured according to the UE reported PMI compared to the case when the transmitter is using random precoding, respectively. When the transmitter uses random precoding, for each PDSCH allocation a precoder is randomly generated with equal propability of each applicable i1 and i2 combination and applied to the PDSCH. A fixed transport format (FRC) is configured for all requirements.

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

 

In the definition of *γ*, for 4TX and 8TX PMI requirements, is 90 % of the maximum throughput obtained at  using the precoders configured according to the UE reports, and is the throughput measured at with random precoding.

6.3.1 1RX requirements

(Void)

<< clauses skipped >>

6.3.2 2RX requirements

6.3.2.1 FDD

6.3.2.1.1 Single PMI with 4TX TypeI-SinglePanel Codebook

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

**Table 6.3.2.1.1-1: Test parameters (single layer)**

|  |  |  |
| --- | --- | --- |
| **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 |  | 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 (k0, k1 ) |  | Row 5, (4,-) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (9,-) |
| CSI-RSinterval 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*) |  | 4 |
| CDM Type |  | FD-CDM2 |
| Density (ρ) |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0, k1 ) |  | Row 4, (0,-) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (13,-) |
| CSI-RSinterval and offset |  | Not configured |
| aperiodicTriggeringOffset |  | 0 |
| CSI-IM configuration | CSI-IM resource Type |  | Aperiodic |
| CSI-IM RE pattern |  | Patten 0 |
| CSI-IM Resource Mapping(kCSI-IM,lCSI-IM) |  | (4,9) |
| CSI-IM timeConfiginterval and offset | slot | Not configured |
| CSI-IM configuration | CSI-IM RE pattern |  | Patten 0 |
| CSI-IM Resource Mapping(kCSI-IM,lCSI-IM) |  | (4,9) |
| CSI-IM timeConfiginterval and offset | slot | 5/1 |
| 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 ConfigurationAssociated Report Configuration contains pointers to NZP CSI-RS and CSI-IM |
| Codebook configuration | Codebook Type |  | typeI-SinglePanel |
| Codebook Mode |  | 1 |
| (CodebookConfig-N1,CodebookConfig-N2) |  | (2,1) |
| (CodebookConfig-O1,CodebookConfig-O2) |  | (4,1) |
| CodebookSubsetRestriction |  | 11111111 |
| RI Restriction |  | 00000001 |
| Physical channel for CSI report |  | PUSCH |
| CQI/RI/PMI delay  | ms | 6 |
| Maximum number of HARQ transmission |  | 4 |
| Measurement channel |  | R.PDSCH.1-6.1 FDD |
| 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 i1, i2 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-3), this reported PMI cannot be applied at the gNB 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** |
| ** | 1.3 |

6.3.2.1.2 Single PMI with 8TX TypeI-SinglePanel Codebook

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

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

|  |  |  |
| --- | --- | --- |
| **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 |  | 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 (k0, k1 ) |  | Row 5, (4,-) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (9,-) |
| CSI-RSinterval 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*) |  | 8 |
| CDM Type |  | CDM4 (FD2, TD2) |
| Density (ρ) |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0, k1 ) |  | Row 8, (4,6) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (5,-) |
| CSI-RSinterval 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(kCSI-IM,lCSI-IM) |  | (4,9) |
| CSI-IM timeConfiginterval 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 ConfigurationAssociated 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) |
| CodebookSubsetRestriction |  | 0x FFFF |
| RI Restriction |  | 00000010 |
| Physical channel for CSI report |  | PUSCH |
| CQI/RI/PMI delay  | ms | 8 |
| Maximum number of HARQ transmission |  | 4 |
| Measurement channel |  | R.PDSCH.1-6.2  |
| 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 i1, i2 combination.Note 2: If the UE reports in an available uplink reporting instance at slot#n based on PMI estimation at a downlink slot not later than slot#(n-4), this reported PMI cannot be applied at the gNB downlink before slot#(n+4).Note 3: Randomization of the principle beam direction shall be used as specified in Annex B.2.3.2.3. |

**Table 6.3.2.1.2-2: Minimum requirement**

|  |  |
| --- | --- |
| **Parameter** | **Test 1** |
| ** | 1.5 |

6.3.2.2 TDD

6.3.2.2.1 Single PMI with 4TX TypeI-SinglePanel Codebook

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

**Table 6.3.2.2.1-1: Test parameters (single layer)**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Test 1** |
| Bandwidth | MHz | 40 |
| 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 2(N1,N2) = (2,1) |
| 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 (k0, k1 ) |  | Row 5, (4,-) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (9,-) |
| CSI-RSinterval 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*) |  | 4 |
| CDM Type |  | FD-CDM2 |
| Density (ρ) |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0, k1 ) |  | Row 4, (0,-) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (13,-) |
| CSI-RSinterval 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(kCSI-IM,lCSI-IM) |  | (4,9) |
| CSI-IM timeConfiginterval 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 ConfigurationAssociated Report Configuration contains pointers to NZP CSI-RS and CSI-IM |
| Codebook configuration | Codebook Type |  | typeI-SinglePanel |
| Codebook Mode |  | 1 |
| (CodebookConfig-N1,CodebookConfig-N2) |  | (2,1) |
| (CodebookConfig-O1,CodebookConfig-O2) |  | (4,1) |
| CodebookSubsetRestriction |  | 11111111 |
| RI Restriction |  | 00000001 |
| Physical channel for CSI report |  | PUSCH |
| CQI/RI/PMI delay  | ms | 5.5 |
| Maximum number of HARQ transmission |  | 4 |
| Measurement channel |  | R.PDSCH.2-8.1 TDD |
| 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 i1, i2 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 6.3.2.2.1-2: Minimum requirement**

|  |  |
| --- | --- |
| **Parameter** | **Test 1** |
| ** | 1.3 |

6.3.2.2.2 Single PMI with 8TX TypeI-SinglePanel Codebook

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

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

|  |  |  |
| --- | --- | --- |
| **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 2(N1,N2) = (4,1) |
| 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 (k0, k1 ) |  | Row 5, (4,-) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (9,-) |
| CSI-RSinterval 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*) |  | 8 |
| CDM Type |  | CDM4 (FD2, TD2) |
| Density (ρ) |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0, k1 ) |  | Row 8, (4,6) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (5,-) |
| CSI-RSinterval 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(kCSI-IM,lCSI-IM) |  | (4,9) |
| CSI-IM timeConfiginterval 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 ConfigurationAssociated 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) |
| CodebookSubsetRestriction |  | 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: 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 i1, i2 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 6.3.2.2.2-2: Minimum requirement**

|  |  |
| --- | --- |
| **Parameter** | **Test 1** |
| ** | 1.5 |

6.3.3 4RX requirements

6.3.3.1 FDD

6.3.3.1.1 Single PMI with 4TX TypeI-SinglePanel Codebook

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

**Table 6.3.3.1.1-1: Test parameters (single layer)**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **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 |  | 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 (k0, k1 ) |  | Row 5, (4,-) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (9,-) |
| CSI-RSinterval 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*) |  | 4 |
| CDM Type |  | FD-CDM2 |
| Density (ρ) |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0, k1 ) |  | Row 4, (0,-) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (13,-) |
| CSI-RSinterval 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(kCSI-IM,lCSI-IM) |  | (4,9) |
| CSI-IM timeConfiginterval 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 ConfigurationAssociated Report Configuration contains pointers to NZP CSI-RS and CSI-IM |
| Codebook configuration | Codebook Type |  | typeI-SinglePanel |
| Codebook Mode |  | 1 |
| (CodebookConfig-N1,CodebookConfig-N2) |  | (2,1) |
| (CodebookConfig-O1,CodebookConfig-O2) |  | (4,1) |
| CodebookSubsetRestriction |  | 11111111 |
| RI Restriction |  | 00000001 |
| Physical channel for CSI report |  | PUSCH |
| CQI/RI/PMI delay  | ms | 6 |
| Maximum number of HARQ transmission |  | 4 |
| Measurement channel |  | R.PDSCH.1-6.1 FDD |
| 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 i1, i2 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-3), this reported PMI cannot be applied at the gNB 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 6.3.3.1.1-2: Minimum requirement**

|  |  |
| --- | --- |
| **Parameter** | **Test 1** |
| ** | 1.3 |

6.3.3.1.2 Single PMI with 8TX TypeI-SinglePanel Codebook

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

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

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Test 1** |
| Bandwidth | MHz | 10 |
| 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 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 (k0, k1 ) |  | Row 5, (4,-) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (9,-) |
| CSI-RSinterval 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*) |  | 8 |
| CDM Type |  | CDM4 (FD2, TD2) |
| Density (ρ) |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0, k1 ) |  | Row 8, (4,6) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (5,-) |
| CSI-RSinterval 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(kCSI-IM,lCSI-IM) |  | (4,9) |
| CSI-IM timeConfiginterval 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 ConfigurationAssociated 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) |
| CodebookSubsetRestriction |  | 0x FFFF |
| RI Restriction |  | 00000010 |
| Physical channel for CSI report |  | PUSCH |
| CQI/RI/PMI delay  | ms | 8 |
| Maximum number of HARQ transmission |  | 4 |
| Measurement channel |  | R.PDSCH.1-6.2 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 i1, i2 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 6.3.3.1.2-2: Minimum requirement**

|  |  |
| --- | --- |
| **Parameter** | **Test 1** |
| ** | 1.5 |

6.3.3.2 TDD

6.3.3.2.1 Single PMI with 4TX TypeI-SinglePanel Codebook

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

**Table 6.3.3.2.1-1: Test parameters (single layer)**

|  |  |  |
| --- | --- | --- |
| **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 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 (k0, k1 ) |  | Row 5, (4,-) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (9,-) |
| CSI-RSinterval 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*) |  | 4 |
| CDM Type |  | FD-CDM2 |
| Density (ρ) |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0, k1 ) |  | Row 4, (0,-) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (13,-) |
| CSI-RSinterval and offset |  | Not configured |
| aperiodicTriggeringOffset |  | 0 |
| CSI-IM configuration | CSI-IM resource Type |  | Aperiodic |
| CSI-IM RE pattern |  | Pattern 0 |
| CSI-IM Resource Mapping(kCSI-IM,lCSI-IM) |  | (4,9) |
| CSI-IM timeConfiginterval 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 ConfigurationAssociated Report Configuration contains pointers to NZP CSI-RS and CSI-IM |
| Codebook configuration | Codebook Type |  | typeI-SinglePanel |
| Codebook Mode |  | 1 |
| (CodebookConfig-N1,CodebookConfig-N2) |  | (2,1) |
| (CodebookConfig-O1,CodebookConfig-O2) |  | (4,1) |
| CodebookSubsetRestriction |  | 11111111 |
| RI Restriction |  | 00000001 |
| Physical channel for CSI report |  | PUSCH |
| CQI/RI/PMI delay  | ms | 5.5 |
| Maximum number of HARQ transmission |  | 4 |
| Measurement channel |  | R.PDSCH.2-8.1 TDD |
| 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 i1, i2 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 6.3.3.2.1-2: Minimum requirement**

|  |  |
| --- | --- |
| **Parameter** | **Test 1** |
| ** | 1.3 |

6.3.3.2.2 Single PMI with 8TX TypeI-SinglePanel Codebook

For the parameters specified in Table 6.3.3.2.2-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.3.2.2-2.

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

|  |  |  |
| --- | --- | --- |
| **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 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 (k0, k1 ) |  | Row 5, (4,-) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (9,-) |
| CSI-RSinterval 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*) |  | 8 |
| CDM Type |  | CDM4 (FD2, TD2) |
| Density (ρ) |  | 1 |
| First subcarrier index in the PRB used for CSI-RS (k0, k1 ) |  | Row 8, (4,6) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (5,-) |
| CSI-RSinterval 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(kCSI-IM,lCSI-IM) |  | (4,9) |
| CSI-IM timeConfiginterval 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 ConfigurationAssociated 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) |
| CodebookSubsetRestriction |  | 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: 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 i1, i2 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 6.3.3.2.2-2: Minimum requirement**

|  |  |
| --- | --- |
| **Parameter** | **Test 1** |
| ** | 1.5 |

<< End of changes >>