**3GPP TSG-RAN4 Meeting #112 *R4-2413487***

**Maastricht, Netherlands, 19th Aug 2024 - 23rd Aug 2024**

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| *CR-Form-v12.3* |
| **CHANGE REQUEST** |
|  |
|  | **38.101-4** | **CR** | **0598** | **rev** | 1 | **Current version:** | **18.4.0** |  |
|  |
| *For* [***HELP***](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:***  | (NR\_redcap\_enh-Perf) CR for 38.101-4: Correction of eRedCap demodulation and CSI reporting requirements |
|  |  |
| ***Source to WG:*** | Ericsson, Huawei, HiSilicon, Nokia, Nokia Shanghai Bell |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_redcap\_enh-Perf |  | ***Date:*** | 2024-08-22 |
|  |  |  |  |  |
| ***Category:*** | **F** |  | ***Release:*** | Rel-18 |
|  | *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-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19) Rel-20 (Release 20)* |
|  |  |
| ***Reason for change:*** | 1. Wrong section numbers in Table 5.1.1.14-1.2. Several FRCs in the bigCR R4-2408778 are not correctly implemented due to the overlap with other CRs. 3. eRedCap PDSCH FDD demodulation requirements are in [].4. PMI reporting requirements for Rel-18 eRedCap UE is specified in the same clause as Rel-17 RedCap UE. But this will be not aligned with RAN5 conformance test TS38.521-4; RAN5 are going to have separate test cases between RedCap and eRedCap in 38.521-4.5. SNR test points for CQI static test is in [].6. CQI fading test is missing. |
|  |  |
| ***Summary of change:*** | 1. Correct section numbers in Table 5.1.1.14-1.2. Correct FRC number* R.PDSCH.1-12.2 FDD -> R.PDSCH.1-25.1 FDD

3. Remove [] from eRedCap PDSCH FDD demodulation requirements4. Split PMI reporting test with test for RedCap and test for eRedCap5. Remove [] from eRedCap CQI statitc tests6. Add CQI fading tests.  |
|  |  |
| ***Consequences if not approved:*** | eRedCap UE demodulation and CSI reporting requirements are not complete.  |
|  |  |
| ***Clauses affected:*** | 5.1.1.14, 5.2.1.1.2, 5.2.2.1.23, 6.1.1.7, 6.2.1.1,1.2, 6.2.1.1.2.2 (new), 6.2.1.2.1.2, 6.2.1.2.2.2 (new), 6.2.2.1.1.5, 6.2.2.1.2.5 (new), 6.2.2.2.1.6 (new), 6.2.2.2.2.5 (new), 6.3.1.1.1, 6.3.1.1.2 (new), 6.3.1.2.1, 6.2.1.2.2 (new), 6.3.2.1.1, 6.3.2.1.10 (new), 6.3.2.2.7, 6.3.2.2.10 (new), Table A.3.2.1.1-25  |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **x** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** | **x** |  |  Test specifications | TS38.521-4  |
| ***(show related CRs)*** |  | **x** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

#### 5.1.1.14 Applicability of requirements for eRedCap

The performance requirements in Table 5.1.1.14-1 shall apply for UEs which support optional feature *supportOfERedCap-r18*.

Other performance requirements mandatory for UE supporting NR operation defined in Section 5 but not included in table 5.1.1.14-1 should not be considered applicable to eRedCap UEs.

**Table 5.1.1.14-1: Requirements applicability for eRedCap UEs**

|  |  |  |  |
| --- | --- | --- | --- |
| **UE capability** | **Test type** | **Test list** | **Applicability notes** |
| eRedCap with 1RX | FR1 FDD and HD-FDD (Note 1) | PDSCH | Clause 5.2.1.1.2 |  |
|  |  | PDCCH | All tests in Clause 5.3.1.1.1 |  |
|  |  | PBCH | All tests in Clause 5.4.1.1 |  |
|  |  | SDR | Clause 5.5.1 |  |
|  | FR1 TDD | PDSCH | Clause 5.2.1.2.2 |  |
|  |  | PDCCH | All tests in Clause 5.3.1.2.1 |  |
|  |  | PBCH | All tests in Clause 5.4.1.2 |  |
|  |  | SDR | Clause 5.5.1 |  |
| eRedCap with 2RX | FR1 FDD and HD-FDD (Note 1) | PDSCH | Clause 5.2.2.1.23 |  |
|  |  | PDCCH | All tests in Clause 5.3.2.1.4 |  |
|  |  | PBCH | Clause 5.4.2.1 (Table 5.4.2.1-2 Test 1)Clause 5.4.2.1 (Table 5.4.2.1-3 Test 1) |  |
|  |  | SDR | Clause 5.5.1 |  |
|  | FR1 TDD | PDSCH | Clause 5.2.2.2.24 |  |
|  |  | PDCCH | All tests in Clause 5.3.2.2.4 |  |
|  |  | PBCH | Clause 5.4.2.2 (Table 5.4.2.2-4 Test 1)Clause 5.4.2.2 (Table 5.4.2.2-5 Test 1) |  |
|  |  | SDR | Clause 5.5.1 |  |
| Note 1: If UE support only HD-FDD in a FDD band, this UE is tested with HD-FDD mode otherwise UE is tested with full-duplex FDD mode |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

##### 5.2.1.1.2 Minimum requirements for eRedCap

The performance requirements are specified in Table 5.2.1.1.2-3 and Table 5.2.1.1.2-4, with the addition of test parameters in Table 5.2.1.1.2-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.1.1.2-1.

Table 5.2.1.1.2-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH mapping Type A normal performance under 1 receive antenna conditions and with different channel models and MCSs for eRedCap UE with reduced baseband bandwidth in FR1. | 1-1, 1-2, 1-3 |
| Verify the PDSCH mapping Type A normal performance under 1 receive antenna conditions and with different channel models and MCSs for eRedCap without reduced baseband bandwidth in FR1. | 2-1, 2-2, 2-3 |

Table 5.2.1.1.2-2: Test parameters

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| Duplex mode |  | FDD / HD-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 and Test 2-12 for other tests |
|  | 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 |  | 2 for Test 1-1 and Test 2-1,1 for other tests |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| CSI-RS for tracking | CSI-RS periodicity | Slots | Table 5.2-1 |
|  | CSI-RS offset | Slots | Table 5.2-1 |
| Number of HARQ Processes |  | 4 |
| The number of slots between PDSCH and corresponding HARQ-ACK information |  | 2 |

Table 5.2.1.1.2-3: Minimum performance for Rank 1 with reduced baseband bandwidth.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel (Note 1) | 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.1-1.5 FDDR.PDSCH.1-2.2 HD-FDD | 10 / 15 | QPSK, 0.30 | TDLB100-400 | 2x1 Low | 70 | 4.4 |
| 1-2 | R.PDSCH.1-25.1 FDDR.PDSCH.1-2.3 HD-FDD | 10 / 15 | 16QAM, 0.48 | TDLC300-100 | 2x1 Low | 70 | 12.3 |
| 1-3 | R.PDSCH.1-12.4 FDDR.PDSCH.1-4.1 HD-FDD | 10 / 15 | 64QAM, 0.50 | TDLA30-10 | 2x1 Low | 70 | 16.1 |
| Note 1: Applied reference channel depends on the supported operation mode: FDD or HD-FDD. |

Table 5.2.1.1.2-4: Minimum performance for Rank 1 without reduced baseband bandwidth.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel (Note 1) | 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.1-1.1 FDDR.PDSCH.1-1.1 HD-FDD | 10 / 15 | QPSK, 0.30 | TDLB100-400 | 2x1 Low | 70 | 3.9 |
| 2-2 | R.PDSCH.1-12.3 FDDR.PDSCH.1-2.4 HD-FDD | 10 / 15 | 16QAM, 0.48 | TDLC300-100 | 2x1 Low | 70 | 12.5 |
| 2-3 | R.PDSCH.1-12.4 FDDR.PDSCH.1-4.1 HD-FDD | 10 / 15 | 64QAM, 0.50 | TDLA30-10 | 2x1 Low | 70 | 16.1 |
| Note 1: Applied reference channel depends on the supported operation mode: FDD or HD-FDD. |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

#####  5.2.2.1.23 Minimum requirements for eRedCap

The performance requirements are specified in Table 5.2.2.1.23-3, Table 5.2.2.1.23-4, Table 5.2.2.1.23-5, and Table 5.2.2.1.23-6, with the addition of test parameters in Table 5.2.2.1.23-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.1.23-1.

Table 5.2.2.1.23-1: Tests purpose

|  |  |
| --- | --- |
| Purpose | Test index |
| Verify the PDSCH mapping Type A normal performance under 2 receive antenna conditions and with different channel models, MCSs for for eRedCap UE with reduced baseband bandwidth in FR1. | 1-1, 1-2, 2-1 |
| Verify the PDSCH mapping Type A normal performance under 2 receive antenna conditions and with different channel models, MCSs for for eRedCap UE without reduced baseband bandwidth in FR1. | 3-1, 3-2, 4-1 |

Table 5.2.2.1.23-2: Test parameters

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| Duplex mode |  | FDD / HD-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 and Test 3-12 for other tests |
|  | 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 |  | 2 for Test 1-1 and Test 3-11 for other tests |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| CSI-RS for tracking | CSI-RS periodicity | Slots | Table 5.2-1 |
|  | CSI-RS offset | Slots | Table 5.2-1 |
| Number of HARQ Processes |  | 4 |
| The number of slots between PDSCH and corresponding HARQ-ACK information |  | 2 |

Table 5.2.2.1.23-3: Minimum performance for Rank 1 with reduced baseband bandwidth.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel (Note 1) | 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.1-1.5 FDDR.PDSCH.1-2.2 HD-FDD | 10 / 15 | QPSK, 0.30 | TDLB100-400 | 2x2, ULA Low | 70 | 0.5 |
| 1-2 | R.PDSCH.1-25.1 FDDR.PDSCH.1-2.3 HD-FDD | 10 / 15 | 16QAM, 0.48 | TDLC300-100 | 2x2, ULA Low | 70 | 8.1 |
| Note 1: Applied reference channel depends on the supported operation mode: FDD or HD-FDD. |

Table 5.2.2.1.23-4: Minimum performance for Rank 2 with reduced baseband bandwidth.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel (Note 1) | 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.1-12.5 FDDR.PDSCH.1-4.2 HD-FDD | 10 / 15 | 64QAM, 0.50 | TDLA30-10 | 2x2, ULA Low | 70 | 19.2 |
| Note 1: Applied reference channel depends on the supported operation mode: FDD or HD-FDD. |

Table 5.2.2.1.23-5: Minimum performance for Rank 1 without reduced baseband bandwidth.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel (Note 1) | 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.1-1.1 FDDR.PDSCH.1-1.1 HD-FDD | 10 / 15 | QPSK, 0.30 | TDLB100-400 | 2x2, ULA Low | 70 | 0.2 |
| 3-2 | R.PDSCH.1-12.3 FDDR.PDSCH.1-2.4 HD-FDD | 10 / 15 | 16QAM, 0.48 | TDLC300-100 | 2x2, ULA Low | 70 | 8.3 |
| Note 1: Applied reference channel depends on the supported operation mode: FDD or HD-FDD. |

Table 5.2.2.1.23-6: Minimum performance for Rank 2 without reduced baseband bandwidth.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel (Note 1) | 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.1-12.5 FDDR.PDSCH.1-4.2 HD-FDD | 10 / 15 | 64QAM, 0.50 | TDLA30-10 | 2x2, ULA Low | 70 | 19.2 |
| Note 1: Applied reference channel depends on the supported operation mode: FDD or HD-FDD. |

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----------------------------------------------------- Beginning of Change ------------------------------------------------------------

####  6.1.1.7 Applicability of requirements for eRedCap

The performance requirements in Table 6.1.1.7-1 shall apply for UEs which support optional feature *supportOfERedCap-r18*.

Other performance requirements mandatory for UE supporting NR operation defined in Section 6 but not included in table 6.1.1.7-1 should not be considered applicable to eRedCap UEs.

**Table 6.1.1.7-1: Requirements applicability for eRedCap UEs**

|  |  |  |  |
| --- | --- | --- | --- |
| UE capability | Test type | Test list | Applicability notes |
| eRedCap with 1RX | FR1 FDD and HD-FDD (Note 1) | CQI | All tests in Clause 6.2.1.1.1.2All tests in Clause 6.2.1.1.2.2 |  |
|  |  | PMI | All tests in Clause 6.3.1.1.2 |  |
|  | FR1 TDD | CQI | All tests in Clause 6.2.1.2.1.2All tests in Clause 6.2.1.2.2.2 |  |
|  |  | PMI | All tests in Clause 6.3.1.2.2 |  |
| eRedCap with 2RX | FR1 FDD and HD-FDD (Note 1) | CQI | All tests in Clause 6.2.2.1.1.5All tests in Clause 6.2.2.1.2.5 |  |
|  |  | PMI | All Tests in Clause 6.3.2.1.10 |  |
|  | FR1 TDD | CQI | All tests in Clause 6.2.2.2.1.6All tests in Clause 6.2.2.2.2.5 |  |
|  |  | PMI | All tests in Clause 6.3.2.2.10 |  |
| Note 1: If UE support only HD-FDD in a FDD band, this UE is tested with HD-FDD mode otherwise UE is tested with full-duplex FDD mode |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

###### 6.2.1.1.1.2 Minimum requirement for periodic CQI reporting for RedCap enhancements

For the parameters specified in Table 6.2.1.1.1.2-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements for the eRedCap UE 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 6.2.1.1.1.2-1: CQI reporting definition test**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Unit** | **Test 1** | **Test 2** |
| Bandwidth | MHz | 10 |
| Subcarrier spacing | kHz | 15 |
| Duplex Mode |  | FDD |
| SNR | dB | 5 | 6 | 11 | 12 |
| Propagation channel |  | AWGN |
| Antenna configuration |  | 2×1 with static channel specified in Annex B.1 |
| Beamforming Model |  | As specified in Annex B.4.1 |
| BWP size  | RB | 52 (PRB 0 to 51) |
| PDSCH BW | RB  | 15 (PRB 0 to 14) |
| 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 (k0) |  | Row 5,4 |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | 9 |
| Frequency Occupation | RB | 0 to 23  |
| CSI-RSperiodicity and offset | slot | 10/5 |
| 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 (k0) |  | Row 3,(6) |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | 13 |
| Frequency Occupation | RB | 0 to 23  |
| NZP CSI-RS-timeConfigperiodicity and offset | slot | 10/5 |
| CSI-IM configuration | CSI-IM resource Type |  | Periodic |
| CSI-IM RE pattern |  | 0 |
| CSI-IM Resource Mapping(kCSI-IM,lCSI-IM) |  | (4, 9) |
| CSI-IM timeConfigperiodicity and offset | slot | 10/5 |
| 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 |  | 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 | 10 |
| Maximum number of HARQ transmission |  | 1 |
| Measurement channel |  | As specified in Table A.4-6, TBS.6-1 |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

###### 6.2.1.1.2.2 Minimum requirement for wideband CQI reporting for RedCap enhancements

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

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

For the parameters specified in Table 6.2.1.1.2.2-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

a) A 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 6.2.1.1.2.2-2;

b) The ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be ≥ *γ*, where *γ* is specified in Table 6.2.1.1.2.2-2;

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 6.2.1.1.2.2-1: 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 | 9 | 10 | 15 | 16 |
| Propagation channel |  | TDLA30-5 |
| Antenna configuration |  | 2×1 |
| Correlation configuration |  | ULA high |
| Beamforming Model |  | As specified in Annex B.4.1 |
| BWP size  | RB | 52 (PRB 0 to 51) |
| PDSCH BW | RB  | 15 (PRB 0 to 14) |
| 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 (k0) |  | Row 5,4 |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | 9 |
| Frequency Occupation | RB | 0 to 23  |
| CSI-RSperiodicity and offset | slot | 10/5 |
| 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 (k0) |  | Row 3,(6) |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | 13 |
| Frequency Occupation | RB | 0 to 23  |
| NZP CSI-RS-timeConfigperiodicity and offset | slot | 10/5 |
| CSI-IM configuration | CSI-IM resource Type |  | Periodic |
| CSI-IM RE pattern |  | 0 |
| CSI-IM Resource Mapping(kCSI-IM,lCSI-IM) |  | (4, 9) |
| CSI-IM timeConfigperiodicity and offset | slot | 10/5 |
| 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 |  | 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 | 10 |
| Maximum number of HARQ transmission |  | 1 |
| Measurement channel |  | As specified in Table A.4-6, TBS.6-1 |

Table 6.2.1.1.2.2-2: Minimum requirements

|  |  |  |
| --- | --- | --- |
| Parameters | Test 1 | Test 2 |
| ** [%] | 20 | 20 |
| **  | 1.05 | 1.05 |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

###### 6.2.1.2.1.2 Minimum requirement for periodic CQI reporting for RedCap enhancements

The purpose of the requirements for the eRedCap UE 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. 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 6.2.1.2.1.2-1, 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 6.2.1.2.1.2-1: CQI reporting definition test**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Unit** | **Test 1** | **Test 2** |
| Bandwidth | MHz | 20 |
| 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 |  | 2×1 with static channel specified in Annex B.1 |
| Beamforming Model |  | As specified in Annex B.4.1 |
| BWP size  | RB | 51 (PRB 0 to 50) |
| PDSCH BW | RB  | 7 (PRB 0 to 6) |
| 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 (k0) |  | Row 5,4 |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | 9 |
| Frequency Occupation | RB | 0 to 23  |
| CSI-RSperiodicity 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 (k0) |  | Row 3,(6) |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | 13 |
| Frequency Occupation | RB | 0 to 23  |
| NZP CSI-RS-timeConfigperiodicity and offset | slot | 10/1 |
| CSI-IM configuration | CSI-IM resource Type |  | Periodic |
| CSI-IM RE pattern |  | 0 |
| CSI-IM Resource Mapping(kCSI-IM,lCSI-IM) |  | (4, 9) |
| CSI-IM timeConfigperiodicity and offset | slot | 10/1 |
| 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 |  | 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.4-6, TBS.6-2 |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

###### 6.2.1.2.2.2 Minimum requirement for wideband CQI reporting for RedCap enhancements

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

The reporting accuracy of CQI under frequency non-selective fading conditions is determined by the reporting variance, the relative increase of the throughput obtained when the transport format is indicated by the reported CQI compared to the throughput obtained when a fixed transport format is configured according to the reported median CQI, and a minimum BLER using the transport formats indicated by the reported CQI. To account for sensitivity of the input SNR the 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 6.2.1.2.2.2-1 and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

a) A 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 6.2.1.2.2.2-2;

b) The ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be ≥ *γ*, where *γ* is specified in Table 6.2.1.2.2.2-2;

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 6.2.1.2.2.2-1: Wideband CQI reporting test under frequency non-selective fading conditions

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Unit | Test 1 | Test 2 |
| Bandwidth | MHz | 20 |
| Subcarrier spacing | kHz | 30 |
| Duplex Mode |  | TDD |
| TDD UL-DL pattern |  | FR1.30-1 |
| SNR |  dB | 9 | 10 | 15 | 16 |
| Propagation channel |  | TDLA30-5 |
| Antenna configuration |  | 2×1  |
| Correlation configuration |  | ULA high |
| Beamforming Model |  | As specified in Annex B.4.1  |
| BWP size  | RB | 51 (PRB 0 to 50) |
| PDSCH BW | RB  | 7 (PRB 0 to 6) |
| 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 (k0) |  | Row 5,4 |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | 9 |
| Frequency Occupation | RB | 0 to 23  |
| CSI-RSperiodicity 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 (k0) |  | Row 3,(6) |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | 13 |
| Frequency Occupation | RB | 0 to 23  |
| NZP CSI-RS-timeConfigperiodicity and offset | slot | 10/1 |
| CSI-IM configuration | CSI-IM resource Type |  | Periodic |
| CSI-IM RE pattern |  | 0 |
| CSI-IM Resource Mapping(kCSI-IM,lCSI-IM) |  | (4, 9) |
| CSI-IM timeConfigperiodicity and offset | slot | 10/1 |
| 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 |  | 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.4-6, TBS.6-2 |

Table 6.2.1.2.2.2-2: Minimum requirements

|  |  |  |
| --- | --- | --- |
| Parameters | Test 1 | Test 2 |
| ** [%] | 20 | 20 |
| **  | 1.05 | 1.05 |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

6.2.2.1.1.5 Minimum requirement for periodic CQI reporting for RedCap enhancements

For the parameters specified in Table 6.2.2.1.1.5-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements for the eRedCap UE 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 6.2.2.1.1.5-1: CQI reporting definition test**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Unit** | **Test 1** | **Test 2** |
| Bandwidth | MHz | 10 |
| Subcarrier spacing | kHz | 15 |
| Duplex Mode |  | FDD |
| 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 Annex B.4.1 |
| BWP size  | RB | 52 (PRB 0 to 51) |
| PDSCH BW | RB  | 15 (PRB 0 to 14) |
| 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 (k0) |  | Row 5,4 |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | 9 |
| Frequency Occupation | RB | 0 to 23  |
| CSI-RSperiodicity and offset | slot | 10/5 |
| 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 (k0) |  | Row 3,(6) |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | 13 |
| Frequency Occupation | RB | 0 to 23  |
| NZP CSI-RS-timeConfigperiodicity and offset | slot | 10/5 |
| CSI-IM configuration | CSI-IM resource Type |  | Periodic |
| CSI-IM RE pattern |  | 0 |
| CSI-IM Resource Mapping(kCSI-IM,lCSI-IM) |  | (4, 9) |
| CSI-IM timeConfigperiodicity and offset | slot | 10/5 |
| 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 |  | 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 | 10 |
| Maximum number of HARQ transmission |  | 1 |
| Measurement channel |  | As specified in Table A.4-6, TBS.6-1 |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

###### 6.2.2.1.2.5 Minimum requirement for wideband CQI reporting for RedCap enhancements

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

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

For the parameters specified in Table 6.2.2.1.2.5-1 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 6.2.2.1.2.5-2;

b) The ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be ≥ *γ*, where *γ* is specified in Table 6.2.2.1.2.5-2;

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 6.2.2.1.2.5-1: Wideband CQI reporting test under frequency non-selective fading conditions

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Test 1 |
| Bandwidth | MHz | 10 |
| Subcarrier spacing | kHz | 15 |
| Duplex Mode |  | FDD |
| SNR | dB | 6 | 7 |
| Propagation channel |  | TDLA30-5 |
| Antenna configuration |  | 2×2  |
| Correlation configuration |  | ULA high |
| Beamforming Model |  | As specified in Annex B.4.1 |
| BWP size  | RB | 52 (PRB 0 to 51) |
| PDSCH BW | RB  | 15 (PRB 0 to 14) |
| 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 (k0) |  | Row 5,4 |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | 9 |
| Frequency Occupation | RB | 0 to 23  |
| CSI-RSperiodicity and offset | slot | 10/5 |
| 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 (k0) |  | Row 3,(6) |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | 13 |
| Frequency Occupation | RB | 0 to 23  |
| NZP CSI-RS-timeConfigperiodicity and offset | slot | 10/5 |
| CSI-IM configuration | CSI-IM resource Type |  | Periodic |
| CSI-IM RE pattern |  | 0 |
| CSI-IM Resource Mapping(kCSI-IM,lCSI-IM) |  | (4, 9) |
| CSI-IM timeConfigperiodicity and offset | slot | 10/5 |
| 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 |  | 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 | 10 |
| Maximum number of HARQ transmission |  | 1 |
| Measurement channel |  | As specified in Table A.4-6, TBS.6-1 |

Table 6.2.2.1.2.5-2: Minimum requirements

|  |  |
| --- | --- |
| Parameters | Test 1 |
| ** [%] | 20 |
| **  | 1.05 |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

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##### 6.2.2.2.1 CQI reporting definition under AWGN conditions

------------------------------------------------- Unchanged sections omitted --------------------------------------------------------

6.2.2.2.1.6 Minimum requirement for periodic CQI reporting for RedCap enhancements

The purpose of the requirements for the eRedCap UE 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. 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 6.2.2.2.1.6-1, 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 6.2.2.2.1.6-1: CQI reporting definition test**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Unit** | **Test 1** | **Test 2** |
| Bandwidth | MHz | 20 |
| 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 Annex B.4.1 |
| BWP size  | RB | 51 (PRB 0 to 50) |
| PDSCH BW | RB  | 7 (PRB 0 to 6) |
| 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 (k0) |  | Row 5,4 |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | 9 |
| Frequency Occupation | RB | 0 to 23  |
| CSI-RSperiodicity 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 (k0) |  | Row 3,(6) |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | 13 |
| Frequency Occupation | RB | 0 to 23  |
| NZP CSI-RS-timeConfigperiodicity and offset | slot | 10/1 |
| CSI-IM configuration | CSI-IM resource Type |  | Periodic |
| CSI-IM RE pattern |  | 0 |
| CSI-IM Resource Mapping(kCSI-IM,lCSI-IM) |  | (4, 9) |
| CSI-IM timeConfigperiodicity and offset | slot | 10/1 |
| 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 |  | 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.4-6, TBS.6-2 |

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

###### 6.2.2.2.2.5 Minimum requirement for wideband CQI reporting for RedCap enhancements

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

The reporting accuracy of CQI under frequency non-selective fading conditions is determined by the reporting variance, the relative increase of the throughput obtained when the transport format is indicated by the reported CQI compared to the throughput obtained when a fixed transport format is configured according to the reported median CQI, and a minimum BLER using the transport formats indicated by the reported CQI. To account for sensitivity of the input SNR the 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 6.2.2.2.2.5-1 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 6.2.2.2.2.5-2;

b) The ratio of the throughput obtained when transmitting the transport format indicated by each reported wideband CQI index and that obtained when transmitting a fixed transport format configured according to the wideband CQI median shall be ≥ *γ*, where *γ* is specified in Table 6.2.2.2.2.5-2;

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 6.2.2.2.2.5-1: Wideband CQI reporting test under frequency non-selective fading conditions

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Test 1 |
| Bandwidth | MHz | 20 |
| Subcarrier spacing | kHz | 30 |
| Duplex Mode |  | TDD |
| TDD UL-DL pattern |  | FR1.30-1 |
| SNR | dB | 6 | 7 |
| Propagation channel |  | TDLA30-5 |
| Antenna configuration |  | 2×2  |
| Correlation configuration |  | ULA high |
| Beamforming Model |  | As specified in Annex B.4.1  |
| BWP size  | RB | 51 (PRB 0 to 50) |
| PDSCH BW | RB  | 7 (PRB 0 to 6) |
| 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 (k0) |  | Row 5,4 |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | 9 |
| Frequency Occupation | RB | 0 to 23  |
| CSI-RSperiodicity 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 (k0) |  | Row 3,(6) |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | 13 |
| Frequency Occupation | RB | 0 to 23  |
| NZP CSI-RS-timeConfigperiodicity and offset | slot | 10/1 |
| CSI-IM configuration | CSI-IM resource Type |  | Periodic |
| CSI-IM RE pattern |  | 0 |
| CSI-IM Resource Mapping(kCSI-IM,lCSI-IM) |  | (4, 9) |
| CSI-IM timeConfigperiodicity and offset | slot | 10/1 |
| 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 |  | 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.4-6, TBS.6-2 |

Table 6.2.2.2.2.4-2: Minimum requirements

|  |  |
| --- | --- |
| Parameters | Test 1 |
| ** [%] | 20 |
| **  | 1.05 |

 ------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

#####  6.3.1.1.1 Single PMI with 4TX TypeI-SinglePanel Codebook for RedCap

For the parameters specified in Table 6.3.1.1.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.1.1.1-2.

Table 6.3.1.1.1-1: 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 ULA 4 x 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 (k0) |  | Row 5,(4) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (9) |
| Frequency Occupation | RB | Same as BWP size |
| CSI-RSperiodicity 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 (k0) |  | Row 4, (0) |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | (13) |
| Frequency Occupation | RB | Same as BWP size |
| CSI-RSperiodicity 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 timeConfigperiodicity 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 periodicity and offset | slot | Not configured |
| Aperiodic Report Slot Offset |  | 3 |
| 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 (Note 4) |  | R.PDSCH.1-6.1 FDDR.PDSCH.1-3.1 HD-FDD |
| PDSCH & PDSCH DMRS Precoding configuration for random Precoding |  | Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i1, i2 combination, and with Wideband granularity |
| Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable 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.Note 4: Applied reference channel depends on the supported operation mode: FDD or HD-FDD |

Table 6.3.1.1.1-2: Minimum requirement

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

##### 6.3.1.1.2 Single PMI with 4TX TypeI-SinglePanel Codebook for eRedCap

For the parameters specified in Table 6.3.1.1.2-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.1.1.2-2.

Table 6.3.1.1.2-1: 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 ULA 4 x 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 (k0) |  | Row 5,(4) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (9) |
| Frequency Occupation | RB | 0 to 27 |
| CSI-RSperiodicity 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 (k0) |  | Row 4, (0) |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | (13) |
| Frequency Occupation | RB | 0 to 27 |
| CSI-RSperiodicity 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 timeConfigperiodicity 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 periodicity and offset | slot | Not configured |
| Aperiodic Report Slot Offset |  | 3 |
| 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 (Note 4) |  | R.PDSCH.1-6.5 FDDR.PDSCH.1-3.2 HD-FDD |
| PDSCH & PDSCH DMRS Precoding configuration for random Precoding |  | Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i1, i2 combination, and with Wideband granularity |
| Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable 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.Note 4: Applied reference channel depends on the supported operation mode: FDD or HD-FDD |

Table 6.3.1.1.2-2: Minimum requirement

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

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

#####  6.3.1.2.1 Single PMI with 4TX TypeI-SinglePanel Codebook for RedCap

For the parameters specified in Table 6.3.1.2.1-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.1.2.1-2.

Table 6.3.1.2.1-1: Test parameters (single layer)

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Test 1** |
| Bandwidth | MHz | 20 |
| 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 ULA 4 x 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 (k0) |  | Row 5,(4) |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | (9) |
| Frequency Occupation |  | Same as BWP size |
| CSI-RSperiodicity 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 (k0) |  | Row 4, (0) |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | (13) |
| Frequency Occupation |  | Same as BWP size |
| CSI-RSperiodicity 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 timeConfigperiodicity 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 periodicity 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.2-8.4 TDD |
| PDSCH & PDSCH DMRS Precoding configuration for random Precoding |  | Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i1, i2 combination, and with Wideband granularity |
| Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable 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 6.3.1.2.1-2: Minimum requirement

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

#####  6.3.1.2.2 Single PMI with 4TX TypeI-SinglePanel Codebook for eRedCap

For the parameters specified in Table 6.3.1.2.2-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.1.2.2-2.

Table 6.3.1.2.2-1: Test parameters (single layer)

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Test 1** |
| Bandwidth | MHz | 20 |
| 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 ULA 4 x 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 (k0) |  | Row 5,(4) |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | (9) |
| Frequency Occupation |  | 0 to 23 |
| CSI-RSperiodicity 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 (k0) |  | Row 4, (0) |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | (13) |
| Frequency Occupation |  | 0 to 23 |
| CSI-RSperiodicity 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 timeConfigperiodicity 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 periodicity 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.2-8.6 TDD |
| PDSCH & PDSCH DMRS Precoding configuration for random Precoding |  | Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i1, i2 combination, and with Wideband granularity |
| Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable 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 6.3.1.2.2-2: Minimum requirement

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

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

#####  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 |  | 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 (k0) |  | Row 5,(4) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (9) |
| Frequency Occupation | RB | Same as BWP size |
| CSI-RSperiodicity 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 (k0) |  | Row 4, (0) |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | (13) |
| Frequency Occupation | RB | Same as BWP size |
| CSI-RSperiodicity 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 timeConfigperiodicity 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 periodicity and offset | slot | Not configured |
| Aperiodic Report Slot Offset |  | 4 for FDD3 for HD-FDD |
| 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 (Note 4) |  | R.PDSCH.1-6.1 FDDR.PDSCH.1-3.1 HD-FDD |
| PDSCH & PDSCH DMRS Precoding configuration for random Precoding |  | Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i1, i2 combination, and with Wideband granularity |
| Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable 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.Note 4: Applied reference channel depends on the supported operation mode: FDD or HD-FDD. |

Table 6.3.2.1.1-2: Minimum requirement

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

#####  6.3.2.1.10 Single PMI with 4TX TypeI-SinglePanel Codebook for eRedCap

For the parameters specified in Table 6.3.2.1.10-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.1.10-2.

Table 6.3.2.1.10-1: 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 (k0) |  | Row 5,(4) |
| First OFDM symbol in the PRB used for CSI-RS (l0, l1) |  | (9) |
| Frequency Occupation | RB | 0 to 27 |
| CSI-RSperiodicity 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 (k0) |  | Row 4, (0) |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | (13) |
| Frequency Occupation | RB | 0 to 27 |
| CSI-RSperiodicity 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 timeConfigperiodicity 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 periodicity and offset | slot | Not configured |
| Aperiodic Report Slot Offset |  | 4 for FDD3 for HD-FDD |
| 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 (Note 4) |  | R.PDSCH.1-6.5 FDDR.PDSCH.1-3.2 HD-FDD |
| PDSCH & PDSCH DMRS Precoding configuration for random Precoding |  | Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i1, i2 combination, and with Wideband granularity |
| Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (1 ms granularity) with equal probability of each applicable 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.Note 4: Applied reference channel depends on the supported operation mode: FDD or HD-FDD. |

Table 6.3.2.1.10-2: Minimum requirement

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

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

#####  6.3.2.2.7 Single PMI with 4TX TypeI-SinglePanel Codebook for RedCap

For the parameters specified in Table 6.3.2.2.7-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.2.7-2.

Table 6.3.2.2.7-1: Test parameters (single layer)

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Test 1** |
| Bandwidth | MHz | 20 |
| 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 |  | 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 (k0) |  | Row 5,(4) |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | (9) |
| Frequency Occupation | RB | Same as BWP size |
| CSI-RSperiodicity 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 (k0) |  | Row 4, (0) |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | (13) |
| Frequency Occupation | RB | Same as BWP size |
| CSI-RSperiodicity 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 timeConfigperiodicity 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 periodicity 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.2-8.4 TDD |
| PDSCH & PDSCH DMRS Precoding configuration for random Precoding |  | Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i1, i2 combination, and with Wideband granularity |
| Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable 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 6.3.2.2.7-2: Minimum requirement

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

##### 6.3.2.2.10 Single PMI with 4TX TypeI-SinglePanel Codebook for eRedCap

For the parameters specified in Table 6.3.2.2.10-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified in Table 6.3.2.2.10-2.

Table 6.3.2.2.10-1: Test parameters (single layer)

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Test 1** |
| Bandwidth | MHz | 20 |
| 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 |  | 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 (k0) |  | Row 5,(4) |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | (9) |
| Frequency Occupation | RB | 0 to 23 |
| CSI-RSperiodicity 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 (k0) |  | Row 4, (0) |
| First OFDM symbol in the PRB used for CSI-RS (l0) |  | (13) |
| Frequency Occupation | RB | 0 to 23 |
| CSI-RSperiodicity 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 timeConfigperiodicity 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 periodicity 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.2-8.6 TDD |
| PDSCH & PDSCH DMRS Precoding configuration for random Precoding |  | Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i1, i2 combination, and with Wideband granularity |
| Note 1: When Throughput is measured using random precoder selection, the precoder shall be updated in each slot (0.5 ms granularity) with equal probability of each applicable 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 6.3.2.2.10-2: Minimum requirement

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

------------------------------------------------------------- End of change ------------------------------------------------------------

----------------------------------------------------- Beginning of Change ------------------------------------------------------------

Table A.3.2.1.1-25: PDSCH Reference Channel for FDD

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| Reference channel |  | R.PDSCH.1-25.1 FDD |  |  |  |  |
| Channel bandwidth | MHz | 10 |  |  |  |  |
| Subcarrier spacing | kHz | 15 |  |  |  |  |
| Number of allocated resource blocks | PRBs | 25 |  |  |  |  |
| 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 |  | 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 | 6272 |  |  |  |  |
| 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 | 1 |  |  |  |  |
| Binary Channel Bits Per Slot |  |  |  |  |  |  |
|  For Slot i = 0 | Bits | N/A |  |  |  |  |
|  For Slots i = 10, 11 | Bits | 12600 |  |  |  |  |
|  For Slots i =1,…, 9, 12, …, 19 | Bits | 13200 |  |  |  |  |
| Max. Throughput averaged over 2 frames | Mbps | 5.958 |  |  |  |  |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 msNote 2: Slot i is slot index per 2 frames |

------------------------------------------------------------- End of change ------------------------------------------------------------