**3GPP TSG-RAN WG4 Meeting #111R4-2409939**

**Fukuoka, Japan, 20 - 24 May, 2024**

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| *CR-Form-v12.3* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.101-4** | **CR** | **0548** | **rev** | 1 | **Current version:** | **17.12.0** |  |
|  | | | | | | | | |
| *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:*** | [NR\_DL1024QAM\_FR1-Perf] Updates to CQI reporting definition test metric under AWGN for 1024QAM test | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Huawei, HiSilicon | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_DL1024QAM\_FR1-Perf | | | | |  | ***Date:*** | | | 2024-04-30 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **F** |  | | | | | ***Release:*** | | | Rel-17 |
|  | *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 can be 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:*** | | For CQI reporting with 1024QAM Table 4, the corresponding CQI index is 14 and 15 as per TS 38.214 Table 5.2.2.1-5: 4-bit CQI Table 4. The SNR values are 28/29dB and 25/26dB for 2Rx and 4Rx respectively for CQI reporting definition test cases for 1024QAM under AWGN condition.  As per approved WF R4-2207254 and R4-2210651, with the assumption of Tx EVM 2.5%, the selected SNR values of 28/29dB for 2Rx and 25/26dB for 4Rx correspond to CQI index 14 for 1024QAM table. But in real testing, if the Tx EVM of the TE is smaller than 2.5%, the selected SNR values can correspond to CQI index 15 for 1024QAM table, i.e. UE will report medium CQI index 15 with BLER <=0.1 during the test. As per Table A.4-5, TBS.5-1 and TBS.5-2, the corresponding MCS is the highest MCS 26 for 1024QAM table for CQI index 15. According to TS38.214 section 5.2.2.1, if the block error rate of transport block corresponding to the reported CQI index is within 0.1, the UE should be regarded as a conformant UE.  The existing test metric requests the BLER corresponding to (median CQI +1) shall be greater than 0.1, if the BLER of the transport block for the reported median CQI is less than or equal to 0.1. This is inconsistent with test purpose, and this is also the reason that RAN4 usually doesn’t select SNR values for CQI test correspods to the boundary CQI index. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | For the test condition of the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, added additional condition: “, and if the reported median CQI is not the highest CQI index,”. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Inaccuracy test requirements will still exist in the specification. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 6.2.2.1.1.3, 6.2.2.2.1.4, 6.2.3.1.1.3, 6.2.3.2.1.4 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | | **X** |  | Test specifications | | | | TS 38.521-4 | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | | Revision of R4-2408995 | | | | | | | | |

<START OF THE CHANGE 1>

### 6.2.2 2RX requirements

This sub-clause includes the requirements for reporting of CQI for UE equipped with 2 receiver antennas.

*<Unchanged Sections are skipped>*

###### 6.2.2.1.1.3 Minimum requirement for periodic CQI reporting with Table 4

For the parameters specified in Table 6.2.2.1.1.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

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

b) If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, and if the reported median CQI is not the highest CQI index, 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 6.2.2.1.1.3-1: CQI reporting test parameters

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | | | Unit | Test 1 | |
| Bandwidth | | | MHz | 10 | |
| Duplex Mode | | |  | FDD | |
| Subcarrier spacing | | | kHz | 15 | |
| SNR | | | dB | 28 | 29 |
| Propagation channel | | |  | AWGN | |
| Antenna configuration | | |  | 2×2 with static channel specified in Annex B.1 | |
| Beamforming Model | | |  | As specified in Annex B.4.1 | |
| ZP CSI-RS configuration | CSI-RS resource Type | |  | Periodic | |
| Number of CSI-RS ports (*X*) | |  | 4 | |
| CDM Type | |  | FD-CDM2 | |
| Density (ρ) | |  | 1 | |
| First subcarrier index in the PRB used for CSI-RS (k0) | |  | Row 5,4 | |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | 9 | |
| CSI-RS  periodicity and offset | | slot | 5/1 | |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type | |  | Periodic | |
| Number of CSI-RS ports (*X*) | |  | 2 | |
| CDM Type | |  | FD-CDM2 | |
| Density (ρ) | |  | 1 | |
| First subcarrier index in the PRB used for CSI-RS (k0, k1 ) | |  | Row 3,(6) | |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | 13 | |
| NZP CSI-RS-timeConfig  periodicity and offset | | slot | 5/1 | |
| CSI-IM configuration | CSI-IM resource Type | |  | Periodic | |
| CSI-IM RE pattern | |  | 0 | |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) | |  | (4, 9) | |
| CSI-IM timeConfig  periodicity and offset | | slot | 5/1 | |
| ReportConfigType | | |  | Periodic | |
| CQI-table | | |  | Table 4 | |
| reportQuantity | | |  | cri-RI-PMI-CQI | |
| timeRestrictionForChannelMeasurements | | |  | Not configured | |
| timeRestrictionForInterferenceMeasurements | | |  | Not configured | |
| cqi-FormatIndicator | | |  | Wideband | |
| pmi-FormatIndicator | | |  | Wideband | |
| Sub-band Size | | | RB | 8 | |
| Csi-ReportingBand | | |  | 1111111 | |
| CSI-Report periodicity and offset | | | slot | 5/0 | |
| aperiodicTriggeringOffset | | |  | Not configured | |
| Codebook configuration | | Codebook Type |  | typeI-SinglePanel | |
| Codebook Mode |  | 1 | |
| (CodebookConfig-N1,CodebookConfig-N2) |  | Not configured | |
| CodebookSubsetRestriction |  | 000001 | |
| RI Restriction |  | N/A | |
| Physical channel for CSI report | | |  | PUCCH | |
| CQI/RI/PMI delay | | | ms | 8 | |
| Maximum number of HARQ transmission | | |  | 1 | |
| Measurement channel | | |  | As specified in Table A.4-5, TBS.5-1 | |

<END OF THE CHANGE 1>

<START OF THE CHANGE 2>

###### 6.2.2.2.1.4 Minimum requirement for periodic CQI reporting with Table 4

The purpose of the requirements is to verify that the reported CQI values are in accordance with the CQI definition given in TS 38.214 [12]. The reporting accuracy of CQI under AWGN condition is determined by the reporting variance and BLER performance using the transport format indicated by the reported CQI median. 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 6.2.2.2.1.4-1, 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, and if the reported median CQI is not the highest CQI index, 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 6.2.2.2.1.4-1: CQI reporting definition test

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | | | Unit | Test 1 | |
| Bandwidth | | | MHz | 40 | |
| Subcarrier spacing | | | kHz | 30 | |
| Duplex Mode | | |  | TDD | |
| TDD UL-DL pattern | | |  | FR1.30-1 | |
| SNR | | | dB | 28 | 29 |
| Propagation channel | | |  | AWGN | |
| Antenna configuration | | |  | 2×2 with static channel specified in Annex B.1 | |
| Beamforming Model | | |  | As specified in Annex B.4.1 | |
| ZP CSI-RS configuration | CSI-RS resource Type | |  | Periodic | |
| Number of CSI-RS ports (*X*) | |  | 4 | |
| CDM Type | |  | FD-CDM2 | |
| Density (ρ) | |  | 1 | |
| First subcarrier index in the PRB used for CSI-RS (k0) | |  | Row 5,4 | |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | 9 | |
| CSI-RS  periodicity and offset | | slot | 10/1 | |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type | |  | Periodic | |
| Number of CSI-RS ports (*X*) | |  | 2 | |
| CDM Type | |  | FD-CDM2 | |
| Density (ρ) | |  | 1 | |
| First subcarrier index in the PRB used for CSI-RS (k0) | |  | Row 3,(6) | |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | 13 | |
| NZP CSI-RS-timeConfig  periodicity and offset | | slot | 10/1 | |
| CSI-IM configuration | CSI-IM resource Type | |  | Periodic | |
| CSI-IM RE pattern | |  | 0 | |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) | |  | (4, 9) | |
| CSI-IM timeConfig  periodicity and offset | | slot | 10/1 | |
| ReportConfigType | | |  | Periodic | |
| CQI-table | | |  | Table 4 | |
| reportQuantity | | |  | cri-RI-PMI-CQI | |
| timeRestrictionForChannelMeasurements | | |  | Not configured | |
| timeRestrictionForInterferenceMeasurements | | |  | Not configured | |
| cqi-FormatIndicator | | |  | Wideband | |
| pmi-FormatIndicator | | |  | Wideband | |
| Sub-band Size | | | RB | 16 | |
| Csi-ReportingBand | | |  | 1111111 | |
| CSI-Report periodicity and offset | | | slot | 10/9 | |
| aperiodicTriggeringOffset | | |  | Not configured | |
| Codebook configuration | | Codebook Type |  | typeI-SinglePanel | |
| Codebook Mode |  | 1 | |
| (CodebookConfig-N1,CodebookConfig-N2) |  | Not configured | |
| CodebookSubsetRestriction |  | 010000 | |
| RI Restriction |  | N/A | |
| Physical channel for CSI report | | |  | PUCCH | |
| CQI/RI/PMI delay | | | ms | 9.5 | |
| Maximum number of HARQ transmission | | |  | 1 | |
| Measurement channel | | |  | As specified in Table A.4-5, TBS.5-2 | |

<END OF THE CHANGE 2>

<START OF THE CHANGE 3>

### 6.2.3 4RX requirements

This sub-clause includes the requirements for reporting of CQI for UE equipped with 4 receiver antennas.

*<Unchanged Sections are skipped>*

###### 6.2.3.1.1.3 Minimum requirement for periodic CQI reporting with Table 4

For the parameters specified in Table 6.2.3.1.1.3-1, and using the downlink physical channels specified in Annex C.3.1, the minimum requirements are specified by the following:

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

b) If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, and if the reported median CQI is not the highest CQI index, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 0.1.

Table 6.2.3.1.1.3-1: CQI reporting test parameters

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | | | Unit | Test 1 | |
| Bandwidth | | | MHz | 10 | |
| Duplex Mode | | |  | FDD | |
| Subcarrier spacing | | | kHz | 15 | |
| SNR | | | dB | 25 | 26 |
| Propagation channel | | |  | AWGN | |
| Antenna configuration | | |  | 2×4 with static channel specified in Annex B.1 | |
| Beamforming Model | | |  | As specified in Annex B.4.1 | |
| ZP CSI-RS configuration | CSI-RS resource Type | |  | Periodic | |
| Number of CSI-RS ports (*X*) | |  | 4 | |
| CDM Type | |  | FD-CDM2 | |
| Density (ρ) | |  | 1 | |
| First subcarrier index in the PRB used for CSI-RS (k0) | |  | Row 5,4 | |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | 9 | |
| CSI-RS  periodicity and offset | | slot | 5/1 | |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type | |  | Periodic | |
| Number of CSI-RS ports (*X*) | |  | 2 | |
| CDM Type | |  | FD-CDM2 | |
| Density (ρ) | |  | 1 | |
| First subcarrier index in the PRB used for CSI-RS (k0, k1 ) | |  | Row 3,(6) | |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | 13 | |
| NZP CSI-RS-timeConfig  periodicity and offset | | slot | 5/1 | |
| CSI-IM configuration | CSI-IM resource Type | |  | Periodic | |
| CSI-IM RE pattern | |  | 0 | |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) | |  | (4, 9) | |
| CSI-IM timeConfig  periodicity and offset | | slot | 5/1 | |
| ReportConfigType | | |  | Periodic | |
| CQI-table | | |  | Table 4 | |
| reportQuantity | | |  | cri-RI-PMI-CQI | |
| timeRestrictionForChannelMeasurements | | |  | Not configured | |
| timeRestrictionForInterferenceMeasurements | | |  | Not configured | |
| cqi-FormatIndicator | | |  | Wideband | |
| pmi-FormatIndicator | | |  | Wideband | |
| Sub-band Size | | | RB | 8 | |
| Csi-ReportingBand | | |  | 1111111 | |
| CSI-Report periodicity and offset | | | slot | 5/0 | |
| aperiodicTriggeringOffset | | |  | Not configured | |
| Codebook configuration | | Codebook Type |  | typeI-SinglePanel | |
| Codebook Mode |  | 1 | |
| (CodebookConfig-N1,CodebookConfig-N2) |  | Not configured | |
| CodebookSubsetRestriction |  | 000001 | |
| RI Restriction |  | N/A | |
| Physical channel for CSI report | | |  | PUCCH | |
| CQI/RI/PMI delay | | | ms | 8 | |
| Maximum number of HARQ transmission | | |  | 1 | |
| Measurement channel | | |  | As specified in Table A.4-5, TBS.5-1 | |

<END OF THE CHANGE 3>

<START OF THE CHANGE 4>

###### 6.2.3.2.1.4 Minimum requirement for CQI periodic reporting with Table 4

The purpose of the requirements is to verify that the reported CQI values are in accordance with the CQI definition given in TS38.214 [12]. The reporting accuracy of CQI under AWGN condition is determined by the reporting variance and BLER performance using the transport format indicated by the reported CQI median. 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 6.2.3.2.1.4-1, 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, and if the reported median CQI is not the highest CQI index, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 0.1.

Table 6.2.3.2.1.4-1: CQI reporting definition test

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | | | Unit | Test 1 | |
| Bandwidth | | | MHz | 40 | |
| Subcarrier spacing | | | kHz | 30 | |
| Duplex Mode | | |  | TDD | |
| TDD UL-DL pattern | | |  | FR1.30-1 | |
| SNR | | | dB | 25 | 26 |
| Propagation channel | | |  | AWGN | |
| Antenna configuration | | |  | 2×4 with static channel specified in Annex B.1 | |
| Beamforming Model | | |  | As specified in Annex B.4.1 | |
| ZP CSI-RS configuration | CSI-RS resource Type | |  | Periodic | |
| Number of CSI-RS ports (*X*) | |  | 4 | |
| CDM Type | |  | FD-CDM2 | |
| Density (ρ) | |  | 1 | |
| First subcarrier index in the PRB used for CSI-RS (k0) | |  | Row 5,4 | |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | 9 | |
| CSI-RS  periodicity and offset | | slot | 10/1 | |
| NZP CSI-RS for CSI acquisition | CSI-RS resource Type | |  | Periodic | |
| Number of CSI-RS ports (*X*) | |  | 2 | |
| CDM Type | |  | FD-CDM2 | |
| Density (ρ) | |  | 1 | |
| First subcarrier index in the PRB used for CSI-RS (k0) | |  | Row 3,(6) | |
| First OFDM symbol in the PRB used for CSI-RS (l0) | |  | 13 | |
| NZP CSI-RS-timeConfig  periodicity and offset | | slot | 10/1 | |
| CSI-IM configuration | CSI-IM resource Type | |  | Periodic | |
| CSI-IM RE pattern | |  | 0 | |
| CSI-IM Resource Mapping  (kCSI-IM,lCSI-IM) | |  | (4, 9) | |
| CSI-IM timeConfig  periodicity and offset | | slot | 10/1 | |
| ReportConfigType | | |  | Periodic | |
| CQI-table | | |  | Table 4 | |
| reportQuantity | | |  | cri-RI-PMI-CQI | |
| timeRestrictionForChannelMeasurements | | |  | Not configured | |
| timeRestrictionForInterferenceMeasurements | | |  | Not configured | |
| cqi-FormatIndicator | | |  | Wideband | |
| pmi-FormatIndicator | | |  | Wideband | |
| Sub-band Size | | | RB | 16 | |
| csi-ReportingBand | | |  | 1111111 | |
| CSI-Report periodicity and offset | | | slot | 10/9 | |
| aperiodicTriggeringOffset | | |  | Not configured | |
| Codebook configuration | | Codebook Type |  | typeI-SinglePanel | |
| Codebook Mode |  | 1 | |
| (CodebookConfig-N1,CodebookConfig-N2) |  | Not configured | |
| CodebookSubsetRestriction |  | 010000 | |
| RI Restriction |  | N/A | |
| Physical channel for CSI report | | |  | PUCCH | |
| CQI/RI/PMI delay | | | ms | 9.5 | |
| Maximum number of HARQ transmission | | |  | 1 | |
| Measurement channel | | |  | As specified in Table A.4-5, TBS.5-2 | |

<END OF THE CHANGE 4>