**3GPP TSG-RAN4 Meeting #112 *R4-2413486***

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

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *CR-Form-v12.3* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.101-4** | **CR** | **0576** | **rev** | 1 | **Current version:** | **18.4.0** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network |  | Core Network |  |

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|  | | | | | | | | | | |
| ***Title:*** | CR on PDSCH TDD Requirements for Enhanced Support of RedCap | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Apple | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_redcap\_enh-Perf | | | | |  | ***Date:*** | | | 2024-08-19 |
|  |  | | | |  | |  | | |  |
| ***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 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:*** | | 1. Confirm PDSCH demodulation requirements for TDD. 2. Reference channel correction since several FRCs in the bigCR R4-2408778 are not implemented correctly. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | 1) Square brackets removal PDSCH demodulation requirements for TDD.  2) Correction of FRCs R.PDSCH.2-26.2 TDD since values do not conform with source draft CR from RAN4#111.  3) Delete wrongly numbered table (A.3.2.2.34-1) and create new table (A.3.2.2.2-39). | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | 1) Requirements for eRedCap PDSCH demodulation performance for TDD will not be formally confirmed.  2) Table numbering and reference channels will remain incorrect. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 5.2.1.2.2, 5.2.2.2.24, A.3.2.2.2, A.3.2.2.34-1 (delete), Table A.3.2.2.2-39 (new). | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **x** | Other core specifications | | | |  | | |
| ***affected:*** | | **x** |  | Test specifications | | | | TS 38.521-4 | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | |  | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

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

##### **5.2.1.2.2 Minimum requirements for eRedCap**

The performance requirements are specified in Table 5.2.1.2.2-3 and Table 5.2.1.2.2-4, with the addition of test parameters in Table 5.2.1.2.2-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.1.2.2-1.

Table 5.2.1.2.2-1: 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 5.2.1.2.2-2: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit | Value |
| Duplex mode | |  | TDD |
| Active DL BWP index | |  | 1 |
| PDSCH configuration | Mapping type |  | Type A |
|  | k0 |  | 0 |
|  | Starting symbol (S) |  | 2 |
|  | Length (L) |  | Specific to each Reference channel |
|  | PDSCH aggregation factor |  | 1 |
|  | PRB bundling type |  | Static |
|  | PRB bundling size |  | 4 for Test 1-1,  2 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,  1 for other tests |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| CSI-RS for tracking | First OFDM symbol in the PRB used for CSI-RS |  | Table 5.2-1 |
|  | CSI-RS periodicity | Slots | Table 5.2-1 |
|  | CSI-RS offset | Slots | Table 5.2-1 |
|  | Frequency Occupation |  | Table 5.2-1 |
| Number of HARQ Processes | |  | 8 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | Specific to each TDD UL-DL pattern and as defined in Annex A.1.2 |

Table 5.2.1.2.2-3: Minimum performance for Rank 1 with reduced baseband bandwidth. (1Rx)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL-DL pattern | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.2-39.1 TDD | 20 / 30 | QPSK, 0.30 | FR1.30-1A | TDLB100-400 | 2x1 Low | 70 | 4.4 |
| 1-2 | R.PDSCH.2-26.3 TDD | 20 / 30 | 16QAM, 0.48 | FR1.30-1 | TDLC300-100 | 2x1 Low | 70 | 12.7 |
| 1-3 | R.PDSCH.2-27.2 TDD | 20 / 30 | 64QAM, 0.50 | FR1.30-1 | TDLA30-10 | 2x1 Low | 70 | 16.2 |

Table 5.2.1.2.2-4: Minimum performance for Rank 1 without reduced baseband bandwidth.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL-DL pattern | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB) |
| 2-1 | R.PDSCH.2-39.2 TDD | 20 / 30 | QPSK, 0.30 | FR1.30-1A | TDLB100-400 | 2x1 Low | 70 | 3.6 |
| 2-2 | R.PDSCH.2-26.4 TDD | 20 / 30 | 16QAM, 0.48 | FR1.30-1 | TDLC300-100 | 2x1 Low | 70 | 12.3 |
| 2-3 | R.PDSCH.2-27.2 TDD | 20 / 30 | 64QAM, 0.50 | FR1.30-1 | TDLA30-10 | 2x1 Low | 70 | 16.2 |

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

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

##### **5.2.2.2.24 Minimum requirements for eRedCap**

The performance requirements are specified in Table 5.2.2.2.24-3, Table 5.2.2.2.24-4, Table 5.2.2.2.24-5, and Table 5.2.2.2.24-6, with the addition of test parameters in Table 5.2.2.2.24-2 and the downlink physical channel setup according to Annex C.3.1.

The test purposes are specified in Table 5.2.2.2.24-1.

Table 5.2.2.2.24-1: 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 5.2.2.2.24-2: Test parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | | **Unit** | **Value** |
| Duplex mode | |  | TDD |
| Active DL BWP index | |  | 1 |
| PDSCH configuration | Mapping type |  | Type A |
|  | k0 |  | 0 |
|  | Starting symbol (S) |  | 2 |
|  | Length (L) |  | Specific to each Reference channel |
|  | PDSCH aggregation factor |  | 1 |
|  | PRB bundling type |  | Static |
|  | PRB bundling size |  | 4 for Test 1-1  2 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  1 for other tests |
|  | Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| CSI-RS for tracking | First OFDM symbol in the PRB used for CSI-RS |  | Table 5.2-1 |
|  | CSI-RS periodicity | Slots | Table 5.2-1 |
|  | CSI-RS offset | Slots | Table 5.2-1 |
|  | Frequency Occupation |  | Table 5.2-1 |
| Number of HARQ Processes | |  | 8 |
| The number of slots between PDSCH and corresponding HARQ-ACK information | |  | Specific to each TDD UL-DL pattern and as defined in Annex A.1.2 |

Table 5.2.2.2.24-3: Minimum performance for Rank 1 with reduced baseband bandwidth.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL-DL pattern | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB) |
| 1-1 | R.PDSCH.2-39.1 TDD | 20 / 30 | QPSK, 0.30 | FR1.30-1A | TDLB100-400 | 2x2, ULA Low | 70 | 0.7 |
| 1-2 | R.PDSCH.2-26.3 TDD | 20 / 30 | 16QAM, 0.48 | FR1.30-1 | TDLC300-100 | 2x2, ULA Low | 70 | 8.5 |

Table 5.2.2.2.24-4: Minimum performance for Rank 2 with reduced baseband bandwidth.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL-DL pattern | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB) |
| 2-1 | R.PDSCH.2-27.3 TDD | 20 / 30 | 64QAM, 0.50 | FR1.30-1 | TDLA30-10 | 2x2, ULA Low | 70 | 19.1 |

Table 5.2.2.2.24-5: Minimum performance for Rank 1 without reduced baseband bandwidth.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL-DL pattern | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB) |
| 3-1 | R.PDSCH.2-39.2 TDD | 20 / 30 | QPSK, 0.30 | FR1.30-1A | TDLB100-400 | 2x2, ULA Low | 70 | 0.4 |
| 3-2 | R.PDSCH.2-26.4 TDD | 20 / 30 | 16QAM, 0.48 | FR1.30-1 | TDLC300-100 | 2x2, ULA Low | 70 | 8.2 |

Table 5.2.2.2.24-6: Minimum performance for Rank 2 without reduced baseband bandwidth.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | TDD UL-DL pattern | Propagation condition | Correlation matrix and antenna configuration | Reference value | |
| Fraction of maximum throughput (%) | SNR (dB) |
| 4-1 | R.PDSCH.2-27.3 TDD | 20 / 30 | 64QAM, 0.50 | FR1.30-1 | TDLA30-10 | 2x2, ULA Low | 70 | 19.1 |

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

Table A.3.2.2.2-26: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-1 (16QAM)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **Value** | | | |  |
| Reference channel |  | R.PDSCH.2-26.1 TDD | R.PDSCH.2-26.2 TDD | R.PDSCH.2-26.3 TDD | R.PDSCH.2-26.4 TDD |  |
| Channel bandwidth | MHz | 20 | 40 | 20 | 20 |  |
| Subcarrier spacing | kHz | 30 | 30 | 30 | 30 |  |
| Allocated resource blocks | PRBs | 51 | 106 | 12 | 20 |  |
| Number of consecutive PDSCH symbols |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} |  | N/A | N/A | N/A | N/A |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} |  | 4 | 4 | 4 | 4 |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} |  | 12 | 12 | 12 | 12 |  |
| Allocated slots per 2 frames |  | 31 | 31 | 31 | 31 |  |
| MCS table |  | 64QAM | 64QAM | 64QAM | 64QAM |  |
| MCS index |  | 13 | 13 | 13 | 13 |  |
| Modulation |  | 16QAM | 16QAM | 16QAM | 16QAM |  |
| Target Coding Rate |  | 0.48 | 0.48 | 0.48 | 0.48 |  |
| Number of MIMO layers |  | 1 | 4 | 1 | 1 |  |
| Number of DMRS Res |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} |  | N/A | N/A | N/A | N/A |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} |  | 6 | 6 | 6 | 6 |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} |  | 12 | 12 | 12 | 12 |  |
| Overhead for TBS determination |  | 0 | 0 | 0 | 0 |  |
| Information Bit Payload per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | Bits | N/A | N/A | N/A | N/A |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | Bits | 4096 | 33816 | 984 | 1608 |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} | Bits | 12808 | 106576 | 3104 | 4992 |  |
| Transport block CRC per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | Bits | N/A | N/A | N/A | N/A |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | Bits | 24 | 24 | 16 | 16 |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6}for i from {1,…,39} | Bits | 24 | 24 | 16 | 24 |  |
| Number of Code Blocks per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | CBs | N/A | N/A | N/A | N/A |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | CBs | 1 | 5 | 1 | 1 |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} | CBs | 2 | 13 | 1 | 1 |  |
| Binary Channel Bits Per Slot |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | Bits | N/A | N/A | N/A | N/A |  |
| For Slots i = 20, 21 | Bits | 25704 | 213696 | 6048 | 10080 |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | Bits | 8568 | 71232 | 2016 | 3360 |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,19,22,…,39} | Bits | 26928 | 223872 | 6336 | 10560 |  |
| Max. Throughput averaged over 2 frames | Mbps | 18.110 | 150.641 | 4.387 | 7.060 |  |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms  Note 2: Slot i is slot index per 2 frames | | | | | | |

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



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#### A.3.2.2.2 Reference measurement channels for SCS 30 kHz FR1

**Table A.3.2.2.2-39: PDSCH Reference Channel for TDD UL-DL pattern FR1.30-1 and FR1.30-1A (QPSK)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **Value** | | | | | |
| Reference channel |  | R.PDSCH.2-39.1 TDD | R.PDSCH.2-39.2 TDD |  |  |  |  |
| Channel bandwidth | MHz | 20 | 20 |  |  |  |  |
| Subcarrier spacing | kHz | 30 | 30 |  |  |  |  |
| Allocated resource blocks | PRBs | 12 | 25 |  |  |  |  |
| Number of consecutive PDSCH symbols |  |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} |  | N/A | N/A |  |  |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} |  | 4 | 4 |  |  |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} |  | 12 | 12 |  |  |  |  |
| Allocated slots per 2 frames |  | 31 | 31 |  |  |  |  |
| MCS table |  | 64QAM | 64QAM |  |  |  |  |
| MCS index |  | 4 | 4 |  |  |  |  |
| Modulation |  | QPSK | QPSK |  |  |  |  |
| Target Coding Rate |  | 0.30 | 0.30 |  |  |  |  |
| Number of MIMO layers |  | 1 | 1 |  |  |  |  |
| Number of DMRS REs |  |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} |  | N/A | N/A |  |  |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} |  | 6 | 6 |  |  |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} |  | 18 | 18 |  |  |  |  |
| Overhead for TBS determination |  | 0 | 0 |  |  |  |  |
| Information Bit Payload per Slot |  |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | Bits | N/A | N/A |  |  |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | Bits | 304 | 640 |  |  |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} | Bits | 928 | 1928 |  |  |  |  |
| Transport block CRC per Slot |  |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | Bits | N/A | N/A |  |  |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | Bits | 16 | 16 |  |  |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} | Bits | 16 | 16 |  |  |  |  |
| Number of Code Blocks per Slot |  |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | CBs | N/A | N/A |  |  |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | CBs | 1 | 1 |  |  |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,39} | CBs | 1 | 1 |  |  |  |  |
| Binary Channel Bits Per Slot |  |  |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 10) = {8,9} for i from {0,…,39} | Bits | N/A | N/A |  |  |  |  |
| For Slots i = 20, 21 | Bits | 2880 | 6000 |  |  |  |  |
| For Slot i, if mod(i, 10) = 7 for i from {0,…,39} | Bits | 1008 | 2100 |  |  |  |  |
| For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,19,22,…,39} | Bits | 3024 | 6300 |  |  |  |  |
| Max. Throughput averaged over 2 frames | Mbps | 1.314 | 2.730 |  |  |  |  |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms  Note 2: Slot i is slot index per 2 frames | | | | | | | |

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