**3GPP TSG-RAN WG4 Meeting #110bis R4-2406052**

**Changsha, China, 15 April ‒ 19 April, 2024**

**Title: Way Forward for [110bis][330] NR\_redcap\_enh\_demod**

**Agenda Item:** 6.21.4

**Source: Ericsson**

**Document for:** Approval

# For agreements

## PDSCH demodulation requirements

**PDSCH test cases for 64QAM**

* Define 64QAM UE demodulation requirements:
	+ For 1Rx UE, define 64QAM rank 1.
	+ For 2Rx UE, define 64QAM rank 2.

**PDSCH test cases for 256QAM**

* Not define 256QAM PDSCH demodulation requirements for Rel-18 eRedCap.

**PDSCH test cases for UE not supporting eRedCapNotReducedBB-BW-r18 (FG 48-1, supportOfERedCap-r18 only)**

* RAN4 define the following PDSCH demodulation requirements for eRedCap UE.
	+ FDD/HD-FDD SCS=15kHz

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Received antennas | Modulation | Code rate | Rank | PRB size | TBS | Propagation |
| QPSK | 1Rx/2Rx | MCS4 in Table 1 | 1/3  | Rank 1 | 25 | 1928 | TDLB100-400 |
| 16QAM | 1Rx/2Rx | MCS13 in Table 1 | 0.47 | Rank 1 | 25 | 6272 | TDLC300-100 |
| 64QAM | 1Rx | MCS19 in Table 1 | 0.50 | Rank 1 | 25 | 9992 | TDLA30-10 |
| 64QAM | 2Rx | MCS19 in Table 1 | 0.50 | Rank 2 | 12 | 9480 | TDLA30-10 |

* + TDD SCS=30kHz

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Received antennas | Modulation | Code rate | Rank | PRB size | TBS | Propagation |
| QPSK | 1Rx/2Rx | MCS4 in Table 1 | 1/3  | Rank 1 | 12 | 928 | TDLB100-400 |
| 16QAM | 1Rx/2Rx | MCS13 in Table 1 | 0.47 | Rank 1 | 12 | 3104 | TDLC300-100 |
| 64QAM | 1Rx | MCS19 in Table 1 | 0.50 | Rank 1 | 12 | 4736 | TDLA30-10 |
| 64QAM | 2Rx | MCS19 in Table 1 | 0.50 | Rank 2 | 6 | 4736 | TDLA30-10 |

**PDSCH test cases for UE supporting eRedCapNotReducedBB-BW-r18 (FG 48-2)**

* RAN4 define the following PDSCH demodulation requirements for eRedCap UE.
	+ FDD/HD-FDD SCS=15kHz

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Received antennas | Modulation | Code rate | Rank | PRB size | TBS | Propagation |
| QPSK | 1Rx/2Rx | MCS4 in Table 1 | 1/3  | Rank 1 | 52 | 3904 | TDLB100-400 |
| 16QAM | 1Rx/2Rx | MCS13 in Table 1 | 0.47 | Rank 1 | 40 | 9992 | TDLC300-100 |
| 64QAM | 1Rx | MCS19 in Table 1 | 0.50 | Rank 1 | 25 | 9992 | TDLA30-10 |
| 64QAM | 2Rx | MCS19 in Table 1 | 0.50 | Rank 2 | 12 | 9480 | TDLA30-10 |

Note: Configuration of 64QAM is same for UE not supporting eRedCapNotReducedBB-BW-r18

* + TDD SCS=30kHz

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Received antennas | Modulation | Code rate | Rank | PRB size | TBS | Propagation |
| QPSK | 1Rx/2Rx | MCS4 in Table 1 | 1/3  | Rank 1 | 51 | 3840 | TDLB100-400 |
| 16QAM | 1Rx/2Rx | MCS13 in Table 1 | 0.47 | Rank 1 | 20 | 4992 | TDLC300-100 |
| 64QAM | 1Rx | MCS19 in Table 1 | 0.50 | Rank 1 | 12 | 4736 | TDLA30-10 |
| 64QAM | 2Rx | MCS19 in Table 1 | 0.50 | Rank 2 | 6 | 4736 | TDLA30-10 |

Note: Configuration of 64QAM is same for UE not supporting eRedCapNotReducedBB-BW-r18

## CSI reporting requirements

**CSI-RS configuration for CSI reporting requirements**

* Configure BWP/PDSCH/CSI-RS PRB size as follows:

|  |  |  |
| --- | --- | --- |
|  | CQI reporting tests (static/fading) | PMI reporting test |
| FDDCBW/SCS=10MHz/15kHz | BWP: 52 RBs CSI-RS: 24RBs (PRB 0 to 23)PDSCH:15 RBs (PRB 0 to 14)) | BWP: 52 RBs CSI-RS: 28RBs (PRB 0 to 27)PDSCH: 25RBs (PRB 0 to 24) |
| TDDCBW/SCS=20MHz/30kHz | BWP: 51 RBs CSI-RS: 24RBs (PRB 0 to 23)PDSCH: 7RBs (PRB 0 to 6) | BWP: 51 RBs CSI-RS: 24RBs (PRB 0 to 23)PDSCH: 15RBs (PRB 0 to 14) |
| Note: BWP size is same as the transmission bandwidth in TS38.101-1 5.3.2.  |

**Test applicability of UE demodulation requirements**

* Add the definition of eRedCap in TS 38.101-4 3.1:
	+ **eRedCap:** A UE with enhanced reduced capabilities as specified in clause 4.2 in TS 38.306 [14].
* Introduce the applicability of demodulation requirements for eRedCap UE as follows in TS 38.101-4 5.1.1.

|  |  |  |  |
| --- | --- | --- | --- |
| **UE capability** | **Test type** | **Test list** | **Applicability notes** |
| eRedCap with 1RX | FR1 FDD and HD-FDD (Note 1) | PDSCH | Clause 5.2.1.1.x |  |
|  |  | 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.x |  |
|  |  | 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.x |  |
|  |  | 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.x |  |
|  |  | 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 |

**Test applicability of CSI reporting requirements**

* Introduce the applicability of demodulation requirements for eRedCap UE as follows in TS 38.101-4 6.1.1.
	+ FFS for the detailed test list.

|  |  |  |  |
| --- | --- | --- | --- |
| UE capability | Test type | Test list | Applicability notes |
| eRedCap with 1RX | FR1 FDD and HD-FDD (Note 1) | CQI | All tests in Clause 6.2.1.1.1.1All tests in Clause 6.2.1.1.2.1 |  |
|  |  | PMI | All tests in Clause 6.3.1.1.1 |  |
|  | FR1 TDD | CQI | All tests in Clause 6.2.1.2.1.1All tests in Clause 6.2.1.2.2.1 |  |
|  |  | PMI | All tests in Clause 6.3.1.2.1 |  |
| eRedCap with 2RX | FR1 FDD and HD-FDD (Note 1) | CQI | All tests in Clause 6.2.2.1.1.4All tests in Clause 6.2.2.1.2.4 |  |
|  |  | PMI | Clause 6.3.2.1.1 (Test 1) |  |
|  | FR1 TDD | CQI | All tests in Clause 6.2.2.2.1.5All tests in Clause 6.2.2.2.2.4 |  |
|  |  | PMI | Clause 6.3.2.2.7 (Test 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 |

## CR work split

Companies are encouraged to provide the draft CR in RAN4#111.

|  |  |  |
| --- | --- | --- |
| Draft CR  | Company | Notes |
| 3. Definitions | Qualcomm |  |
| 5.1.1.x Applicability of demodulation requirements | Qualcomm |  |
| 5.2.x PDSCH demodulation (FDD and HD-FDD) | Ericsson | Including FRC for FDD/HD-FDD |
| 5.2.x PDSCH demodulation (TDD) | Apple | Including FRC for TDD |
| 5.5.1 SDR requirements | Apple |  |
| 6.1.1.x Applicability of CSI reporting requirements | Qualcomm |  |
| 6.2.x CQI reporting requirements in static/fading condition | Nokia | Including CQI-TBS mapping in A.4 |
| 6.3.x PMI reporting requirements | Huawei, HiSilicon | Including FRC for FDD/HD-FDD/TDD |
| Big CR | Ericsson |  |

# Way forward

**PDSCH demodulation requirements**

* Interested companies are encouraged to provide both the ideal and impairment simulation results in RAN4#111.

**CQI reporting test in static condition**

* Interested companies are encouraged to provide the simulation results whether to apply the same test points as Rel-17 RedCap CQI reporting requirements in static condition.
	+ SNR=5/6dB and SNR=11/12dB for FDD/HD-FDD/TDD with 1Rx.
	+ SNR=8/9dB and SNR=14/15dB for FDD/HD-FDD/TDD with 2Rx.

**CQI reporting test in fading condition**

* Interested companies are encouraged to provide the simulation results whether to apply the same test points and requirements as Rel-17 RedCap CQI reporting requirements in fading condition.
	+ SNR=9/10dB and SNR=15/16dB for FDD/HD-FDD/TDD with 1Rx.
	+ SNR=6/7dB for FDD/HD-FDD/TDD with 2Rx.
	+ Requirements:
		- 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 = 20%.
		- Throughput ratio of follow CQI and fixed median CQI shall be ≥ γ, where γ = 1.05
		- Average BLER with follow CQI shall be greater than or equal to 0.02.

**PMI reporting tests**

* Interested companies are encouraged to provide the simulation results whether to apply the same test points and requirements as Rel-17 RedCap PMI reporting requirements for FDD/HD-FDD/TDD with 1Rx/2Rx.
	+ Set the test metric as $γ=\frac{t\_{ue}}{t\_{rnd}}$, where $t\_{ue}$ is 90 % of the maximum throughput obtained at $SNR\_{ue}$ using the precoders configured according to the UE reports, and $t\_{rnd}$ is the throughput measured at $SNR\_{ue}$ with random precoding based on type I Single Panel codebook.
	+ γ=1.3.