**3GPP TSG-RAN WG4 Meeting # 112 R4-2412828**

Maastricht, Netherlands, 19th – 23rd August, 2024

**Agenda item:** 8.7.3

**Source:** Moderator (China Telecom)

**Title:** Topic summary for [112][126] NR\_PC2\_RedCap\_UE

**Document for:** Information

# Introduction

This discussion summary will cover agenda:

8.7 PC2 RedCap

The topics/sub-topics for corresponding agendas are listed as follows:

* Topic#1: [8.7] PC2 RedCap
  + Sub-topic 1-1: PC2 RedCap UE for TDD bands
  + Sub-topic 1-2: Work plan and WI scopes

# Topic #1: [8.7] PC2 RedCap

## Companies’ contributions summary

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| **T-doc number** | **Proposals / Observations/Abstracts** | **Company** |
| R4-2411115 | Title：On UE RF requirements for PC2 RedCap  **Proposal 1: To complete the missing piece in current specification, RAN4 should add one sub-clause as following:**   |  | | --- | | **6.1I General**  **For a Redcap UE the requirements in Section 6 shall be verified with the channel bandwidth up to 20MHz and requirements specified in clause 6.2I.** |   **Proposal 2: Revise sub-clause 6.2I.1 to capture maximum output power for RedCap:**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **6.2I.1 Maximum output power for RedCap** **For Redcap UE, the requirements for power class 3 specified in clause 6.2.1 apply, and the requirements for power class 2 are specified in the following table for any transmission bandwidth configuration within the channel bandwidth of NR carrier up to 20MHz unless otherwise stated. The period of measurement shall be at least one sub frame (1ms).**   |  |  |  | | --- | --- | --- | | **NR band** | **Class 2 (dBm)** | **Tolerance (dB)** | | **n41** | **26** |  | | **n77** | **26** |  | | **n78** | **26** |  | | **n79** | **26** |  | | | CATT |
| R4-2411171 | Title: On PC2 RedCap UE in FR1  ***Proposal 1****: Enable RedCap UE PC2 feature for all TDD bands which have been specified to support PC2 for non-RedCap UE.*  ***Proposal 2****: Consider the specifications change text proposal below to enable the RedCap UE PC2 feature for TDD bands.*   |  | | --- | | 6.2I.1 Maximum output power for RedCap For Redcap UE, the requirements for power class 3 FDD and TDD bands and power class 2 TDD bands specified in clause 6.2.1 apply. | | Apple |
| R4-2411242 | Title: Enabling PC2 RedCap UEs in TDD and FDD bands  **Proposal for 1Tx PC2 TDD RedCap UEs:**   * **PC3 RedCap REFSENS in 38.101-1 clause 7.3I.2 can be reused as is for 1Tx TDD PC2 RedCap UE** * **1Tx PC2 MPR in 38.101-1 Table 6.2.2-2 Maximum power reduction (MPR) for power class 2 can be reused as-is for 1Tx PC2 RedCap UE** * **Similar to the corresponding PC3 case, to meet non-RedCap UE PC2 A-MPR for NS\_04 and NS\_50, RF filter rejection is needed.** * **Hence, there is no additional work for 1Tx PC2 RedCap UEs compared to 1Tx PC3 RedCap UEs.**   **Proposal for 1Tx PC2 FDD RedCap UEs:**   * **PC3 RedCap REFSENS in 38.101-1 clause 7.3I.2 can be reused as-is for 1Tx PC2 HD-FDD RedCap UE** * **PC2 1Tx RSD can be reused as-is for 2Rx/1Tx RedCap FD-FDD UEs.** * **For 1Rx/1Tx FD-FDD RedCap UEs** * **1Tx PC2 MPR in 38.101-1 Table 6.2.2-2 Maximum power reduction (MPR) for power class 2 can be reused as-is for 1Tx PC2 FDD RedCap UE** * **Similar to the corresponding PC3 case, to meet non-RedCap UE PC2 A-MPR for NS\_07, NS\_46 and NS\_48/49, RF filter rejection is needed.** * **Hence, there only additional work for 1Tx FDD PC2 RedCap UEs compared to 1Tx PC3 FDD RedCap UEs is to develop RSD for 1Rx/1Tx FD-FDD case.**   **Proposal for the WI scope:**   * **Given that 1Tx PC2 HD-FDD case is equivalent to the TDD case, this should be added as an objective without additional work. One of the TDD example bands could be changed to an HD-FDD Band.** * **Given that the TDD and HD-FDD cases do not require the development of a generic specification framework, part of the effort could focus on further developing the RSD specification framework to encompass the 1Rx FD-FDD case to be added as an objective using the same band example than for HD-FDD** * **The FDD band example should be chosen such that Tx interference affects REFSENS (n1 and n66 should be avoided).** | Skyworks Solutions Inc. |
| R4-2411744 | Title: PC2 requirements for TDD RedCap and eRedCap  In order to support PC2 for RedCap and eRedCap on TDD bands, following changes can be applied.   |  | | --- | | 6.2I Transmitter power for RedCap  6.2I.1 Maximum output power for RedCap  For Redcap and eRedCap UE, the requirements for power class 3 specified in clause 6.2.1 apply.  For RedCap and eRedCap UE, the requirements for power class 2 specified in clause 6.2.1 [for TDD bands] apply. | | CMCC |
| R4-2412465 | Title: Work plan on power class 2 RedCap in FR1 | China Telecom |
| R4-2412466 | Title: Discussion on PC2 RedCap for TDD bands  **Proposal 1:** Add one sentence in the clause of 6.2I.1 to state that PC2 also applies for RedCap UE.  **Proposal 2:** Keepreference sensitivity for RedCap for TDD bands unchanged since no additional emission is received by the Rx antenna | China Telecom |
| R4-2412467 | Title: draft CR on power class 2 RedCap for TDD bands | China Telecom, ZTE |
| R4-2412957 | Title: Discussion on the RF impacts for Rel-19 PC2 TDD RedCap UE  **Observation 1: for TDD bands, PC2 RF requirements for non-RedCap UE can be re-used for PC2 RedCap UE in a band agnostic way based on the WID.**  **Observation 2: From technical implementation perspective, the Tx requirements for 1Tx normal PC2 UE in the exemplary TDD bands can be reused for RedCap UE due to the similar RFFE implementation.**  **Proposal 1: for PC2 RedCap UE in TDD bands, it’s identified that the spec impact is to clarify the power class in the clause 6.2I.1 of TS 38.101-1.** | Huawei, HiSilicon |
| R4-2412984 | Title: PC2 RedCap RF overview  **Observation 1: No impact on Redcap REFSENS in Rel-17 and Rel-18 for PC2 RedCap for TDD band.**  **Observation 2: NR PC2 UE MPR and A-MPR can be reused for PC2 RedCap.**  **Observation 3: For FDD band, RSD for 1Tx PC2 could be considered as starting point.**  **Observation 4: RF impact for FDD band can be discussed before RAN#106.** | Ericsson |

## Open issues summary

### Sub-topic 1-1: PC2 RedCap UE for TDD bands

Sub-topic description: Discuss how to introduce PC2 for RedCap UE for TDD bands

**Issue 1-1-1: PC2 RedCap UE for TDD bands**

* Proposals
  + Option 1: Add one sentence in the clause of 6.2I.1 to state that PC2 also applies for RedCap/eRedCap UE in a band agnostic way.
    - Proposal 1:

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| 6.2I Transmitter power for RedCap6.2I.1 Maximum output power for RedCap For Redcap UE, the requirements for power class 3 FDD and TDD bands and power class 2 TDD bands specified in clause 6.2.1 apply. |

* + - Proposal 2:

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| 6.2I Transmitter power for RedCap 6.2I.1 Maximum output power for RedCap  For Redcap and eRedCap UE, the requirements for power class 3 specified in clause 6.2.1 apply.  For RedCap and eRedCap UE, the requirements for power class 2 specified in clause 6.2.1 [for TDD bands] apply. |

* + - Proposal 3:

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| 6.2I Transmitter power for RedCap6.2I.1 Maximum output power for RedCap For Redcap UE, the requirements for power class 3 and the requirements for TDD bands for power class 2 specified in clause 6.2.1 apply. |

* + Option 2: Add a general description in sub-clause 6.2I and revise sub-clause 6.2I.1 to capture maximum output power for RedCap :

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| 6.2I Transmitter power for RedCap For a Redcap UE the requirements in Section 6 shall be verified with the channel bandwidth up to 20MHz and requirements specified in clause 6.2I. 6.2I.1 Maximum output power for RedCap For Redcap UE, the requirements for power class 3 specified in clause 6.2.1 apply, and the requirements for power class 2 are specified in the following table for any transmission bandwidth configuration within the channel bandwidth of NR carrier up to 20MHz unless otherwise stated. The period of measurement shall be at least one sub frame (1ms).   |  |  |  | | --- | --- | --- | | NR band | Class 2 (dBm) | Tolerance (dB) | | n41 | 26 |  | | n77 | 26 |  | | n78 | 26 |  | | n79 | 26 |  | |

* Recommended WF1:
  + Option 1: Add one sentence in the clause of 6.2I.1 to state that PC2 also applies for RedCap/eRedCap UE in a band agnostic way.
  + The following change is suggested as the starting point for specification revision.

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| 6.2I Transmitter power for RedCap For Redcap and eRedCap UE the requirements in Section 6 shall be verified with the channel bandwidth up to 20MHz and requirements specified in clause 6.2I.  6.2I.1 Maximum output power for RedCap  For Redcap and eRedCap UE, the requirements for power class 3 specified in clause 6.2.1 apply.  For RedCap and eRedCap UE, the requirements for power class 2 specified in clause 6.2.1 [for TDD bands] apply. |

Qualcomm: We are fine to take this WF. We need further consider band agnostic way. On the other hand, we have specific band requested in the WI. Some proposals for 20MHz in the box have already been covered by other clause.

Nokia: Clarify comment from Qualcomm.

Skyworks: [for TDD bands], whether FDD band will be covered or not needed?

CMCC: [ ] means that we wait for FDD feasibility study in the late stage.

Huawei: In the WID, there is checking out. We cannot open the discussion in the WG.

China Telecom: to Qualcomm, regarding 20MHz which is overlapped with clause of channel bandwidth, we just indicate that this applies to transmit requirement in this clause. This is useful. For band agnostic way, it is clearly captured in the WID for TDD bands.

Qualcomm: We are not ready to accept the recommended changes now.

Agreement:

* Add one sentence in the clause of 6.2I.1 to state that PC2 also applies for RedCap/eRedCap UE in a band agnostic way for TDD bands.

### Sub-topic 1-2: Work plan and WI scopes

Sub-topic description: discuss the work plan and revise the WI scopes in next RAN meeting.

**Issue 1-2-1: Work plan and WI scopes proposals for FDD bands**

* Proposals
  + Proposal 1 (R4-2412465): Initial discussion for the feasibility study to enable PC2 RedCap for FDD bands in 3GPP RAN4#113 (Nov. 2024)
  + Proposal 2 (R4-2412984): RF impact for FDD band can be discussed before RAN#106
  + Proposal 3 (R4-2411242): Given that 1Tx PC2 HD-FDD case is equivalent to the TDD case, this should be added as an objective without additional work. One of the TDD example bands could be changed to an HD-FDD Band.
  + Proposal 4 (R4-2411242): Focus on further developing the RSD specification framework to encompass the 1Rx FD-FDD case to be added as an objective using the same band example than for HD-FDD
* Recommended WF
  + RF impact for FDD band can be discussed before RAN#106
  + Revise the work plan according to agreement

Skyworks: At least HD-FDD has the same requirement as TDD. We should make sure that HD-FDD approach is similar to TDD. Only FD-FDD needs further attention.

Huawei: Based on the WID, only TDD bands are included in the WID. It is better to request it in RAN.

OPPO: when discussing this WID, some companies have concern on feasibility on developing FDD for wearable. Currently the WI is only for TDD.

Vivo: share the similar view as Huawei and OPPO.

Qualcomm: 1Tx RSD is the only work to do. RAN4 would spend the time for FD-FDD.

Huawei: HD-FDD RF component will be reused for FD-FDD. It is very challenging especially for wearable devices.

Qualcomm: it is challenging for some form factor but it cannot preclude the usefulness for other form factor.

Skyworks: we do not see any difference between HD-FDD PA and TDD PA. The difference is on duplex.

Apple: Although the scope only considers TDD band, WID says FDD bands will be checked. FDD band can still be discussed and RAN4 can decide whether FDD bands can be included.

China Telecom: agree with Apple. This is our recommended WF.