3GPP TSG RAN Meeting #98-e
Electronic Meeting, December 12-16, 2022

RP-223038

Views on Rel-18 eRedCap WID scope

Agenda Item: 9.3.1.7

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Document for: Discussion/Decision

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Issue 1: What's the minimum supported peak data rate of R18 RedCap?

Background of issue 1:

- **In RAN1, different companies have different understandings of the minimum supported peak data rate of R18 RedCap**
  - In RAN1#111, the supported peak data rate for R18 RedCap was discussed, some companies think that the peak data rate can be lower than 10Mbps, while some other companies think that 10Mbps is the only target data rate for R18 RedCap.
  - As the peak data rate is more related to the understanding of the R18 RedCap WID, RAN1 mentioned that this issue can be further discussed and checked in RAN plenary. If RAN can make consensus on the other minimum supported peak data rate for R18 RedCap, RAN1 will follow RAN's conclusion, otherwise, 10Mbps will be adopted in RAN1.

Observations for issue 1:

- **Observation 1: The target peak data rate for R18 RedCap described in the current WID is a reference peak date rate.**
  - In R17, the achievable peak data rates of R17 RedCap are not equal to the peak date rates described in R17 WID justification part. Similar to R17, we don't need to create a R18 RedCap that strictly meet the peak rate of 10Mbps (described in R18 WID justification part). Smaller or larger peak rate can be considered, if there are benefits.

The peak date rates described in R17 WID (3 typical use cases)	The actual achievable peak data rates of R17 RedCap (Take FD-FDD as example)
Wearable: Reference can be **5-50 Mbps** in DL and **2-5 Mbps** in UL and peak bit rate of the device higher, up to **150 Mbps** for downlink and up to **50 Mbps** for uplink.	1Rx with 256QAM: **113Mbps/120Mbps** 1Rx with 64QAM: **85Mbps/90Mbps** 2Rx with 256QAM: **226 Mbps/120Mbps** 2Rx with 64QAM: **170Mbps/90Mbps**
Video surveillance: reference economic video bitrate would be **2-4 Mbps**. High-end video e.g. for farming would require **7.5-25 Mbps**.	
Industrial wireless sensors: **＜2Mbps**	

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- Issue 1: What's the minimum supported peak data rate of R18 RedCap?

Observations for issue 1: (continued)

- **Observation 2: 10Mbps is actually overdesigned for R18 RedCap target use cases.**
  - According to the R18 RedCap WID (copied below), the target use cases for R18 RedCap are low-end use cases, e.g., sensors. The peak rate requirement for these use cases is generally **smaller than 4Mbps**. In addition, there will be some other use cases that with low peak rate requirements, e.g., smart grid differential protection (peak rate <2.5Mbps). Obviously, 10Mbps is actually overdesigned for these use cases.
    - *"To further expand the market for RedCap use cases with relatively low cost, low energy consumption, and low data rate requirements, e.g., industrial wireless sensor network use cases, some further complexity reduction enhancements should be considered."*

The target/potential use cases for R18 RedCap	The corresponding data rate requirements
Industrial wireless sensors	**< 2Mbps**
Low-end video Surveillance e.g., economic video	**2-4 Mbps**
Other low end use case e.g., smart grid differential protection	**< 2.5 Mbps ***

- **Observation 3: Further reduce the supported peak rate to 6Mbps will not introduce additional impacts/UE types**
  - According to the previous study and the typical payload size assumptions for the signals, if the allowed TBS within a TTI is around 3000bits (i.e. 6Mbps), the SIB/paging reception in idle mode and the RACH procedure will not be impacted (no additional impacts were expected compared to 10Mbps peak rate). The UE with can report 6Mbps capability after initial access. Therefore, further reduce the supported peak rate to 6Mbps will not introduce additional impacts and will not introduce another UE type.

*3GPP TS 22.104 V18.3.0, Service requirements for cyber-physical control applications in vertical domains;

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- Issue 1: What's the minimum supported peak data rate of R18 RedCap?

Observations for issue 1: (continued)

- **Observation 4: Further reduce the supported peak rate to 6Mbps is benefit to the UE complexity and implementation**
  - As captured in TR 28.865, further peak rate reduction to 6Mbps is benefit to the memory/buffer requirements and then cost. In addition, take 6Mbps as the target peak rate can potentially provide more flexibility for UE implementation, since the UE can use a lower memory to match the low-end use cases.
  - With minimum supported peak data rate of 6Mbps, the UE vendors are still allowed to design a UE that support 10Mbps peak data rate(use a larger memory and report the capability by larger modulation order and/or scaling factor).
  - In addition, 6Mbps does not overlap with LPWA, as the peak data rate of LTE-MTC is 4Mbps.
- **Observation 5: Further reduce the supported peak rate to 6Mbps in R19 or R18 TEI phase will lead the fragmentation problem**
  - If we adopt 10Mbps as the minimum supported peak data rate for R18 RedCap, there will be another item for 6Mbps RedCap in R19 or in R18 TEI pahse, since there are requirements and benefits of lower peak date rate (e.g., 6Mbps). Introducing 6Mbps RedCap in TEI phase or next release will introduce another UE type, becuase the spec version differece. Therefore, we don't think it is neccessary/reasonable to consider RedCap enhencements on lower peak data rate in TEI phase or R19, we propose to consider 6Mbps RedCap in R18 WI, and it would be easy to do so.

Proposals for issue 1:

Proposal 1: The minimum supported peak data rate of R18 RedCap can be 6Mbps.

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- Issue 2: Whether and what complexity reduction solution for FR2 is needed?

Background of issue 2:

- **For complexity reduction solutions discussed in R18 RedCap WI, only FR1 is considered**.
  - The discussed solutions for R18 RedCap are only apply to FR1 for now. Some companies proposed that FR2 should also be considered in the previous RAN1 and RAN meeting.

Observations for issue 2:

- **Observation 1: The peak rate achieved by R17 FR2 RedCap is still high for some FR2 indoor use cases**
  - In Rel-17, we already defined some complexity reduction solutions for both FR1 and FR2, as there are also cost/complexity reduction requirements for FR2. However, with Rel-17 solutions (100MHz BW+1MIMO layer), the supported peak data rate of an FR2 RedCap UE is around 400 Mbps. This kind of peak rate is still high for some indoor RedCap cases, (e.g., industry AGV, etc.). In order to enlarge the RedCap market for FR2, and to avoid subsequent standalone enhancement for FR2, further complexity reduction for FR2 can be considered together with FR1 in Rel-18 WI phase.
  - In Rel-18, among all the discussed solutions in SI phase, PR1 is one of the candidate solutions for FR2, as the expected impact is quite small, e.g., constraint relaxation. A suitable target peak rate for FR2 can be further discussed and confirmed. In our understanding, the target peak rate for FR2 can be around 100Mbps or smaller, and then the constraint can be relaxed from 4 to 1. Other solutions with small spec impacts are also can be considered。
  - Also, we don't think it is neccessary/reasonable to consider RedCap enhencements for FR2 in TEI phase or R19, we propose to consider further complexity reduction solutions for FR2 RedCap in R18 WI, and the solutions that with small spec impacts are preferred.

Proposals for issue 2:

Proposal 2: For FR2, further complexity reduction solutions can be considered in Rel-18 phase.

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Issue 3: Whether PR1 is supported as a standalone solution for FR1?

Background of issue 3:

- **Whether PR1 is supported as a standalone solution for FR1 needs to be decided in RAN plenary**.
  - In RAN1#110b meeting, it was agreed that whether standalone PR1 is supported will be decided in RAN plenary (marked in red below).

> *RAN1#110b Agreement*
> - *If UE peak data rate reduction is supported as a standalone feature,*
> - *The constraint $v_{Layers} \cdot Q_m \cdot f \geq 4$ is relaxed to $v_{Layers} \cdot Q_m \cdot f \geq Y$.*
> - *FFS: the value of Y*
> - *Note: Whether this option is supported will be decided in RAN plenary.*

Observations for issue 3:

- **Observation 1: Standalone PR1 achieves very limit cost saving gain**
  - According to the conclusion of Rel-18 SI, the cost saving gain of standalone PR1 is quite limited (only 4% compared to Rel-17 RedCap). Making PR1 as a standalone Rel-18 RedCap UE complexity reduction option is not meaningful.
- **Observation 2: Standalone PR1 may introduce another UE type**
  - If standalonePR1 is supported, at least two UE types need to be introduced, this does not meet the target of Rel-18, i.e., aim to define at most one Rel-18 RedCap UE type for further UE complexity reduction, and would further fragment RedCap ecosystem.
- **Observation 3: The current solutions for FR1 can meet the dual-model requirements**
  - With BB BW reduction and add-on PR1, the supported peak rate can be 10Mbps, this can meet the requirements of LTE-NR dual mode devices. In addition, as discussed in RAN1, the spec impacts of BB BW reduction and add-on PR1 solutions are very small.

Proposals for issue 3:

Proposal 3: Standalone PR1 is not supported in Rel-18 for FR1.

Summary of views

- According to the previous discussion and analysis, we have the following proposals:

Proposal 1: The minimum supported peak data rate of R18 RedCap can be 6Mbps.

Proposal 2: For FR2, further complexity reduction solutions can be considered in Rel-18 phase.

Proposal 3: Standalone PR1 is not supported in Rel-18 for FR1.

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