3GPP TSG RAN #94-e

e-Meeting, December 6th – 17th, 2021

RP-212920

Views on Rel-18 eRedCap

Agenda Item: 8A.1

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Rel-18 eRedCap

- At the end of the pre-RAN #94 email discussions on Rel-18 scoping, **RP-212705** and **RP-212732** were provided by the moderator suggesting separate SI and WI for Rel-18 eRedCap
- **Observation 1:** RP-212732 suggests approval of a RAN1-led WI while there is currently no RAN1-led objective.
- **Observation 2:** A separate SI as suggested in RP-212705 is unnecessary.
  - The benefits from potential new Rel-18 cost/complexity reduction features can be estimated following from the studies during Rel-17.
  - If at all, the study should focus on determining the optimal combination of cost/complexity features for Rel-18 eRedCap *in addition to reduced BW of 5 MHz in FR1*.
  - A single (work) item with a study phase would not only avoid unnecessary procedural overhead but also be more efficient in terms of WG work planning and management.
- ***A single Rel-18 WI on eRedCap with a study phase on further UE complexity/cost reduction is preferred.***

Cellular IoT: A spectrum of requirements

- Cat M (eMTC) and NB-IoT remain as suitable options for the most cost- and power-sensitive LPWA market with very low data rate requirements *(e.g., typically < 1 Mbps, no more than ~4/7 Mbps in DL/UL for Cat M2)*
  - Use cases include: smart meters, basic inventory/asset trackers, etc.
- Rel-17 NR introduces a framework for NR IoT with introduction of Reduced Capability (RedCap) NR devices
  - BW limited to 20 MHz (in FR1) and 100 MHz (in FR2)
  - Peak rates of 80~200 Mbps in the DL and around ~90 Mbps in the UL
- While offering potential reduction in device cost/complexity and power consumption compared to "eMBB" or "URLLC/IIoT" UEs, Rel-17 NR RedCap offers a considerable over-design in terms of device cost/complexity or power consumption for IoT use cases demanding peak rates of a few Mbps *(e.g., 1~20 Mbps)*
  - Use cases include: wireless sensors, low-end wearables, basic (SD) video surveillance, asset trackers (with mobility support), IoT use-cases with human-machine interfaces involving voice (VoIP), etc.
  - Currently, these use cases are mostly served by Cat 1, Cat 1bis, or Cat M UEs
  - This category of IoT devices offers the largest potential volume for NR IoT, second only to LPWA
- It would be imperative to specify NR IoT solutions to better address IoT use cases with 1~20 Mbps data rates with higher sensitivity to cost/complexity and UE power consumption to enable migration of Cat 1/Cat 1bis based solutions to NR
  - This can further facilitate towards enabling an eventual migration of LTE-based IoT solutions to NR, possibly including Cat M.

Addressing lower data rates and device cost/complexity in Rel-18

- Following cost/complexity reduction features are commensurate to the max BW reduction to 5 MHz, and facilitate an **overall cost/complexity reduction by 20~25% compared to Rel-17 RedCap**:
  - Relaxed UE processing times
  - Reduced number of HARQ processes
  - Reduced peak rates (e.g., TBS restrictions)
  - Type B HD-FDD
- Bulk of **UE power consumption** can be reduced with reduction in UE BW from 20 MHz to 5 MHz
- On **market fragmentation**: At the price-point for low-end IoT, the sensitivity to cost is high
  - **20~25% cost/complexity reduction w.r.t. Rel-17 RedCap is significant**
  - The bulk of the volume for NR IoT is expected to be driven by use cases with reduced QoS requirements but high sensitivity to cost and power consumption
  - Optimizing for the category corresponding to **the bulk of the NR IoT volume** allows 3GPP to offer meaningful solutions against competing non-3GPP solutions – and can offset the detriments from apparent market fragmentation
- "Patch-work" should be avoided
  - E.g., only restricting peak rates via scaling factor is a "patch" with rather limited impact on cost/complexity reduction as PHY features cannot be simplified for a 20 MHz UE (compared to UE max BW reduction).
- **Further reducing max UE BW to around 5MHz is critical in realizing meaningful solutions for low-end NR IoT design.**

Rel-18 eRedCap: Further UE cost/complexity reduction

- Study objectives from RP-212705:
  - Study further UE complexity / cost reduction techniques based on Rel-17 evaluation methodology [RAN1]
    - Consider network impact, compatibility with Rel-17, coexistence of RedCap and non-RedCap UEs, UE impact, specification impact
    - Potential solutions, which may complement each other, for reducing device complexity/cost are, e.g.,
      - UE bandwidth reduction to 5MHz in FR1,
      - reduced the UE peak data rate,
      - relaxing UE processing timeline,
      - etc.

- Proposed updates to study objectives:
  - Study and specify means to support further reduced max UE BW of 5 MHz in FR1, and potential further UE complexity/cost reduction techniques based on Rel-17 evaluation methodology [RAN1]
    - Consider network impact, compatibility with Rel-17, coexistence of RedCap and non-RedCap UEs, UE impact, specification impact
    - Potential solutions, in addition to reduced max UE BW of 5 MHz in FR1, which may complement each other, for reducing device complexity/cost are, e.g.,
      - ~~UE bandwidth reduction to 5MHz in FR1,~~
      - reduced the UE peak data rate,
      - relaxing UE processing timeline,
      - Reduced number of HARQ processes,
      - Type B HD-FDD,
      - etc.

Rel-18 eRedCap: Summary

- Proposal 1:
  - *Approve a single Rel-18 WI on eRedCap with a study phase on further UE complexity/cost reduction.*
- Proposal 2:
  - *Update the objectives from RP-212705 and merge them with the objectives in RP-212732 as below:*
    - Cost/complexity reduction
      - ~~*TBD based on SI outcome: Further reduced UE cost / complexity [RAN1]*~~
      - Study and specify means to support further reduced max UE BW of 5 MHz in FR1, and potential further UE complexity/cost reduction techniques based on Rel-17 evaluation methodology [RAN1]
        - Consider network impact, compatibility with Rel-17, coexistence of RedCap and non-RedCap UEs, UE impact, specification impact
        - Potential solutions, in addition to reduced max UE BW of 5 MHz in FR1, which may complement each other, for reducing device complexity/cost are, e.g.,
          - ~~UE bandwidth reduction to 5MHz in FR1,~~
          - reduced the UE peak data rate,
          - relaxing UE processing timeline,
          - Reduced number of HARQ processes,
          - Type B HD-FDD,
          - etc.
    - Support for lower UE power class [RAN4]
      - Focus on non-coverage-limited scenarios, e.g., indoor industrial

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