
**3GPP TSG RAN Meeting #93-e
Electronic Meeting, September 13 - 17, 2021**

RP-212161

**Agenda Item: 9.0.2
Document for: Discussion**

Discussion on RedCap evolution in Rel-18

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- Summary of RAN Rel-18 Workshop (RWS-210659)
 - 7. **RedCap evolution (excluding positioning)**, with the following example areas:
 - » **New use cases and new UE bandwidths (5MHz?)**
 - » Power saving enhancements

- Moderator proposal for RedCap evolution (RP-211657)
 - Main goal: further embrace new use cases, especially requiring low-cost devices and low energy consumption
 - Study low power wake-up receiver / wake-up signal (WUR/WUS)
 - » *The study should target ultra-low power WUS/WUR required by RedCap use cases. The specified solutions shall not be limited to RedCap UEs only.*
 - » *As opposed to the work on UE power savings in previous releases, this study will not require existing signals to be used as WUS. Solutions should give justifiable gains compared to the existing Rel-16/17 UE power saving enhancements.*
 - » Objectives:
 - Study use cases, evaluation methodology & KPIs, and compatibility with other UE power saving solutions
 - Study and evaluate low-power wake-up receiver architectures
 - Study and evaluate wake-up signal designs to support wake-up receivers
 - Study and evaluate protocol changes needed to support wake-up receivers
 - Study potential system impact, such as network and other UE's power consumption, coexistence with R17 RedCap and non-RedCap UEs, network coverage
 - Power saving/energy efficiency enhancements
 - » Enhanced DRX in RRC_INACTIVE (>10.24s) (*if not completed in R17*)
 - » Identify use cases and study corresponding protocol enhancements to support operation on intermittently available energy harvested from the environment
 - Note that how the devices harvest and store energy is outside the scope of 3GPP
 - **Complexity/cost reduction**
 - » **Study further reduced UE bandwidth of 5MHz, especially considering**
 - **expected UE complexity/cost reduction based on Rel-17 evaluation methodology**
 - **network impact, compatibility with Rel-17, coexistence of RedCap and non-RedCap UEs, UE impact, specification impact**
 - **other solutions for reducing the UE peak data rates**
 - » Support for lower UE power class
 - Considering NW impact, e.g. coverage aspects
- Moderator's notes:
 - *TBD whether the WUR/WUS study is part of RedCap or of a separate SI*
 - *TBD in which email thread the WUR/WUS discussions should continue*

■ Rel-17 Reduced Capability NR devices (RedCap)

- UE complexity reduction
 - » Max 20MHz BW for FR1, max 100MHz BW for FR2
 - » 1 or 2 Rx branches and max DL MIMO layers
 - » Optional support of 256QAM (instead of mandatory) for FR1
 - » HD-FDD type A in addition to FD-FDD and TDD

50~70% device cost reduction

- Power saving
 - » eDRX for RRC inactive and idle states
 - » RRM measurement relaxations
 - » Solutions specified in Rel-17 power saving WI are available by default

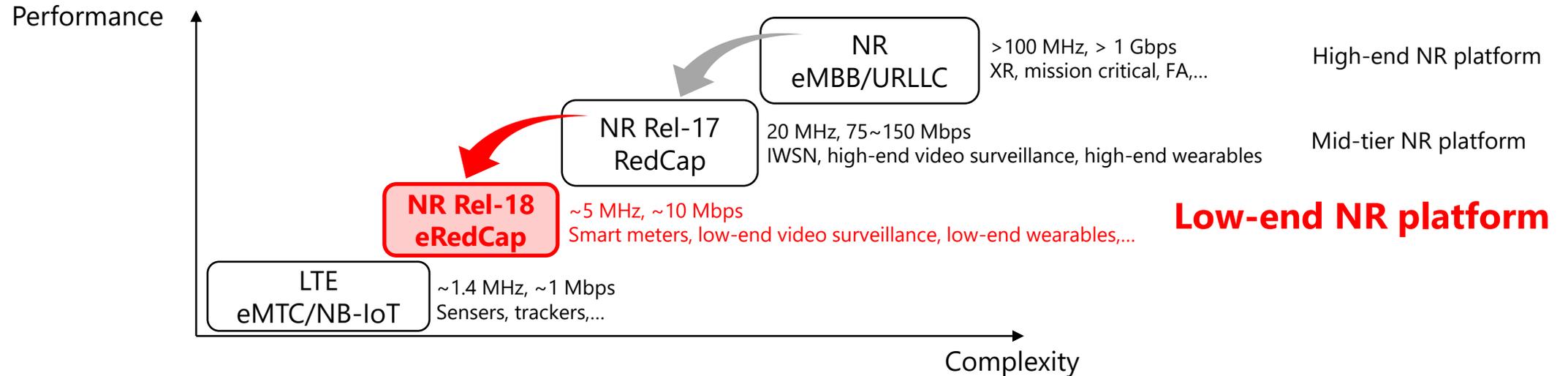
**80~90% and 10~25% gains
by eDRX and RRM relaxations**

- UL coverage recovery
 - » Solutions specified in Rel-17 CovEnh WI are available by default
- Rel-15 SSB is reused and minimum L1 changes
- Ensure coexistence with non-RedCap UEs

Minimum impact on current NW

→ Rel-17 RedCap will extend NR market to IWSN, video surveillance, wearables, etc., which were not covered by Rel-15/16 eMBB/URLLC UEs

- **RedCap evolution (eRedCap)** for further extending NR-IoT market to smart meters, low-end video surveillance, low-end wearables, etc.



- Key directions toward Rel-18 eRedCap
 - **Further UE complexity reduction**
 - » Room for further BW reduction and reduced peak data rate
 - **Further power saving**
 - » Based on Rel-17 power saving WI outcome
 - **Minimum impact on current NW**
 - » Ensure coexistence with non-RedCap UEs and Rel-17 RedCap UEs

■ Further reduced UE bandwidth of 5MHz

- ~10% cost saving gain can be expected based on the evaluation results in RAN Rel-18 workshop
 - » RWS-210313 from Ericsson, RWS-210409 from CATT, and RWS-210476 from ZTE
- *We agree with following arguments*
 - » Consider coexistence with non-RedCap UEs and Rel-17 RedCap UEs
 - Current SSB can be reused for 15KHz SCS
 - Similar approach as Rel-17 RedCap can be applied to Rel-18 eRedCap
 - ✓ Separate initial DL/UL BWPs, PUCCH FH enabling/disabling,...
- *We don't agree with following arguments*
 - » Consider compatibility with Rel-17
 - Not necessary for “reduced cost/complexity” devices from previous releases
 - Rel-17 RedCap UEs are not backward compatible with 100 MHz BW mandatory for non-RedCap UEs
 - ✓ Rel-17 RedCap UE-specific initial access procedure is being specified in RAN1

→ It is fair to say “Rel-15 SSB bandwidth is reused and L1 changes minimized” as Rel-17 RedCap WID

■ Other complexity reduction schemes

- UE processing time relaxation (data, CSI)
 - » provide around 6% and 5% cost reduction gain, respectively, according to TR38.875
- Reduced number of HARQ processes
 - » Some companies observed 3~9% cost saving gain according to R1-2009393

→ Support these features which provide low-end NR platform and have reasonable tradeoff between cost reduction gain and specification/NW impact

- Update moderator proposal in RP-211657 as below:
 - ...
 - Complexity/cost reduction
 - » Study further reduced UE bandwidth of 5MHz, especially considering
 - expected UE complexity/cost reduction based on Rel-17 evaluation methodology
 - network impact, ~~compatibility with Rel-17~~, coexistence of RedCap and non-RedCap UEs, UE impact, specification impact
 - other solutions for reducing the UE peak data rates
 - Further complexity reduction schemes for UEs with 5 MHz BW:
 - ✓ Relaxed UE processing times for data and CSI
 - ✓ Reduced number of HARQ processes
 - Note: Rel-15 SSB bandwidth is reused and L1 changes minimized
 - » Support for lower UE power class
 - Considering NW impact, e.g. coverage aspects

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