



3GPP TSG RAN Rel-18 workshop
Electronic Meeting, June 28 - July 2, 2021

RWS-210504

Views on Redcap Enhancements for Rel-18

Apple Inc.

Enhanced Redcap | Power Efficiency Enhancement

- Rel-17 Redcap established the basic and common framework to enable reduced capability NR devices
 - Use Cases:
 - Industrial Sensor.
 - Video Surveillance
 - Wearable
 - Key requirements in SID RP-193238
 - Reference bit rate, Latency, Reliability, Battery life of devices
 - Objectives
 - Identify and study potential UE complexity reduction features
 - Study UE power saving and battery lifetime enhancement
 - Rel-17 Redcap WI mainly focused on UE complexity reduction features study (i.e. 1st objective) due to limited TU. Further improve power efficiency for Redcap should be considered as one objective of Rel-18 eRedcap.
 - The eDRX and RRM relaxation can reduce power consumption. However, NOT sufficient to meet the battery life target list in Table 1.

Table 1: Requirements of Redcap Use Cases

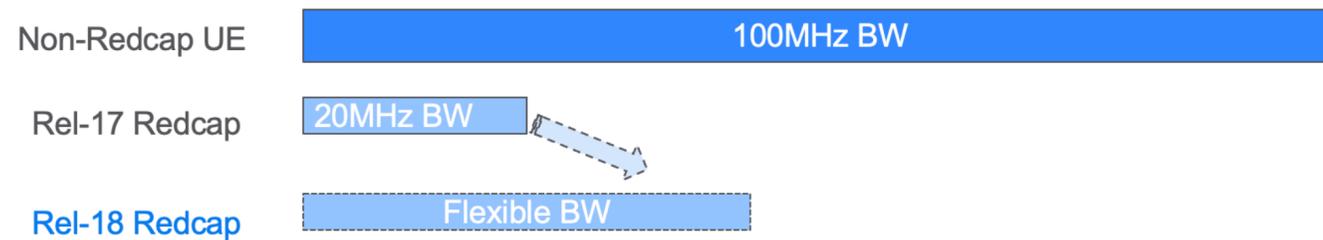
	Data Rate	E-to-E latency	Reliability	Battery Life
Industrial sensors	< 2 Mbps	<100ms	99%~ 99.99%	Few years (≥5 yr in TR 22.832)
Video Surveillance	Economic video: 2-4Mbps High-end video: 7.5-25 Mbps	<500ms	99%~ 99.9%	N/A
Wearable	Peak rate: up to DL 150Mbps, up to UL 50Mbps, Reference bit rate: 5-50Mbps Mbps in DL and Minimum 2-5 Mbps in UL	Relaxed	N/A	Multiple days (up to 1-2 weeks)

Improve power efficiency for Redcap in Rel-18 to fulfill the target!!



Enhanced Redcap | Flexible BandWidth and Rel-17 Leftovers

- Support high-end Redcap Device with flexible bandwidth larger than Rel-17 reduced BW (i.e., FR1: 20MHz, FR2: 100MHz)



- Rel-17 leftovers
 - Layer-1 UE processing time relaxation
 - Relaxed PDSCH/PUSCH processing time in terms of N_1/N_2 e.g. doubled.
 - Relaxed UE CSI computation time
 - Benefit in both complexity reduction and power saving.

Table 7.5.2-1: Estimated relative device cost for relaxed UE processing time in terms of N_1 and N_2 [TR 38.875]

Relaxed processing time (doubled N_1 and N_2)	FR1 FDD	FR1 TDD	FR2 TDD
RF: Antenna array	-	-	33.0%
RF: Power amplifier	25.0%	25.0%	18.0%
RF: Filters	10.0%	14.7%	8.0%
RF: Transceiver (including LNAs, mixer, and local oscillator)	45.0%	54.3%	41.0%
RF: Duplexer / Switch	20.0%	6.0%	0.0%
RF: Total relative cost	100.0%	100.0%	100.0%
BB: ADC / DAC	10.0%	9.0%	4.0%
BB: FFT/IFFT	4.0%	4.0%	4.0%
BB: Post-FFT data buffering	10.0%	10.0%	11.0%
BB: Receiver processing block	20.3%	24.6%	19.5%
BB: LDPC decoding	6.6%	5.9%	5.9%
BB: HARQ buffer	14.0%	12.0%	11.0%
BB: DL control processing & decoder	4.1%	3.3%	4.0%
BB: Synchronization / cell search block	9.0%	9.0%	7.0%
BB: UL processing block	3.7%	3.6%	5.0%
BB: MIMO specific processing blocks	8.8%	8.8%	17.5%
BB: Total relative cost	90.5%	90.1%	88.9%
RF+BB: Total relative cost	94.3%	94.1%	94.4%



Enhanced Redcap | Summary

- Justification
 - Rel-17 Redcap WI creates the basic framework for enabling Redcap and mainly focused on cost reduction features
 - Three use cases: Industrial sensors, video surveillance and wearable.
 - Rel-18 eRedcap targets to improve the power efficiency and Rel-17 leftover due to limited Rel-17 TU budget.
- Objectives
 - Improve the power efficiency for Redcap UEs
 - Consider low-power wake-up radio and related signaling/protocol design for RRC Idle Redcap devices.
 - New Use Cases with High-End Redcap
 - Flexible Bandwidth larger than the max. BW supported in Rel-17.
 - Rel17 leftovers (PDSCH/PUSCH/CSI processing timeline relaxation).

