

China Academy of Telecommunication Technology -

3GPP TSG RAN Meeting #93-e

Electronic Meeting, September 13th - 17th, 2021

RP-212254

Views on Rel-18 UE Power Saving

CATT

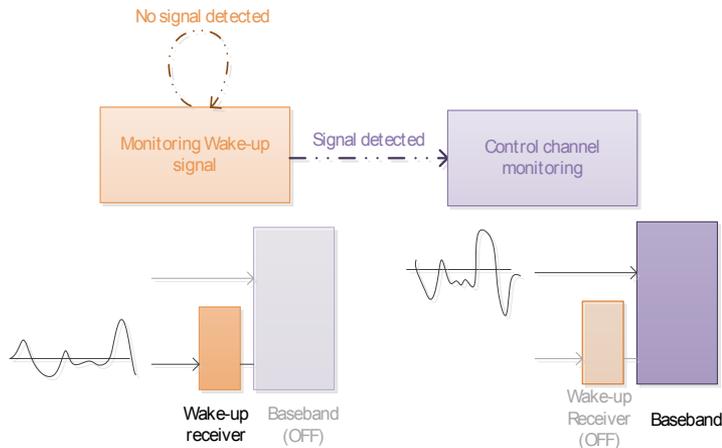
Study of Low or no power Receiver for UE Wakeup

- The wakeup signal in Rel-16 DRX adaptation provides UE power saving gain by waking up at DRX ON only when there is a data arrival
 - The efficiency of UE power saving gain is tight to the DRX configuration
 - Long DRX cycle would improve the power saving gain but reduced the user perceived throughput (increasing the latency)
 - Shorter DRX cycle would limit the UE power saving gain
 - UE still needs to wake up all RF and baseband component and decode the wakeup signals at each DRX cycle
 - The power consumption of preparation of wakeup signal detection at front-end device could be further reduced with low power or no power front end device
 - More than 90% of time UE is not indicated to wakeup
- A low-power or no power front-end device to detect the wakeup signal and trigger the RF and baseband processing when positive wakeup signal is detected
 - The study of low or no power front end device would further reduce the UE power consumption in multiple folds.
 - The low-power or no power wakeup signals could also trigger the wakeup of other technologies supported by UE
 - Legacy 3GPP technologies – 4G LTE or 3G HSPA/W-CDMA
 - WiFi

UE Wakeup Mechanism with front-end device

UE Wakeup Mechanism with lower power active device or no power passive device

- An external front device (RF or baseband) with low power consumption or passive device (no power)
- Wakeup signal is detected by the external wakeup device
- If UE detects its wakeup signal, it trigger the main RF and baseband receiver

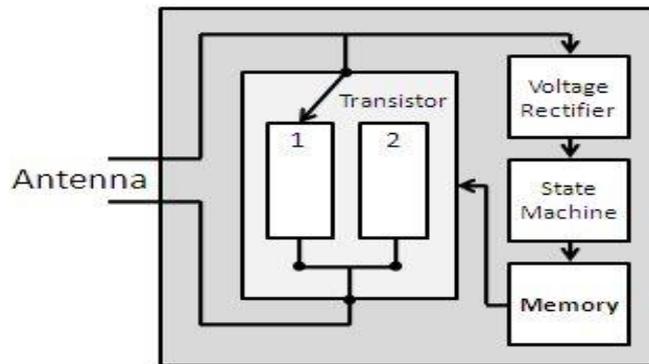


UE Wakeup Signals with front end low/no power device

- Wakeup Receiver with front-end low/no power device
 - Low or no power consumption
 - Simple RF circuit with Energy detection and memory logic
 - Drawback: low receiver sensitivity and low noise resistance
- System enhancement in supporting front-end low/no power device for wakeup signals
 - Operating frequency band
 - Inband – NR physical channel is enhanced for transmitting wakeup signals to improve the coverage
 - Out-of-band – A dedicated band to transmit the Wakeup signal in improving the coverage
 - Low-frequency band with lower propagation loss

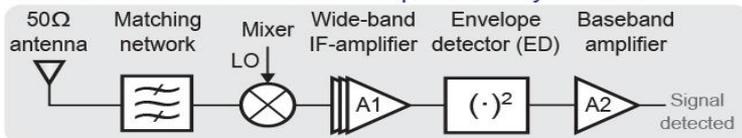
Wakeup Passive Receiver

- Passive circuit: similar to RFID or ETC (Electrical Toll Collection) receiver
 - Backscattering technology –
 - Highly reactive RF front end to stimulate the electromagnetic wave of the received signals from the gNB. The
 - RF power is converted into DC power to power the control logic of wakeup trigger
 - Receiver Sensitivity: -40 to -50 dBm



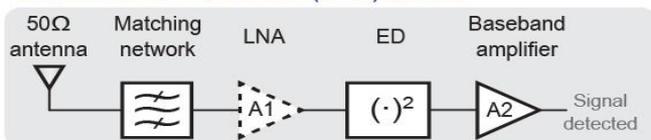
A 4.5nW Wake-Up Receiver with -69dBm Sensitivity

Conventional IF/uncertain-IF Superheterodyne WuRX



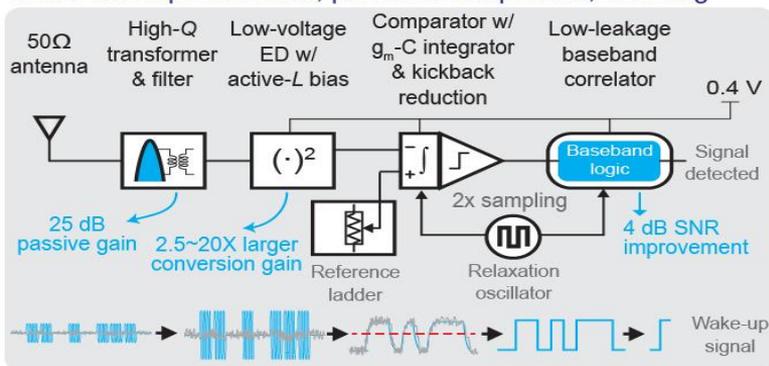
- + Eliminate power-hungry PLL and LNA
- Sensitivity limited by large IF noise BW
- RF LO/IF-amplifier dominate power consumption

Conventional Tuned RF (TRF) WuRX



- + Eliminate power-hungry RF LO/IF-amplifier
- LNA is power-hungry if implemented
- Matching network and envelope detector have modest gain → poor sensitivity

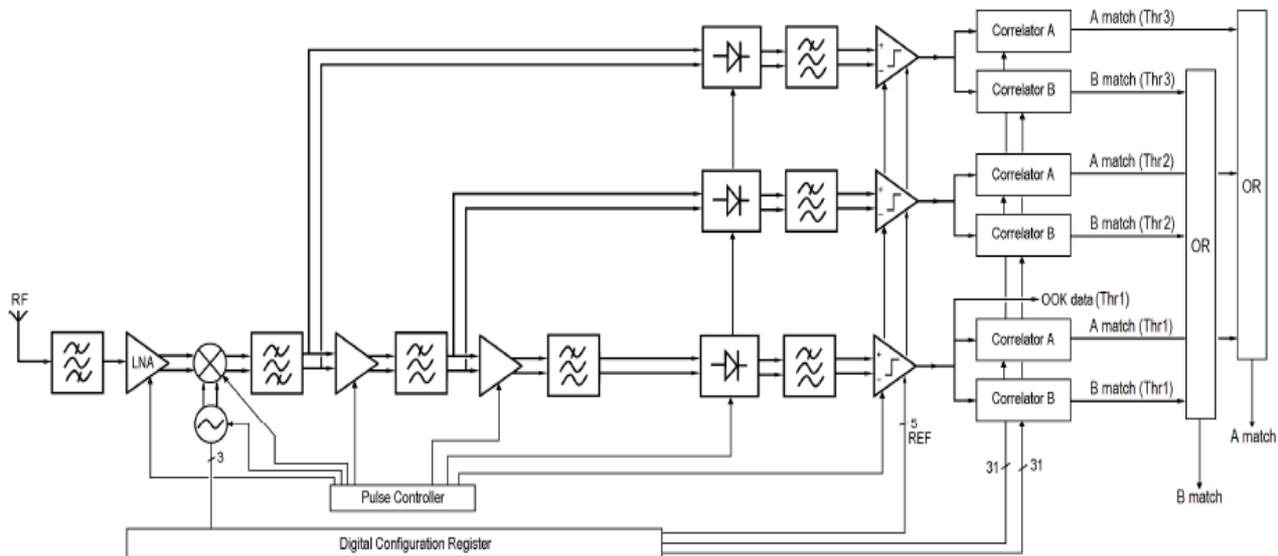
Proposed low-voltage TRF WuRX with passive RF gain, high-gain active envelope detection, precision comparison, & coding



- + High-Q transformer provides high passive gain at front-end
- + Envelope detector provides 2.5~20 times larger conversion gain via active inductor
- + Low-noise high-gain regenerative comparator slices bits at low-power
- + Optimal coding scheme improves required decoding SNR
- + All circuits operate at 0.4V for low-noise & low-power

A 7- μ W 2.4-GHz Wake-Up Receiver with -80 dBm Sensitivity and High Co-Channel Interferer Tolerance

Receiver structure



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