Asleep Yet Aware, Awake on Declare
Virginia Efficient Near-zero Ultra-low-power System

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Driving Applications: Near Zero Power RF and Sensor Operations (N-ZERO)

Overview of Event Driven Sensor Nodes

How Low is Low Enough Power?

System Opportunities:
Large Scale Fields of Sensor Nodes that can last for years on a small coin-cell battery
Ongoing Needs:
Sensitivity, High RF Freq., Self-Calibration, Node Selectivity, Efficient Low Power Transmitter

Virginia Efficient Near-zero Ultra-low-power System (VENUS) Concept

Passive Envelope Detector
Opportunities: Create very sensitive, passive detection by trading off sensitivity, speed and input impedance at frequencies where low power RF amplification is not attainable. RF frequencies detectable at GHz or more [2].

Ultra-Low Power Active Circuits
Opportunities: Enables detection of mV level baseband signals while consuming just a few nW of power. Increase reliability and error correct for imperfect RF and mixed signal circuits and provide selectivity between signals [1-3].

System Performance

DC Power: <10 nW
Sensitivity: >76 dBm
False Alarm Rate: <1/hour
Signal Energy: c/2µJ
Signal Detection: c/2µJ

Interference and Process Variation Rejection

Opportunities: Enable robust performance in a variety of electromagnetic environments by actuating the receiver threshold based upon measured response of the comparator.

Acoustic MEMS Devices

Opportunities: Very high quality factors enable transformations to very large impedances found within ultra low power systems.

Acoustic RF Filters and Impedance Transformers

Lithium Niobate Chip Compressors

Lithium Niobate - CMOS Integration

References


For event driven sensor nodes with low activity factors, WuRx power can dominate battery lifetime.

The self discharge of a battery is about 10nW. Assuming that a sensor node turns on for approximately 10 seconds to take a measurement and transmit the data back, and uses 1mA DC current draw during active mode, it becomes critical to keep all a

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Fully-Integrated Automatic Offset Control Demonstration

Interference Factors: -75dBm Wakeup

Acoustic RF Filter Tuning

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