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Firefly Radios : Biologically Inspired Low Power Radio Networks

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Ultra-low power wireless transceivers that operate on harvested energy or use tiny batteries are a critical enabling technology for applications in biomedical (i.e. wireless ECG, EKG) and environmental monitoring (i.e. hazardous gas detection). However, inexpensive radios communicating continuously at power levels below 100uW even over short distances have been elusive for a variety of reasons. Among these reasons is a fundamental limit imposed by the power overhead required to overcome signal and receiver noise in continuous wave radios and the power required to maintain FCC compliance. In this talk I will discuss approaches to overcoming these limits through various signaling alternatives, new radio architectures, and use of effective duty cycling. I will discuss the problems associated with duty cycling and wideband communication over a wireless medium and propose a biologically inspired solution from my research based on the behavior of Southeast Asian Fireflies. I will discuss a full transceiver solution in 90nm CMOS based upon this idea and its relative merit and drawbacks compared to other traditional and state-of-the-art-approaches. Finally, I will consider emerging applications for such low power transceivers and discuss future directions for research.

Alyssa Apse received the B.S. from Swarthmore College in 1995 and the Ph.D. from Johns Hopkins University, Baltimore, MD, in 2002. She joined Cornell University in 2002, where she is currently an Associate Professor of Electrical and Computer Engineering. The focus of her research is on power-aware mixed signal circuits and design for highly scaled CMOS and modern electronic systems. She has authored or coauthored over 90 refereed publications in related fields of RF mixed signal circuit design, interconnect design and planning, photonic integration with VLSI, and process invariant circuit design techniques resulting in five patents and several pending patent applications. She received a best paper award at ASYNC 2006, had a MICRO “Top Picks” paper in 2006, received a college teaching award in 2007, received the National Science Foundation CAREER Award in 2004, and was selected by Technology Review Magazine as one of the Top Young Innovators in 2004. She has also served as an Associate Editor of various journals including IEEE Transactions on Circuits and Systems I and II and as the chair of the Analog and Signal Processing Technical committee of ISCAS 2011.