Tutorial: Ultra-Low-Power Wi-Fi connectivity via Backscatter Communication: Theory, Prototypes to Integrated Circuits

Presenter: Dinesh Bharadia, Assistant Professor, UC San Diego

Abstract: Emerging Internet-of-Things (IoT) devices for use in smart homes, wearable systems, industrial monitoring, smart cities, and beyond all require robust yet low-power wireless communications. Unfortunately, most current wireless standards do not intrinsically support low-power operation due to strict requirements on modulation formats, data rates, linearity, packet overheads, and so on. These restrictions impose minimum power consumption requirements for cellular standards (e.g., GSM, LTE, and 5G) and WiFi, but also surprisingly limit the ability of supposedly low-power standards (e.g., Bluetooth Low Energy and Narrowband-IoT) from reaching new application-enabling power levels.
This tutorial will outline the major challenges facing power reduction in modern wireless systems and will describe several possible solutions to these challenges while connecting to existing infrastructure. Specifically, we will explore the use of backscatter communication as a means to reduce the power overhead of communication systems with existing infrastructure. Then, we will discuss a variety of alternative communication schemes that can help to reduce the power of communication in WiFi systems by >1,000x through the use of WiFi-compliant backscatter communication via a code-word translation technique. We will then introduce new simulations, design techniques that would cover all aspects of backscatter communications while communicating with existing state of art WiFi communication. It would cover papers on this topic from publication: https://wcsng.ucsd.edu/ubiquitousIoT/

We would also towards the end the RFIC design based on the simulations of the system design to demonstrate 1000x savings. The topic is published in a form of multiple papers at NSDI, Sensys, ISSCC, and JSSC venues.

List of topics: Backscatter Communication and their simulation, code-word translation technique simulations, range and coverage analysis for backscatter systems, interference analysis within the backscatter systems, syncrhonization

Presenter Bio: Dinesh Bharadia is Assistant Professor at UC San Diego, where he leads the wireless communication sensing and networking group (wcsng.ucsd.edu). His group works from the theory, design, and prototyping to building integrated circuits for modern wireless communication and sensing systems, and low-power networks. His thesis invalidated a long-held assumption in wireless communication by enabling in-band full-duplex radios. From 2013 to 2015, he was a Principal Scientist for Kumu Networks, where he worked to commercialize his research on full-duplex radios, building a product that underwent successful field trials at Tier 1 network providers worldwide like Deutsche Telekom and SK Telecom. In recognition of his research, he was named a Marconi Young Scholar for outstanding wireless research and awarded the Michael Dukkakis Leadership award. He was also named as one of the top 35 Innovators under 35 in the world by MIT Technology Review in 2016 and worldwide Forbes 30 under and 30 for Science category in 2018.