Illinois Center for Wireless Systems

ICWS Seminar Series

TRILLIONS OF COMPUTERS: FROM PERVASIVE TO PERPETUAL COMPUTING

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Monday, April 2, 2012
3:00 p.m.
B02 Coordinated Science Lab

Abstract: This talk will present our work on scaling the platforms and protocols for perpetual computing at scale, from microwatt sensor "motes" to nanowatt "smart dust," enabling multi-scale sensing of people, places, and things. We will discuss how the next tier of computing -- pervasive, wireless, networked, energy-harvesting sensors with ever-decreasing dimensions, from cubic-cm to cubic-mm – will lead to perpetual monitoring of the built and natural environments. Our work at the cm-scale has shown the viability of wireless nodes built from commercial off-the-shelf components to operate from ambient indoor light levels (~10 uW) and deliver sensor readings wirelessly to battery-powered sensor networks, thus extending their reach without sacrificing a decade of progress in multi-hop routing. At the mm-scale, we are creating a modular, die-stack architecture to finally realize the decades-old vision of smart dust, with a fully self-contained wireless sensor system operating on ultralow power budgets (~10 nW).

A major challenge with realizing microwatt and nanowatt networked systems is shifting from just a low-power mindset to a low-energy one. This talk will discuss the systems challenges and present A-MAC, a receiver-initiated link layer for low-power wireless networks that supports several services under a unified architecture more efficiently and scalably than prior approaches. A-MAC's versatility stems from layering a range of link layer services above a single, flexible synchronization primitive called Backcast. A-MAC's efficiency stems from optimizing this primitive, and with it the most consequential decision that a low-power link makes: whether to stay awake or go to sleep after probing the channel. Modern receiver-initiated protocols require more time and energy to make this decision, and they exhibit worse judgement as well, leading to many false positives and negatives, and lower packet delivery ratios. A-MAC makes this decision quickly, and decides more conclusively and correctly, than earlier approaches. Experiences with A-MAC show that a unified implementation that supports unicast, broadcast, wakeup, pollcast, and discovery is feasible and efficient across a range of communications workloads and duty cycles, highlighting new directions for radio hardware and link layer research.

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Biography: Prabal Dutta is an Assistant Professor at the University of Michigan, Ann Arbor. He researches the circuits, systems, and software necessary to realize pervasive sensing, computing, and communications at scale and in the service of society. His work has yielded over a dozen hardware and software systems, has won four best paper awards (Sensys'10, IPSN'10, HotEmNets'10, and IPSN'08) and several design awards (ISLPED'10, ISLPED'08, and PC Week's Comdex Best of Show), has been commercialized by Aginova, Arch Rock (now Cisco), Crossbow (now Memsic), Moteiv (now Sentilla), Moteware, Sonnonet, and Vectare, and has been utilized by thousands of researchers and practitioners worldwide. He earned a Ph.D. in Computer Science from the University of California, Berkeley (2009), where he designed and deployed some of the largest academic sensor networks, and where his work was supported by NSF and Microsoft Graduate Fellowships.

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