Making Enterprise Computing Green: Energy-Efficiency Challenges in Enterprise Data Centers

by

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Architects and circuit designers have made enormous strides in managing the energy efficiency and peak power demands of processors and other silicon systems. Sophisticated power management features and modes are now myriad across system components, from DRAM to processors to disks. And yet, despite these advances, typical data centers today suffer embarrassing energy inefficiencies: it is not unusual for less than 20% of a data center’s multi-megawatt total power draw to flow to computer systems actively performing useful work. These inefficiencies lead to worldwide energy waste measured in billions of dollars and tens of millions of metric tons of CO2.

Our collective narrow view “inside the box” fails to capture opportunities for energy, power, and thermal management that cut across system components or extend beyond the server to the data center’s physical infrastructure. In this talk, I first discuss the massive power wasted due to idleness—systems that are powered on, but not performing useful work—and survey techniques to reduce this waste. I then give examples of opportunities for computer system designers to impact power management of physical infrastructure like power delivery and cooling systems. I close with a call-to-arms for our community to create and disseminate the modeling tools, benchmarks, and characterizations of real-world systems that are needed to make rapid progress on system- and data-center-level power management.

Thomas Wenisch is an Assistant Professor of Computer Science and Engineering at the University of Michigan, specializing in computer architecture. Dr. Wenisch’s prior research includes memory streaming for commercial server applications, store-wait-free multiprocessor memory systems, memory disaggregation, and rigorous sampling-based performance evaluation methodologies. He is a principle developer of the Flexus full-system cycle-accurate simulation infrastructure. His ongoing work focuses on data center architecture, energy-efficient server design, and multi-core / multiprocessor memory systems. Dr. Wenisch received an NSF CAREER award in 2009. Prior to his academic career, Dr. Wenisch was a software developer at American Power Conversion, where he worked on data center thermal topology estimation. He is co-inventor on three patents. Dr. Wenisch received his Ph.D. in Electrical and Computer Engineering from Carnegie Mellon University.