Enabling Always-On Sensor Nodes Entirely Powered by Sustainable Energy Sources – Making Our World Smarter and Greener

SPEAKER:

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ABSTRACT: Aggressive shrinkage of batteries and their ultimate replacement by sustainable energy sources is a crucial goal in the evolution of the Internet of Things (IoT), in view of the massive environmental impact of their production and disposal for the expected Trillion of IoT edge devices that will be deployed in the upcoming decade. Wide power-performance adaptation down to nWs is becoming crucial in always-on nearly real-time and energy-autonomous silicon systems that are subject to wide variability in the power availability and the performance target. Wide adaptation is indeed a prerequisite to assure continuous operation in spite of the widely fluctuating energy/power source (e.g., energy harvester), and to grant swift response upon the occurrence of events of interest (e.g., on-chip data analytics), while maintaining extremely low consumption in the common case. These requirements have led to the strong demand of systems having an extremely wide performance-power scalability and adaptation, so that they can relentlessly operate without interruption in spite of the highly-uncertain power availability.

In this talk, new directions to drastically extend the performance-power scalability of digital, analog and power management circuits and architectures are presented. New directions to achieve full-system coordinated power-performance scaling across all other sub-systems are also discussed. Silicon demonstrations and trends in the state of the art of battery-light, battery-less and battery-indifferent systems are illustrated to quantify the benefits offered by wide power-performance adaptation, identifying opportunities and challenges for the decade ahead. Finally, a mm-scale integrated system that operates uninterruptedly when solely powered by moonlight is demonstrated, paving the way to a new generation of always-on systems with little or no battery. This ultimately makes our world smarter through ubiquitous always-on edge devices, and greener through the exclusive adoption of sustainable energy sources.

BIO: Massimo Alioto is with the ECE Department of the National University of Singapore, where he leads the Green IC group, the Integrated Circuits and Embedded Systems area and the FD-FAbrICS industry-sponsored lab on FD-SOI intelligent&connected systems. Previously, he held positions at the University of Siena, Intel Labs – CRL, University of Michigan - Ann Arbor, University of California - Berkeley, EPFL - Lausanne.

He is author of 300+ publications on journals and conference proceedings, and four books with Springer, including the popular "Enabling the Internet of Things – from Integrated Circuits to Integrated Systems", which is the first book published in the area of integrated system design for the edge of the Internet of Things. His primary research interests include ultra-low power circuits and systems, self-powered integrated systems, near-threshold circuits for green computing, widely energy-scalable integrated systems, circuits for machine intelligence, hardware security, and emerging technologies.

He is the Editor in Chief of the IEEE Transactions on VLSI Systems, and was Deputy Editor in Chief of the IEEE Journal on Emerging and Selected Topics in Circuits and Systems. Prof. Alioto is a Distinguished

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