ASCENT

FROM THE DIRECTORS' DESK

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Notre Dame to Lead $26 Million Multi-university Research Center Developing Next-generation Computing Technologies

In today's age of ubiquitous computing, society produces the same amount of data in only 10 minutes than it produced in the last 100 years. Experts anticipate that within the next 10 years approximately 100 years' worth of data could be created, shared, and stored in less than 10 seconds.

However, researchers and technologists must first overcome data-transfer bottlenecks and improve the energy efficiency of current electronic devices.

Researchers have been addressing these and other limitations of complementary metal-oxide semiconductor (CMOS) technology since the advent of modern computing systems.

Each initiative has brought them closer to to a solution. Yet the super exponential rise in connected devices — big data analytics in the cloud and machine learning-enabled edge devices — continues to challenge semiconductor technology researchers to come up with innovations that transcend the limits of traditional CMOS devices.

To that end, the University of Notre Dame has been selected to lead a foundational multidisciplinary research center that will share $26 million in funding from the Semiconductor Research Corporation's (SRC) Joint University Microelectronics Program (JUMP) and the Defense Advanced Research Projects Agency (DARPA) to expand the growth and leadership of the U.S. semiconductor industry, specifically increasing the performance, efficiency and capabilities of electronics systems for commercial and military applications. It is one of only six research centers to be funded as part of this prograAdditionally, at the state level, the Indiana Economic Development Corporation (IEDC) has offered to provide funding for strategic equipment, pending final approval from the IEDC Board of Directors, to support execution of the program's deliverables.

Titled the Applications and Systems-driven Center for Energy-efficient integrated NanoTechnologies (ASCENT), the new center consists of 20 faculty members

across 13 of the nation's leading research universities. According to Center Director Suman Datta, the Frank M. Freimann Professor of Engineering at Notre Dame, "We have assembled a group of globally recognized technical leaders in a wide range of areas — from material science and device physics to circuit design and advanced packaging."

Datta notes that the research agenda of ASCENT is shaped by the valuable lessons learned from work conducted by Notre Dame's Center for Nano Science and Technology (ND*nano*), as well as the Notre Dame-led Center for Low Energy Systems Technology (LEAST) and the Midwest Institute for Nanoelectronics Discovery (MIND), which stemmed from the SRC's STARnet program and its Nanoelectronics Research Initiative, respectively.

"The problems that Professor Datta and his team will try to solve are among the most challenging and important facing the electronics industry," said Thomas G. Burish, the Charles and Jill Fischer Provost of Notre Dame. "The selection committee in their feedback was highly complimentary of the vision, technical excellence, diverse talent, and collaborative approach that Suman and his colleagues have undertaken. Notre Dame is delighted to be able to host this effort."

On the Notre Dame campus, research activities will take place in the University's Nanofabrication Facility and other laboratories of Stinson-Remick Hall of Engineering. It will also occur across the country at ASCENT participating institutions: Arizona State University, Cornell University, Georgia Institute of Technology, Purdue University, Stanford University, University of Minnesota, University of California-Berkeley, University of California-Los Angeles, University of California-San Diego, University of California-Santa Barbara, University of Colorado, and University of Texas.

Sayeef Salahuddin, professor of electrical engineering and computer science at UC-Berkeley, will serve as the center's associate director. "ASCENT represents a radical departure from the norm in that we are not focusing on traditional scaling paths to improve transistor characteristics or system performance," he says. "Instead, functions such as in-memory computing, cognitive computing, and adaptive and dynamically reconfigurable microsystems will guide our efforts."

Researchers at ASCENT will pursue four areas of technology including three-dimensional integration of device technologies beyond a single planar layer (vertical CMOS); spin-based device concepts that combine processing and memory functions (beyond CMOS); heterogeneous integration of functionally diverse nano-components into integrated microsystems (heterogeneous integration fabric); and hardware accelerators for data intensive cognitive workloads (merged logic-memory fabric).

"Notre Dame has long been a leader in nanotechnology, nanoelectronics and systems technologies, from MIND to LEAST, and now we are beginning a new era of discovery and leadership with ASCENT. We are confident that the University and its partners in this center will be able to address one of the greatest energy challenges facing our world today and develop new devices, circuits, and architectures that perform faster than ever while consuming less energy," says Peter Kilpatrick, the McCloskey Dean of Notre Dame's College of Engineering.