

ICSS Research Needs: Circuit Design

Addressing the Grand Challenges listed in the 2006 International Technology Roadmap for Semiconductors (<http://public.itrs.net>) requires the focus of circuit design research in three main areas: management and optimization of circuit power and energy, design of robust circuits, and design of high-performance circuits. The SRC circuit design research needs highlight these three areas. Technology scaling results in increasingly high levels of integration, along with significantly increasing levels of leakage current. This requires a focus on power optimization that needs to be exercised at every level of circuit design from the selection of devices, to the circuit topologies used, to the methods of interconnecting the circuits. Technology scaling also results in reduced control over feature sizes and reduced reliability of devices. This requires a focus on the design of robust circuits that can tolerate the variability of device parameters due to process spread. It also requires a focus on the design of circuits that will continue to operate in the situation that all individual devices may not be functional, or in the situation where there is excessive coupling from other devices and interconnects due to the high density of implemented circuits. Technology scaling also allows the design of higher performance circuits either through increase in circuit frequency, or increase in the level of integration. This requires a focus on improving the performance of the core digital circuits, as well as addressing the issues of clock scalability that arise in highly integrated silicon ICs. In addition to these focus areas, the SRC continues to be interested in specific application areas for advanced circuit design including memory and RF circuits. The SRC also continues to strongly encourage work in topics that bridge multiple research areas including semiconductor device processing and modeling, packaging, and CAD tools.

White Papers and proposals for all the categories below will be considered for funding. Please note the categories in bold were highlighted by member companies for this 2007 solicitation as being particularly valuable to the industry.

2007 Circuit Design Needs Categories

C1	Circuit Power/Energy Management/Optimization
C1.1	Minimize circuit, device, and interconnect power; multiple voltage/multiple threshold domain designs
C1.2	Control or exploitation of gate and channel leakage
C1.3	Circuits used for power management, including regulators, converters, and controllers
C1.4	Thermal management circuitry
C1.5	Circuits techniques for energy storage
C1.6	Energy scavenging
C2	Circuit Design Robustness
C2.1	Tolerance and increased reliability for manufacturing/process variability, including random and systematic fluctuations
C2.2	Design for increasing reliability with unreliable components and soft errors
C2.3	Circuits that reduce the effects of circuit generated noise in communication system and optimize efficiency (e.g. DSP techniques)
C2.4	Noise tolerant circuits/isolation techniques and signal integrity
C2.5	Adaptive analog, digital, and memory circuits
C3	High Performance Circuits
C3.1	On-chip interconnect scaling, including high-speed signaling techniques and interconnect driven design techniques
C3.2	Circuits for high-speed communications
C3.3	Circuits for analog/RF BIST/EFT
C3.4	High performance digital circuit design
C3.5	Clocking: Scaling, multiple clock domains, and asynchronous
C4	Circuits in Advanced Technologies
C4.1	Analog/RF design in scaled "digital" technologies
C4.2	Digital circuits with low I_{on}/I_{off} in extreme scaled CMOS
C4.3	Low voltage circuit design including subthreshold design
C4.4	Circuit design techniques with advanced CMOS device structures
C5	Application Areas for Advanced Circuit Research
C5.1	Digital equivalent implementations of analog/RF circuit designs
C5.2	On-chip memory circuits
C5.3	Silicon CMOS integration and electrical interface for on-chip photonics and MEMs circuits
C6	Bridging Research Across Disciplines
C6.1	Semiconductor materials/processes/device and circuit design interactions/co-development
C6.2	Design productivity – CAD and circuit interactions
C6.3	Device modeling in advanced technologies
C6.4	Package and circuit interactions – high frequency, low noise, EMI management, cost effective packaging
C6.5	Mixed-signal isolation technologies for SoC and SiP