ICSS Research Needs: Circuit Design

Addressing the Grand Challenges listed in the 2003 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.

	2004 Circuit Design Needs Category
C 1-	**Circuit Power/Energy Management/Optimization**
C 1.1	Minimize circuit, device, and interconnect power
C 1.2	Control or exploitation of gate and channel leakage
C 1.3	Energy scavenging
C 1.4	Thermal management circuitry
C 1.5	Energy storage
C 2-	**Circuit Design Robustness**
C 2.1	Noise tolerant circuits/isolation techniques and signal integrity
C 2.2	Tolerance for manufacturing/process variability, increased defects and decreased reliability
C 2.3	Design For Reliability
C 2.4	Adaptive analog and digital circuits
C 3-	**High Performance Circuits**
C 3.1	High performance digital circuit design
C 3.2	Clocking: scalability, multiple clock domains, and asynchronous
C 3.3	On-chip interconnect scaling, including high-speed signaling techniques and interconnect driven design techniques
C 3.4	Circuits for high-speed communications
C 3.5	Circuits for analog/RF BIST/EFT
C 4-	**Circuits in Advanced Technologies**
C 4.1	Low voltage circuit design
C 4.2	Digital circuits with low Ion/Ioff in extreme scaled CMOS
C 4.3	Analog/RF design in scaled "digital" technologies
C 5-	**Application Areas for Advanced Circuit Research**
C 5.1	RF design/implementation
C 5.2	Memory circuits
C 6-	**Bridging Research Across Disciplines**
C 6.1	Device modeling in advanced technologies
C 6.2	Design Productivity - CAD and circuit interactions
C 6.3	Semiconductor materials/processes/device and circuit design interactions/co-development
C 6.4	Package and circuit interactions - high frequency, low noise, EMI management, cost effective packaging
C 6.5	Mixed-Signal Isolation Technologies for SOC and SiP