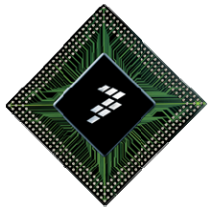
2009 GRC ETAB Summer Study
La Quinta Golf Resort, CA
June 29-30, 2009

Systems, Software, and Applications Research for the Semiconductor Industry



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Working Committee

- David Seeger, SRC
- Betsy Weitzman, FCRP
- Shahrokh Daijavad, IBM
- Steve Hillenius, SRC
- David Yeh, SRC
- Bill Joyner, SRC

Motivation

►SRC was founded in 1982 to increase fundamental research in semiconductors

"As semiconductor technology becomes more complex with VLSI (very large-scale integration), and more dependent on sophisticated processes, designs, technologies, packaging and testing, there is a clear need to channel more funds to research….. We hope that shared-research programs will encourage a broader spectrum of participation and increased research activity." Robert Noyce, Chair of the SIA

► The ETAB has been concerned with the research gaps and the fulcrum of scaling for years.

►Analogous to scaling, our definition of the systems/applications research agenda may be critical to our economic growth and the appropriate growth of academic research.

Programs started by the SRC in 2008-2009:

- Parallel Computing will become a major category of GRC research with the help of the NSF and the 2007 Summer Study.
- The creation of the GRC Texas Analog Center of Excellence (TxACE).
- The GSRC began to define a long-range research agenda for system applications.

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What should the ETAB recommend next to the BoD for the Design Sciences of the GRC?

What is the Scope of Research: Embedded Systems?

The Wikipedia definition of embedded systems comprises the software, hardware, and application research in which the GRC should be engaged.

An **embedded system** is a special-purpose computer system designed to perform one or a few dedicated functions, often with real-time computing constraints. It is usually *embedded* as part of a complete device including hardware and mechanical parts.

Embedded systems control many of the common devices in use today.

The SRC Member Companies are diverse and moving across the application spaces within embedded systems:

- Consumer electronics
- Networking and communications
- Household
- Automotive
- Transportation and industrial
- Medical Electronics
- Energy

All at reduced power and energy usage

Embedded system requirements ‘sounds like’ SoC Research …… with differences

- Resilient architectures for zero-defect operation
- Interfaces and more interfaces: between workloads, application codes, hardware, software
- Reliability, Debugging
- Optimizing power/energy management, QoS, architectures, and timing tradeoffs in the face of operating environment, (ultra low) power, and safety constraints

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- Use cases and workloads (including “synthetic workloads”) must handle cases where actual application code is unavailable
- Background research for Standards
- Model-based design: more math, more algorithms, more theory, more fundamental research for both HW and SW

HW/SW and applications research come from the nature of embedded systems

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Barriers that the ETAB must address within the Design Sciences:
Specialization of the workforce and the diversity of our market interests

- ***current embedded systems development for cyber-physical domains relies on a separation of concerns***
  - *domain experts develop applications*
  - *computing experts develop platforms*
  - *interface is handled by exchanging constraints and requirements*

- ***new characterizations of constraints and requirements are needed that***
  - *support more accurate representations of CPS workloads*
  - *offer more degrees of freedom to exploit design trade-offs across the cyber-physical interface*
  - *facilitate the design of platforms that better meet the demands of domain-specific CPS workloads*

--- from Prof. Bruce Krogh, CMU; presented at Freescale May 2009

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System, Software, and Applications Research Session II

- Vision of the Future (Needs): Prof. Jan Rabaey, Berkeley

  "The transformation of the semiconductor industry: from integrated platforms to distributed systems "

- Opportunities and New Ideas from the NSF: Dr. Ty Znati, NSF

  The NSF CISE Directorate, emphasis on CyberPhysical Systems

- The Big System: Dr. Shahrokh Daijavad, IBM

  "Application and Network Optimized Next Generation System Research"

- Consumer: Dr. Pradeep Dubey, Intel

  "Massive Data Computing in a Connected World"

- Industrial: Prof. Raj Rajkumar, CMU

  Electronic Systems Research for Automotive

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What are Your Systems/Software/Applications Research Needs?

- Don't try too hard to be consortial
- Jot down your systems/software/application research needs now….
- Each speaker will present research directions, needs, topics
  - Jot down and prepare questions
    - What can you ask that better explains their ideas for you?
    - What can you ask that gets us beyond our narrow 'separate concerns'.
- Be prepared to submit the top 2-3 for your company (whether presented or not).
- Circulate highlights (with your comments) later to your companies

Two example Precompetitive Topics from Freescale:

- How does one partition a workload so that optimal performance can be met across different processor and controller architectures including constraints such as safety critical constraints?
- Background research for standard xxxxxx that is of interest to GRC member companies.

- Backup

Embedded System Characteristics, Trends

- System functionality is enabled by ever more tightly coupled **hardware and software** that is **invisible** to the end user.
- Most embedded systems increasingly interact with the “real” **analog world,** bringing uncertainty, ambiguity, drift, hysteresis, stuck values, and nonlinear responses.
- Applications demand **robust, resilient, fault tolerant** operation without user intervention, including ability to autonomously detect, compensate, avoid, or correct anomalous conditions.
- System and application development requires extensive **cross-disciplinary** skill and collaboration including hardware/software co-design.
- Software development for chips require highly capable **compilers, assemblers and debuggers**.
- **User interfaces** range from none to complex GUI to web interface

We have entered the world of top down design