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

Session II: Systems, Software, and Applications Research for the Semiconductor Industry

Summary, Marie Burnham

- 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.

- 4 Application Spaces of future multicore systems were presented:
    - Cyber-Physical Systems (embedded plus networking) – Ty Znati, NSF
    - Hybrid (data + networking): Shahrokh Daijavad, IBM
    - Industrial (automotive): Raj Rajkumar, CMU
    - Massive data computing: Pradeep Gupta, Intel
- Trends going beyond SoC: Jan Rabaey
    - Complexity, reliability, and energy providing problems that require solutions going beyond the silicon level and top-down design.
    - Broad collaboration needed
- ETAB generally agrees that system design research needs to be more strategically guided into the GRC.
    - **Biggest Issue: 'Systems and/or Applications' Research too broad.**
    - **'Embedded Systems' (Real**-time Computing) may not be appropriate scope.
    - Appropriate research topics in right time frame appear to be definable.
        - More work needed to make specific recommendations.
    - Zero-sum funding issue not resolved.

System tools that provide an integrated strategy :
- System Verification and Synthesis including hardware, OS software and application software
- Workloads (part of both top-down and bottoms-up SoC design. Workload requirements drive design and multicore architectural decisions and validate designs)
  - Workload theory/partitioning for interfacing of silicon cores and microcontrollers to the application
  - Note: Workloads will not drive innovation for an application space
- System design, exploration and optimization tools
- On-chip tools such as debuggers, compilers (for complexity from asynchronous clocks, for example).

Architectural Research
- **Feeding the Beast "memory hierarchy design" (Research: capacity**- BW tradeoff)
  - Stacked **–** packed **–** embedded
  - Volatile **–** non-volatile **–** remote
- Manycore Scalability Research
  - Fine-grain sharing of control and data
  - Unstructured parallelism support
  - Client-server computing
- Acceleration
  - Unifying software framework to deal with accelerators in a holistic way across networking and massive data domains.
  - Domain/Application-specific
  - What lies beyond, crypto, video, texture, scatter/gather?
- Programmability, debug, and reliability support
- Resilient architectures
  - for zero-defect operation
  - Robust, fault tolerant operation without user intervention, including ability to autonomously detect, compensate, avoid, or correct anomalous conditions.

Design Complexity
- Top Down design: Model-based design: more math, more algorithms, more theory needed in face of complexity
- Comprehending emergent behavior from cyber-physical systems, for example.
- What are the interfaces of most concern across GRC membership: between workloads, application codes, hardware, software?
- Optimizing power/energy management, QoS, architectures, and timing tradeoffs in the face of operating environment, (ultra low) power, and safety constraints
- More fundamental research for both HW and SW
- Cross-disciplinary linkages between semiconductor systems research and relevant application domains

Other
- **Industry/university needs to collaborate on developing system performance metric trends**
- Background research for Standards of interest to several GRC member companies
- Interaction with the analog world (Analog design)

- Map New Multicore portfolio (25 CADTS/ICSS projects) against
  - Resiliency and concurrency
  - Other system research topics/applications
- Form TAB between ICSS and CADTS to
  - complete system/applications research topics, and their evaluation
  - **Does 'embedded systems' help restrain the topic of** systems research or not?
- Follow up on CPS joint NSF/GRC solicitation

Working Committee

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

- 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

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

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