

## Summary of the Third IEEE Rebooting Computing Summit (RCS 3)



The third IEEE Rebooting Computing Summit (RCS 3), organized by the Future Directions Committee (FDC) Rebooting Computing Initiative, was held on October 23-24, 2014 at the Hilton, Santa Cruz, CA. RCS 3 included 44 invited participants who are thought leaders from government agencies, academia and industry. RCS 3 built on the findings of the first Rebooting Computing Summit (RCS 1, Dec 11-13, 2013, Washington DC) and the second Rebooting Computing Summit (RCS 2, May 14-16, 2014, Santa Cruz), with a theme of **“Rethinking Structures of Computation”**, and focused on the topics of **Parallelism, Security, Approximation, and Human-Computer Interface (HCI)**.

On Oct. 23, Tom Conte and Elie Track, RCS 3 Co-Chairs, opened the Summit, welcomed participants and provided a recap of RCS 1 and RCS 2 followed by an introduction to the RCS 3 agenda, goals, and expected outcomes. Next, Facilitator Scott Holmes led a group discussion to restate and adjust the goals of RCS 3. This was followed by four plenary talks that focused somewhat on the software.

- **“Trust and Security in Future Computer Systems”** Neal Ziring, NSA  
The current state of computer security is not satisfactory. The key challenge is how to assure trust in computer and data systems. We need to establish standards and practices for identity and privilege in platforms and computation, including networks and the cloud. These need to be viable both economically and politically.
- **“HCI – What does the future hold for the human experience?”** Gregory Abowd, Georgia Tech.  
We have entered the 4<sup>th</sup> generation of computing, in which the distinction between computers and humans is being blurred, symbolized by *“the Cloud, the Crowd, and the Shroud”*. This will enable improved human self-sufficiency, with applications to health, navigation, education, and sustainability.
- **“Randomness and Approximation”** Dick Lipton, Georgia Tech.  
Classic computing focused on exact solutions and algorithms, but we need to create a computer culture that uses randomness and approximation more easily. Approximation can be used to reduce computing time in a variety of applications, and random sampling can be used to reduce data processing in large data sets.

- “*Rebooting Computing : Parallelism*” Pete Beckman, Argonne National Laboratory  
Present supercomputers based on massive parallelism use ~ 25 MW power, with electricity cost ~ \$25M. This may be extended to the exascale in the near term, but this approach is too expensive and inefficient. Programming of parallel computers needs to be more efficient and portable between systems, with dynamical access to processors and memory as well as tolerance of latency.

The discussion portion of the Summit, moderated by Scott Holmes, began on Oct. 23 afternoon. Participants divided themselves into four working groups

- Parallelism, facilitated by Sudip Dosanjh, (Lawrence Berkeley Laboratory)
- Approximate Computing, facilitated by Hadi Esmaeilzadeh (Georgia Tech)
- HCI, facilitated by Erik DeBenedictis (Sandia National Laboratories)
- Security, facilitated by David Mountain (NSA) and LeAnn Miller (Sandia National Laboratories)

A set of posters on related topics was presented on the evening of Oct. 23:

- Self-Authenticating Chip Architecture Using Embedded DRAM, S. Rosenblatt et al., IBM
- Memcomputing: Computing with and in Memory, Max di Ventra, UCSD & Yuriy Pershin, U.S.C.
- Optimal Adiabatic Scaling and Processor-In-Memory-and-Storage, E. DeBenedictis, Sandia
- Nanoprocessor Thermodynamics: Probing Nature's Boundary Conditions, N. Anderson, U. Mass
- Energy Efficient Cryogenic Computing for Exascale Systems, O. Mukhanov & A. Kadin, Hypres Inc.

Each of the four working groups continued their group discussions, then provided outbriefs of their respective discussions. Just before the end of the Summit, Randal Bryant of the White House Office of Science and Technology Policy (OSTP) gave a brief pre-announcement of a new inter-agency government initiative on supercomputing research, which will address many of the issues discussed during the Summit. This is expected to be officially announced in the next few months. The Summit concluded with a plenary discussion where participants shared their insights and conclusions on RCS.

The general consensus of the participants was that a Rebooting of Computing will be necessary on both the software and hardware levels. In terms of “Structures of Computation”, software should be more adaptive, portable, secure, efficient, and compatible with ubiquitous parallelism and imprecision. Throughout this 2-day Summit, the high energy level, interactive discussions of an engaging audience and the genuine and insightful contributions of all participants were key ingredients to the success of RCS 3.

The RCS 3 Final Report, as well as PDF slides and links to videos of the four plenary presentations will be posted on the Rebooting Computing Portal <http://rebootingcomputing.ieee.org> soon.