

ECTC 2011 Plenary Session

Power Efficiency Challenges and Solutions:
From Outer Space to Inside the Human Body

ECTC 2011 Plenary Session
Power Efficiency Challenges and Solutions
From Outer Space to Inside the Human Body



- M.S. in EE, Michigan State University, 1995
- M.S. in EE, University of Hanover, Germany, 1996
- Ph.D. in EECS, Massachusetts Institute of Technology, 2001
- At Intel Corporation in Chandler, Arizona, since 2001, working on research in microelectronic packaging
- More than 25 US patents
- Over 70 technical papers
- Senior Member, IEEE
- Past Chair, IEEE Phoenix Section

Session Chair

Henning Braunsch

Principal Engineer, Intel Corporation

ECTC 2011 Plenary Session
Power Efficiency Challenges and Solutions
From Outer Space to Inside the Human Body

Introduction

Why is the power efficiency problem important?

- Many microelectronic devices and systems power or energy limited
- At all levels of human activity
- Examples:
 - Communication distance
 - Computing performance
 - Economics of the Internet
 - Environmental impact
 - Thermal issues
 - Battery life
- Let's explore, but first...

ECTC 2011 Plenary Session
Power Efficiency Challenges and Solutions
From Outer Space to Inside the Human Body

Introduction (cont'd)

Food for thought!

- From Nicholas Carr's blog Rough Type (2006): *Avatars consume as much electricity as Brazilians*
- *Second World* is a popular on-line community where people navigate an "avatar" living in a virtual world
- On average 12,500 avatars are supported by 4,000 servers
- Including the individual personal computers controlling the avatars and datacenter air conditioning, assuming "always on" leads to an annual energy consumption per avatar of 1,752 kWh
- In the real world energy consumption per capita ranges from 1,015 kWh to 7,702 kWh, depending on country
- For example, the average citizen of Brazil consumes 1,884 kWh
- Hence, avatars (in about 2006) consume as much energy as Brazilians! 😊
- *"Avatars don't have bodies, but they do leave footprints."*

Acknowledgement: Jerry Bautista, Intel

ECTC 2011 Plenary Session
Power Efficiency Challenges and Solutions
From Outer Space to Inside the Human Body

Outline

Topics looked at tonight:

- Space exploration
- Supercomputing
- Datacenters
- Consumer Electronics
- Medical Implants

ECTC 2011 Plenary Session
Power Efficiency Challenges and Solutions
From Outer Space to Inside the Human Body



- Studied Physics at Reed College in Portland, Oregon
- Ph.D. in Aeronautics, California Institute of Technology, 1993
- Taught Mechanical and Aerospace Engineering at Illinois Institute of Technology
- In 1996 joined NASA's Jet Propulsion Laboratory in Pasadena, California
- Has been involved in several technology development and JPL flight projects
- Since 2009 has been Supervisor of the Power Systems Engineering Group of the Power and Autonomous Systems Section

Space Exploration

Greg Cardell

Power Systems Engineering Group Supervisor, Jet Propulsion Laboratory

ECTC 2011 Plenary Session
Power Efficiency Challenges and Solutions
From Outer Space to Inside the Human Body



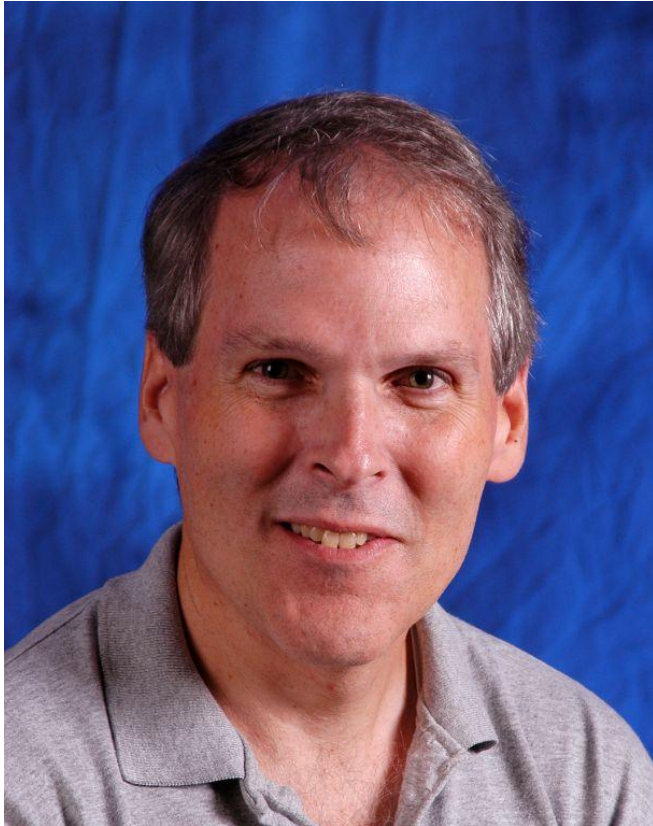
- M.S., University of Lulea, Sweden, 1996
- Ph.D., University of Utah, 2004
- Since 2001 has been with the Design Automation and Microarchitecture departments at IBM T. J. Watson Research Center
- Has developed power modeling methodologies and tools currently in use in IBM microprocessor design
- Has been part of the power modeling, design, and verification of several IBM microprocessors and test chips
- Is currently power lead for a future IBM processor chip

Supercomputing

Hans Jacobson

Research Staff Member, IBM Corporation

ECTC 2011 Plenary Session
Power Efficiency Challenges and Solutions
From Outer Space to Inside the Human Body



- M.S. in EE, Brigham Young University, Utah
- Intel Fellow and director of I/O research in Intel's Microprocessor Technology Lab, part of Intel Labs
- Joined Intel in 1992 and is responsible for circuit and interconnect research for multi-gigabit, chip-to-chip connections on microprocessor platforms
- Has been instrumental in driving consolidation of Intel's processor platform interconnect roadmap
- Pioneered fundamental circuit technology used in technologies such as PCI Express
- Holds 39 patents

Datacenters

Randy Mooney

Intel Fellow & Director I/O Research, Intel Corporation

ECTC 2011 Plenary Session
Power Efficiency Challenges and Solutions
From Outer Space to Inside the Human Body



- Joined Microsoft in 2008
- General Manager for IC Packaging, Silicon Operations, Quality and Reliability
- Covers all hardware products in Microsoft, including Xbox, Accessories, Zune, Keyboard, Mice, Webcam, Roundtable etc.
- From 1996 to 2008 was Corporate Fellow and Chief Technologist at AMD
- Led organic packaging development and manufacturing into high volume production
- Previously spent 21 years at IBM where he was Senior Technical Staff member
- Holds 50 US patents
- Published over 80 technical papers

Consumer Electronics

Raj Master

General Manager, IC Packaging, Quality and Reliability, Microsoft Corporation

ECTC 2011 Plenary Session
Power Efficiency Challenges and Solutions
From Outer Space to Inside the Human Body



- Joined Department of Electrical Engineering at Arizona State University in 2001
- Professor and Associate Dean of Research
- Director of both Connection One and WINTech research centers
- Connection One is a National Science Foundation Industry/University Cooperative Research Center established by ASU to enable an all-in-one communication device
- WINTech is research center for enabling development of fully autonomous nanoscale communication devices and systems
- Published over 100 technical papers

Medical Implants

Sayfe Kiaei

Associate Dean of Research, School of ECEE, Arizona State University