

Center for Experimental Research in Computer Systems

Georgia Institute of Technology
Ohio State University

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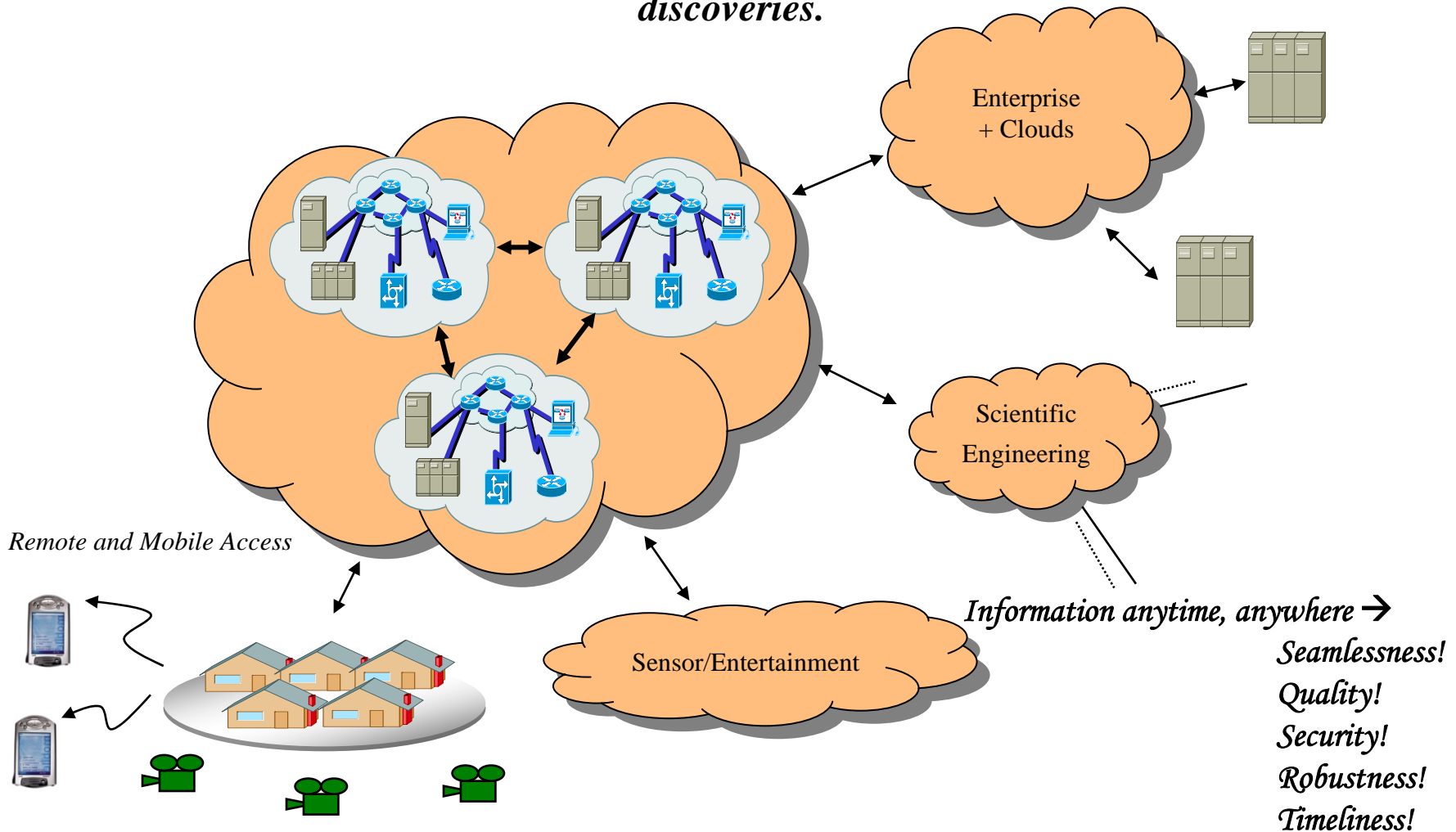
Jay Ramananathan
Rajiv Ramnath

IUCRCERCS NSF Industry University Co-operative Research Center



Mission

Lead the innovation of systems, computing, and information technologies, to further the development of the interactive and distributed information services of the future, and to create the intellectual capital that can advance these technologies and fuel future discoveries.



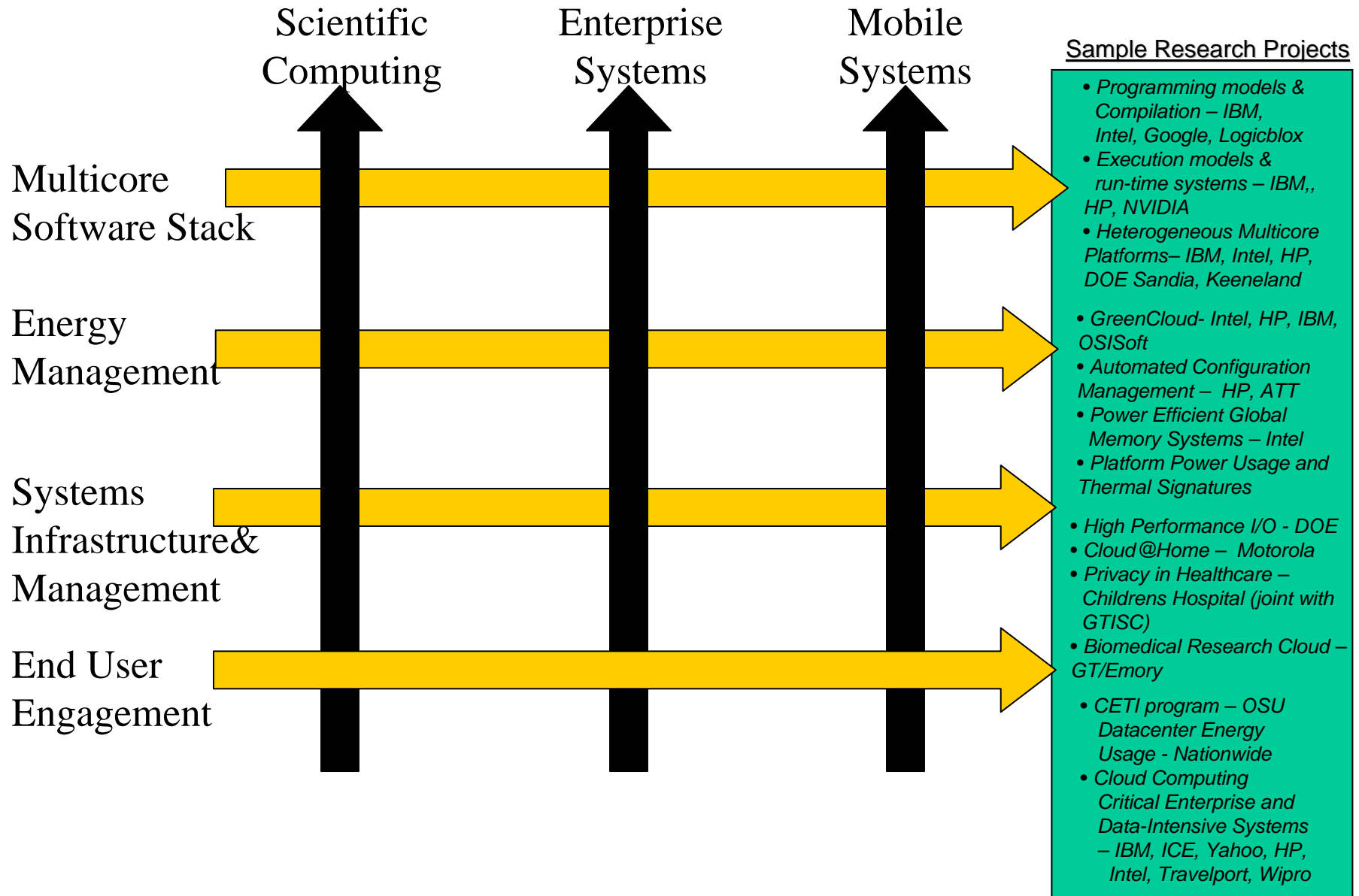


Extended Mission

- Educational:
 - Seed new curricula and serve as a curricular resource for educational institutions worldwide
 - Business models for curricular and professional education delivery
 - Training of graduate students through the administration of an extensive internship program
- Outreach:
 - Work with our alumni to create new opportunities and build networks
 - Service to the broader community



CERCS Research Thrusts

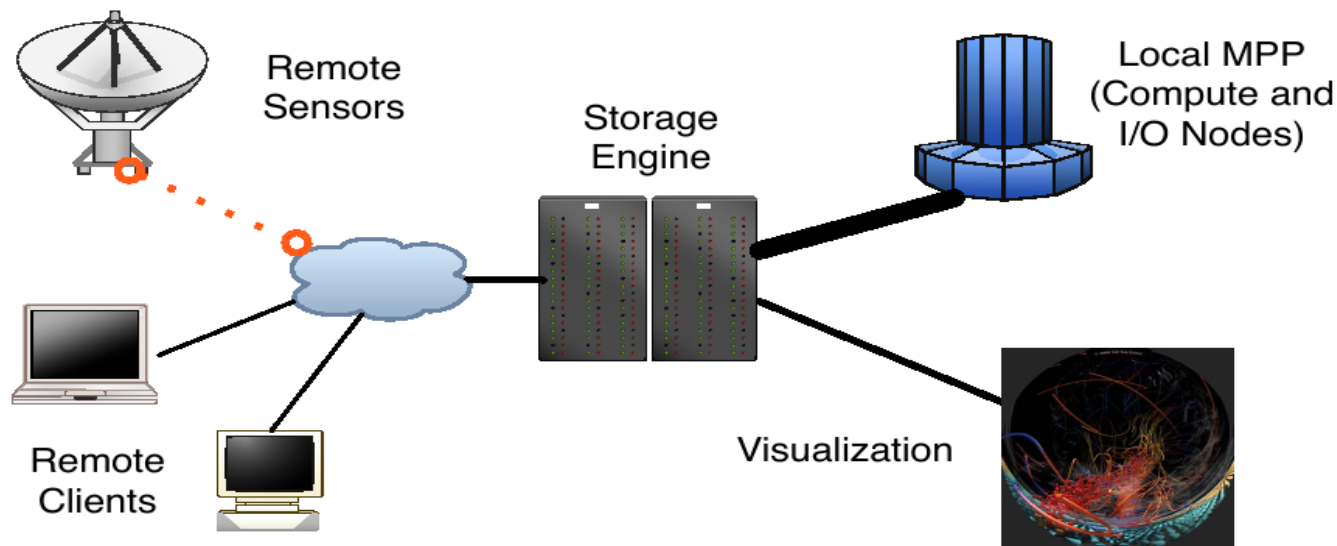




Strategic Thrusts - Highlights

– Scientific/Technical Computing – ‘Big Data’: Scalable, Reliable Access:

- **GT: IHPCL Laboratory: Intel and NVIDIA** donations *Heterogeneous Virtualized Multicore (HVM) Platforms Lab* – GPUs and newer asymmetric platforms; **Intel** multicore education - cercs.gatech.edu/multicore.
- **DOE: ORNL, Sandia:** *High Performance I/O initiative*; involvement with startups (RNet – Ohio); joint proposals, joint research/interns, joint papers, joint work with CMU.
- **IBM/Intel:** IBM OCR grant: managed multicore systems, **Intel** - HVM; **LogicBlox** (Atlanta); Benchmarks **ICE** (Atlanta).
- **News:** Exascale dimensions explored in outstanding proposals; **NSF Track II** ‘Keeneland’ heterogeneous cluster machine, Oct. installation; New awards from **DOE** ORNL; **Intel** EAPF; joint proposals with **Emory CCI** – complex data sets.

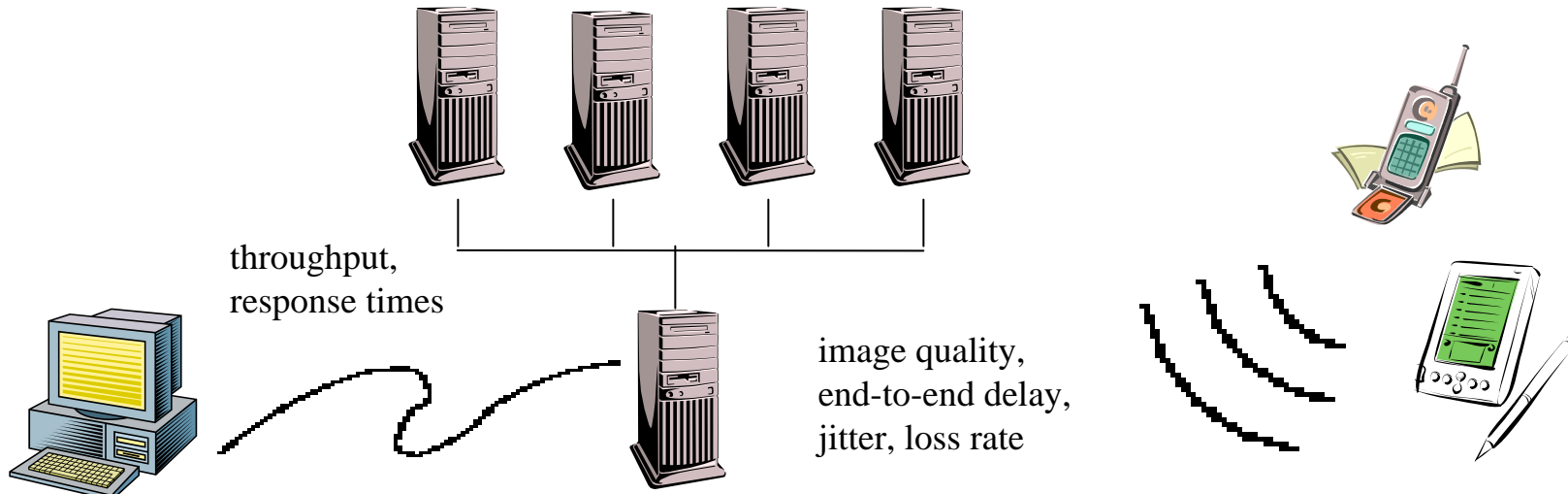




Strategic Thrusts - Highlights

– Embedded Systems/Computer Architecture: *Focus on Multicore:*

- **IBM/Intel** (asymmetric multi-core platforms; 'islands of cores'; NUCA and NUMA properties); **NVIDIA** GPU-based results (Kim, Yalamanchili).
- **Motorola/Intel**: virtualizing mobile platforms; cloud@home.
- **Federal**: pervasive applications (transportation, robotics, sensors).
- **Logicblox**: heterogeneous parallelism – data/threads and GPU acceleration.
- Samsung (Star Center) center - separate efforts
- **News**: GreenIT focus permits linkage with 'Smarter Planet' initiative (**IBM**); **Motorola** (joint with GVU and other research centers at Georgia Tech) with focus on EaaS (cloud@home): IP-TV head end used at GT; **NSF** 'Web on Demand' (Ramachandran/Essa); **NSF** CRI simulation award (Yalamanchili et al.); **NSF** GPU autotuning award; **NVIDIA** and **Intel** equipment and student fellowship awards; Gavrilovska book on high performance communications; **award** 3D die stacking (Lee).

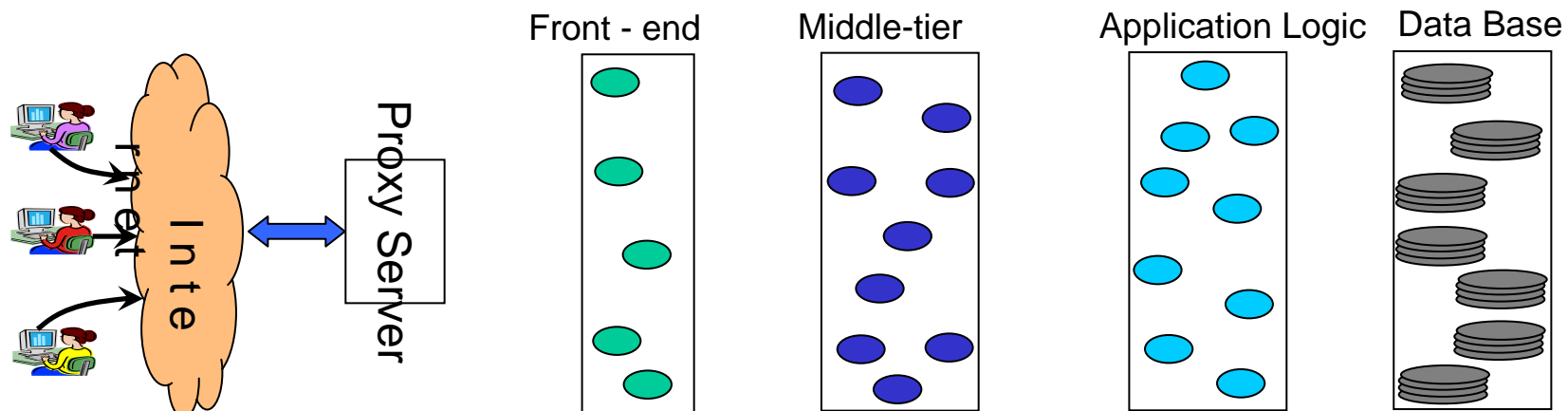




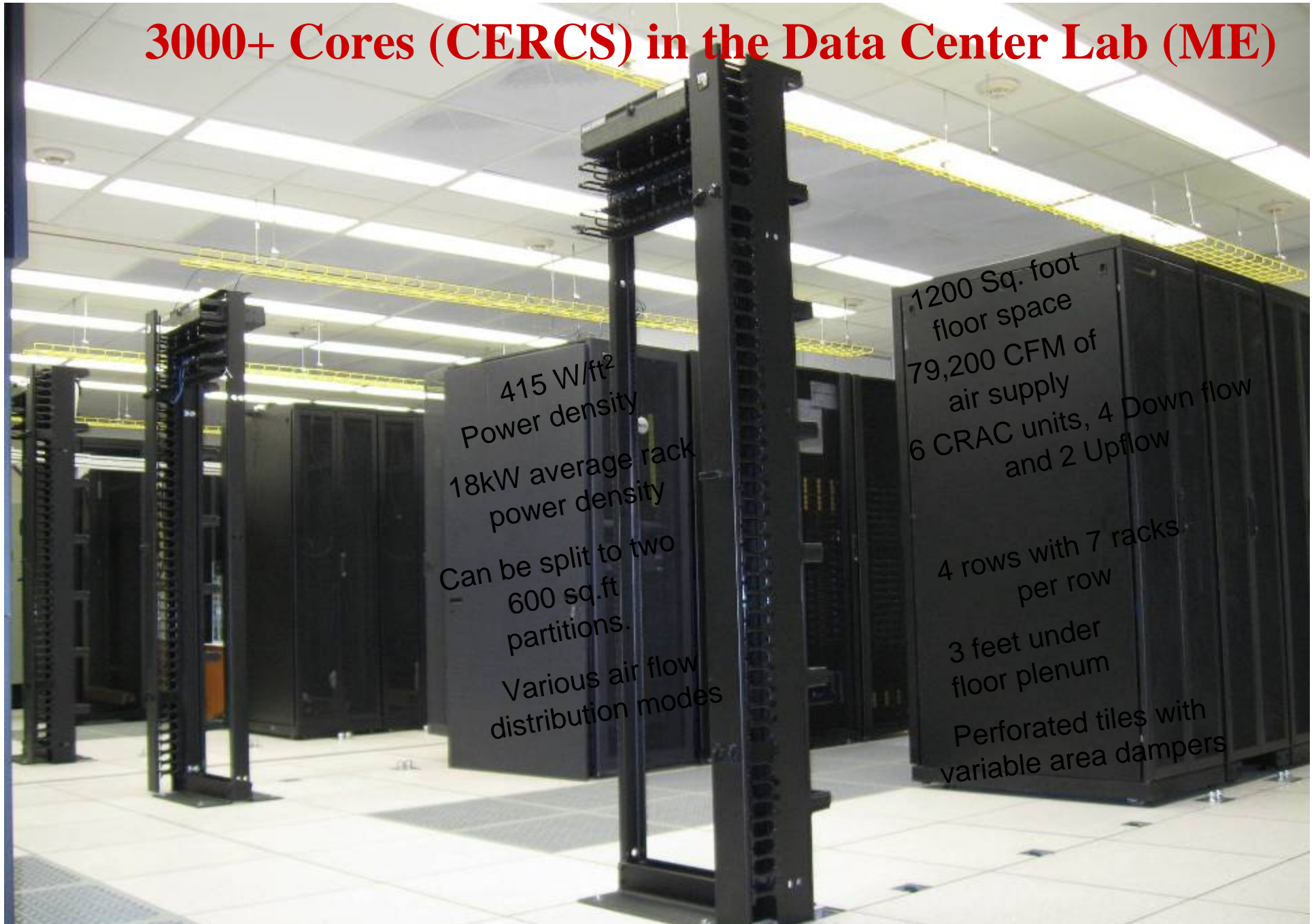
Strategic Thrusts - Highlights

– Enterprise Computing – *Clean Information: Adaptive, Trusted, Sustainable:*

- Cisco: network and device virtualization; potential joint work in cloud computing.
- **IBM, Intel, OSISoft** (critical enterprise cloud computing (CECCS); automated management in virtualized systems; SOA; I/O and hybrid platform virtualization; coordinated power management; `GreenIT` effort joint with ME; **GreenIT NSF** award to GT faculty group; new **GT TechWay** facility)
- **HP, Yahoo**: automated deployment; `monalytics` – toward exascale utility clouds, via OpenCirrus.
- **Travelport**: data caching for enterprise applications; benchmarks.
- **ICE**: high performance financial codes; testing; automated configuration management – also with **ATT Labs**.
- **VMWare**: cloud resource management; numerous summer interns.
- **Wipro**: cloud computing, and Wipro – India; **Infosys** – India; **GT India**.
- **News: GreenIT** facility operational: **NSF CRI**; **OpenCirrus** membership; **NSF**-funded projects on data privacy preserving indexing and search; `health cloud` collaboration with Center on Comprehensive Informatics (**Emory**); new **NSF** awards (e.g., debugging – Orso, spam detection - Pu); joint work with **CMU, Intel Pgh** on data-intensive applications; keynotes and invited talks by CERCS faculty; **Yahoo** student award.



3000+ Cores (CERCS) in the Data Center Lab (ME)



415 W/ft²
Power density
18kW average rack
power density
Can be split to two
600 sq.ft
partitions.
Various air flow
distribution modes

1200 Sq. foot
floor space
79,200 CFM of
air supply
6 CRAC units, 4 Down flow
and 2 Upflow
4 rows with 7 racks
per row
3 feet under
floor plenum
Perforated tiles with
variable area dampers



Strategic Thrusts - Highlights

End user engagement – CETI@OSU (Ramanathan, Ramnath)

*Vision: “Enable Enterprise Transformation with Innovations and Dissemination of Advanced Knowledge for **Service Intensive Processes**”*

- Modeling and Analysis Frameworks for Adaptive Complex Enterprises (ACE)
 - Enterprise modeling and analysis for architecture evaluation, operational improvements
 - Outputs: Reference Enterprise Architectures, Governance methods. Roadmaps, Portfolios
- Collaborative Enterprise Systems (KI) – The ‘Mirror’
 - For enabling collaboration, service composition, intelligence mining, location-based services
 - Outputs: Reference system architectures, Design of intelligent services, component models, integration architectures.
- Integrated Development Environments (IDE)
 - For developing, managing and monitoring the ACE
 - Outputs: Tools, cognitive models
- Software Engineering Research and Education (SE)
 - Agile and structured SDLC, ITIL, Technology Strategy and Management, Enterprise System Architecture Design and Evaluation
 - Outputs: Case studies, methodologies, education models, curriculum



OSC



Kiplinger

The McGraw-Hill Companies



Office of Information Technology





High Quality Engagement

Nationwide Insurance 2005-2010

Current Research

- **Data Quality Reference Architecture**
- **Data center power conservation**
- **Document management reference architecture**

Classroom and Peer-Based Learning

- **11 EA Forums**
- **Enterprise Java workshop**
- **Innovation and leadership workshop**
- **CETI Colloquia**
- **Curriculum influence of MEL program**

Collaboration metrics to-date:

- **8 research projects**
- **Interactions with 30+ local companies and CERCS at Georgia Tech.**
- **35 Nationwide personnel**
- **44 students made visible to Nationwide**
- **8 internships, 2 hire**

Next Steps:

- **Involvement in Capstone projects**
- **Professional development programs**

ities for broader impact/reach: Agrawal, Arora, Srinivasan, Stev



CETI@OSU Projects 2009-2010

- Completed:
 - Ontology-based RBAC (OSU Medical Center)
 - Data Center optimization (Nationwide)
 - Inter-Dimensional Traceability and Intelligence Mining for Complex System Improvement (City of Columbus)
 - Exploring a Framework for Goal-Driven Collaboration through Serious Gaming
 - Sense Respond Environment for Adaptive Participatory Services (City of Columbus)
 - Enterprise Architecture Ontology: A shared vocabulary for efficient decision making for Software Development Organizations (ODJFS)
 - Agility Performance Framework for education and quicker adoption (Gap Inc.)
 - Towards Metadata Driven User Interfaces (CableLabs Inc.)
- Ongoing:
 - Data quality reference architecture (Nationwide)
 - My Neighborhood Portal Architecture (City of Columbus)
 - Machine-learning approaches for Insurance Claim Fraud Detection (Grange Insurance)
 - iPod-based conversation analysis (Dept. of Communications)
 - Software Engineering Processes for Micro-Teams (MyLee Inc.)
 - Evaluating Use of Architecture Views for Software Developer Training (Kuali.org)



CERCS Personnel

- Faculty
 - Mustaque Ahamad, Mostafa Ammar, Doug Blough, George Biros, Greg Eisenhauer, Nick Feamster, Ada Gavrilovska, Jon Giffin, Alexander Gray, Mary Jean Harrold, Hyesoon Kim, Hsien-Hsin Lee, Wenke Lee, Ling Liu, Saibal Mukhopadhyay, Alex Orso, Henry Owen, Santosh Pande, Milos Prvulovic, Calton Pu, Kishore Ramachandran, Jay Ramanathan (Ohio State), Rajiv Ramnath (Ohio State), George Riley, David Schimmel, Karsten Schwan, Magda Slawenska, Rich Vuduc, Matthew Wolf, Hongyan Zha, Sudhakar Yalamanchili
- Associated Faculty/Researchers
 - Tucker Balch (GT-Robotics), Patrick Bridges (UNM), Ron Brightwell (Sandia), Irfan Essa, Byron Jeff (Clayton State), Yogendra Joshi (ME), Scott Klasky (ORNL), Tahsin Kurc (Emory), Kang Li, Sung Kyu Lim, Arthur Maccabe (ORNL), Vernard Martin (Emory), Vincent Mooney, Jeff Nichols (ORNL), Ron Oldfield (Sandia), Kevin Pedretti (Sandia), Kalyan Perumalla (ORNL), Joel Saltz (Emory), Jeff Vetter (ORNL), Patrick Widener (Emory)



Industrial Relations

- IUCR CERCS Center
 - Contributors (GT): Boeing, Cisco, Delta, **DOE**, **Fujitsu**, **HP**, **IBM**, **ICE**, **Intel**, **LogicBlox**, **Motorola**, Netronome, **NVIDIA**, **OSISoft**, **TCS**, **Travelport** (Worldspan), **VMWare**, **Wipro**, **Yahoo**, more in **Ohio**
 - Industry Workshops and Industrial Advisory Board
- Joint initiatives - e.g., Ohio State (joint curriculum/facility efforts), joint work with Emory's CCI, OpenCirrus participation, CMU/Intel Pgh. collaboration
- Internship Program
 - Amazon, ATT, CISCO, Dell, Delta, (DoCoMo), DOE (ORNL, Sandia), Google, HP, IBM, ICE, Intel, Microsoft, Motorola, NEC, NetApp, Qualcomm, TCS, TravelPort (Worldspan), VMWare, Wipro, Yahoo
- Evolving relationships:
 - **Amazon**, **ATT**, DoCoMo, Infosys, **Microsoft**, **NEC**, **NetApp**, Nokia, Qualcomm, Raytheon, RNet, Xilinx