Center for Experimental Research in Computer Systems

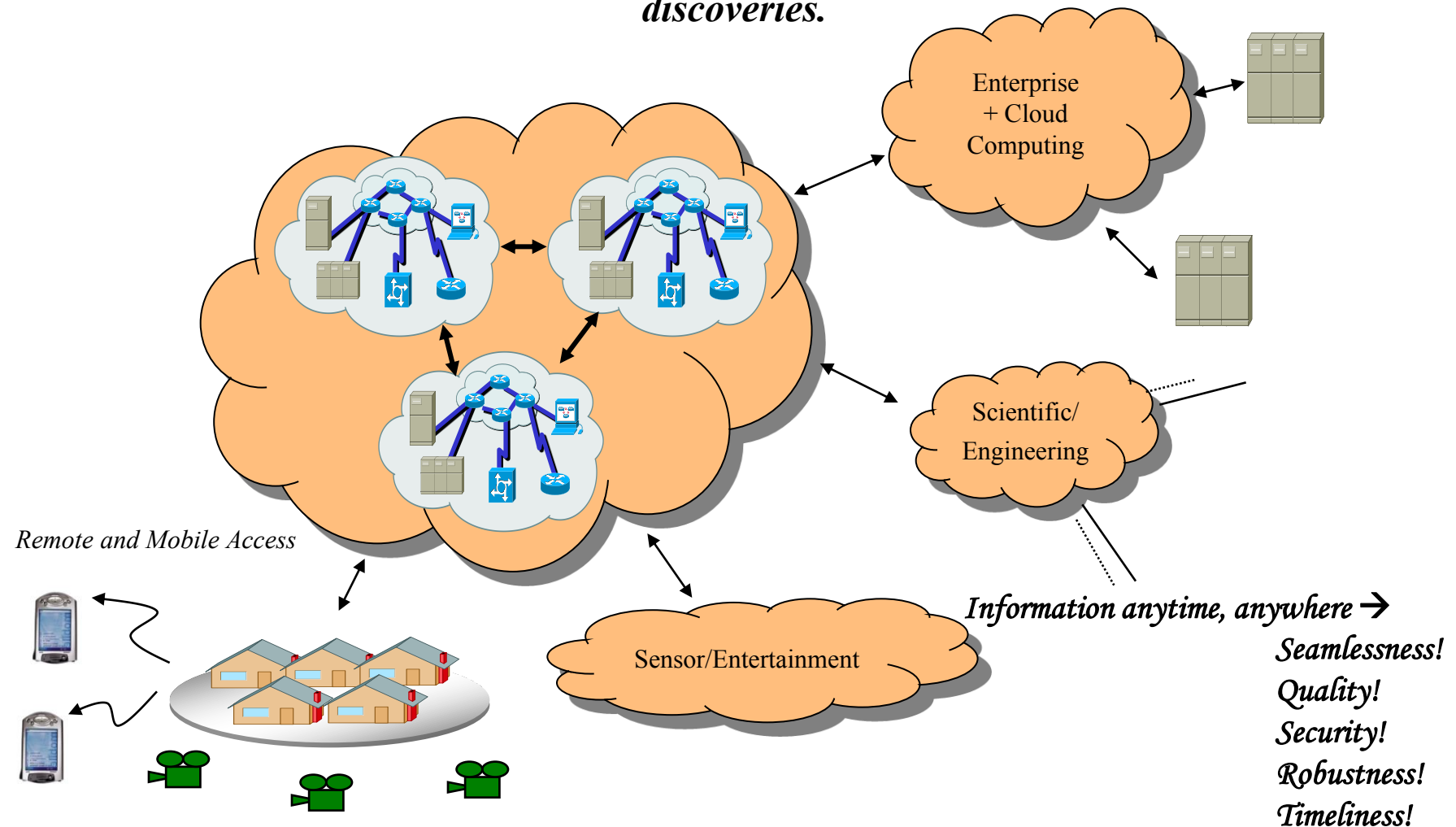## Georgia Institute of Technology
Ohio State University

Karsten Schwan, Calton Pu, Douglas Blough, Sudhakar Yalamanchili

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.

Enterprise + Cloud Computing

Scientific/ Engineering

Remote and Mobile Access

Sensor/Entertainment

Information anytime, anywhere →

Seamlessness!
Quality!
Security!
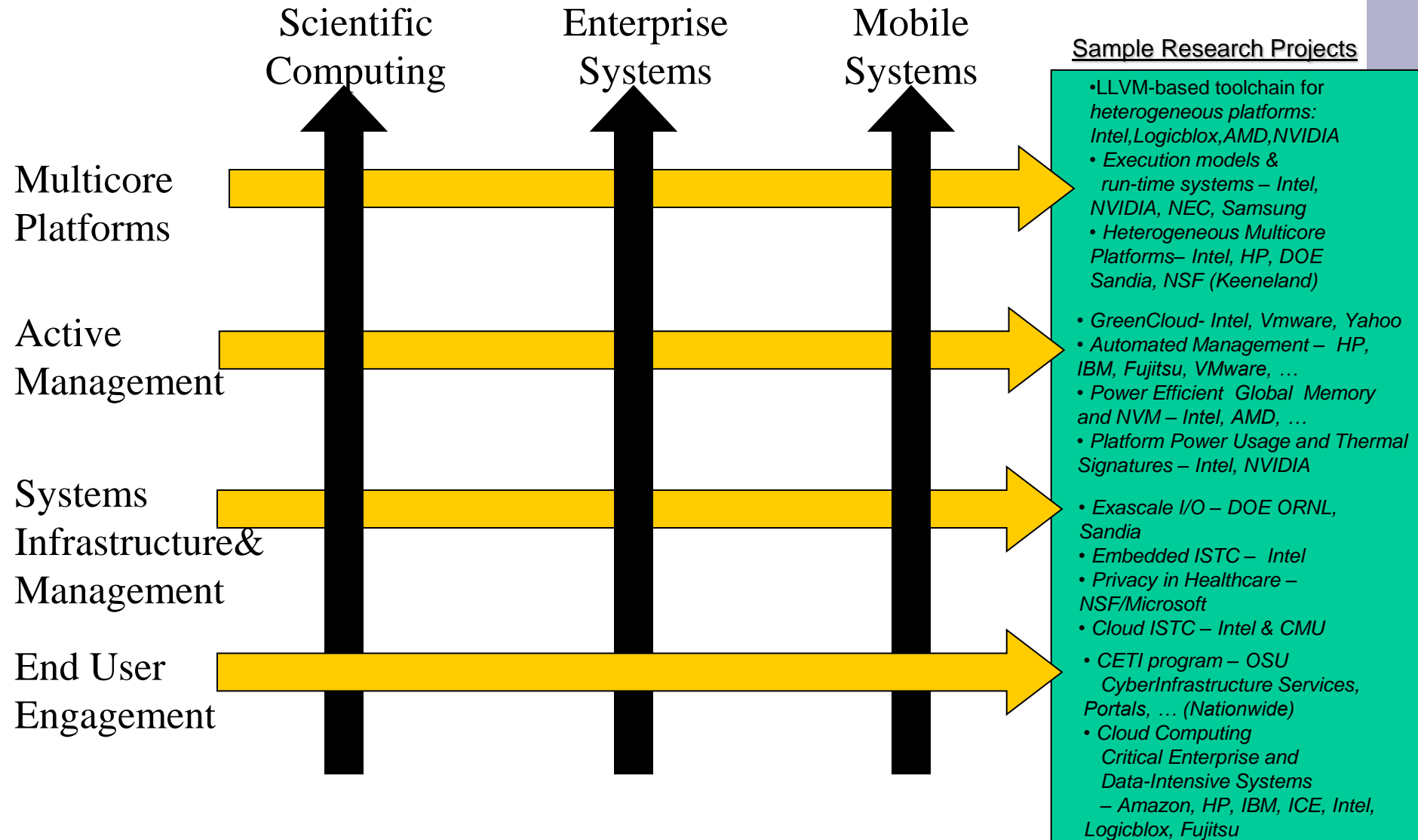*Robustness!*
Timeliness!

Extended Mission

- Educational:
  - Seed new curricula and serve as a curricular resource for educational institutions worldwide
    - Matt Wolf – Intel hackday, Yahoo hackfest
    - CETI at Ohio State (with multiple partners); Android for Dummies book: Rajiv Ramnath

  - **Training of graduate students through internships**
    - **Most of our PhD students will work with external collaborators in in Summer 2013**
    - **Many of our MS students also summer interns, including at Amazon, Avaya, Google, IBM, Intel, …**
- Outreach:
  - **Alumni: creating new opportunities and building networks**
    - **Active groups in Seattle, Portland, Silicon Valley, Boston, NY**

  - Service to the broader community
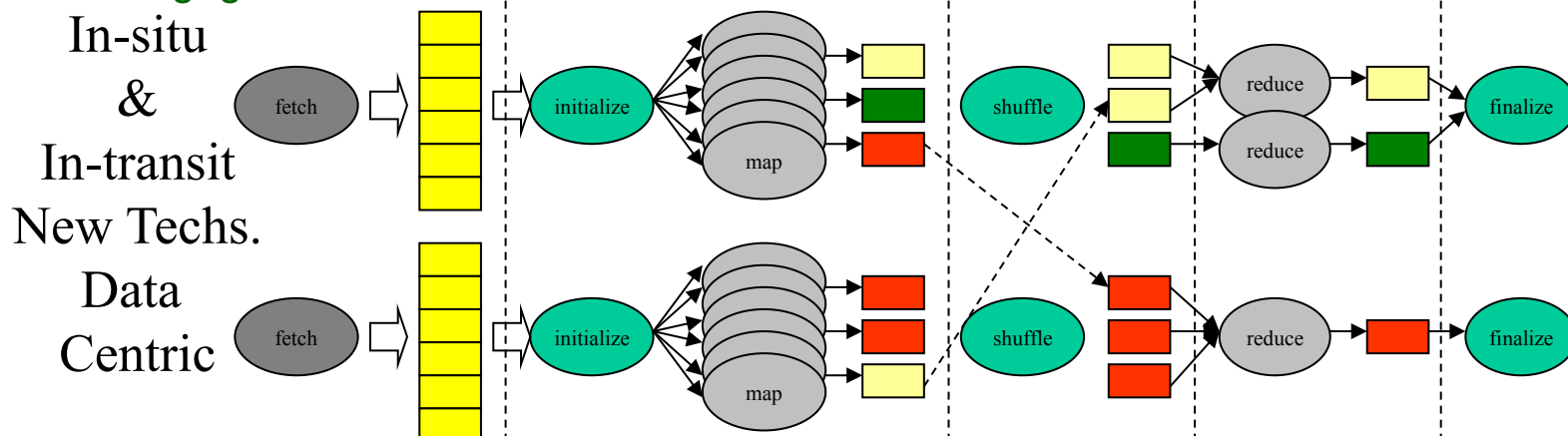   - Involvement in campus efforts: Healthcare, Cloud Computing, …

CERCS Research Thrusts

Strategic Thrusts - Update

- **Scientific/Technical Computing** – *`Big Data': Scalable, Reliable Access:*
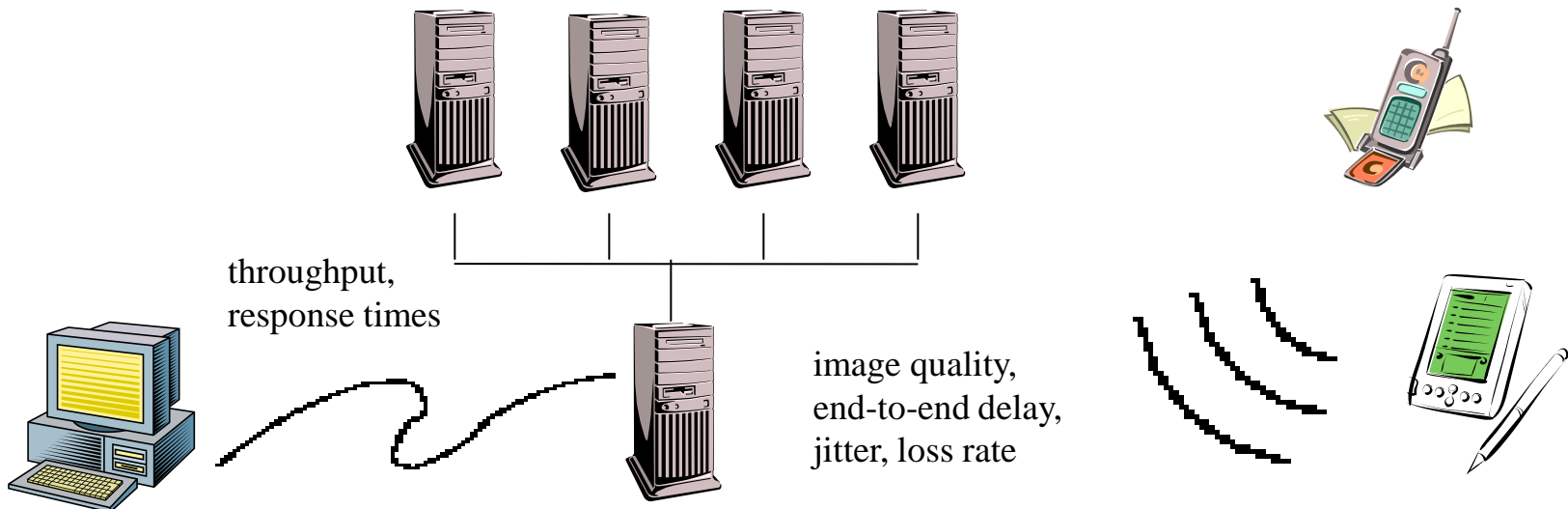
  - **Intel** processor donation, **Intel** Cloud ISTC, **NVIDIA**: *heterogeneous multicore platforms* (+accelerator-based systems); **DOE** ExaOSR engagement (**Sandia, ORNL**); **NEC Labs** interactions; **Intel** NVM award; **HP** 'Blackcomb' project collaboration (NVRAM).

  - **ORNL, Sandia, LBL, Argonne:** *High Performance I/O*: joint research/interns, joint papers: **DOE SDAV, ExACT, SDM** awards; additional work with **CMU** on 'big data'; **IBM** on data streaming (SPL); **Sandia** work on resilience.

  - `Database' operators on GPUs (**LogicBlox** – Atlanta, **NVIDIA**); Benchmarks (**ICE** - Atlanta); PGAS memory (**AIC**, **AMD**)**; DOE Sandia and Los Alamos, IBM**: toolchain and simulator development.

  - **News: NSF SSI** 'Glassbox' award first outcomes; **NSF RDAV** award engagement with Maya team; **NSF Track II** `Keeneland' machine scaled out Fall 2012; New CERCS researcher: Xuechen Zhang. Potential joint work with **DDN** Networks. Extensive **DOE** engagements.

In-situ & In-transit New Techs. Data Centric

Strategic Thrusts - Updates

- **Embedded/Operating Systems/Computer Architecture:** *Heterogeneous Multicore Platforms and Cloud2theEdge:*
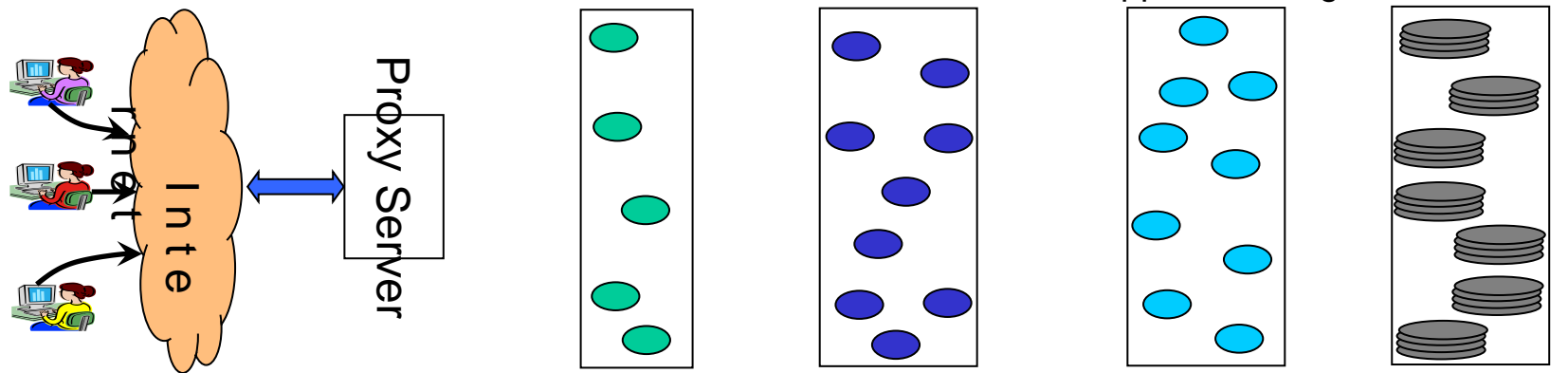 - **Intel** (asymmetric multi-core platforms (big/little cores => faster/slower memories); **NVIDIA** GPU-based investigations (Kim, Yalamanchili); **Samsung** funding.
  - **Intel (Nokia)**: Cloud2theEdge: end system/cloud interactions, engagement with UFL researchers. **Qualcomm** engagement.
  - **News: Intel EC ISTC** effort going strong,with additional collaborations with CMU researchers; Cloud@home: computation 'outsourcing' (**Intel)**, via summer interns; new publications on 'power' topics (**IBM**, **Intel**); Android-based infrastructure; **Intel** NVM usage for client platforms, with Moin Qureshi. **NSF** award for cloud mobility – Ammar/Naik/Zegura; **Google** engagement.

throughput, response times

image quality, end-to-end delay, jitter, loss rate

- **Enterprise and Cloud Computing – *Dynamic Information: Adaptive, Clean, Sustainable, Trusted:***
  - **HP,** IBM**, Intel Cloud ISTC, VMware:** automated management in virtualized systems; QoS Clouds; I/O and hybrid platform virtualization (now also involves Japanese collaborators); IB bypass; 'Monalytics': additional work planned with **Amazon** (Summer 2013), interest from **IBM**; heavily leveraging **OpenCirrus** facilities; **ATT Labs** joint effort on black box monitoring.
  - '**GreenIT**' joint effort and facility with ECE and ME faculty; **Yahoo** donations. **VMware** cloud infrastructure support, plus joint work on IB and online management.
  - Travelport**:** data caching for enterprise applications; benchmarks.
  - **ICE:** high performance financial codes (Nectere benchmarks); **VMware**: cloud benchmark suite (Xerxes).
  - **Data-intensive systems and infrastructures**: **Intel Cloud ISTC, IBM SPL, startups, …**
  - **Fujitsu:** cloud computing; Infosys, Wipro – India.
  - **News**: 'Big Data' track in upcoming ICAC conference (with **HP**); Calton Pu, ICAC PC chair (with Vmware); **ACM Middleware** 2013 in Beijing, Karsten Schwan, PC chair. Book published (Prof. Joshi -ME); **OpenCirrus** joint proposal pending, **OpenStack/Xen** cloud on 1000+ cores; **DARPA** funding on clean information; Scalable Flume benchmark suite, with online auto-conf and Troubleshooting annotated biblio; CERCS **NSF** IUCRC research project (Liu, Blough, **Microsoft**). **IEEE** Technical Achievement award to Prof. Ling Liu. Excellent results with **Intel** Cloud ISTC.

Front - end   Middle-tier   Application Logic   Data Base

Proxy Server

Inte

CERCS Personnel

- Faculty
  - Mustaque Ahamad, **Mostafa Ammar**, **Doug Blough, Greg Eisenhauer**, Nick Feamster**, Ada Gavrilovska**, Mary Jean Harrold, **Hyesoon Kim**, Hsien-Hsin Lee, Wenke Lee, **Ling Liu**, **Saibal Mukhopadhyay**, **Mayur Naik**, Alex Orso, **Santosh Pande**, Milos Prvulovic, **Calton Pu**, **Moin Qureshi**, **Kishore Ramachandran**, **Jay Ramanathan** (Ohio State), **Rajiv Ramnath** (Ohio State), George Riley, David Schimmel, **Karsten Schwan**, **Magda Slawenska**, Chris Stewart (Ohio State), Rich Vuduc, Matthew Wolf, **Sudhakar Yalamanchili**, Hongyan Zha, **Xuechen Zhang**.

- Associated Faculty/Researchers
  - **Hasan Abbasi** (ORNL), Tucker Balch (GT-Robotics), Patrick Bridges (UNM), **Ron Brightwell** (Sandia), Alexander Gray, Irfan Essa, **Yogendra Joshi** (ME), **Scott Klasky** (ORNL), Tahsin Kurc (Emory), Kang Li, Sung Kyu Lim, **Jay Lofstead** (Sandia), Arthur Maccabe (ORNL), Vernard Martin (Emory), Vincent Mooney, Henry Owen, Jeff Nichols (ORNL), **Ron Oldfield** (Sandia), **Kevin Pedretti** (Sandia), Kalyan Perumalla (ORNL), Joel Saltz (Emory), **Jeff Vetter** (ORNL), **Patrick Widener** (Sandia), **Weikuan Yu** (Auburn), Zlatko Zografski (USC).

Industrial Relations

- IUCR CERCS Center
  - Contributors (GT): **AIC**, **AMD**, Boeing, Cisco, Delta, **DOE**, **Fujitsu**, **HP**, IBM**, ICE, Intel, LogicBlox,** Motorola, Netronome**,** Nokia, **NVIDIA,** OSISoft, **Samsung**, TCS, Travelport (Worldspan), **VMware,** Wipro**, Yahoo,** many more at **CETI-Ohio**
  - Industry Workshops and Industrial Advisory Board

- Joint initiatives - e.g., Ohio State (joint curriculum/facility efforts), OpenCirrus participation, CMU/Intel ISTC collaboration, …

- Internship Program
  - **Adobe**, **Amazon**, **Avaya**, ATT, CISCO, Dell, Delta, **DOE** (ORNL, Sandia), **Google**, **HP**, **IBM**, ICE, **Intel**, **Microsoft**, (Motorola), **NEC** Labs, NetApp, Nokia, **QualComm**, Samsung, SRI, TCS, TravelPort (Worldspan), **VMware**, Wipro, Xerox, **Yahoo**

- Evolving relationships:
  - **Amazon**, **ATT**, Infosys, **Microsoft**, **NEC**, **NetApp**, **QualComm**, Wipro, Xilinx.