Signal Processing Research for Communications

ICASSP 2005 Special Panel

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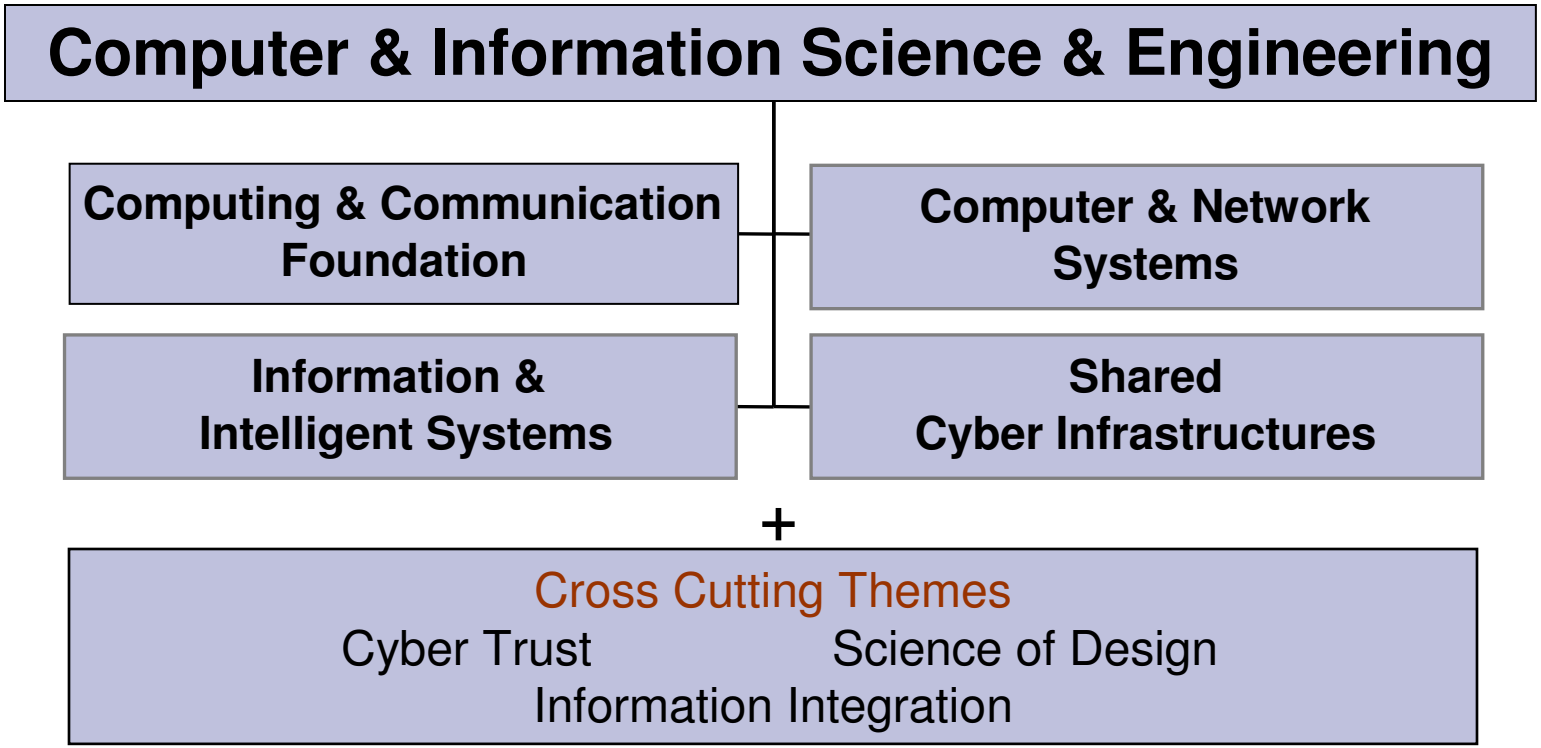
The Reorganized CISE



Key Concept: Clusters

- Comprehensive activity in coherent area of research and education
- Teams of Program Officers and Staff working closely with community
- Initially: groups of existing programs
- Eventually: ***one program per cluster***

Computing & Communication Foundations (CCF)

- **Theoretical foundations (TF)**
  - Theory of computing; computational algebra and geometry; **communications; signal processing**
- **Foundations of computing processes and artifacts (CPA)**
  - Software engineering; software tools for HPC; programming language design; compilers; computer architecture; graphics and visualization
- **Emerging models and technologies for computation (EMT)**
  - Computational biology; quantum computing; nano-scale computing; biologically inspired computing

TF - Communications Research

- Information Theory
- Source/Channel Coding, Encryption, Modulation
- Receiver Design
- Multiuser Communication Theory
- Cross-Layer Issues in Networks with a Physical Layer Emphasis
- Channels: MIMO, UWB, Optical, Bio, …

TF – Signal Processing

- 1-D and MD signal processing including image compression and enhancement
- Statistical signal and array processing
- (Wireless) multimedia signal processing
- Collaborative/distributed signal processing
- Biometric, biomedical and related applications

SP for COM - Current Topics

- Signaling and Receiver Design for
  - CDMA Systems
  - MIMO Wireless Links
  - OFDM Systems
  - UWB Communications
- Cross-layer Design for Wireless Networks
- Collaborative/Distributed Signal Processing for Sensor Networks
- Others

Some Challenges/Questions for Immediate Future

- **Mobile Cellular Wireless**
  - Cellular voice – a solved problem?
  - **Challenge:** reliable, high rate communication for multimedia
  - But how much do we need? Do we want users on the highway watching video?
  - **Challenge:** better interfaces to process information in mobile environment

Some Challenges/Questions for Immediate Future (Cont.)

- **Indoor Wireless, WLANs, WiFi**
  - **Challenge:** match wireline capacity/quality
  - MIMO, relaying, etc. are getting us there?
  - The role of UWB?
- **Ad Hoc Wireless**
  - **Challenge:** transport capacity that scales well with number of nodes
  - Cross-layer design, relaying, user cooperation?

Some Challenges/Questions for Immediate Future (Cont.)

- **Collaborative/Distributed Signal Processing for Sensor Networks**
  - Joint design/optimization of communication and sensing/actuation
  - **Challenge:** Energy aware processing
  - To network or not?
  - Killer applications?

Some Future Challenges

- **Impact of the "glass-wired world"**
  - Signal processing for new applications enabled by fat data pipes – virtual reality, telepresence, enhanced reality, etc.
  - Signal processing at the **interface** to allow humans to effectively process information
    - **fresh look** at speech and vision

Some Future Challenges (cont)

- **Broadening Scope and Support Through Cross-Disciplinary Research**
  - Control – distributed control, control over networks
  - Biology – bioinformatics, genomics, inter- and intra-organism communication
  - Materials – “smart materials” that respond to sensor measurements
  - Other areas