Networking and Security Research Center at Penn State

nsrc.cse.psu.edu

Professor Thomas F. La Porta, Director

Department of Computer Science and Engineering
Networking and Security Research Center - Goals

For Penn State
- Build relationships with Industry
- Define interesting and realistic research problems
- Diversify research collaborators
- Expose students to industrial research environments
- Increase impact of research

For companies
- Build relationship with Professors and students
- Develop new collaborations to solve interesting problems
- Partner on proposals
- Access to wide area of expertise

Members
- Telcordia Technologies (Full)
- Raytheon (Associate)
Center Expertise

By Project
- **Wireless networking**
  - telecommunications
  - mobile Internet
  - ad hoc networking
- **Wired networking**
  - quality of service and scheduling
  - admission controls and pricing
- **Security**
  - spans wireline and wireless
- **Application specific networks**
  - sensor networks

By Area
- **Performance**
  - modeling
  - simulation
- **Networking software**
  - protocols
  - large software systems
- **Communications**
  - communication theory
  - access protocols
- **Distributed systems**
  - fault tolerance
  - distributed applications
Networking Research Center

Spans Colleges and Departments

- College of Engineering
  - Computer Science and Engineering
  - Electrical Engineering
- School of Information Sciences and Technology

Members

- Telcordia Technologies (Full)
- Raytheon (Associate)

Diverse Expertise

- Software systems and protocol design
- Performance analysis and optimization
- Network security
- Communications

Industrial Experience

- Many members have worked in industry and actively consult

Well Funded

- Many individual & joint grants (NSF, DARPA, ONR, PDG, DOE, Industry)
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Tom La Porta – Professor, CSE

**Education**
- PhD, Columbia University, Electrical Engineering

**Background**
- Director of Mobile Networking Research at Bell Labs until 2002

**Professional Activities**
- Founding Editor-in-Chief, *IEEE Transactions on Mobile Computing*
- Past Editor-in-Chief (Senior Advisor), *IEEE Personal Communications*
- Steering Committee, *IEEE Transactions on Networking, IEEE TMC*
- General Co-Chair: *ACM Mobicom 2005*
- Program Co-Chair: *IEEE ICNP 2004*

**Awards**
- Bell Labs Fellow
- IEEE Fellow
- Bell Labs Distinguished Technical Staff Award

**Expertise**
- Mobile networking, wireless networking, telecommunication networks, signaling and control, protocol design

**Support**
- Pittsburgh Digital Greenhouse
- DARPA/ONR MURI (subcontract through ARL)
- CISCO URP
Tom La Porta – Projects

• Evolution of all-IP Mobile Networks
  – Network architectures and protocols for 3G/Mobile Internet interworking

• Secure all-IP Mobile Telecommunication Networks
  – Combat threats (exploit) introduced by interfaces to IP networks

• Mobile Multilayered IPSec
  – Improves security and performance in wireless, mobile networks

• Secure Data Dissemination for sensor networks
  – Efficient key distribution in constrained environments

• Heterogeneous ad hoc relay networks of agile radios
  – New architecture to improve performance and capacity

• Node mobility for Robust Mission-Oriented Sensor Networks
  – Deployment and relocation strategies for sensors
Guohong Cao – Associate Professor, CSE

Education
- PhD, Ohio State University, Computer Science

Professional Activities
- Associate Editor, *IEEE Transactions on Mobile Computing*
- Associate Editor, *IEEE Transactions on Wireless Communications*
- Program committee of *IEEE ICDCS, ACM MOBICOM, IEEE ICNP* and *IEEE INFOCOM*

Awards
- Presidential Fellowship at the Ohio State University
- NSF CAREER, 2001

Expertise
- Mobile computing, wireless networks, and distributed fault-tolerant computing, resource management and data dissemination in mobile environments

Support
- NSF ITR
- NSF CAREER
- NSF CNS
- PDG
- DARPA/ONR MURI (subcontract through ARL)
Guohong Cao – Projects

- **Collaborative Data Access in Mobile Ad Hoc Networks**
  - Improves performance and efficiency in constrained environments
- **Controllable Node mobility for Robust Mission-Oriented Sensor Networks**
  - Deployment and relocation strategies for sensors
- **Mobile Multi-layered IP Security**
  - Improves security and performance in wireless, mobile networks
- **A Data-Centric Framework for Target Tacking and Data Dissemination in Sensor Networks**
  - New architecture enabling mobility and improving robustness
- **Secure Wireless Sensor Networks**
  - Defend against node compromises; self-healing mechanisms for sensor networks
- **Designing Efficient Resource Management Schemes to Support Integrated Services in Mobile Computing Systems**

- **Efficient Power Aware Data Access in Pervasive Computing Environment**
Wang-Chien Lee – Associate Professor, CSE

Education
- PhD, Ohio State University

Background

Awards
- Achievement Award: GTE/Verizon Laboratories Incorporated (1999).

Professional Activities
- Steering Committee: International Conference on Mobile Data Management
- TPC Member (2005): ICNP, ICDE, ICDCS, SAC, VLDB (Demo)

Expertise
- Pervasive Computing, Wireless Networks, Network Services, Data Management, TMN

Current & Past Support
- NSF, GENUITY, RGC (Hong Kong)
Wang-Chien Lee - Projects

• Location-Based Information Access in Pervasive Computing
  – Investigate new ways of indexing and caching spatial data in support of location based services in pervasive computing environments.

• Semantic Small World: A Multi-Dimensional Overlay Network
  – Design of a multi-dimensional overlay network, called semantic small world (SSW), that facilitates efficient semantic based search in P2P systems.
  – SSW is adaptive to distribution of data and locality of interest; is very resilient to failures; and has great load balancing property.

• Protocols and Services for Location-Aware Wireless Sensor Networks
  – Design of a suite of protocols, algorithms and services to provide energy-aware, time-efficient, robust and scalable location-aware wireless sensor networks.
  – Tackled research issues include communication collisions, communication voids, packet losses, location errors, scalability, service latency and validity of services.

• Automata-Based XML Access Control for Networked Computing
  – Design of a new XML access control mechanism, called QFILTER, for Internet-scale networked information systems.

• Secure Wireless Data Broadcast
  – Development of new air indexing and key management techniques to address the security concerns in wireless data broadcast systems.
Patrick McDaniel – Assistant Professor, CSE

Director of the Systems and Internet Infrastructure Security Lab: http://siis.cse.psu.edu

Education
- PhD, University of Michigan, Electrical Engineering and Computer Science

Professional Activities
- Program Chair, 15th USENIX Security Symposium, August 2005.
- Vice-Chair, Security and Privacy Track, 14th World Wide Web Conference (WWW), May 2005.
- Associate editor, ACM Transactions on Internet Technology (TOIT), April 2004-present.
- Program Chair, Industry Track, 11th ACM Conference on Computer and Communications Security (CCS), November 2004.
- Program Committee Member (2005): ESORICS, ACSAC, CCS (I&G), ICIS, ACM EC SACMAT, SNS

Expertise
- Systems security, security policy, network security, digital rights management, digital content and public policy, network management, applied cryptography, privacy

Past and Current Support
- NSF (EMIST)
- DARPA (Dynamic Coalitions Program)
- USAF (P2INGS)
Patrick McDaniel – Projects

- **Searching for Privacy: Design and Implementation of a P3P-Enabled Search Engine**
  - Extending search engines to support privacy-enhanced web surfing

- **On the Performance, Feasibility, and Use of Forward Secure Signatures**
  - Understanding the use and cost of sophisticated FSS crypto construction

- **Analysis of Communities of Internet in Data Networks**
  - Understanding interrelationships between users, hosts, and service locality

- **Path Validation in Interdomain Routing**
  - Design and application of efficient constructions for secure path discovery and validation on the Internet

- **Internet Origin Disturbances**
  - Route announcement wave-fronts cause odd oscillation, explanation and characterization

- **Collaborative Research: Flexible, Decentralized Information-flow Control for Dynamic Environments**
  - Extending strong language type-safety to distributed environments
Sencun Zhu – Assistant Professor, CSE and IST

Education
– Ph.D. in Information Technology from George Mason University (Aug. 2004)

Expertise
– Network and system security
– Wireless ad hoc and sensor networks
– Peer-to-peer computing
– Performance evaluation

Professional activities
– TPC members for ACM SASN’04, SASN’05, IEEE ICPADS 2005

Support
– Research funded by: NSA, Lucite, DoD, MITRE
Sencun Zhu – Projects

- **Security and reliability for sensor networks**
  - Key management framework that supports in-network processing as well as localizes the impact of node compromises
  - Authentication scheme for filtering of injected false data packets by compromised sensor nodes
  - Detection and revocation of compromised sensor nodes
  - Multicast protocols for reliable and secure distribution of bulk data (e.g., remote sensor re-tasking)
  - Security and privacy for data-centric sensor networks

- **Security for ad hoc networks**
  - Pairwise key establishment for private and secure two-party communication
  - Group key management for secure group-orient communication
  - Network access control for combating resource consumption attacks
  - Traceback of compromised nodes in mobile ad hoc networks

- **Secure multicast**
  - Multicast source authentication for resource-constrained nodes
  - Secure and resilient overlay multicast

- **Countering DoS attack**

- **Preventing email worm spreading**
George Kesidis – Associate Professor, EE and CSE

**Education**
- Ph.D. in EECS from U.C. Berkeley

**Background**
- 1992-2000: prof. in E&CE Dept, University of Waterloo, Canada
- 1999: sabbatical with Nortel Networks, Ottawa
- 2001: part-time technical staff at Mahi Networks

**Professional Activities**
- IEEE INFOCOM’07 TPC co-chair

**Expertise**
- queuing, optimization, scheduling, traffic shaping, quick simulation, performance evaluation and testing, traffic and network measurement and modeling

**Support**
- NSF ITR Routing of Dynamic SLAs: Internet economics, pricing, billing, traffic control
- NSF ITR Surveillance networks
- DARPA/ONR Emerging Surveillance Plexsus (ESP): mobile sensor networking
- DHS/NSF Evaluation Methods for Internet Security Technology (EMIST)
- Cisco Ltd URP (2003): Internet forensics
George Kesidis - Projects

- **Dynamic SLAs: Internet economics, pricing, billing, traffic control**
- **Evaluation Methods for Internet Security Technology (EMIST) (ongoing)**
  - Testbed and methods – part of a major NSF initiative
- **Dynamic quarantine of misbehaving flows**
  - Detect and isolate non-conforming TCP flows
- **Surveillance networks (ongoing)**
- **Emerging Surveillance Plexsus (ESP): mobile sensor networking (ongoing)**
- **Other**
  - residential broadband access, wireless relay systems, Internet forensics
Aylin Yener – Assistant Professor, Electrical Engineering

Education
- PhD, Wireless Information Network Laboratory (WINLAB), Rutgers University

Background
- 2000- 2001, Assistant Professor, EECS Dept., Lehigh University
- Research group at Penn State (2002-Present): WCAN@PennState, Wireless Communications and Networking Laboratory:

Professional Activities
- 2001- Present, Editor, IEEE Transactions on Wireless Communications
- Co-chair, Asilomar Conference Communications Track (2005); Co-chair, WirelessCom Symposium on Information Theory (2005); TPC member in IEEE Globecom, IEEE ICC, IEEE VTC (yearly)

Awards
- NSF CAREER Award 2003
- P.C. Rossin Endowed Assistant Professorship at Lehigh University, 2001

Expertise (http://labs.ee.psu.edu/labs/wcan)
- Physical layer optimization of multiuser systems; cross-layer design; CDMA systems, MIMO, relay networks

Support
- Current: National Science Foundation
- Current: Pittsburgh Digital Greenhouse
- Completed: USMC, AT&T Foundation, BenFranklin
Aylin Yener – Projects

- **Multiuser MIMO systems**
  - Design of transceivers to realize the potential capacity that multiple antenna systems offer in an environment where multiple simultaneous MIMO users transmit.

- **Throughput/Capacity enhancement for single and multiple antenna CDMA systems**
  - Performance enhancement techniques that employ adaptive beamwidth directional antennas
  - Performance optimization of MIMO-CDMA uplink by signature and beamformer design.
  - Throughput enhancement for data-centric downlink via user scheduling.

- **Secure physical layer design for multiuser systems**
  - Transmit waveform, multiaccess strategy, and power allocation for secure wireless communications. User strategies in response to various jammer and eavesdropper capabilities.

- **Relay networks/Hybrid networks and cooperative communications**
  - Physical layer design for networks that relay information on behalf of other nodes, network formation, transmission strategies, impact of physical layer on MAC/routing.
  - Distributed resource allocation algorithms.
  - User cooperation strategies, multiuser relay networks.

- **Cross-layer design for AdHoc wireless networks and wireless sensor networks**
  - Power control for multi-hop AdHoc networks, the impact of optimum physical layer design on MAC and network layers for AdHoc networks
  - Physical layer inspired techniques for lifetime maximization for sensor networks.

- **RFID networks**
  - Algorithm design to dramatically reduce tag collisions and interference for low power RFID networks with communication delay constraints.
Chita Das - Professor, CSE

Education
- Ph.D., University of Louisiana

Background
- IIT Kharagpur (India)
- Joined Penn State in 1986

Awards
- IEEE Fellow
- Best Paper Awards (ICPP, ICDCS, PRDC)
- CSE Dept Teaching Award

Expertise
- communication networks & communication mechanisms; resource management (scheduling); QoS support in clusters and Internet; mobile computing; performance evaluation; parallel distributed computer architectures; clusters; fault-tolerant computing

Support
- NSF (scheduling, QoS, Infrastructure), Unisys (performance)
Chita Das - Projects

- **Dynamic Quarantine of Unresponsive TCP Flows**
  - Detect and isolate non-conforming TCP flows
- **Adaptive AQM Schemes for Internet and Wireless Networks**
  - Improve performance of Internet and limited wireless networks
- **QoS Provisioning in InfiniBand Architecture (IBA) for System Area Networks**
  - Design and analysis of IBA-style SANs
- **Scalable and Efficient Scheduling Techniques for Clusters**
  - Aims at developing practical scheduling techniques for large clusters
- **Performance Analysis with Commercial Workloads**
  - Analysis of TPC-C workloads
- **Design of Cluster-based Datacenters**
  - Design of 3-tier data centers on cluster platforms
- **Design and Analysis of System-on-Chip (SoC) Interconnects**
  - Design of on-chip interconnects considering area, power and reliability constraints
John Metzner - Professor, CSE and EE

**Education**
- Eng. Sc. D., New York University

**Background**
- Acting director of the Computer Engineering Program in Electrical Engineering (two years)
- Acting Dean, School of Engineering and Computer Science, Oakland University, Rochester 1974-1980
- Professor, Electrical Engineering, Wayne State University, Detroit, Michigan
- Associate Professor, Electrical Engineering New York University
- Associate Professor, Polytechnic Institute of New York
- Research Scientist, Electrical Engineering Department, New York University

**Awards**
- IEEE Fellow
- Fellowships: Link Aviation, National Science Foundation, David Sarnoff
- IEEE Computer Society Distinguished Speaker/Visitor

**Expertise**
- ARQ protocols for reliable and efficient data communication, methods for efficient comparison of remote replicated data files, efficient reliable and secure multicasting, improved utilization of ALOHA in multi-access, error correction techniques, efficient use of wireless network resources

**Support**
- Many previous grants from NSF
John Metzner - Projects

- **Secure Reliable Multicasting (SAM) (Poster)**
  - Simple acknowledgment and key changing for combined secure and reliable multicast in moderate size groups

- **Reliable multicasting**
  - Efficient methods of gathering acknowledgments with a tree topology and a virtual ring
  - Increased value of hop-by-hop versus end-to-end error control in multicasting
  - Improved efficiency by cooperation of local network stations in receiving a satellite or other multicast transmission

- **Ultra wideband or light traffic ALOHA**
  - Communication from a mobile to a network of cooperating base stations or to other stations in an Ad Hoc network for minimal interference and energy utilization.

- **Vector Symbol decoding extensions**
  - Study of interaction of inner codes and outer vector symbol code
  - Correcting combinations of erasures and errors
  - Further studies of convolutional vector symbol codes
  - Applications to multi-reception code combining with vector symbol codes
Raj Acharya – Head and Professor, CSE

**Education**
- PhD, University of Minnesota, Mayo Graduate School of Medicine

**Background**
- Research Scientist, Mayo Clinic
- Research Scientist, GE (Thomson)
- Faculty Fellow, Night Vision Laboratory, Fort Belvoir, Washington, D.C.
- NASA-ASEE Faculty Fellow, Johnson Space Center, Houston, TX
- Director, Advanced Laboratory for Information Systems and Analysis

**Professional Activities**
- General Chair, *SPIE International Conference on Physiology and Function from Multidimensional Images*
- Co-Chair, *IEEE Workshop on Biomedical Image Analysis*
- General Chair, *SPIE Conference on Biomedical Image Processing*
- Associate Editor, *International Journal of Computerized Medical Imaging and Graphics*

**Expertise**
- Net-centric computing, resource management for ad hoc networks, information fusion, bioinformatics, data mining

**Support**
- NSF ITR
Raj Acharya - Projects

• Service level agreements using bandwidth brokers
• Quality of service in wireless ad hoc networks (Poster)