

PENNSSTATE



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)



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)

Networking Research Center



Faculty	Department/College	Expertise
Raj Acharya	Computer Science and Engineering (CSE)/College of Engineering (COE)	QoS
Guohong Cao	CSE/COE	Mobility, Distributed Systems
Chita Das	CSE/COE	Network Performance
George Kesidis	CSE & Electrical Engineering/COE	Network Performance, Modeling, Pricing, Security
Thomas La Porta, Director	CSE/COE	Mobility, Networking Software, Telecommunications
Wang-Chien Lee	CSE/COE	Pervasive computing, Network Services, Data Management
Patrick McDaniel	CSE/COE	Network Security
John Metzner	CSE & EE/COE	Coding, Reliable Data Communication
Aylin Yener	EE/COE	Wireless Communications, Physical Layer Optimization, Cross-layer Design
Sencun Zhu	CSE/COE and IST	Network Security

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



- **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

- 1996 - 2001, GTE/Version Research Laboratories, Inc.
- Research group at Penn State (2002-Present): Pervasive Data Access Research Group (<http://www.cse.psu.edu/pda>)

Awards

- Excellence Award: GTE/Verizon Laboratories Incorporated (1997, 1999, 2000).
- Achievement Award: GTE/Verizon Laboratories Incorporated (1999).

Professional Activities

- Guest Editor, IEEE Transaction on Computer, IEEE Personal Communication Magazine, ACM Mobile Networks and Applications (MONET), ACM Wireless Networks (WINET)
- Technical Program Chair: International Conference on Mobile Data Access (1999); International Workshop on Pervasive Computing (2000); International Workshop on Wireless Networks and Mobile Computing (2000/2001).
- Industrial Program Chair: International Conference on Mobile Data Management (2001-2002).
- 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)



- **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.
- Guest editor, [*Journal of Computer Networks*](#), Special issue on Web Security, Summer 2005.
- **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)



- **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



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
- Referee for ACM PODC 2003, ACM CCS 2001, 2002, 2003, ICDE 2002, Indocrypt 2002, MONET, JCS, et al.

Support

- Research funded by: NSA, Lucite, DoD, MITRE



- **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: **N**ational **S**cience **F**oundation
- Current: **P**ittsburgh **D**igital **G**reenhouse
- Completed: USMC, AT&T Foundation, BenFranklin



- **Multuser 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)



- **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



- **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)