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## ***Highlights***

Director, School of Electrical Engineering and Computer Science. Evan Pugh Professor. IEEE Fellow and Bell Labs Fellow. Received an Eta Kappa Nu Outstanding Young Electrical Engineer Award (one of three awarded), Bell Labs Distinguished Technical Staff Award, and four best paper awards. Founding Editor-in-Chief of *IEEE Transactions on Mobile Computing* and past Editor-in-Chief of *IEEE Personal Communications*. Founding Director of the Institute of Networking and Security Research at Penn State. Previously Director of both the Mobile Networking Research in Bell Labs Research and the Advanced Mobile Networking in the Wireless Business Unit of Lucent. Co-inventor on 38 patents related to telecommunications, including two that won the Thomas Alva Edison Patent Award.

## ***Education***

1992 Ph.D., Electrical Engineering, Columbia University, New York, NY
1987 M.E., Electrical Engineering, The Cooper Union, New York, NY
1986 B.E., Electrical Engineering, The Cooper Union, New York, NY

## ***Employment***

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| 2016 | Director, School of Electrical Engineering and Computer Science, Penn State |
| 2016- | Evan Pugh Professor, Computer Science and Engineering, Penn State |
| 2014- | Director, Semantically-Aware Quality of Information-Aware Networking Thrust, Network Sciences Collaborative Technology Alliance (five year renewal of award directly below) |
| 2009-14 | Director, Collaborative Technology Alliance Network Sciences Communications Network Academic Research Center (awarded $35M grant to lead a major network sciences research center sponsored by the U.S. Army Research Lab) |
| 2012-22 | William E. Leonhard Chair in Engineering, Computer Science and Engineering, Penn State |
| 2007- | Distinguished Professor, Computer Science and Engineering, Penn State |
| 2006, 2009 | Distinguished Researcher, University of Roma La Sapiena (Su 06, Sp 09) |
| 2002-06 | Professor, Computer Science and Engineering, Penn State |
| 2002- | Founding Director, Institute of Networking and Security Research (formerly Networking and Security Research Center, Ben Franklin Center of Excellence), Penn State. Founded center that currently includes faculty from the College of Engineering, Smeal College of Business, Dickinson |



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| | Law School, Great Valley Campus, Applied Research Lab, and the College of Information Sciences and Technology. Members have received more than $30M in new funds since 2006. |
| 2000-02 | Director, Advanced Mobile Networking Department, Wireless Networks Group, Lucent Technologies (concurrent with below) |
| 1997-02 | Director, Mobile Networking Research Department, Bell Laboratories Research, Lucent Technologies |
| 1991-97 | Distinguished Member of Technical Staff/Member Technical Staff, Bell Laboratories Research, Lucent Technologies |
| 1986-91 | Member Technical Staff, Network Performance Center, AT&T Bell Labs |

***Consulting***

2023 *Perkins Coie – on behalf of Intel*
Consulted on several IPRs related to OFDM systems.

2022 *DLA Piper – on behalf of Applie*
Consulted on three IPRs related to mobile data systems. Wrote and was deposed on three declarations.

2021-22 *Duane Morris – on behalf of Metaswitch C.A. No. 17-1736-RGA-SRF*
Consulted on VoIP switching technology, wrote reports.

2020 *Haynes and Boone – on behalf of Google*
Pre-IPR consulting on telephony systems.

2019 *EriseIP – Apple Inc. v. Maxell LTD, Case IPR2020-00201, on behalf of Apple*
Consulting on systems for wireless electronic displays and control, wrote declaration with respect to IPR. Deposed on declaration.

2017-18 *Sidley – Huawei Technologies v. Samsung Electronics v. HiSilicon, N.D. California. Civil Action No. 3:16-cv-2787-WHO, on behalf of Samsung*
Consulting on cellular telecommunications systems on 2 patents. Wrote infringement, validity, non-infringement and invalidity reports, deposed.

2017 *Ropes and Gray - Nokia Technologies Oy & Alcatel-Lucent USA Inv. v. Apple Inc. (E.D. Tex. Civil Action Nos. 2:16-cv-144 and 2:16-cv-1441, on behalf of Apple*
Consulting on cellular communication systems.

2015-17 *Sidley - Intellectual Ventures LLC v. AT&T Mobility, et al Civil Action No. 12-cv-193-LPS, on behalf of US Cellular*
Consulting on cellular communication systems. Wrote report on invalidity. Deposed on report.

2016-17 *Duane Morris - Patent Asset Licensing, LLC v. WideOpenWest Finance, LLC et al., Case No. 3:15-cv-743-J-32MCR*
Wrote declarations with respect to IPRs for three patents. Deposed on declarations.

2014 *Sidley Austin – on behalf of Apple*
Consulting on cellular communication systems. Wrote declarations with respect to IPRs for three patents.

2012-14 *Winston Strom - Prism Technologies LLC v. Cellco Partnership d/b/a Verizon Wireless No. 8:12-cv-126-LES-TDT, on behalf of Verizon*
Consulting on secure transaction systems. Wrote report with respect to non-infringement.

2015 *Haynes Boone*
Consulted on patents with respect to signaling in cellular systems

2015 *Duane Morris AIP Acquisition, LLC v. Verizon Services Corp., et al., Case No. 1:14-cv-516-GMS, on behalf of Verizon*
Wrote declarations with respect to IPRs for two patents.

2011-2012: *Sidley Austin (EON vs. T-Mobile et al) Case No. 6:10-CV-379-LED-JDL, on behalf of RIM*
Consulted on telecommunications systems. Wrote expert report with respect to non-infringement. Deposed on report.

2009-2014: *Hogan Lovells (High Point SARL vs. Sprint Nextel Corp) Case No. 09-2269-CM-DJW, on behalf of Sprint*
Consulted on cellular telecommunications equipment. Deposed with respect to declaration on claim construction. Presented tutorial to court appointed Special Master. Testifed as expert witness at Markman hearing. Wrote declarations with respect to inventorship, deposed twice on declarations.

2011 – 2012: *Nixon Peabody*
Consulted on cellular telecommunication systems.

2009 – 2010: *Goodwin Proctor*
Consulted on hybrid circuit/packet switched systems for voice communication. Deposed on expert report with respect to validity.

2009-2010: *Crowell and Moring*
Consulted on patent litigation for wireless messaging systems.

2007 - 2009: *Goodwin Proctor*

Consulted on cellular telecommunications systems. Deposed on expert report with respect to validity.

2007 - 2008: *Moses and Singer*
Consulted on patent litigation regarding secure data access.

2007: *Latham*
Consulted on patent litigation regarding telecommunications systems.

2006 – 2007: *Kirkland and Ellis*
Consulted on patent litigation regarding cellular services and Internet telephony (two clients).

2005-2006: *Moses and Singer*
Consulted on patent litigation regarding smart card technology. Deposed on expert reports regarding infringement and validity.

2005-2006: *Fish and Richardson*
Consulted on two patent litigations regarding security in cellular networks (2G and 3G), and WiFi, WiMax, 3G networks; evaluated one patent on wireless technology.

2005-2006: *Howrey*
Consulted on patent litigation regarding packet multimedia telephony and wireless technology. Deposed on expert report with respect to claim construction.

## ***Honors and Awards***

- **Evan Pugh Professor,** 2016, Penn State University (top 1% of faculty)
- **Faculty Teaching Award,** 2014, Dept. of Computer Science and Engineering
- **William E. Leonhard Chair in Engineering**, 2012
- **Thomas Alva Edison Patent Award,** 2009, Multiple-protocol home location register and method of use
- **Distinguished Professor**, 2007
- **IEEE Computer Society Golden Core Member,** 2005, for being a distinguished volunteer
- **Thomas Alva Edison Patent Award,** 2005, Wireless Packet System for Efficient Wide Area Bandwidth Utilization
- **IEEE Computer Society Meritorious Service Award,** 2004, for outstanding service as Editor-in-Chief of IEEE Transactions on Mobile Computing
- **IEEE Fellow,** 2002, to contributions to systems for advanced broadband, mobile data and mobile telecommunication networks
- **Bell Labs Fellow,** 2000, for outstanding contributions in mobile wireless networks in the areas of call processing, signaling, mobility management, and applications
- **An Eta Kappa Nu Outstanding Young Electrical Engineer Award** (one of three awarded), 1996

- **Bell Labs Distinguished Staff Award,** 1996, for outstanding research in call processing
- **Keynote talks,** IEEE ICDCS, IEEE MASS, IEEE ICCCN
- **Six best paper awards** (IEEE ISSLS 1993, IEEE BSS 1995, IEEE ISSLS 1996, IEEE ICNP 2010, ACM Symposium on SDN Research 2017, SECURECOMM 2018)

## ***Professional Service***

### *Editorships*

| | |
|---|---|
| 2006-08 | Editor-in-Chief, IEEE Applications of Practice Magazine |
| 2003-04 | Technical Editor, ACM Mobile Communications Review |
| 2001-04 | Founding Editor-in-Chief, IEEE Transactions on Mobile Computing |
| 2000-10 | Senior Advisor, IEEE Personal Communications Magazine |
| 2000-05 | Technical Editor, KICS/IEEE Journal of Communications and Networks |
| 1997-99 | Editor-in-Chief, IEEE Personal Communications Magazine |
| 1995-10 | Associate Editor, ACM/Kluwer Journal on Wireless Networks |
| 1995-10 | Associate Editor, ACM/Baltzer Journal of Mobile Networks and Applications |
| 1993-96 | Technical Editor, IEEE Personal Communications Magazine |

## ***Professional Societies and Associations***

| | |
|---|---|
| 2013 | Chair, IEEE Computer Society Transactions on Mobile Computing EiC Search Committee |
| 2007-09 | Member, Board of Governors, IEEE Communications Society |
| 2006-07 | Director of Magazines, IEEE Communications Society |
| 2005-10 | Steering Committee Member, IEEE/ACM Transactions on Networking (Co-chair, 2007) |
| 2005- | Steering Committee Member, IEEE Transactions on Mobile Computing (Chair, 2008-10) |
| 2005 | IEEE Computer Society Golden Core Member |
| 2004-06 | The President's National Security Telecommunications Advisory Committee (NSTAC) |
| 2003 | Chair, IEEE Computer Society Pervasive Computing EiC Search Committee |
| 2003- | ACM Member |
| 1984- | IEEE (Fellow, 2002) |

## ***Conference Committees***

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|---|---|
| 2013 | General Chair, ACM Workshop on Mission Oriented Sensor Networks (MiseNet 2013) |
| 2011 | General Co-Chair, IEEE International Conference on Network Protocols (ICNP 2011) |
| 2009 | Program Co-Chair, Annual IEEE Communications Society Conference on Sensor, Mesh and Ad Hoc Communications and Networks (SECON 2009) |
| 2009 | Co-Chair, NSF Workshop on Future Directions of Wireless Sensor Systems |
| 2008 | Chair, NSF Workshop on Wireless Security, Atlanta, GA |
| 2008 | General Chair, IEEE Mobile Ad-hoc and Sensor Systems (MASS 2008) |

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| 2007 | Program Chair, Annual IEEE International Conference on Pervasive Computing and Communications (PerCom 2007) |
| 2006 | General Co-Chair, International ICST Conference on Mobile and Ubiquitous Systems (MobiQuitous 2006) (sponsored by IEEE, ICST, and ACM) |
| 2005 | General Co-Chair, Annual International Conference on Mobile Computing and Networking (MobiCom 2005) |
| 2004 | Program Co-Chair, IEEE International Conference on Network Protocols (ICNP 2004) |
| 2004 | Program Co-Chair, International ICST Conference on Mobile and Ubiquitous Systems (MobiQuitous 2004) (co-sponsored by IEEE and ACM) |
| 2004 | Tutorial Chair, Annual IEEE Communications Society Conference on Sensor, Mesh and Ad Hoc Communications and Networks (SECON 2004) |
| 2003 | Co-Chair, NSF Workshop on Wireless Networks |
| 2001 | Panel Chair, Annual International Conference on Mobile Computing and Networking (MobiCom 2001) |
| 2000 | Panel Chair, IEEE International Conference on Network Protocols (ICNP 2000) |
| 1997 | Tutorial Chair, IEEE INFOCOM 1997 |
| 1997 | Tutorial Chair, IEEE International Conference on Network Protocols (ICNP 1997) |
| 1996 | Vice-Chair, Annual International Conference on Mobile Computing and Networking (MobiCom 1996) |

## ***Research Programs***

### *Network Science:*

Director and overall PI of the Communications Network Academic Research Center funded by the U.S. Army Research Lab leading a team of 23 PIs and 9 institutions (Penn State (prime), USC, UC Davis, UC Santa Cruz, CUNY, UC Riverside, North Carolina State, Stanford and Raytheon BBN). Awarded five year renewal; now Director of Semantically-Aware Quality-of-Information Aware Networking Thrust, 25% of overall $135M Army Research Lab Network Science project. To date research contributions include:

- Defining and formalizing a metric called Quality of Information which allows requestors of information to specify characteristics of the information they require to make decisions, and then enable network algorithms to provide data transport and security services to meet these requirements. Work transitioned to Harris Corp.
- Defined, formalized and modeled a new measure of network capacity called the Operational Information Content Capacity (OICC) which measures the amount of information of sufficient quality carried by a network.
- Working with computational linguistics researchers, defined algorithms for optimal information retrieval strategies given uncertainty of query requirements based on pragmatic query transformation.
- Developed new general models to determine network scalability accounting for realistic network configurations and application-specific quality of information

requirements.
- Developed algorithms for resource allocation in highly dynamic wireless environments for extracting information of specified quality from stored video.

Leading Defense Threat Reduction Agency (DTRA) funded effort on network reliability jointly with Army Research Lab. To date research contributions include:

- Defined new algorithms for diagnosing large-scale network failures based on partial information of network endpoint connectivity.
- Defined new algorithms for minimum cost network restoration given mission critical applications that must be supported.
- Developed models for the spread of failures between multiple networks with different structures, determining topologies and interconnect architectures that slow and speed the spread between networks; won best student poster at DTRA PI meeting.
- Developed algorithms to infer a network topology based on partial information; resulting algorithm performed significantly better than competing solutions in terms of network metrics.

***Network Security:***

Co-PI on a $48M 10-year science of cyber security program funded by the Army Research Lab. To date contributions include:

- Developed algorithms to prevent malicious users from detecting the migration of a virtual machine between servers. The algorithms prevent timing analysis attacks by making packet inter-arrival time statistics and the distribution of overall response time delays mathematically indistinguishable from normal traffic.

***Wireless Sensor Networks:***

Leader of the Sensor Information Processing and Delivery Technical Area of the U.S. ARL and U.K. MoD 10-year joint International Technology Alliance (ITA) program for five years, and currently Project Champion. Also partially funded by NSF. To date research contributions include:

- Developed algorithms for resource allocation given statistical uncertainty of the value of future observations, the exact resources consumed by future tasks, and the uncertainty of event of interest that will occur. This work is being featured at the ITA capstone event.
- Algorithms to formalize information needs and allocate sensing and communications resources to meet these needs. Work has been transitioned into both the U.S. Army and U.K, MoD.
- Algorithms and protocols to optimally allocate resources in a multi-hop wireless sensor networks to maximize network utility including in-network data transformations.

- Algorithms based on Voronoi and Laguerre geometry to move sensors to increase network coverage and recover from node failure.
- Key distribution algorithms to ensure secure sensor communication. Submitted to IEEE 802.11 standards group by partnering company (3ETI).

***Mobile Telecommunication Networks:***

Leading research on signaling, call processing, mobility management, security, and hybrid wireless solutions for cellular telecommunication systems. Funded by NSF and ARO. Contributions include:

- Tools and algorithms for ensuring security in wireless telecommunication networks. Feature article in *NY Times* business section, October 2005. Appointed to The President's National Security Telecommunications Advisory Committee.
- Develop lightweight protocol interworking algorithms that led to the industry's first system supporting seamless global roaming between U.S. and international standards, and WiFi networks. Resulted in product deployed in Lucent-built third generation wireless networks and currently supports more than 100 million subscribers. Team consisted of 8 researchers and up to 50 developers. Won Bell Labs President's Gold Medal and Thomas Alva Edison Patent Award.
- Distributed software control architectures based formal decomposition of functions and data structures that drastically reduced data movement and signaling overhead in mobile environments. Led to network controllers deployed in CDMA2000 and UMTS networks.
- An IP-based mobile switching center with new efficient mobility management and signaling protocols. This was the first "soft-switch" which is now a standard part of all Internet-telephony and third generation wireless systems. Awarded Thomas Alva Edison Patent Award.
- Multiclass algorithms and software for signaling overload control for wireless call processing. Deployed in CDMA2000 mobile switching centers.
- Architecture and protocols for forming and managing hybrid wireless networks that maintain signal orthogonality and support diversity to improve wireless network performance.

***Mobile Wireless Data Systems:***

Leading research on network architectures, protocol design, and software systems to enable all-IP mobile networks. Funded by NSF. Contributions include:

- Algorithms and protocols to preserve location privacy while enabling the use of network-based location-based services.
- A novel architecture, service-set, and protocols for web access and messaging services from traditional cellular handsets. Led to initial text messaging products from Lucent Technologies.
- Algorithms for optimal rate control and resource allocation for networks that employ network coding.
- Algorithms for enabling secure and highly scalable RFID networks.
- Security solutions that enable network-based performance enhancements

- Micromobility protocol (HAWAII) and IP paging services. Led to formation of a working group at the Internet Engineering Task Force.
- Security protocols application support to enable 802.11/3G roaming. Led to product offering from Lucent Technologies.
- An asymmetric link layer protocol (AIRMAIL) designed specifically for wireless links. Incorporated into CDMA2000 standards.

***Software for Telecommunication Network Control:***

Led and participated in several projects on call processing and service control for ISDN and B-ISDN networks.

***Ph.D. Research* (advised by Prof. Mischa Schwartz)**

**MultiStream Protocol (MSP)**: Designed, validated, and implemented a new feature-rich high-speed transport protocol on a parallel processor platform.

## ***Students***

Advising 7 Ph.D. students; graduated 17 Ph.D. students, 16 M.S. students, and 4 Honors students.

## ***Grants***

**CPS: Medium: Coupled cAscade Modeling, Prevention, and Recovery,** Co-PI (PI: Chaudhuri, Co-PI: He), NSF, $999,000, 2018-20

**CSR: Small: Energy-Aware and QoE-Aware Video Streaming on Mobile Devices**, Co-PI (PI: Cao), NSF, $, 2018-20.

**International Technology Alliance, Distributed Analytics Information Sciences (DAIS)**, US Army Research Lab & UK Ministry of Defence, PI, $1.6M, 9/16–9/21. (One of 6 project leads on team of 14 partners including industry and academia, Prime: IBM).

**International Technology Alliance (CONCERTO),** Network and Information Sciences International Technology Alliance, US Army Research Lab & UK Ministry of Defence, PI, $2.5M, 5/06–5/14. (One of 4 technical area leads on team of 12 partners including industry and academia, Prime: IBM).

**Collaborative Technology Alliance Network Sciences Communications Network Academic Research Center,** Overall PI and Center Director ARL, $35M, 2009–2018 (renewed in 2014). (Penn State Amount for 9/08–9/16 is $7.7M).

**HDTRA1-10-1-0085: State Estimation and Optimal Recovery in networks with Massive Cascading Failures – Topic D: Network Adaptability from WMD Disruption and Cascading Failures**, PI (Co-PI: Cao and Swami [US-ARL]), Defense Threat Reduction Agency, (option years added in 2014) $1,650,000, 8/10–5/16.

**Collaborative Research Alliance**, Co-PI (PI: McDaniel), ARL, up to $48M ($600K for candidate), 2013–2022.

**Wireless Network Defense**, PI, DARPA (sub to Lockheed Martin), $150,000, 2013–2014.

**MANET and DTN Routing for Tactical Networks,** PI (Co-PI: Cao), CERDEC,

$175,000, 2013–2014.

**Small: Efficient Energy-Aware Web Browsing in Wireless Networks,** Co-PI (PI: Cao), NSF, $499,368, 2012–2015.

**QoI-Aware Named Data Networking,** PI, Harris Corp, $50,000, 2012–2013.

**Student Travel Support for IEEE ICNP,** PI, NSF, $10,000, 2011.

**Aqua – QoI-Aware client,** co-PI (PI: Govindan, USC), US-Army Research Lab, $50,000, 2011–2012.

**Harnessing Network Coding Gains in Multi-Rate Wireless Networks**, PI (PI: Krishnamurthy, UC Riverside), NSF, $240,000, 2010–2013.

**Characterizing and Mitigating Wireless Systems Vulnerabilities, Defense University Research Instrumentation Program (DURIP**), Co-PI (PI: McDaniel), Army Research Office (ARO), $150,000, 5/09–5/10.

**Supporting Multi-Missions in Wireless Sensor Networks,** Co-PI (PI: Cao), NSF, $450,000, 2009–2012.

**Collaborative Research: Security Services in Open Telecommunications Networks,** Co-PI (PI: McDaniel), NSF, $598,488, 2009–2012.

**Secure Supply Chain Management for Telecom,** PI (with McDaniel and Shu), Alcatel-Lucent, $110,000, 2009.

**Secure 3G/4G Mobility**, PI, SPRINT Labs, $55,000, 2008–2009.

**Network State Discovery and Analysis in Defense of WMD Attacks**, PI, (with Cao), Defense Threat Reduction Agency, $215,000, 2008–2009.

**Wireless Mesh with Mobility,** PI (with Cao), The Technology Collaborative, $172,000, 8/07–7/08.

**ARSENAL: A Cross Layer Architecture for Secure and Resilient Tactical Mobile Ad Hoc Networks,"** co-PI (PI: Cao), ARO MURI, $780,000, 6/07–5/12.

**Wireless Network Security**, PI (with Yener and Jaeger), Raytheon, $50,000, 1/07–12/07.

**Security for Internet/IMS Convergence**, PI (with Jaeger and McDaniel), Cisco URP, $100,000, 2007–2008.

**NeTS WN: Protecting Services for Emerging Wireless Telecommunications Infrastructure**, PI, NSF, $400,000, 2007–2009.

**Ben Franklin Center of Excellence for the Networking and Security Research Center**, Director and PI, $175,000, 2007–2009.

**Mobile Sensor Systems**, PI (with Cao), The Technology Collaborative, $140,000, 7/06–6/07.

**Telecommunications Evolution and Security,** PI (with Yener and Jaeger), Raytheon, $50,000, 6/06–12/06.

**Distributed Adaptive Channelization Control**, DARPA CBMANET Program, PI (with Yener), $303,000, 6/06–12/07. (Prime: BAE Systems CONCERTO Project).

**Overload Controls for SIP Servers,** IBM Faculty Award Program, PI, $30,000, 2006.

**NeTS-NOSS: Controllable Node Mobility for Mission-Oriented Sensor Networks**, co-PI (PI: Cao, Kesidis, Das), National Science Foundation, $458,000, 9/05–8/09.

**Capacity Building Information Assurance**, senior personnel (PI: Liu and others), National Science Foundation DUE, $296,466 8/05–7/06.

**CRI: Collaborative Research: WORKIT: A Universal Wireless Open Research KIT**, PI (with other institutions), National Science Foundation, $124,956, 8/05–7/08.

**Efficient Hybrid Security for Networks of Simple Devices**, PI (with Cao), The Technology Collaborative, $166,288, 7/05–6/06.

**SGER: Exploratory Research on Relay Network of Agile Radios**, National Science Foundation, PI (with Yener), $95,018, 3/05–9/06.

**Group Mobility Management for Sensors**, DARPA/ONR Emerging Surveillance Plexsus (ESP), subcontract with PSU ARL, $72,000, 1/05–12/05.

**Mobile Multi-Layered IPSec: Advanced Services**, PI (with Cao), The Technology Collaborative, $178,435, 1/05–12/05.

**Secure Services in IP-Based Third Generation Wireless Networks**, IBM Faculty Award Program, PI, $30,000, 2005.

**Student International Travel Support for IEEE International Conference on Networking Protocols (ICNP 2004); October 5-8, 2004; Berlin, Germany**, PI, National Science Foundation, $15,500, 9/04–8/05.

**Asymmetric Security Solutions for Networks of Simple Devices**, PI (with Cao), The Technology Collaborative, $184,000, 7/04–6/05

**Group Mobility Management for Sensors**, **DARPA/ONR Emerging Surveillance Plexsus (ESP),** subcontract with PSU ARL, $30,000, 5/04–12/04.

**Mobile Multi-layered IP Security**, PI (with Cao), Pittsburgh Digital Greenhouse, $189,000, 7/03–6/04.

**CISCO CIAG Equipment Donation,** co-PI (with Liu, Chen), $110,000, 2003.

***Journals Publications***

1. La Porta, T. F., M. Schwartz. May 1993. The MultiStream Protocol: A Highly Flexible High-Speed Transport Protocol. *IEEE Journal on Selected Areas in Communications* 11(4):519-530.
2. La Porta, T. F., M. Schwartz. December 1993. Performance Analysis of MSP Feature-Rich High-Speed Transport Protocol. IEEE/ACM Transactions on Networking 1(6):740-753.
3. La Porta, T. F., M. Veeraraghavan. 1993. Evaluation of Broadband UNI Signaling Protocol Techniques. *Journal of High Speed Networks* 2(3):209-238. IOS Press.
4. La Porta, T. F., M. Schwartz. February 1994. Verification of the MultiStream Protocol (MSP) Using COSPAN. *Formal Methods in System Design* 4(2):123-153.
5. Veeraraghavan, M., T. F. La Porta. 1994. Object-Oriented Analysis of Signaling and Control in Broadband Networks. *International Journal of Communication Systems* 7:131-148.
6. Ayanoglu, E., S. Paul, T. F. La Porta, K. K. Sabnani. R. D. Gitlin. 1995. AIRMAIL: A Link-Layer Protocol for Wireless Networks. *ACM/Baltzer Wireless Networks Journal* 1(1):47-59.
7. Veeraraghavan, M., T. F. La Porta, R. Ramjee. 1995. A Distributed Control Strategy for Wireless ATM Networks. *ACM/Baltzer Wireless Networks Journal* 1(3):323-339.
8. La Porta, T. F., M. Veeraraghavan, P. Treventi, R. Ramjee. June 1995. Distributed Call Processing for Personal Communications Services. *IEEE Communications Magazine* 33(6):66-75.
9. Veeraraghavan, M., T. F. La Porta, W. S. Lai. November 1995. An Alternative Approach to Call/Connection Control in Broadband Switching Systems. *IEEE Communications Magazine* 33(11):90-97.
10. Ramjee, R., T. F. La Porta, M. Veeraraghavan. December 1995. The Use of Network-based Migrating User Agents for PCS. *IEEE Personal Communications Magazine*. pp. 62-68.
11. La Porta, T. F., K. K. Sabnani, A. S. Sawkar. Autumn, 1996. Distributed Call Processing for Wireless Mobile Networks. *Bell Labs Technical Journal* 1(2):127-142.
12. La Porta, T. F., K. K. Sabnani, R. D. Gitlin. 1996. Challenges for Nomadic Computing: Mobility Management and Wireless Communications. *ACM/Baltzer Journal on Mobile Networks and Nomadic Applications* 1(1):3-16.
13. La Porta, T. F., M. Veeraraghavan, R. W. Buskens. December 1996. Comparison of Signaling Loads for PCS Systems. *IEEE/ACM Transactions on Networking* 4(6):840-856.
14. La Porta, T. F., K-W. Chen. August 1997. A Direct Signaling System for Flexible Access and Deployment of Telecommunication Services. *IEEE/ACM Transactions on Networking* 5(4):489-501.
15. Woo, T., T. F. La Porta, K. K. Sanbani. October 1997. Pigeon: A Wireless Two-Way Messaging System. IEEE Journal on Selected Areas in Communications 15(8):1391-1405.

16. Ramjee, R., T. F. La Porta, J. Kurose, D. Towsley. June 1998. Performance Evaluation of Connection Re-Routing Schemes for ATM-based Wireless Networks. *IEEE/ACM Transactions on Networking* 6(3):249-261.
17. La Porta, T. F., R. Ramjee, T. Woo, K. K. Sabnani. August 1998. Experiences with Network-Based User Agents for Mobile Applications. *ACM/Baltzer Journal of Mobile Networks and Applications* 3(2):123-141.
18. La Porta, T. F. 1999. Signaling. Chapter in *Wiley Encyclopedia of Electrical and Electronics Engineering* 19:276-284. Ed. J. G. Webster.
19. Shah, N., A. Sawkar, J. Marinho, K. K. Sabnani, T. F. La Porta, T. C. Chiang. January-March 2000. Wireless Data Networking, Standards, and Applications. 5(1):130-149.
20. Ramjee, R., T. F. La Porta, L. Salgarelli, S. Thuel, K. Varadhan, L. Li. August 200. IP-Based Access Network Infrastructure for Next Generation Wireless Data Networks. IEEE Personal Communications Magazine 7(4):34-41.
21. Ramjee, R., T. F. La Porta, J. Kurose, D. Towsley. November 2000. User Agent Migration Policies in Wireless Networks. *IEEE Journal of Selected Areas of Communication* 18(11):2465-2489.
22. Lennox, J., K. Murakami. M. Karaul, T. F. La Porta. October 2001. Interworking Internet Telephony and Wireless Telecommunications Networks. *ACM Computer Communications Review* 31(5):25-36.
23. Thuel, S., L. Salgarelli, R. Ramjee, T. F. La Porta. 2002. Dynamic Configuration of Mobile Devices for Wireless Internet Access. *Mobile and Wireless Internet Access*, Chapter 10. Edited by K. Makki. Kluwer Academic Publishers.
24. Ramjee, R., K. Varadhan, L. Salgarelli, S. Thuel, T. F. La Porta. June 2002. HAWAII: A Domain Based Approach for Mobility in Wide-Area Wireless Networks. *IEEE/ACM Transactions on Networking* 10(3):396-410.
25. Ramjee, R., L. Li, T. F. La Porta, S. Kasera. September 2002. IP Paging Service for Mobile Hosts. *ACM/Kluwer Journal on Wireless Networks* 8(5):427-441.
26. Haase, O., K. Murakami, T. F. La Porta. August 2003. Unified Mobility Manager - Enabling Efficient SIP/UMTS Mobile Network Control. *IEEE Wireless Communications* 10(4):66-75.
27. Murakami, K., O. Haase, J. Shin*, T. F. La Porta. June 2004. Mobility Management Alternatives for Migration to Mobile Internet Session-Based Services. *IEEE Journal on Selected Areas of Communications* 22(5):818-833. (Third author supervised by candidate)
28. Yashiro, T., T. F. La Porta. December 2005. Nomadic Agent System: Infrastructureless Location Based Service System. *Journal of Information Processing Society of Japan* 46(12):2952-2962.
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***Patents (with various co-inventors)***

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332. **5,563,939 (10/8/96)**: Method and System for Delivering a Communication Service
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334. **5,600,663 (2/4/97)**: Adaptive Forward Error Correction System
335. **5,659,544 (8/19/97)**: Method and System for Distributed Control in Wireless Cellular and Personal Communications Networks
336. **5,918,158 (6/28/99)**: Two-Way Wireless Messaging System
337. **5,943,408 (8/24/99)**: Flexible Direct Signaling System
338. **5,943,334 (8/24/99)**: Method of Using an Intelligent Mobile Terminal for Reconnecting Calls in a Wireless Network

339. **5,953,331 (9/14/99)**: Wireless Packet System for Efficient Wide Area Bandwidth Utilization
340. **5,959,543 (9/28/99)**: Two-Way Wireless Messaging System with Flexible Messages
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343. **6,014,429 (1/11/00)**: Two-Way Wireless Cellular Messaging System with Transaction Server
344. **6,016,319 (1/18/00)**: Communication System for Transmission of Datagram Packets Over Connection-Oriented Networks
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349. **6215782 (4/1/01)**: Method for Reconnecting Calls in a Wireless Telecommunications System
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357. **6,842,462 (1/11/05)**: Wireless Access Of Packet Based Networks
358. **7,085,260 (8/1/06)**: Internet protocol based wireless call processing
359. **7,120,453 (10/10/06)**: Paging of mobile hosts on an internet protocol network
360. **7,239,618 (7/3/07)**: Single phase local mobility scheme for wireless access to packet-based networks (Filed while at Bell Labs with several other inventors)
361. **7,340,253 (3/4/08)**: IP-based Distributed Wireless Access Network Architecture for CDMA Networks
362. **7,522,632 (4/21/09)**: Multiple-protocol home location register and method of use (with several co-inventors)
363. **7,554,967 (6/30/09)**: Transient tunneling for dynamic home addressing on mobile hosts (with several co-inventors)
364. **7,729,252 (6/1/2010)**: Methods and devices for providing fast and robust overload control
365. **7,822,416 (10/26/2010)**: Methods and systems for allowing global roaming between devices supported by different protocols