

**UNITED STATES INTERNATIONAL TRADE COMMISSION  
Washington, D.C. 20436**

**Before the Honorable David P. Shaw  
Administrative Law Judge**

**In the Matter of**

**CERTAIN POINT-TO-POINT NETWORK  
COMMUNICATION DEVICES AND  
PRODUCTS CONTAINING SAME**

**Investigation No. 337-TA-892**

**RESPONDENTS' IDENTIFICATION OF EXPERT WITNESSES**

Pursuant to the Procedural Schedule, Respondents AmTRAN Logistics, Inc. and AmTRAN Technology Co., Ltd., LG Electronics, Inc., LG Electronics U.S.A., Inc., and LG Electronics MobileComm U.S.A., Inc., Panasonic Corporation and Panasonic Corporation of North America, Sharp Corporation and Sharp Electronics Corporation, Sony Corporation, Sony Corporation of America, Sony Electronics Inc., Sony Mobile Communications AB, Sony Mobile Communications (USA) Inc., Sony Computer Entertainment, Inc., and Sony Computer Entertainment America LLC, Toshiba Corporation, Toshiba America, Inc., and Toshiba America Information Systems, Inc., and VIZIO, Inc. (collectively "Respondents") hereby identify the following expert witnesses, including their expertise and curriculum vitae, who may testify on behalf of one or more Respondents at the hearing in this investigation. Respondents will present the testimony of these expert witnesses live, through witness statements, or through depositions. This identification of experts is based on Respondents' current understanding of the evidence produced thus far during discovery. In as much as discovery is ongoing, Respondents reserve the right to supplement this identification as warranted.

## **1. Donal O'Mahony**

Professor Donal E. O'Mahoney received a degree in Engineering and a Ph.D in Computer Science from Trinity College Dublin, where he is presently a professor of Computer Science. Professor O'Mahoney's areas of expertise include network protocols, security applications, mobility, ad-hoc networking, and the software engineering of networked systems. He has over twenty years of experience in networking and published a text (Local Area Networks & Their Applications) in 1988.

Professor O'Mahoney's qualifications are further set forth in his curriculum vitae, attached as Exhibit 1. He may testify regarding matters including non-infringement, domestic industry technical prong, validity, enforceability, claim construction, technological background, and the qualifications of a person of ordinary skill in the art.

## **2. Ellen W. Zegura**

Professor Ellen W. Zegura received her D.Sc. in Computer Science from Washington University in St. Louis, Missouri. She is a Professor of Computer Science in the College of Computing at the Georgia Institute of Technology. Professor Zegura's areas of expertise include network design and networking services, including multi-media distribution, peer-to-peer, and overlay networks.

Professor Zegura's qualifications are further set forth in her curriculum vitae, attached as Exhibit 2. She may testify regarding matters including non-infringement, domestic industry technical prong, validity, enforceability, claim construction, technological background, and the qualifications of a person of ordinary skill in the art.

### **3. Michael Zyda**

Professor Michael Zyda received a D.Sc. in Computer Science from Washington University in St. Louis, Missouri. He is the Founding Director of the University of Southern California's GamePipe Laboratory and a Professor of Engineering Practice in the USC Department of Computer Science. Professor Zyda's areas of expertise include networked virtual environments, computer graphics, modeling, and simulation.

Professor Zyda's qualifications are further set forth in his curriculum vitae, attached as Exhibit 3. He may testify regarding matters including non-infringement, domestic industry technical prong, validity, enforceability, claim construction, technological background, and the qualifications of a person of ordinary skill in the art.

### **4. Richard Goodin**

Richard Goodin received a degree in Electrical Engineering from the University of Delaware. He is presently the President of Goodin & Associates, Inc. and has been a technical and litigation consultant for over twenty years. Mr. Goodin's areas of expertise include hardware and software design, development and implementation, and software analysis.

Mr. Goodin's qualifications are further set forth in his curriculum vitae, attached as Exhibit 4. He may testify regarding matters including non-infringement, domestic industry technical prong, validity, enforceability, claim construction, technological background, and the qualifications of a person of ordinary skill in the art.

### **5. Bruce Maggs**

Professor Bruce Maggs received a Ph.D in Computer Science from the Massachusetts Institute of Technology. He is presently the Pelham Wilder Professor of Computer Science at Duke University. Professor Maggs' areas of expertise include networking and algorithms.

Professor Maggs' qualifications are further set forth in his curriculum vitae, attached as Exhibit 5. He may testify regarding matters including non-infringement, domestic industry technical prong, validity, enforceability, claim construction, technological background, and the qualifications of a person of ordinary skill in the art.

## **6. Philip Green**

Philip Green received his M.B.A. from Rutgers Graduate School of Management. He has extensive professional experience and is presently a Principal at Hoffman Alvary & Company LLC. Mr. Green's areas of expertise include commercial litigation and damages, as well as remedy and domestic industry analyses in intellectual property cases before the U.S. International Trade Commission.

Mr. Green's qualifications are further set forth in his curriculum vitae, attached as Exhibit 6. He may testify regarding matters including domestic industry economic prong, remedy, bond, licensing, and public interest considerations.

## **7. Azer Bestavros**

Professor Azer Bestavros received a Ph.D in computer science from Harvard University. He is the Founding Director of the Hariri Institute for Computing and Computational S & E at Boston University. Professor Bestavros' areas of expertise include networking, internet/web protocols and services, and real-time systems.

Professor Bestavros' qualifications are further set forth in his curriculum vitae, attached as Exhibit 7. He may testify regarding matters including non-infringement, domestic industry technical prong, validity, enforceability, claim construction, technological background, and the qualifications of a person of ordinary skill in the art.

## **8. Vijay Madisetti**

Professor Vijay Madisetti received a Ph.D in Electrical Engineering & Computer Science from the University of California Berkeley. He is a Professor of Electrical and Computer Engineering at Georgia Tech. Professor Madisetti's areas of expertise include networking, networking protocols, wireless technology, and system level design methodology.

Professor Madisetti's qualifications are further set forth in his curriculum vitae, attached as Exhibit 8. He may testify regarding matters including non-infringement, domestic industry technical prong, validity, enforceability, claim construction, technological background, and the qualifications of a person of ordinary skill in the art.

## **9. Philip Greenspun**

Philip Greenspun received his Ph.D. in electrical engineering and computer science from the Massachusetts Institute of Technology. He is an MIT affiliate with MIT's Computer Science and Artificial Intelligence Laboratory (CSAIL) and has extensive experience in technical consulting. Dr. Greenspun's areas of expertise include networking, Internet software applications, relational database management systems, and computer application design and user interface.

Dr. Greenspun's qualifications are further set forth in his curriculum vitae, attached as Exhibit 9. He may testify on matters including background technology relevant to the asserted patents, terminology in the relevant technical fields, non-infringement, invalidity, unenforceability, claim construction, and the qualifications of a person of ordinary skill in the art.

#### **10. John P. Morgan**

John P. Morgan received his M.S. in Systems Engineering from Worcester Polytechnic Institute. Mr. Morgan is an independent consultant and software analyst. Mr. Morgan's areas of expertise include networking, computer architecture and relational database management systems.

Mr. Morgan's qualifications are further set forth in his curriculum vitae, attached as Exhibit 10. He may testify on matters including background technology relevant to the asserted patents, terminology in the relevant technical fields, non-infringement, invalidity, unenforceability, claim construction, and the qualifications of a person of ordinary skill in the art.

#### **11. Nathaniel Polish**

Nathaniel Polish received his Ph.D. in Computer Science from Columbia University. He is a computer consultant and Co-Founder of Daedalus Technology Group, Inc. His areas of expertise include networking, software engineering, distributed systems, and interactive environments.

Dr. Polish's qualifications are further set forth in his curriculum vitae, attached as Exhibit 11. He may testify on matters including background technology relevant to the asserted patents, terminology in the relevant technical fields, non-infringement, invalidity, unenforceability, claim construction, and the qualifications of a person of ordinary skill in the art.

#### **12. Brett L. Reed**

Brett L Reed received his M.A. in Economics from the University of California, Los Angeles. He is an economic consultant and the Co-Founder and Director of Competition Economics, LLC. Mr. Reed's area of expertise is economics, particularly focused on economic

analysis of intellectual property and the competitive, licensing, and financial environments of high tech industries.

Mr. Reed's qualifications are further set forth in his curriculum vitae, attached as Exhibit

12. He may testify on matters including public interest, remedy, bond, licensing, and domestic industry economic prong.

### **13. Paul Min**

Paul Min received his Ph.D. in Computer Science from the University of Michigan. He is a professor of Electrical and Systems Engineering at Washington University, St. Louis. His areas of expertise include software engineering, data and communication networks, and networking systems.

Dr. Min's qualifications are further set forth in his curriculum vitae, attached as Exhibit

13. He may testify on matters including background technology relevant to the asserted patents, terminology in the relevant technical fields, non-infringement, invalidity, unenforceability, claim construction, domestic industry, and the qualifications of a person of ordinary skill in the art.

### **14. Jack Chang**

Jack Chang received his Masters in Electrical Engineering from Stanford University. He has extensive experience in telecommunications and currently is the president and chief operating officer for TelTel (dba 9x9.tv), a company offering end-to-end Cloud TV solutions. His areas of expertise include telecommunications, computer telephony, computer networking, and networking systems.

Mr. Chang's qualifications are further set forth in his curriculum vitae, attached as

Exhibit 14. He may testify on matters including background technology relevant to the asserted patents, terminology in the relevant technical fields, non-infringement, invalidity,

unenforceability, claim construction, domestic industry, and the qualifications of a person of ordinary skill in the art.

#### **15. James Olivier**

James Olivier received his Ph.D. in Electrical Engineering from The Ohio State University in 1988. Dr. Olivier's areas of technical expertise are outlined in his curriculum vitae, and include but are not limited to basic and applied research, in the areas of hardware and software systems design, targeted to the areas of wired and wireless data telecommunications.

Dr. Olivier's curriculum vitae is attached hereto as Exhibit 15. He may testify regarding matters including background technology relevant to the asserted patents, terminology in the relevant technical fields, non-infringement, invalidity, unenforceability, claim construction, and the qualifications of a person of ordinary skill in the art.

#### **16. Frank Koperda**

Frank Koperda received his M.S. in Computer Engineering from Case-Western Reserve University in 1976. Mr. Koperda's areas of technical expertise are outlined in his curriculum vitae, and include but are not limited to computer systems and data communications.

Mr. Koperda's curriculum vitae is attached hereto as Exhibit 16. He may testify regarding matters including background technology relevant to the asserted patents, terminology in the relevant technical fields, non-infringement, invalidity, unenforceability, claim construction, and the qualifications of a person of ordinary skill in the art.

#### **17. Katia Obraczka**

Professor Katia Obraczka received a Ph.D. in Computer Science from the University of Southern California. She is a Professor of Computer Engineering at University of California Santa Cruz. Professor Obraczka's areas of expertise include computer networks, distributed systems, Internet information systems, and wireless networks.



Professor Obraczka's qualifications are further set forth in her curriculum vitae, attached as Exhibit 17. She may testify on matters including background technology relevant to the asserted patents, terminology in the relevant technical fields, non-infringement, invalidity, unenforceability, claim construction, and the qualifications of a person of ordinary skill in the art.

#### **18. Robert S. Printis**

Dr. Robert S. Printis received a Ph.D. in Electrical Engineering from the University of Maryland. He is the founder of Robert S. Printis & Associates where he works as a technology consultant. Dr. Printis has over thirty years of experience in computer software and hardware, with an emphasis on systems engineering, and computer and communication networks, and software development.

Dr. Printis' qualifications are further set forth in his curriculum vitae, attached as Exhibit 18. He may testify on matters including background technology relevant to the asserted patents, terminology in the relevant technical fields, non-infringement, invalidity, unenforceability, claim construction, and the qualifications of a person of ordinary skill in the art.

#### **19. Robert Akl**

Dr. Robert Akl received a D. Sc. in Electrical Engineering from Washington University in Saint Louis. Dr. Akl has over 19 years of industry and academic experience. He was the 2008 recipient of the IEEE Professionalism Award and winner of the 2010 Tech Titan of the Future Award. He is currently a Tenured Associate Professor at the University of North Texas in the Department of Computer Science and Engineering and a Senior Member of IEEE. Dr. Akl's areas of expertise include wireless communication, VoIP, computer architecture, and computer networks.

Dr. Akl's qualifications are further set forth in his curriculum vitae, attached as Exhibit 19. The general nature of Dr. Akl's hearing testimony, if any, is expected to relate to the background technology relevant to the asserted patents, terminology in the relevant technical fields, non-infringement, domestic industry technical prong, invalidity, unenforceability, claim construction, and the qualifications of a person of ordinary skill in the art.

## **20. George Cybenko**

Dr. George Cybenko received a Ph.D. in Electrical Engineering/Computer Science and Applied Mathematics from Princeton University. He is a Dorothy and Walter Gramm Professor of Engineering at the Thayer School of Engineering at Dartmouth College. Dr. Cybenko's areas of expertise include computer science, computer networking, applied mathematics, and algorithms.

Dr. Cybenko's qualifications are further set forth in his curriculum vitae, attached as Exhibit 20. The general nature of Dr. Cybenko's hearing testimony, if any, is expected to relate to the background technology relevant to the asserted patents, terminology in the relevant technical fields, non-infringement, domestic industry technical prong, invalidity, unenforceability, claim construction, and the qualifications of a person of ordinary skill in the art.

## **21. Benjamin F. Goldberg**

Dr. Benjamin F. Goldberg received a Ph.D in Computer Science from Yale University. Dr. Goldberg is an expert in the field of computer science, including programming languages and embedded systems.

Dr. Goldberg's qualifications are further set forth in his curriculum vitae, attached as Exhibit 21. The general nature of Dr. Goldberg's hearing testimony, if any, is expected to relate to the background technology relevant to the asserted patents, terminology in the relevant

technical fields, non-infringement, domestic industry technical prong, invalidity, unenforceability, claim construction, and the qualifications of a person of ordinary skill in the art.

## **22. Henry H. Houh**

Dr. Henry H. Houh received a Ph.D in Electrical Engineering from the Massachusetts Institute of Technology. Dr. Houh is an expert in the fields of electrical engineering and network technologies, including social networking, web site development, data networking, optical networking, telecommunications, media streaming and Voice Over IP.

Dr. Houh's qualifications are further set forth in his curriculum vitae, attached as Exhibit 22. The general nature of Dr. Houh's hearing testimony, if any, is expected to relate to the background technology relevant to the asserted patents, terminology in the relevant technical fields, non-infringement, domestic industry technical prong, invalidity, unenforceability, claim construction, and the qualifications of a person of ordinary skill in the art.

## **23. Nader F. Mir**

Dr. Nader F. Mir received a Ph.D in Electrical Engineering from Washington University. He is a Professor in the Department of Electrical Engineering at San Jose State University. Dr. Mir is an expert in the fields of computer networks and internet protocols, VoIP, multimedia networking, communication devices and interfaces, telecommunication and telephone networks, as well as wireless and mobile networks.

Dr. Mir's qualifications are further set forth in his curriculum vitae, attached as Exhibit 23. The general nature of Dr. Mir's hearing testimony, if any, is expected to relate to the background technology relevant to the asserted patents, terminology in the relevant technical fields, non-infringement, domestic industry technical prong, invalidity, unenforceability, claim construction, and the qualifications of a person of ordinary skill in the art.

#### **24. Leo Hoarty**

Leo Hoarty is a technology executive and holds over 20 utility patents. Mr. Hoarty's areas of expertise include digital media networks, speech recognition systems, wireless communications, telematics, consumer electronics and digital watermarking.

Mr. Hoarty's qualifications are further set forth in his curriculum vitae, attached as Exhibit 24. He may testify regarding matters including non-infringement, domestic industry technical prong, validity, enforceability, claim construction, technological background, and the qualifications of a person of ordinary skill in the art.

#### **25. Charles D. Knutson**

Professor Charles D. Knutson received a Ph.D in Computer Science from Purdue University. Dr. Knutson is a Professor at Brigham Young University. Professor Knutson's areas of expertise include software engineering, mobile computing, wireless data, network integration, system and server operating systems, network design, system architecture, embedded systems, Bluetooth applications and software quality.

Professor Knutson's qualifications are further set forth in his curriculum vitae, attached as Exhibit 25. He may testify regarding matters including non-infringement, domestic industry technical prong, validity, enforceability, claim construction, technological background, and the qualifications of a person of ordinary skill in the art.

#### **26. Robert L. Stevenson**

Professor Robert L. Stevenson received a Ph.D in Electrical Engineering from Purdue University. Dr. Stevenson is a Professor at the University of Notre Dame. Professor Stevenson's areas of expertise are outlined in his curriculum vitae, and include but are not limited to image processing and signal processing.

Professor Stevenson's curriculum vitae is attached hereto as Exhibit 26. He may testify regarding matters including non-infringement, domestic industry technical prong, validity, enforceability, claim construction, technological background, and the qualifications of a person of ordinary skill in the art.

**27. Scott D. Hampton**

Scott D. Hampton received his Bachelor of Science in Accounting from the University of Utah in 1986. He has extensive professional experience and is the founder of Hampton IP & Economic Consultants. Mr. Hampton's areas of expertise include forensic accounting and intellectual property valuation.

Mr. Hampton's qualifications are further set forth in his curriculum vitae, attached as Exhibit 27. He may testify regarding matters including domestic industry economic prong, remedy, bond, licensing, and public interest considerations.

Date: December 13, 2013

Respectfully submitted,

<p><u>/s/ James B. Altman</u> James B. Altman Barbara A. Murphy Kandis C. Gibson FOSTER, MURPHY, ALTMAN &amp; NICKEL, PC 1899 L Street, NW, Suite 1150 Washington, DC 20036 Telephone: 202-822-4100 Facsimile: 202-822-4199</p> <p>Michael N. Rader Allen S. Rugg Charles T. Steenburg D. Alexander Ewing Turhan F. Sarwar WOLF GREENFIELD &amp; SACKS 600 Atlantic Avenue Boston, MA 02210 Telephone: 617-646-8000 Facsimile: 617-646-8646</p> <p><i>Counsel for Respondents Sony Corporation, Sony Corporation of America, Sony Electronics Inc., Sony Mobile Communications AB, Sony Mobile Communications (USA) Inc., Sony Computer Entertainment, Inc., and Sony Computer Entertainment America LLC</i></p>	<p><u>/s/ Paul T. Meiklejohn</u> Paul T. Meiklejohn David Tseng Lukas Dudkowski Mudit Kakar William Perry Emily Lawson Jennifer Spait DORSEY &amp; WHITNEY L.L.P. 701 Fifth Avenue, Suite 6100 Seattle, WA 98104 Telephone: 206-903-8800 Facsimile: 206-903-8820</p> <p>Paul Ackerman Gary Abelev DORSEY &amp; WHITNEY L.L.P. 51 West 52nd Street New York, NY 10019-6119 Telephone: 212-415-9200 Facsimile: 212-953-7201</p> <p><i>Counsel for Respondents Toshiba Corporation, Toshiba America, Inc., and Toshiba America Information Systems, Inc.</i></p>
<p><u>/s/ Rajeev Gupta</u> Smith R. Brittingham IV Rajeev Gupta Michael E. Kudravetz FINNEGAN, HENDERSON, FARABOW GARRETT &amp; DUNNER, LLP 901 New York Avenue, N.W. Washington, D.C. 20001-4413 Telephone: (202) 408-4000 Facsimile: (202) 408-4400</p> <p>Andrew C. Sonu FINNEGAN, HENDERSON, FARABOW GARRETT &amp; DUNNER, LLP Two Freedom Square</p>	<p><u>/s/ Kevin M. O'Brien</u> Kevin M. O'Brien Richard V. Wells Matt S. Dushek Baker &amp; McKenzie LLP 815 Connecticut Ave., N.W. Washington, DC 20006 Tel: (202) 452-7000 Fax: (202) 452-7074</p> <p>D. James Pak Baker &amp; McKenzie LLP Two Embarcadero Center, 11th Floor San Francisco, CA 94111 Tel: (415) 592-3209</p>

<p>11955 Freedom Drive Reston, VA 20190-5675 Telephone: (571) 203-2700 Facsimile: (202) 408-4400</p> <p><i>Counsel for Respondents LG Electronics, Inc., LG Electronics USA., Inc., and LG Electronics MobileComm USA., Inc.</i></p>	<p>Fax: (202) 416-7033</p> <p>Edward K. Runyan Baker &amp; McKenzie LLP 300 E. Randolph St. Chicago, Illinois 60601 Tel: (312) 861-8000 Fax: (312) 861-2829</p> <p><i>Attorneys For Respondent VIZIO, Inc.</i></p>
<p><u>/s/ Steven J. Routh</u> Steven J. Routh Sten A. Jensen T. Vann Pearce, Jr. Diana M. Szego Jordan L. Coyle Christopher J. Higgins ORRICK, HERRINGTON &amp; SUTCLIFFE, L.L.P. 1152 15th Street, NW Washington, D.C. 20005 Telephone: 202-339-8400 Facsimile: 202-339-8500</p> <p>William H. Wright Christopher P. Broderick Andrew Y. Yen ORRICK, HERRINGTON &amp; SUTCLIFFE, L.L.P. 777 South Figueroa Street Los Angeles, CA 90017 Telephone: 213-629-2020 Facsimile: 213-612-2499</p> <p><i>Counsel for Respondents Panasonic Corporation and Panasonic Corporation of North America</i></p>	<p><u>/s/ Kevin J. Patariu</u></p> <hr/> <p>John P. Schnurer Jack Ko Kevin J. Patariu Perkins Coie LLP 11988 El Camino Real, Suite 200 San Diego, California 92130 Telephone: (858) 720-5700 Facsimile: (858) 720-5799 Email: JSchnurer@perkinscoie.com JKo@perkinscoie.com KPatariu@perkinscoie.com</p> <p>James B. Coughlan Perkins Coie LLP 700 Thirteenth Street, NW, Suite 600 Washington, DC 20005 Telephone: (202) 654-6200 Facsimile: (202) 654-6211 Email: JCoughlan@perkinscoie.com</p> <p>Yitai Hu ALSTON &amp; BIRD LLP 275 Middlefield Road, Suite 150 Menlo Park, CA 94025 Telephone: 650-838-2000 Facsimile: 650-838-2001 Email: yitai.hu@alston.com</p>

	<p>Christopher R. Byrnes  ALSTON &amp; BIRD LLP  950 F Street, NW  Washington, DC 20004  Telephone: 202-239-3300  Facsimile: 202-239-3333  Email: chris.byrnes@alston.com</p> <p><i>Counsel for Respondents  AmTRAN Technology Co., Ltd. and  AmTRAN Logistics, Inc.</i></p>
	<p><u>/s/ Benjamin Hershkowitz</u>  Josh A. Krevitt  Benjamin Hershkowitz  R. Scott Roe  Eric T. Syu  Joshua E. Dubin  Won Joon Lee  GIBSON DUNN &amp; CRUTCHER L.L.P.  200 Park Avenue  New York, NY 10166  Telephone: 212-351-4000  Facsimile: 212-351-4035</p> <p>Sarah J. Sladic  Jill M. McCormack  GIBSON DUNN &amp; CRUTCHER L.L.P.  1050 Connecticut Avenue, N.W.  Washington, DC 20036-5306  Telephone: 202-955-8500  Facsimile: 202-467-0539</p> <p><i>Attorneys for Respondents Sharp Corporation  and Sharp Electronics Corporation</i></p>



# **EXHIBIT 1**

## CURRICULUM VITAE

Revised: December, 2013

**NAME:** Donal Edward O'Mahony  
**DATE OF BIRTH:** April 17th, 1961  
**MARITAL STATUS:** Married to Mary Bell, 3 Children  
**CITIZENSHIP:** Irish  
**ADDRESS:** 7 Longford Place, Monkstown, Co Dublin, Ireland  
**Tel:** +353 1 896 8445 (Office)  
**EMAIL:** Donal.OMahony@cs.tcd.ie  
**FAX:** +353 1 677 2204

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DEGREE	INSTITUTION	FIELD	DATE
B.A.	University of Dublin, Trinity College	Mathematics	1982
B.A.I.(1 <sup>st</sup> Class)	University of Dublin, Trinity College	Engineering	1982
Ph.D.	University of Dublin, Trinity College	Computer Science	1991

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### EMPLOYMENT HISTORY

DATES	POSITION	DEPARTMENT	INSTITUTION
<b>2011- 2010</b>	<b>Head of Discipline Director</b>	<b>Computer Systems Telecommunications Graduate Initiative National Initiative funding 30 students + Advanced Training modules in Telecommunications</b>	<b>Trinity College Dublin</b>
<b>2004- 2009</b>	<b>Research Centre Founder Director</b>	<b>Centre for Telecommunications Value-Chain Research National Centre, 100 Researchers 5-year budget approx €25m</b>	<b>University of Dublin, Trinity College</b>
<b>2010--</b>	<b>Vice-President Business Development</b>	<b>Xcelerit (Xcelerit.com)– A campus spinout company specializing in addressing complex calculations with Graphics Processing Units</b>	
<b>2007-</b>	<b>Full Professor</b>	<b>Computer Science</b>	<b>University of Dublin,</b>
2001	Visiting Professor	Faculty of Math & Computer & Computer Science	Nicholas Copernicus University, Torun, Poland
1998-99	Fulbright Fellow	Computer Systems Lab	Stanford University, California, USA
1984	Assistant Professor	Computer Science Dept	Trinity College Dublin
1983-1984	Systems Engineer	Department established to launch IBM PC in Ireland	IBM Ireland
1982-83	R&D Engineer	Operating Systems Division	Sord Computer Systems A Microcomputer start- up company, Dublin & Tokyo

## **CONSULTING:**

I occasionally act as an expert witness in legal cases involving computer science, computer security or intellectual property matters. A summary of these cases is given in the following table:

Time Period	Attorney	Client	General Area
2003	Cooley LLP	E-Bay	Electronic Payment
2004-5	Kirkland & Ellis LLP	Amazon.com	Electronic Payment
2008-2009	Independent Assessor Assisting Judge	EMI & Others versus Eircom	Copyright Infringing Downloads
2010-2011	Gibson, Dunne & Crutcher	Moneycat	Electronic Payment
2010	Gallen & Associates	Ryanair	Web Technology
2013	Bird & Bird	Nokia	Mobile Telephony Services
2013	Mintz, Levin..	Moneycat	Electronic Payment
2013-	Wolf-Greenfield	Sony	Voice-over-IP and content distribution over the internet

### **Other Consulting**

2000-2005, United Nations Commission for Trade & Development (UNCTAD) on role of Electronic Payments can play in developing countries

1994-1995 : Irish Government – Design of a National Trunk Data Network to meet the telecommunications needs of central government, state agencies and emergency services

## **HONOURS AND AWARDS**

1998 Awarded Fulbright Fellowship award to visit Stanford University, California

2001 Awarded Fellowship of Trinity College Dublin

2007 Winner of the Irish National Media Awards for the production of TV science animation series entitled “The Resistors” – broadcast on Irish National TV with excellent audience ratings

## **SCHOLARLY AND PROFESSIONAL ACTIVITIES**

2007- Member, Editorial Board of Elsevier Journal of Electronic Commerce Research and Applications

2006 to date Reviewer for Qatar National Research Fund

2005 to date Reviewer for the Belgian National Fund for Scientific Research

## **UNIVERSITY COMMITTEE SERVICES (at Trinity College Dublin)**

**October 2013-** Member of Steering Group which will drive the implementation of the University's Innovation & Entrepreneurship Strategy

2012/3: Member of group tasked to devise an Innovation Strategy for Trinity College Dublin- Dec 2012-July 2013, This strategy involved the planning of a new iconic building, the recruitment of up to 10 new professors and the creation of many cross-institutional programs. The resulting strategy was subject to review by leading professors from Stanford, Aalto and the University of Copenhagen.

2006- Member of the Research Committee, School of Computer Science & Statistics

1990-94 Member of the Graduate Studies Committee, Trinity College Dublin

### **PROFESSIONAL COMMITTEE SERVICES**

2006- 2009 Member of the Royal Irish Academy Engineering Sciences Committee

2000-2005 – Member of Irish Communications Regulator (COMREG) Numbering Advisory Panel

2013 to date Board Member of the Commissioners of Irish Lights (CIL.IE) : This is a state body charged with operating all Lighthouses and Aids to Navigation around the Irish Coastline – Member of the Board and also the Corporate Planning sub-committee

### **CONFERENCE SERVICES**

2013 member of the TPC for IEEE International Workshop on Software Defined Systems (SDS - 2014), March 11, 2014, Boston, Massachusetts, USA

2013 member of TPC for ICC'14 Selected Areas in Communications Symposium (Cloud Computing)

2013, member of TPC for ICCVE 2013, International Conference on Connected Vehicles & Expo, Las Vegas, 2-6 December 2013

2013, member of TPC for the IEEE Globecom 13 International Workshop on Cloud Computing Systems, Networks and Applications, Atlanta, Georgia, Dec 9-13th, 2013

2013, member of the TPC for 22<sup>nd</sup> International ACM Symposium on High Performance Parallel and Distributed Computing (HPDC'13), June 17<sup>th</sup>-21<sup>st</sup>, New York

2012, member of TPC for IEEE International Communications Conference (ICC) Selected Areas in Communications Symposium on Green Communications Systems and Networks

2012, Member of TPC for 1<sup>st</sup> International Workshop on Extreme Scale Parallel Architectures and Systems (ESPAS 2012), January 23<sup>rd</sup>, 2012

2008, Member of the Program Committee for The China-Ireland International Conference on Information and Communications Technologies (CICT 2008), September 26<sup>th</sup>-28<sup>th</sup>, Beijing, P.R. China

2007-2008 Member of the Technical Program Committee for MobiArch'08 (The Third International Workshop on Mobility in the Evolving Internet Architecture), collocated with ACM SIGCOMM 2008, Seattle, WA, USA, August 17-22, 2008.

2005- General Chair, IEEE Vehicular Technology Conference VTC'06, Dublin, Ireland, March, 2006  
2006 Steering Committee Member, China-Ireland International Conference on ICT(CIICT06), Dublin, Ireland, 2006

**INVITED SPEAKER:** (in recent years)

June, 2013: keynote speaker at 10<sup>th</sup> International Joint Conference on E-Business and Telecommunications, Reykjavik, Iceland: topic: Smart Grid & The Internet

Nov, 2007 keynote speaker at IEEE Local Computer Networks Conference, Dublin, Ireland

2005 keynote speaker at IEEE Vehicular Technology Conference, VTC'06, Dublin Ireland

**EXTERNAL THESIS EXAMINER:**

2007 Queens University, Belfast, Ireland

2006 University of London, Royal Holloway, London

2004 University College Dublin, Ireland

**REVIEWER:**

IEEE Internet Computing

European Union Auditor and Reviewer for Telecommunicaitons Projects and for Advanced Informatics in Medicine Programme

Electronics Letters

Software Practice & Experience

Wiley

**PROFESSIONAL ASSOCIATIONS:**

1989- Member, IEEE

2011- Senior Member of the IEEE

**COURSES TAUGHT**

**CS4081 – Entrepreneurship & High Tech Venture Creation**

**CS7051 Sustainable ICT Systems**

**4BA2 Computer Systems : Advanced Computer Networking**

These courses are always popular and well received - Some comments from recent (2013 CS7051 course) :

Interesting Subject; Great Lecturer; Well Delivered;

I enjoy the lecturer's style and his enthusiasm. Content is interesting and varied with videos etc.

Content clear and easily understood;

Different style of teaching: Not just boring slides; The content is interesting and relevant.

**10 Years Experience of teaching introductory programming courses in C and Java**

2000-2004 : Acted as Course Directory for the department's flagship course : BA (moderatorship) in Computer Science.

**RESEARCH GRANTS AND CONTRACTS (recent)**

2011-2014 The Telecommunications Graduate Initiative (€8 million over 5 years) – support for 35 PhD students across participant Universities (10 at TCD)

2004-2009 The Centre for Telecommunications Value-Chain Research (€20 million over 5 years)

2008- 2012 Irish Government of Ireland Research Scholarship : Enterprise Partnership fund

Recent Applications:

January 2012 – Proposed a European Union STREP called C-Shift with Keith Nolan

April 2012 – Proposed a European Union STREP called DYRECT (Dynamic Spectrum Access for Reliable Mobile Wireless Capacity)

April 2013 – ICT call 11 – Proposed a European Union STREP with Nicola Marchetti – Project ADEL(Advanced Decentralized Licenced shared access) – Funding to TCD: €400K

## GRADUATE STUDENT SUPERVISION

Student	Degree	Title	Date of Award
Argyroudis, Patroklos	PhD	Authorization management for pervasive computing	2006
Cunningham, Donal	MSc	Securing pay-per-view systems in an open video distribution environment	2000
Collins, Diarmuid	PhD	Accountability in Content Distribution Architectures	Current
Doval, Diego	PhD	Self-organizing resource location and discovery	2005
Doyle, Joseph	PhD	Load Balancing and Rate Limiting Based Algorithms for Improving Cloud Computing Performance	2013
Greede, Abdolbast	MSc	Service driven bluetooth networks	2004
Greevy, Orla	MSc	An object oriented framework for the design of an EDI user agent	1996
Lee, Brian	PhD	A policy based framework for real time charging in next generation networks	2005
Lloyd, David John	MSc	Efficient transporting of IP over ATM using Smart IP switching	1999
McAdoo, Robert	PhD	Sobriquet: A personal naming and identity management system	2012
McCourt, Maurice	MSc	The design and development of an EDI audit and control workbench	1996
McGlinchey, Dominic	MSc	An investigation into the negotiation and provisioning of quality of service in high speed networks	1996
Ní Fhloinn, Eabhnat	PhD	Biometric retrieval of cryptographic keys	2006
Pearce, Michael Edward	PhD	Multi-party electronic payments for mobile communications	2001
Ruffini, Marco	PhD	Optical IP switching	2008
Tewari, Hitesh	PhD	Authentication and accounting for network services in next-generation mobile networks	2005
Tewari, Hitesh	MSc	A flexible electronic payment system FlexiCheck	1996
Toner, Stephen	PhD	Transit: adapting the internet for mobile & ad hoc operation	2006
Verma, Raja	PhD	Secure group communications in emergency ad hoc networks	2006

## PUBLICATIONS

Appended in Separate file

# **EXHIBIT 2**

**Ellen W. Zegura**  
**Professor and Chair**  
**School of Computer Science, College of Computing**  
**Georgia Institute of Technology**  
**Atlanta, Georgia 30332-0765**  
[ewz@cc.gatech.edu](mailto:ewz@cc.gatech.edu)  
<http://www.cc.gatech.edu/fac/Ellen.Zegura/>

### **EDUCATIONAL BACKGROUND**

D.Sc.	1993	Washington University	Computer Science
M.S.	1990	Washington University	Computer Science
B.S.	1987	Washington University	Computer Science
B.S.	1987	Washington University	Electrical Engineering

### **EMPLOYMENT HISTORY**

<b>Title</b>	<b>Organization</b>	<b>Years</b>
School Chair	Computer Science Georgia Institute of Technology	February 2007-present
Division Chair	Computing Science and Systems Georgia Institute of Technology	August 2005-January 2007
Professor	College of Computing Georgia Institute of Technology	2004-present
Associate Dean	College of Computing Georgia Institute of Technology	2003-2007
Interim Dean	College of Computing Georgia Institute of Technology	May 2002-October 2002
Assistant Dean	College of Computing Georgia Institute of Technology	2000-2003
Associate Professor	College of Computing Georgia Institute of Technology	1999-2004
Assistant Professor	College of Computing Georgia Institute of Technology	1993-1998
Research Assistant	Department of Computer Science Washington University	1987-1993



## **CURRENT FIELDS OF INTEREST**

**Computer networking and Computing for social good.** Specific areas of current interest include network design, algorithms and services for Internetworking, peer-to-peer and overlay networks, mobile wireless networks and computing for social good.

### **I. TEACHING**

#### **A. Courses Taught**

College of Computing, Georgia Institute of Technology

<b><u>Term/Year</u></b>	<b><u>Course</u></b>	<b><u>Number of Students</u></b>	<b><u>Comments</u></b>
Fall 1993	CS/CmpE 4760Advanced Computer Architecture	33	New
Winter 1994	CS 8113 High Speed Switching Systems	16	
Spring 1994	CS 4380 Data Communication	25	
Fall 1994	CS/CmpE 4760Advanced Computer Architecture	35	
Fall 1994	CS 8115 Introduction to Graduate Studies	24	
Winter 1995	CS 8113 High Speed Switching Systems	17	
Spring 1995	CS 4380 Data Communication	35	
Fall 1995	CS 6380 Computer Networks	37	
Fall 1995	CS 1155 Understanding and Constructing Proofs	51	
Winter 1996	CS 8113 High Speed Switching Systems	20	
Sum 1996	CS 1155 Understanding and Constructing Proofs	38	
Fall 1996	CS 1155 Understanding and Constructing Proofs	60	
Winter 1997	CS 4380 Data Communication	28	
Winter 1997	CS 6386 High Speed Switching Systems	28	
Fall 1997	CS 1155 Understanding and Constructing Proofs	62	
Fall 1997	CS 6380 Computer Network	38	
Winter 1998	CS 6386 High Speed Switching Systems	31	
Sum 1998	CS 1155 Understanding and Constructing Proofs	61	
Winter 1999	CS 6380 Computer Networks	30	
Spring 1999	CS 4385 Computer Network Protocols	43	
Fall 1999	CS 3251 Computer Networking I	105	
Spring 2000	CS 7270 Networked Applications and Services	40	
Fall 2000	CS 3251 Computer Networking I	100	
Spring 2002	CS 7270 Networked Applications and Services	26	
Fall 2003	CS 6250 Computer Networks	60	
Fall 2004	CS 8803 Prep for an Academic Teaching Career	25	
Spring 2005	CS 3251 Computer Networking I	50	Seminar
Fall 2005	CS 3251 Computer Networking I	48	
Fall 2006	CS 1100 Freshman Leap	20	
Spring 2007	CS 4001 Computers and Society	~40	

Summer2007	CS 4001 Computers and Society	~35	Barcelona w/Foley
Summer2007	CS 4235 Intro to Information Security	~25	Barcelona
Spring 2008	CS 8803 Compute for Good	~20	New w/Vempala
Spring 2009	CS 1050 Constructing Proofs	60	
Fall 2009	CS 4911 Senior Design/8803 Compute for Good	35	w/Vempala
Spring 2010	CS 4001 Computers and Society	40	
Fall 2010	CS 4911 Senior Design/8803 Compute for Good	35	

## **B. Continuing Education**

**Emerging Technologies: Asynchronous Transfer Mode, October 1994.** Dr. Zegura was the sole developer and teacher of a section on Asynchronous Transfer Mode as part of the Emerging Transfer Technologies Continuing Education Course.

## **C. Curriculum Development**

**CS 6386/8113: High Speed Switching Systems.** New graduate course concentrating on the design and analysis of switching systems capable of operating at high speeds (mega bits per second per interface) and supporting diverse application needs (e.g., real-time, bursty, rate-adaptive, multipoint). This course has become part of the regular Networking and Telecommunications curriculum.

**CS3251: Computer Networks I.** New undergraduate course providing an introduction to problems in computer networking, including errors, medium access, routing, flow control and transport. Emphasis is on current best practice, and specifically on solutions deployed in the current Internet. Includes programming of networked applications.

**CS 7270: Networked Applications and Protocols.** New graduate course providing depth in the upper layer(s) of the protocol stack. The course covers a selection of network applications and services that may vary from one offering to the next. In Spring 2002, the set of topics included peer-to-peer networks, server selection, network monitoring, mobile/ad-hoc services and active services. The course material will come primarily from research papers. The course will include a significant project component that will typically require sockets programming.

**CS 4803/8803: Compute for Social Good.** New undergraduate and graduate course emphasizing real-world projects that apply computing to solve social problems. Co-developed with Santosh Vempala.

## **D. Individual Student Guidance**

### 1. Postdoctoral Fellows Supervised

**M. Bill McKinnon III:** Winter 1998-Winter 1999 (25% time)

Co-supervised by Ken Calvert

Performance analysis of active networking

**Sapan Bhatia:** Fall 2006

Automated methods for making legacy protocols delay tolerant

Position: Research scientist, Princeton University

### 2. Ph.D. Students Supervised

**Michael Jeff Donahoo**

Graduation date: Summer 1998  
Thesis title: Application-based enhancement to network-layer multicast  
Initial Position: Assistant Professor, Baylor University

**Samrat Bhattacharjee**

Graduation date: Summer 1999 (co-supervised by Ken Calvert)  
Thesis title: Active networking: architectures, composition, and applications  
Initial Position: Assistant Professor, University of Maryland

**Fang Hao**

Graduation date: Summer 2000  
Thesis title: Scalability techniques in QoS networks  
Initial Position: Lucent Technologies, Bell Labs Research

**Zhiruo Cao**

Graduation date: Summer 2000  
Thesis title: Network support for adaptive applications  
Initial Position: Cisco Systems

**Tianji Jiang**

Graduation date: Summer 2000 (co-supervised by Mostafa Ammar)  
Thesis title: Accommodating heterogeneity and scalability for multicast communication  
Initial Position: Cisco Systems

**Youngsu Chae**

Graduation date: Fall 2002  
Thesis title: Algorithms, protocols and services for scalable multimedia streaming  
Initial Position: Samsung, Korea

**Richard Liston**

Graduation date: August 2004  
Thesis title: Measuring user-perceived Internet performance in multiple locations  
Initial Position: Assistant Professor, Ursinus College, Pennsylvania

**Shashidhar Merugu**

Graduation date: Fall 2005  
Thesis title: Network design and routing in peer-to-peer and mobile ad-hoc networks  
Initial Position: Riverbed Networks, San Francisco, California

**Pradnya Karbhari**

Graduation date: Fall 2005 (co-supervised by Mostafa Ammar)  
Thesis title: Throughput and fairness considerations in overlay networks for content distribution  
Initial Position: Google Research, Mountain View, California

**Meng Guo**

Graduation date: Fall 2005 (co-supervised by Mostafa Ammar)  
Thesis title: Supporting scalable and resilient video streaming applications in evolving networks  
Initial Position: Google Research, Mountain View, California

**Abhishek Kumar**

Graduation date: Fall 2005 (co-supervised by Jim Xu)  
Thesis title: Network data streaming: Algorithms for network measurement and monitoring  
Initial Position: Eagle Eye Networks (startup)

**Wenrui Zhao**

Graduation date: Summer 2006 (co-supervised by Mostafa Ammar)  
Thesis title: Routing and network design in delay tolerant networks  
Initial Position: Ask.com

**Ruomei Gao**

Graduation date: August 2007 (co-supervised by Constantinos Dovrolis)  
Thesis title: Interdomain traffic engineering for multihomed networks  
Initial Position: Akamai

**Hyewon Jun**

Graduation date: Fall 2007 (co-supervised by Mostafa Ammar)  
Thesis title: Power management in disruption tolerant networks  
Initial position: Google, New York

**Sridhar Srinivasan**

Graduation date: Spring 2007  
Thesis title: Design and use of managed overlay networks  
Initial position: Google

**Cong Shi**

In progress (co-supervised by Mostafa Ammar)  
Thesis topic: Security and applications in disruption tolerant networks

**Samantha Lo**

In progress (co-supervised by Mostafa Ammar)  
Thesis topic: Network virtualization

3. Ph.D. Special Problems Students [incomplete]

**Yang Chen**

Topic: Characterization and control of mobile wireless networks

**Ahmed Mansy**

Topic: Mobile wireless networks

**Lei Li:** Spring 2002-Spring 2003  
Session layers in wireless networks

**Matthew Sanders:** Spring 2000-2002  
Active anycasting

**Lenitra Clay:** Spring1997, 2000-2002  
Replication techniques for content distribution

**Siddharth Bajaj:** Winter 1997-Spring1997  
Network services in asymmetric environments

**Yaakov Eisenberg:** Winter1995  
Large-scale addressing

**Phyllis Schneck:** Winter 1994-Spring 1996  
Networking and scientific computation for atmospheric applications  
Workload generation and graph models for networks  
Dynamic resource reservation

4. M.S. Special Problems Students [incomplete]

**Sethu Raman:** Fall 2010 - present  
Adaptive networking for the developing world

**Daphne Larose:** Spring 2011 - present  
Technology support for Mental Health in Liberia

**Stefano Parmesan:** Spring 2011 - present  
Data collection, analysis and visualization for agro-dealers in Zambia

**Ankita Jain:** Fall 2005  
Mobility models for disruption tolerant networking

**Trevor Robbie:** Spring, Fall 2001  
Implementation of scalable fair queuing

**Matthew Sanders,** Spring 1998 – Fall 1998  
Active anycasting

**Ramkumar Krishnan:** Winter 1998 – Fall 1998  
Simulation of active networking

**Albert Leach:** Winter 1997  
ATM laboratory assistant

**David Pope:** Winter 1998  
Networking to the home

**Jae Young Jang:** Summer 1998  
ATM switching and multi-chip modules

**Chang-tien Lu:** Summer 1995  
Wide-area multicast routing

**Wei Guan:** Summer 1995  
Wide-area multicast routing

**Weimin Feng:** Fall 1994  
Network modeling

**Richard Dennis:** Summer 1994  
Experimentation with ATM switches

**Yoshikatsu Fujita:** Winter 1994  
Comparison of queuing in switching networks

**Ramesh Madhavan:** Winter 1994  
Issues in core-based tree implementation

#### 5. Undergraduate Special Problem Students [incomplete]

**Evan Zanoski:** Fall 2007 – Spring 2008  
DTN application development

**Kevin Webb:** Fall 2006 – Spring 2008  
Prototyping a disruption-tolerant network with message ferrying

**Jon Olson:** Summer 2005 – Summer 2008  
Prototyping a disruption-tolerant network with message ferrying

**Alex Levin:** Spring 2002  
Design and Implementation of a Virtual ATM Link over IP

**Arief Sugianto:** Fall 2000 – Spring 2001  
Design and Implementation of a Virtual ATM Link over IP

**Victor Pate:** Spring 2000  
Applications of a high speed switch kit

**Scott McMahon and Yasir Arain:** Spring 2000

## Design and Implementation of a Virtual ATM Link over IP

**Holly Fait:** Summer 2000

Implementation of scalable fair queuing  
Participant in CRA Distributed Mentor Program

**Ching-Ying Wang:** Summer 2000

Implementation of a dynamic community infrastructure  
Participant in CRA Distributed Mentor Program

**Catherine Eichholz:** Summer 1998

Anycasting  
Participant in CRA Distributed Mentor Program  
Position: Computer Science Ph.D. Program at Georgia Tech

**David Haynes:** Fall 1996 – Spring 1998

Demonstration of active networking

**Maria Gullickson:** Summer 1997 – Winter 1998

Adaptive applications and anycasting  
Participation in CRA Distributed Mentor Program  
Position: Computer Science Ph.D. Program at U. of Washington

**Alisa Marzilli:** Summer 1997

Adaptive applications  
Participant in CRA Distributed Mentor Program

**Ojas Parekh:** Fall 1996

Dynamic resource management  
Position: Mathematical Sciences Ph.D. Program at Carnegie Mellon

**M. Scott McFarland:** Winter 1997

Dynamic resource management

**Elizabeth Edwards:** Summer 1995

A network topology tool  
Participant in CRA Distributed Mentor Program  
Position: Computer Science Ph.D. Program at Georgia Tech

**Megan Thomas:** Summer 1994

Random graphs to model internetworks  
Participant in CRA Distributed Mentor Program  
Position: Computer Science Ph.D. Program at U.C. Berkeley

## **II. RESEARCH AND CREATIVE SCHOLARSHIP**



## **A. Thesis**

### **D.Sc. Thesis**

Title: Analysis of Switching Networks for Multipoint and Multirate Communication

Completed: August 1993

Advisor: Professor Jonathan S. Turner

University: Washington University

### **M.S. Thesis**

Title: Parallel Simulated Annealing Using Speculative Computation

Completed: May 1990

Advisor: Professor Mark A. Franklin

University: Washington University

## **B. Published Journal Papers (refereed)**

1. Witte (Zegura), E., Chamberlain, R., Franklin, M. "Parallel Simulated Annealing Using Speculative Computation." IEEE Transactions on Parallel and Distributed Systems, 2(4), October 1991.
2. Zegura, E.W. "A Quantitative Comparison of Architectures for ATM Switching Systems." IEEE Communications Magazine, 31(2), February 1993.
3. Zegura, E.W. "Evaluating Blocking Probability in Generalized Connectors." ACM/IEEE Transactions on Networking, August 1995.
4. Calvert, K.L., Doar, M., Zegura, E.W. "Modeling Internet Topology." IEEE Communications Magazine, June/July 1997.
5. Donahoo, M.J., Zegura, E.W., Calvert, K.L. "Center Selection and Migration for Wide-area Multicast Routing." Journal of High Speed Networks, 6(2,) 1997.
6. Zegura, E.W., Calvert, K.L., Donahoo, M.J. "A Quantitative Comparison of Graph-based Models for Internet Topology." ACM/IEEE Transactions on Networking, 5(6), December 1997.
7. Zegura, E.W., McFarland, S., Parekh, O. "A Survey and New Results in Renegotiated Service." Journal of High Speed Networks, 6(3), 1997.
8. Park, W.-B., Owen, H., Zegura, E.W. "SONET/SDH Traffic Generation Models." European Transactions on Telecommunications, M. Decina, editor-in-chief, January/February 1998.
9. Bhattacharjee, S., Calvert, K.L., Zegura, E.W. "Active Networking and End-to-end Arguments." IEEE Network, May 1998. (Note that this is a two-page peer-reviewed commentary.)
10. Calvert, K.L., Bhattacharjee, S., Zegura, E.W., Sterbenz, J. "Directions in Active Networks." IEEE Communications Magazine Special Issue on Programmable Networks,

October 1998.

11. Park, W.-B., Owen, H., Zegura, E.W. "Intact versus Fractional Switching in SONET/SDH Crossconnects." European Transactions on Telecommunications, M. Decina, editor-in-chief, 1999.
12. Zegura, E.W., Ammar, M., Bhattacharjee, S., Fei, Z. "Application Layer Anycasting: A Server Selection Architecture and Use in a Replicated Web Service." IEEE/ACM Transactions on Networking, August 2000.
13. Hao, F., Zegura, E.W., Ammar, M. "QoS Routing for Anycast Communications: Motivation and an Architecture for DiffServ Networks." IEEE Communications Magazine, June 2002.
14. Fei, Z., Ammar, M., Zegura, E. W. "Multicast Server Selection: Problems, Complexity and Solutions." IEEE Journal on Selected Areas in Communications, September 2002.
15. Chae, Y., Guo, K., Buddhikot, M., Suri, S., Zegura, E.W. "Silo, Rainbow and Caching Token: Schemes for Scalable, Fault Tolerant Stream Caching." IEEE Journal on Selected Areas in Communications, Fall 2002.
16. Fei, Z., Yang, M., Ammar, M., Zegura, E.W. "A Framework for Allocating Clients to Rate-Constrained Multicast Servers." Computer Communications, July 2003.
17. Merugu, S., Srinivasan, S., Zegura, E.W. "Adding Structure to Unstructured Peer-to-Peer Networks: the Use of Small-World Graphs." Special Issue of Journal of Parallel and Distributed Computing on Theoretical and Algorithmic Aspects of Sensor, Ad Hoc Wireless and Peer-to-Peer Networks, Vol. 65, No. 2, pp. 142-153, February 2005.
18. Jun, H., Zhao, W., Ammar, M., Zegura, E.W., Lee, C. "Trading Latency for Energy in Densely Deployed Wireless Ad Hoc Networks using Message Ferrying." Elsevier Ad Hoc Networks Journal, May 2007.
19. Jun, H., Ammar, M., Corner, M., Zegura, E.W. "Hierarchical Power Management in Disruption Tolerant Networks Using Traffic Aware Optimization." Elsevier Computer Communications, October 2009.
20. Chen, Y., Borrel, V., Ammar, M., Zegura, E.W. "A Framework for Characterizing the Wireless and Mobile Network Continuum." Computer Communications Review, January 2011.
21. Polat, B., Sachdeva, P., Ammar, M., Zegura, E.W. "Message Ferries as Generalized Dominating Sets in Intermittently Connected Mobile Networks", to appear in Pervasive and Mobile Computing Journal.

### **C. Conference Presentations**

### **C.1. Conference Presentations with Proceedings (refereed)**

1. Chamberlain, R., Edelman, M., Franklin, M., Witte (Zegura), E. "Simulated Annealing on a Multiprocessor." Proceedings of IEEE International Conference on Computer Design (ICCD), 1988.
2. Witte (Zegura), E., Chamberlain, R., Franklin, M. "Parallel Simulated Annealing Using Speculative Computation." Proceedings of International Conference on Parallel Processing (ICPP), 1990.
3. Witte (Zegura), E., Chamberlain, R., Franklin, M. "Task Assignment by Parallel Simulated Annealing." Proceedings of IEEE International Conference on Computer Design (ICCD), 1990.
4. Zegura, E.W. "Evaluating Blocking Probability in Distributors." Proceedings of IEEE INFOCOM, 1993.
5. Zegura, E.W. "Routing Algorithms in Multicast Switching Topologies." Proceedings of Allerton Conference on Communication, Control and Computing, 1993.
6. Zegura, E.W. "An Improved Model for Evaluating Blocking Probability in Generalized Connectors." Proceedings of IEEE INFOCOM, 1994.
7. Park, W.-B., Owen, H.L., Zegura, E.W. "Sonet/SDH Multicast Routing Algorithms in Symmetrical Three-Stage Networks." Proceedings of International Conference on Communications (ICC), 1995.
8. Calvert, K.L., Zegura, E.W., Donahoo, M.J. "Core Selection Methods for Multicast Routing." Proceedings of International Conference on Computer Communications and Networks (ICCCN), 1995.
9. Zegura, E.W. "Impact of Multichip Module Technology on ATM Switch Architectures." Proceedings of Third ORSA Telecommunications Conference, Boca Raton, FL. 1995.
10. Zegura, E.W., Calvert, K.L., Bhattacharjee, S. "How to Model an Internetwork." Proceedings of IEEE INFOCOM, 1996.
11. Park, W.-B., Owen, H.L., Zegura, E.W. "Connection Request Model for Sonet/SDH Switch Evaluation." Proceedings of International Conference on Communications (ICC), 1996.
12. Donahoo, M.J., Zegura, E.W. "Core Migration for Dynamic Multicast Routing." Proceedings of International Conference on Computer Communications and Networks (ICCCN), 1996.
13. Schneck, P., Zegura, E.W., Schwan, K. "DRRM: Dynamic Resource Reservation

Manager.” Proceedings of International Conference on Computer Communications and Networks (ICCCN), 1996.

14. Hao, F., Wilson, K., Fujimoto, R., Zegura, E. “Logical Process Size in Parallel Simulations.” Proceedings of Winter Simulation Conference '96. Hao is the primary author, with contributions from Wilson and supervision by Fujimoto and Zegura.
15. Bhattacharjee, S., Calvert, K.L., Zegura, E.W. “An Architecture for Active Networking.” Proceedings of IFIP Conference on High Performance Networking, 1997.
16. Bhattacharjee, S., Ammar, M., Zegura, E.W., Shah, V., Fei, Z. “Application-Layer Anycasting.” Proceedings of IEEE INFOCOM, 1997.
17. Cao, Z., Zegura, E.W. “ABR Service for Applications with Non-linear Bandwidth Utility Functions.” Proceedings of International Conference on Network Protocols (ICNP), 1997.
18. Bhattacharjee, S., Calvert, K.L., Zegura, E.W. “Active Networking Applications and the End-to-End Argument.” Proceedings of IEEE International Conference on Network Protocols (ICNP), 1997.
19. Fei, Z., Bhattacharjee, S., Zegura, E.W., Ammar, M. “A Novel Server Selection Technique for Improving the Response Time of a Replicated Service.” Proceedings of IEEE INFOCOM, 1998.
20. Bhattacharjee, S., Calvert, K.L., Zegura, E.W. “Self-Organizing Wide-Area Network Caches.” Proceedings of IEEE INFOCOM, 1998.
21. Hao, F., Nikolaidis, I., Zegura, E.W. “Efficient Simulation of ATM Networks with Accurate End-to-End Delay Statistics.” Proceedings of IEEE International Conference on Communications (ICC), 1998.
22. Jiang, T., Ammar, M., Zegura, E.W. “Inter-Receiver Fairness: A Novel Performance Measure for Multicast ABR Sessions.” Proceedings of ACM SIGMETRICS, 1998.
23. Jiang, T., Zegura, E.W., Ammar, M. “Improved Consolidation Algorithms for Point-to-Multipoint ABR Service.” Proceedings of IEEE ATM Workshop, 1998.
24. Hao, F., Zegura, E.W., Bhatt, S. “Performance of the PNPI Protocol in Large Networks.” Proceedings of IEEE ATM Workshop, 1998.
25. Bhattacharjee, S., Calvert, K.L., Zegura, E.W. “Reasoning about Active Networking Protocols.” Proceedings of IEEE International Conference on Network Protocols (ICNP), 1998.
26. Chae, Y.-S., Zegura, E.W. “Service-Specific ABR Routing Algorithms.” Proceedings of International Conference on Computer Communications and Networks (ICCCN), 1998.

27. Chamlee, M., Zegura, E.W. "Clustering Algorithms for Hierarchical Address Assignment." Proceedings of International Conference on Computer Communications and Networks (ICCCN), 1998.
28. Cao, Z., Zegura, E.W. "Utility Max-Min: An Application-Oriented Bandwidth Allocation Scheme." Proceedings of IEEE INFOCOM, March 1999.
29. Donahoo, M., Ammar, M., Zegura, E.W. "Multiple-Channel Multicast Scheduling for Scalable Bulk-data Transport." Proceedings of IEEE INFOCOM, March 1999.
30. Jiang, T., Ammar, M., Zegura, E. W. "Inter-receiver fair multicast communication over the Internet. "Proceedings of NOSSDAV, June 1999.
31. Merugu, S., Bhattacharjee, S., Chae, Y., Sanders, M., Calvert, K., Zegura, E.W. "Bowman and CANEs: Implementation of an Active Network." Invited paper in Thirty-Seventh Annual Allerton Conference on Communication, Control and Computing, Monticello, Illinois, September 1999.
32. Fei, Z., Ammar, M., Zegura, E.W. "Optimal Allocation of Clients to Replicated Multicast Servers." Proceedings of IEEE International Conference on Network Protocols (ICNP), October 1999.
33. Cao, Z., Zegura, E.W., Wang, Z. "Rainbow Fair Queueing: Fair Bandwidth Sharing Without Per-Flow State." Proceedings of IEEE INFOCOM, March 2000.
34. Cao, Z., Zegura, E.W., Wang, Z. "Performance of Hashing-Based Schemes for Internet Load Balancing." Proceedings of IEEE INFOCOM, March 2000.
35. Hao, F., Zegura, E.W. "On Scalable Qos Routing: Performance Evaluation of Topology Aggregation." Proceedings of IEEE INFOCOM, March 2000.
36. Merugu, S., Bhattacharjee, S., Calvert, K., Zegura, E.W. "Bowman: A NodeOS for Active Networking." Proceedings of IEEE INFOCOM, March 2000.
37. Jiang, T., Ammar, M., Zegura, E.W. "On the Use of Destination Set Grouping to Improve Inter-Receiver Fairness for Multicast ABR Sessions." Proceedings of IEEE INFOCOM, March 2000.
38. Chae, Y., Merugu, S., Zegura, E. W., Bhattacharjee, S. "Exposing the Network: Support for Topology Sensitive Applications." Proceedings of IEEE Open Arch, March 2000.
39. Hao, F., Zegura, E.W., Ammar, M. "Supporting Server Selection in Differentiated Service Networks." Proceedings of IEEE INFOCOM, April 2001.
40. Sanders, M., Keaton, M., Bhattacharjee, S., Calvert, K., Zabele, S., Zegura, E.W. "Active

Reliable Multicast on CANEs: A Case Study.” Proceedings of IEEE Open Arch, April 2001.

41. Liston, R. and Zegura, E.W. “Using a Proxy to Measure Client-Side Web Performance.” Proceedings of Web Caching and Content Distribution Workshop, June 2001.
42. Fei, Z., Ammar, M., Zegura, E.W. “Efficient server replication and client re-direction for multicast services.” SPIE Int'l Conference on Scalability and Traffic Control in IP Networks, August 2001.
43. Hutchins, R., Zegura, E.W., Liashenko, A., Enslow, P. Jr. “Internet User Access via Dial-up Networks-Traffic Characterization and Statistics.” Proceedings of IEEE International Conference on Network Protocols (ICNP), November 2001.
44. Fei, Z., Yang, M., Ammar, M., Zegura, E.W. “Allocating Clients to Constrained Multicast Servers: An Optimal Solution.” Proceedings of International Conference on Computer Communications and Networks (ICCCN), October 2001.
45. Srinivasan, S., Zegura, E.W. “Network Measurement as a Cooperative Enterprise.” Proceedings of International Workshop on Peer-to-Peer Systems (IPTPS), March 2002.
46. Hutchins, R., Zegura, E.W. “Measurements from a Campus Wireless Network.” Proceedings of IEEE International Conference on Computer Communications (ICC), April 2002.
47. Guo, M., Ammar, M., Zegura, E.W., Hao, F. “A Probe-Based Server Selection Protocol for Differentiated Service Networks.” Proceedings of IEEE International Conference on Computer Communications (ICC), April 2002.
48. Guo, M., Ammar, M., Zegura, E.W., “Selecting Among Replicated Batching Video-on-Demand Servers.” Proceedings of NOSSDAV, May 2002.
49. Chae, Y., Zegura, E.W., Delalic, H. “PAMcast: Programmable Any-Multicast for Scalable Message Delivery.” Proceedings of Open Arch, June 2002.
50. Clay, L., Ammar, M., Zegura, E.W. “Protocols for Selection Among Replicated Multicast Servers”. Proceedings of the International Conference on Internet Computing, June 2002.
51. Zou, L., Zegura, E.W., Ammar, M. “The Effect of Peer Selection and Buffering Strategies on the Performance of Peer-to-Peer File Sharing.” IEEE/ACM MASCOTS, October 2002.
52. Liston, R., Zegura, E.W. “Diversity in DNS Performance Measures.” Internet Measurement Workshop (IMW), November 2002.
53. Karbhari P., Zegura, E.W., Ammar, M. “Multipoint-to-point Session Fairness in the Internet.” Proceedings of INFOCOM, March 2003.

54. Clay, L., Ammar, M., Zegura, E.W., Clark, R. "Posting Protocol for Improved Keyword Searches in Peer-to-Peer Systems." Proceedings of Multimedia Computing and Networking (MMCN), January 2003.
55. Jun, H., Sanders, M., Ammar, M., Zegura, E.W. "Binding Clients to Replicated Servers: Initial and Continuous Binding." Proceedings of the IEEE Workshop on Future Trends in Distributed Computing Systems (FTDCS), June 2003.
56. Karbhari, P., Ammar, M., Dhamdhere, A., Raj, H., Riley, G., Zegura, E.W. "Bootstrapping in Gnutella: A Measurement Study," Proceedings of the Passive and Active Networking Workshop (PAM), April 2004.
57. Zhao, W., Ammar, M., Zegura, E.W. "A Message Ferrying Approach for Data Delivery in Sparse Mobile Ad Hoc Networks." Proceedings of ACM MOBIHOC, May 2004.
58. Guo, M., Ammar, M., Zegura, E.W. "Cooperative Patching: A Client-based P2P Architecture for Supporting Continuous Live Video Streaming," Proceedings of the IEEE International Conference on Computers, Communications and Networks (IC3N), October 2004.
59. Zhao, W., Ammar, M., Zegura, E.W. "The Energy-Limited Capacity of Wireless Networks." Proceedings of IEEE Conference on Sensor and Ad hoc Communications and Networks, October 2004.
60. Zhao, W., Ammar, M., Zegura, E.W. "Controlling the Mobility of Multiple Data Transport Ferries in a Delay Tolerant Network." Proceedings of IEEE INFOCOM, 2005.
61. Guo, M., Ammar, M., Zegura, E.W. "V3: A Vehicle-to-Vehicle Live Video Streaming Architecture." Proceedings of IEEE Conference on Pervasive Computing and Communications (PerCom), March 2005.
62. Jun, H., Zhao, W., Ammar, M., Zegura, E.W. "Trading Latency for Energy in Wireless Ad hoc Networks using Message Ferrying." Proceedings of IEEE PerCom Workshop on Pervasive Wireless Networking, March 2005.
63. Karbhari, P., Ammar, M., Zegura, E.W. "Optimizing End-to-End Throughput for Data Transfers on an Overlay-TCP Path." Proceedings of IFIP NETWORKING, May 2005.
64. Srinivasan, S. Zegura, E.W. "Scheduling Uplink Bandwidth in Application-Layer Multicast Trees." Proceedings of IFIP NETWORKING, May 2005.
65. Gao, R., Dovrolis, C., Zegura, E.W. "Interdomain Ingress Traffic Engineering through Optimized AS-Path Prepending." Proceedings of IFIP NETWORKING, May 2005.
66. Zhao, W., Ammar, M., Zegura, E.W. "Multicast Routing in Delay Tolerant Networks:

Semantic Models and Routing Algorithms.” SIGCOMM DTN Workshop, August 2005.

67. Jun, H., Ammar, M., Zegura, E.W. “Power Management in Delay Tolerant Networks: A Framework and Knowledge-Based Mechanisms” IEEE Conference on Sensor and Ad hoc Communications and Networks, September 2005.
68. Gao, R., Dovrolis, C., Zegura, E.W. “Avoiding Oscillations due to Intelligent Route Control Systems.” IEEE Infocom, April 2006.
69. Tariq, M., Ammar, M., Zegura, E.W., “Message Ferry Route Design for Sparse Ad hoc Networks Ad hoc Networks with Mobile Nodes,” ACM Mobihoc, May 2006.
70. Chen, Y., Yang, J., Zhao, W., Ammar, M., Zegura, E.W., “Multicasting in Sparse MANETs using Message Ferrying,” IEEE Wireless Communications and Networking Conference (WCNC), April 2006.
71. Jun, Y., Ammar, M., Corner, M., Zegura, E.W. “Hierarchical Power Management in Disruption Tolerant Networks with Traffic-Aware Optimization.” ACM CHANTS, September 2006.
72. Zhao, W., Chen, Y., Ammar, M., Corner, M., Levine, B., Zegura, E.W. “Capacity Enhancement using Throwboxes in DTNs.” IEEE MASS, October 2006.
73. Chen, Y., Zhao, W., Ammar, M., Zegura, E.W. "Hybrid Routing in Clustered DTNs with Message Ferrying," Proceedings of ACM MobiOpp Workshop, Puerto Rico, May 2007.
74. Borrel, V., Ammar, M., Zegura, E.W., "Understanding the Wireless and Mobile Network Space: A Routing-Centered Classification," Proceedings of CHANTS 2007, Montreal, September 2007.
75. Mansy, A., Ammar, M., Zegura, E.W. "Reliable Roadside-to-Roadside Data Transfer Using Vehicular Traffic," Proceedings of The IEEE International Workshop on Mobile Vehicular Networks (MoVeNet) (IEEE MASS Workshop), Pisa, Italy, October 2007.
76. Gao, R., Blair, D., Dovrolis, C., Morrow, M., Zegura, E.W. “Interactions of Intelligent Route Control with TCP Congestion Control,” In the Proceedings of the Networking conference, Atlanta, May 2007.
77. Polat, B., Sachdeva, P., Ammar, M., Zegura, E.W. "Message Ferries as Generalized Dominating Sets in Intermittently-Connected Networks", 2nd ACM International Workshop on Mobile Opportunistic Networking, February 2010, Pisa, Italy.

## **C.2. Conference Presentations with Proceedings (non-refereed)**



1. Bhattacharjee, S., Calvert, K., Zegura, E.W. 1996 "Implementation of an Active Networking Architecture." Washington University Gigabit Networking Workshop. St. Louis, MO, July 1996.
2. Bhattacharjee, S., Calvert, K., Zegura, E.W. 1996. "Active networking: An End to the IP/ATM Debate?" Workshop on the Integration of IP and ATM. St. Louis, MO, November 1996.
3. Zegura, E.W. 1996. "Mapping Complex Applications to Network Services." 7<sup>th</sup> Workshop on Very High Speed Networks. Baltimore, MD, November 1996.
4. Bhattacharjee, S., Calvert, K., Zegura, E.W. 1998. "Congestion Control and Caching in CANEs." IEEE International Conference on Communications (ICC '98), Workshop on Active Networking and Programmable Networks.
5. Zhiruo, C., Zegura, E.W. 2000. "Rainbow fair queueing: fair bandwidth sharing without per-flow state." 2<sup>nd</sup> Washington University/NSF Gigabit Kits Workshop. January 2000.
6. Zegura, E.W. 2000. "Progress on rainbow fair queueing and virtual link implementations." 3<sup>rd</sup> Washington University/NSF Gigabit Kits Workshop. July 2000.

### **C.3. Conference Presentations without Proceedings**

1. "A Quantitative Comparison of Architecture for ATM Switching Systems." 3<sup>rd</sup> Workshop on Very High Speed Networks, Greenbelt, MD, March 1992.
2. Panel participant, IEEE Infocom '98 panel on Active Networking. San Francisco, CA, March 1998.
3. "Performance Monitoring for Dynamic Server Selection." 1<sup>st</sup> Workshop on Internet Server Performance, Madison, WI, June 1998.
4. Panel participant, Global Internet 2001 panel on Network Topology, San Antonio, TX November 2001.

### **D. Other**

#### **D.1. Submitted Journal Papers**

None.

#### **D.2. Published Papers (non-refereed)**

##### **a. Technical Reports**

1. Chamberlain, R., Edelman, M., Franklin, M., Witte (Zegura), E. 1988. "Parallel Simulated

Annealing.” Technical Report WUCS-88-12, Department of Computer Science, Washington University.

2. Witte (Zegura), E. 1991. “A Quantitative Comparison of Architectures for ATM Switching Systems.” Technical Report WUCS-91-47. Department of Computer Science, Washington University.
3. Witte (Zegura), E. 1992. “The Clos Network as a Multirate Distributor with a Greedy Routing Algorithm.” Technical Report WUCS-92-13. Department of Computer Science, Washington University.
4. Calvert, K.L. Madhavan, M., Zegura, E.W. 1994. “A Comparison of Two Practical Multicast Routing Schemes.” Technical Report GIT-CC-94-25. College of Computing, Georgia Tech.
5. Thomas, M., Zegura, E.W. 1994. “Generation and Analysis of Random Graphs to Model Routing.” Technical Report GIT-CC-94-46, College of Computing, Georgia Tech.
6. Calvert, K.L., Zegura, E.W., Donahoo, M.J. 1995. “Core Selection Methods for Multicast Routing.” Technical Report GIT-CC-95-15, College of Computing, Georgia Tech.
7. Donahoo, M.J., Zegura, E.W. 1995. “Core Migration for Dynamic Multicast Routing” Technical Report GIT-CC-95-28, College of Computing, Georgia Tech.

### **D.3. Software**

#### **1. GT-ITM: Georgia Tech Internetwork Topology Models**

This is a collection of routings to generate and analyze graphs using a wide variety of models for internetwork topology.

#### **2. CANEs/Bowman**

A platform for active networking, including the CANEs execution environment and the Bowman Node Operating System.

B. Bhattacharjee, S. Merugu, M. Sanders, K. Calvert, E. Zegura  
Released Fall 2002.

#### **3. WISL: What the Internet Sounds Like**

Distributed network monitoring and sound generation.

R. Liston, E. Zegura  
Released in 2003.

#### **4. p-sim**

Simulator for peer-to-peer networks.

S. Merugu, S. Srinivasan, E. Zegura  
Released Spring 2003.

**5. Disruption Tolerant Networking on Handhelds**

DTN bundle specification implementation in .net for handheld devices

J. Olson, K. Webb, M. Ammar, E. Zegura

Released Fall 2006.

**E. Research Proposals and Grants (Principal Investigator)**

**a. Approved and Funded**

**1. Distributed Mentor Project**

Computing Research Association (CRA)

Funded \$5,000 per year (1994, 1995, 1996, 1997, 1998, 2000)

**2. A Testbed for Multimedia Communication Protocols**

AT&T Special Purpose Grants

Joint proposal with M. Ammar, K. Calvert, P. Enslow, Jr., A. Mukherjee (co-PIs)

Funded \$20,000, September 1994

**3. Low-Cost ATM Switch Architectures**

Georgia Tech Engineering Research Center in Packaging

Funded \$17,500, Fall 1994 – Summer 1995

**4. CAREER: A Systematic Approach to the Design of Cost-Effective, High Performance Switching Architectures**

CAREER Program, National Science Foundation (NSF)

Funded \$131,479, 5/1/95 – 5/1/98

**5. Networking Instructional Laboratory Enhancements**

AT&T Special Purpose Grants

Joint Proposal with M. Ammar, K. Calvert, P. Enslow, Jr., J. Limb, A. Mukherjee (co-PIs)

Result: Funded \$30,000, October 1995

**6. Application-Based Traffic Management for ATM Networks**

Hitachi Telecom, USA

Joint proposal with J. Aaron, M. Ammar, J. Evans, D. Howard, J. Limb (co-PIs)

Funded \$260,000, 11/1/95 – 11/1/96

**7. S3: Scalable, Self-Organizing Simulations**

Defense Advanced Research Projects Agency (DARPA)

Joint proposal with M. Chen, J. Cowie, R. Fujimoto, D. Leskiw, D. Nichol, A. Ogielski, S. Bhatt (co-PIs)

Funded \$3,200,000, 8/1/96 – 8/1/99

GT Subcontract Amount: \$440,000

**8. Remote Teaching and Collaboration Facility**

AT&T Special Purpose Grants  
Joint Proposal with M. Ammar, K. Calvert, P. Enslow, Jr., J. Limb (co-PIs)  
Funded \$20,000, October 1996

**9. Application-Driven ABR Support**

Hitachi Telecom, USA  
Funded \$54,100, 11/1/96 – 11/1/97

**10. Research Experience for Undergraduates – Supplement to CAREER Award**

National Science Foundation (NSF)  
Funded \$20,125, April 1997

**11. Research and Teaching in High Performance Networking and Distributed Systems**

Washington University and NSF (Gigabit ATM Network Kits Program)  
Joint Proposal with K. Calvert, K. Schwan and S. Yalamanchili  
Funded, Summer 1997

**12. CANEs: Composable Active Network Elements**

Defense Advance Research Projects Agency (DARPA)  
Joint proposal with K. Calvert and J. Sterbenz (co-PIs)  
Funded \$944,248, 6/15/97 – 6/1/99

**13. Satellite Aware Multicasting**

NASA Graduate Student Researchers Program  
Funded \$44,000, 6/1/97 – 6/1/99

**14. Travel Support for ACM Sigcomm '97**

National Science Foundation (NSF)  
Funded \$14,000, September 1997

**15. LAWS: Load-Adaptive Web Server**

Georgia Tech Broadband Telecommunications Center  
Funded \$45,000, May 1997

**16. ActiveCast**

Defense Advance Research Projects Agency (DARPA)  
Joint proposal with K. Calvert and J. Griffioen (co-PIs)  
Funded \$1.5M, 5/99 – 4/02  
GT Subcontract Amount: \$500,000

**17. Server Selection in Emerging Information Delivery Environments**

National Science Foundation  
Joint Proposal with M. Ammar (co-PI)  
Funded \$399,000, 11/99 – 10/02

**18. ITR/SII: Collaborative Research in Internet Topology Models – A Foundation for**

**Large-Scale Simulations**

National Science Foundation

Joint Proposal with J. Stasko and K. Calvert (co-PIs)

Funded \$500,000, 9/00 – 8/03

GT Amount: \$385,000

**19. MOWER – Mobile Endpoint Wireless Routing for the LAWN**

Cisco

Joint Proposal with R. Clark and R. Hutchins (co-PIs)

Funded \$60,000, January 2002 – January 2003

**20. Peer-to-Peer Content Distribution Services and Architectures**

Georgia Tech Broadband Institute

Joint Proposal with M. Ammar (co-PI)

Result: Funded \$30,000, August 2002 – July 2003

**21. Design and Evaluation of Retrieval Functions in Peer-Peer File Sharing Systems**

National Science Foundation (NSF)

Joint Proposal with M. Ammar (co-PI)

Funded \$300,000, October 2003 – September 2006

**22. ITR: Message Ferrying: Mobility-Assisted Data Delivery in Highly Partitioned Networks**

National Science Foundation (NSF)

Funded \$300,000, October 2003 – September 2006

**23. Mobility-Assisted Data Delivery in Wireless Networks**

Georgia Tech Broadband Institute

Joint Proposal with M. Ammar (co-PI)

Funded \$30,000, August 2004 – July 2005

**24. ALeRT: Adaptive Learning and Routing Technologies for Disruption Tolerant Networks**

Defense Advance Research Projects Agency (DARPA)

Joint Proposal with M. Ammar, M. Corner and B. Levine (co-PIs)

Funded \$274,400, February 2005 – April 2006

**25. Collaborative Research in Construction of Robust and Efficient Disruption Tolerant Networks**

National Science Foundation (NSF)

Joint Proposal with M. Ammar, Mark Corner (UMass) and Brian Levine (UMass) (co-PIs)

Funded \$1,500,000, August 2005 – July 2009

GT Amount: \$750,000

**26. Intelligent Route Control**

National Science Foundation (NSF)

Joint Proposal with M. Ammar, C. Dovrolis (co-PIs)  
Result: Funded \$200,000, September 2005 – August 2007

**27. Architectures and Protocols for Disruption Tolerant Mobile Wireless Networks**

Cisco University Research Program  
Joint Proposal with M. Ammar (co-PI)  
Result: Funded \$80,000, September 2006 – August 2007

**28. DOME: Disruption Tolerant Outdoor Mobile Environments**

Defense Advance Research Projects Agency (DARPA)  
Joint Proposal with M. Ammar, M. Corner and B. Levine (co-PIs)  
Funded \$600,000, September 2006 – March 2008  
Funding \$600,000, Fall 2008 – April 2010

**29. The WAM Continuum: Unified Design and Operation for Mobile Wireless Networks**

National Science Foundation  
Joint Proposal with M. Ammar (co-PI)  
Result: Funded \$450,000, August 2008 – July 2011

**30. ARRA: Campus Trials of Enterprise GENI**

BBN System and Technologies  
Joint Proposal with R. Clark, N. Feamster (co-PIs)  
Result: Funded \$252,800, March 2010

**31. ICTD PEER MENTORSHIP PROGRAM**

International Development Corporation  
Joint Proposal with M. Best (co-PI)  
Result: Funded approx \$90,000, June 2011

**32. Recovery and Transformation of Human Mobility Traces for Mobile Wireless Experimentation**

National Science Foundation  
Joint Proposal with M. Ammar (co-PI)  
Result: Funded \$399,000, August 2011-September 2014

**b. Pending**

None.

**F. Research Proposals and Grants (Contributor)**

**1. Low-Cost Electronic Packaging**

Engaging Research Center, National Science Foundation

Amount Requested: \$2M, Fall 1993

Result: Funded \$2M, Fall 1994

Contribution: Member of Systems Integration thrust area; speaking during Industrial and NSF site visit.

## **2. Distributed Laboratories**

CISE Research Infrastructure Program

Amount Requested: \$1,320,833, Fall 1994

Result: Funded \$1M, Spring 1995

Contribution: Participating Investigator; organized demonstrations during NSF site visit.

## **G. Research Honors and Awards**

1. IEEE Fellow, Fall 2010
2. DARPA Active Networks Coordination Award, December 2000.
3. Edenfield Faculty Fellowship, College of Computing, 2000.
4. College of Computing Outstanding Junior Faculty Research Award, 1997.
5. National Science Foundation CAREER Award, 1995.
6. Dissertation nominated by Washington University for ACM Dissertation Award, 1993.

## **III. SERVICE**

### **A. Professional Activities**

#### **A.1. Membership and Activities in Professional Societies**

1. Member Institute of Electrical and Electronics Engineers (IEEE), IEEE Computer Society, IEEE Communications Society, Association of Computing Machinery (ACM) and ACM SIGCOMM.
2. Member of ACM Data Networking Curriculum Committee, 1997-1998.

#### **A.2. Conference Committee Activities [incomplete]**

1. Program Committee Co-Chair, ACM SIGCOMM 2004
2. Program Committee Co-Chair, IEEE ICNP 2003
3. Program Committee, IEEE INFOCOM 1994-1998, 2000-2004, 2006
4. Program Committee, IEEE International Conference on Network Protocols (ICNP) 1997-

2000, 2003

5. Executive Committee (Publicity Chair), IEEE International Conference on Network Protocols (ICNP) 1997
6. Executive Committee (Co-chair, Student Travel Award Committee), ACM SIGCOMM Conference 1997
7. Executive Committee (Tutorials Chair), ACM SIGCOMM Conference 1999
8. Co-chair for 2<sup>nd</sup> Workshop on Internet Server Performance, 1999
9. Program Committee, ACM SIGCOMM Conference 1999-2004, 2006, 2008, 2011
10. Program Committee, ACM SIGMETRICS Conference 1999-2000, 2003
11. Program Committee, IEEE OpenArch 2000, 2001
12. Program Committee, International Conference on Peer-to-Peer Systems (IPTPS) 2003
13. Program Committee, ACM Hot Topics in Networks (HotNets) Workshop, 2003-2004
14. Program Committee, USENIX Networked Systems Design and Implementation (NSDI) 2005, 2010
15. Program Committee, CHANTS 2010
16. Executive Committee (General Co-Chair), Information and Communication Technologies for Development (ICTD) 2013
17. Executive Committee (General Co-Chair), ACM Development (DEV) 2013

### **A.3. Workshops and External Courses**

1. Invited Participant, NSF Workshop on Scalable Information Infrastructure, October 1998.
2. Invited Participant, National Academy of Sciences CSTB Workshop on Research Horizons in Networking, January 2001.
3. Tutorial on “Internet Topology Modeling”, UCLA Institute for Pure and Applied Mathematics, Program on Large Scale Communication Networks, March 2002.



## **B. On-campus Georgia Tech Committees [incomplete]**

Core Qualifier Review Committee, College of Computing, 1993-1994  
Task Force on Core Qualifier Review, College of Computing, 1994  
Graduate Committee, College of Computing, 1994-1996  
Dean's Advisory Committee, College of Computing, 1995-1996  
Undergraduate Curriculum Committee, College of Computing, 1996-1997  
Space Task Force, College of Computing, 1996-1997  
PhD Admissions Committee, College of Computing, 1997-1998  
Ad-hoc Undergraduate Curriculum Committee, College of Computing, 1997-1998  
Faculty Recruiting Committee, College of Computing, 1999-2000  
Yamacraw Design Center Building Programming Committee, 2000-2002  
Klaus Building Programming Committee, 2001-2006  
Honorary Degree Nominating Committee, 2002-2006  
Task Force to Restructure Computing and Networking Services, Fall 2005  
Ad-hoc Committee on the School of Computational Science and Engineering, Fall 2006  
Search Committee, Dean of College of Sciences, 2006-2007  
Search Committee, Dean of Libraries, Spring 2008  
Library Faculty Advisory Committee (Chair), 2007-present

## **C. External Member of Ph.D. Examining Committees**

### **Ph.D. Examining Committees – Georgia Tech (not up to date)**

<b><u>Name</u></b>	<b><u>College/School</u></b>	<b><u>Advisor</u></b>	<b><u>Defense Date</u></b>
B. Yi	Computing	Prof. G. Neiger	December 1993
P. Scholander	ECE	Prof. H. Owen	February 1995
R. Clark	Computing	Prof. M. Ammar	May 1995
W.B. Park	ECE	Prof. H. Owen	November 1996
W. Lacy	ECE	Prof. S. Wills	December 1996
C. Autry	ECE	Prof. H. Owen	May 1997
K. Almeroth	Computing	Prof. M. Ammar	June 1997
R. Talpade	Computing	Prof. M. Ammar	September 1997
V. Garg	ECE	Prof. D. Schimmel	September 1997
D. Sala	ECE	Prof. J. Limb	February 1998
H. Uzunalioglu	ECE	Prof. I Akyildiz	May 1998
X. Li	Computing	Prof. M. Ammar	June 1998
J. Inwhee	ECE	Prof. I Akyildiz	July 1998
P. May	ECE	Prof. S. Wills	May 1999
Z. Fei	CoC	Prof. M. Ammar	April 2000
R. West	CoC	Prof. K. Schwan	June 2000
X. Wang	ECE	Prof. J. Copeland	November 2000
P. Torab	ECE	Prof. E. Kamen	November 2000
J. McNair	CoC	Prof. I. Akyildiz	November 2000
V. Vellanki	CoC	Prof. A. Chervenak	March 2001
G. Riley	CoC	Ammar/Fujimoto	May 2001

R. Hutchins	CoC	Enslow	May 2001
L. Clay	CoC	Prof. M. Ammar	August 2002
P. Judge	CoC	Prof. M. Ammar	April 2002

#### **External Member of Ph.D. Examining Committees**

<b><u>Name</u></b>	<b><u>College/School</u></b>	<b><u>Advisor</u></b>	<b><u>Defense Date</u></b>
S. Scott	Washington University (CS)	Prof. S. Goldman	July 1998
J. Gao	Carnegie Mellon (CSD)	Prof. P. Steenkiste	Fall 2004

#### **D. Consulting and Advisory Appointments**

Timeplex, Inc., Simulation of ATM architectures. Summer 1993.

NASA Lewis, Current and emerging Internet research and technology. August 1997

Scientific Systems Co., Active networking consulting. Fall 1997-Spring 1998

Growth Networks, Inc., Scalable switching systems. Fall 1999-Winter 2000.

Sutherland, Asbill and Brennan, LLP. Expert witness consulting. 2004-2005.

Duane Morris, LLP. Expert witness consulting. 2005.

Washington University, Department of Computer Science Advisory Board, 2005-present

National Science Foundation, Computer and Information Science and Engineering (CISE)  
Advisory Board, 2005-2009

CRA GENI Community Advisory Board, Fall 2006

CRA Interim Computing Community Consortium Council, Fall 2006

Co-chair CRA GENI Science Council, Spring 2007-Spring 2008

Co-chair then Chair CRA Networking Science and Engineering Research Council, Spring  
2008-Fall 2009

Kilpatrick Stockton, LLP. Expert witness consulting. 2009

Wilmer Hale, LLP. Expert witness consulting. 2011

#### **E. Research Project Reviewer**

National Science Foundation, 1995-present

CRA Distributed Mentor Project, 1996, 2000  
Southern Technology Council, Innovation Alabama Program, 1998

#### **IV. NATIONAL AND INTERNATIONAL PROFESSIONAL RECOGNITION**

##### **A. Honors and Awards**

1. DARPA Coordination Award, December 2000.
2. GT College of Computing Dean's Award, May 2002
3. GT College of Computing Dean's Award, May 2003
4. GT College of Computing Faculty Mentor Award, May 2010

##### **B. Patents**

1. "Cross-connect multirate/multicast SDH/SONET rearrangement procedure and cross-connection using same," W. B. Park, E. Zegura and H. Owen. Submitted November 1996.
2. "System and method for data streaming." J. Xu, J., E. Zegura, A. Kumar, and M. Sung, Patent pending, filed in June 2006 by Georgia Institute of Technology.

##### **C. Editorial and Reviewer Work for Technical Journals and Publishers**

1. Editorial Board, Journal of High Speed Networks, 1996-1999
2. Editorial Board, IEEE/ACM Transactions on Networking, 1999-2002
3. Editor-in-Chief, IEEE/ACM Transactions on Networking, 2002-2004
4. Reviewer for IEEE Transactions on Computers, IEEE Transactions on Communications, CM/IEEE Transactions on Networking, IEEE Transactions on Parallel and Distributed Systems, Performance Evaluation, Computer Networks and ISDN Systems, Morgan Kaufmann Publishers, Addison Wesley Publishers.

#### **V. OTHER CONTRIBUTIONS**

##### **A. Seminar Presentations**

1. Columbia University, New York, NY, March 1993. "Design and Analysis of Practical Switching Networks."

2. University of Virginia, Charlottesville, VA, March 1993. "Design and Analysis of Practical Switching Networks."
3. Stanford University, Palo Alto, CA, April 1993. "Design and Analysis of Practical Switching Networks."
4. 2<sup>nd</sup> Workshop on ATM: Real Choices, Baltimore, MD, November 1994. "Implementation Complexity of ATM Switch Architectures."
5. Hughes Network Systems, Gaithersburg, MD, October 1995. "Implementation Complexity of ATM Switch Architectures."
6. University of Wisconsin, Madison, WI, February 1996. "How to Model an Internetwork."
7. University of California, Berkeley, CA, April 1996. "How to Model an Internetwork."
8. Harvard University, Cambridge, MA, February 1997. "Improving the Quality of Best-Effort Service."
9. Intel Corporation, Portland, OR, August 1997. "CANES: Composable Active Network Elements."
10. University of Missouri, Kansas City, MO, October 1997. "Improving Replicated Service with Application-Layer Anycasting."
11. University of Pennsylvania, Philadelphia, PA, May 1998. "Application-aware Network Services."
12. Carnegie Mellon University, Pittsburgh, PA, April 2002. "The SOREN Project: Server Selection in Emerging Environments."
13. UCLA Institute for Pure and Applied Mathematics, Concluding Conference on Large Scale Communication Networks, "New Directions and Half-Baked Ideas in Topology Modeling." Los Angeles, CA, June 2002.
14. Yale University, New Haven, CT, April 2004, "Message Ferrying: Communication in Sparsely-Connected Networks."
15. University of Pennsylvania, Philadelphia, PA, October 2004, "Mobility-Assisted Communication in Challenged Networks."
16. CRAW Distinguished Lecture, University of Wisconsin, Madison, WI, November 2004, "Mobility-Assisted Communication in Challenged Networks."
17. Invited Lecture, University of Kentucky, Lexington, KY, April 2005, "Can You Hear Me? Disruption Tolerant Network Design and Services."

18. EURO NGI Next Generation Internet Networks Conference, April 2005, Invited Talk, "The Royal Carriage: Content Distribution in the Internet"
19. STIC - Bi-annual meeting of three French IT national networks, November 2006, Invited Talk, "FINDing a GENI in a CCCastle"

# **EXHIBIT 3**

# Michael Zyda

## Work Address:

Director, USC GamePipe Laboratory  
Department of Computer Science  
941 W. 37<sup>th</sup> Pl., SAL 300  
Los Angeles, California 90089-0781  
(310) 463-5774

## Home Address (two homes):

Torres 5 SW of First  
P.O. Box 5774  
Carmel, California 93921  
**(310) 463-5774 (cell)**  
240 ½ Hampton Dr.  
Venice, California 90291

E-mail: [zyda@usc.edu](mailto:zyda@usc.edu)

Web: <http://gamepipe.usc.edu/~zyda>

**Research Interests:** computer graphics, large-scale, networked 3D virtual environments, agent-based simulation, modeling human and organizational behavior, interactive computer-generated story, computer-generated characters, video production, entertainment/defense collaboration, serious and entertainment games, and modeling and simulation.

**Pioneer in the following fields:** computer graphics, networked virtual reality, modeling and simulation, serious and entertainment games.

## Education

**Washington University** - St. Louis, Missouri 1978-1984  
D.Sc. Computer Science - Awarded January, 1984  
School of Engineering and Applied Science  
“Algorithm Directed Architectures for Real-Time Surface Display Generation”

**University of Massachusetts, Amherst** - Amherst, MA  
1976-1978  
M.S. Computer and Information Science Awarded September 1978

**University of California, San Diego**, Revelle College - La Jolla, California 1972-1976  
B.A. Applied Mechanics and Engineering Sciences/Bioengineering - Awarded 1976  
Minor in Spanish Literature

**Languages** – Spanish (6 years), Japanese (2.5 years).

## Academic Positions

**University of Southern California – Los Angeles**  
Founder & Director of the USC GamePipe Laboratory &  
Viterbi School’s Games degree programs.  
Founder USC’s Joint Games Program, now part of USC Games October 2004 – present  
Professor of Engineering Practice, USC Department of Computer Science March 2006 – present  
Research Staff, USC, Information Sciences Institute January 2005 – March 2006  
Visiting Research Scholar, USC, Information Sciences Institute February 2004 – December 2004

**Naval Postgraduate School - Monterey, CA**  
Founder & Director, The MOVES Institute November 2000 – November 2004  
Professor of Computer Science July 93 – January 2005  
Founding Chair, Modeling, Virtual Environments and Simulation Academic Group April 96 – April 01  
Academic Associate Chair for the Modeling, Virtual Environments and Simulation Curriculum March 97 - April 99  
Academic Associate Chair for the Department of Computer Science July 92 - March 97  
Granted tenure in the Department of Computer Science July 90  
Associate Chair for Research, Department of Computer Science April 90 - June 91

Associate Chair for Instruction, Department of Computer Science	July 88 - June 89
Associate Chair for Administrative Affairs, Department of Computer Science	May 87 - June 88
Associate Professor of Computer Science	July 87 - June 93
Assistant Professor of Computer Science	Feb. 84 - June 87

**Washington University - St. Louis, MO**

Research Associate, Department of Computer Science	August 83 - January 84
Research Associate, Department of Computer Science and Department of Biological Chemistry Washington University and Washington University School of Medicine, St. Louis.	March 83 - August 83
Research Associate, Department of Computer Science	September 81 - March 83
Research Assistant, Department of Computer Science	September 78 - August 81

**University of Massachusetts, Amherst - Amherst, MA**

Teaching Associate/Teaching Assistant Department of Computer and Information Science	September 76 - August 78
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**University of California, San Diego - La Jolla, CA**

Research Assistant, Department of Chemistry	June 73 - July 76
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## Complete Publications List

### Books

1. "[America's Army PC Game - Vision and Realization](#)," published by the MOVES Institute and the US Army, February 2004, 40 pages.
2. Singhal, Sandeep and Zyda, Michael [Networked Virtual Environments - Design and Implementation](#), ACM Press Books, SIGGRAPH Series, 23 July 1999, ISBN 0-201-32557-8, 315 pages.
3. Cockayne, William and Zyda, Michael J., [Mobile Agents](#), Manning Press/Prentice-Hall, August 1997, ISBN: 1-884777-36-8.

### NRC Reports – Member or Chair of Committee

4. [Future U.S. Workforce for Geospatial Intelligence](#), Board of Earth Sciences and Resources and Board on Higher Education and Workforce, Committee on the Future U.S. Workforce for Geospatial Intelligence, National Research Council, National Academies Press, Washington, DC January 2013, ISBN 0-309-xxx. Member of the NRC Committee.
5. [The Rise of Games and High-Performance Computing for Modeling and Simulation](#)," Division of Engineering & Physical Sciences Tiger Standing Committee, National Research Council, National Academies Press, Washington, DC, 2009, ISBN 0-309-14777-8-X, 129 pages. Member of the NRC committee.
6. [Behavioral Modeling and Simulation: from Individuals to Societies](#), Committee on Human Factors, Division of Behavioral and Social Sciences and Education, National Research Council, National Academies Press, Washington, DC, 2008, ISBN 0-309-11862-X. Member of the NRC committee.
7. [Defense Modeling, Simulation, and Analysis](#), Committee on Defense, Modeling, Simulation and Analysis, Mathematical Sciences and Their Application Board, National Research Council, National Academies Press, Washington, DC, 2006, ISBN 0309103037, 96 pages, member of the NRC committee.
8. [FORCenet Implementation Strategy](#), Committee on the FORCenet Implementation Strategy, Naval Studies Board, Division on Engineering and Physical Sciences, National Research Council, National Academies Press, Washington, DC, July 2005, ISBN 0309100259, 260 pages, member of the NRC committee.
9. [Embracing Change - the Way Ahead for NASA's Computing and Communications Technology](#), Editor: Michael Zyda as Chair of the Potomac Institute's NASA Computing and Communications Technology Advisory Group, 23 December 2004, 81 pages.
10. [An Assessment of NASA's Aeronautics Technology Programs](#), Committee for the Review of NASA's Revolutionize Aviation Program, Aeronautics and Space Engineering Board, Division on Engineering and Physical Sciences, National Research Council, National Academy Press, Washington, DC, January 2004, ISBN-0-309-09119-5, 195 pages, member of the Panel on the Vehicle Systems Program.
11. [An Assessment of NASA's Pioneering Revolutionary Technology Program](#), Committee for the Review of NASA's Pioneering Revolutionary Technology (PRT) Program, Aeronautics and Space Engineering Board, Division on Engineering and Physical Sciences, National Research Council, National Academy Press, Washington, D.C., October 2003, ISBN 0-309-09080-6, 189 pages. Chair of the CICT Panel of this Committee.
12. [Advanced Engineering Environments Phase 2 – Design in the New Millennium](#), National Academy Press, September 2000, ISBN 0-309-07125-9, 67 pages. Member of NRC committee.
13. [Advanced Engineering Environments - Achieving the Vision, Phase 1](#), National Academy Press, June 1999, ISBN 0-309-06541-0, 48 pages. Member of NRC committee.
14. Zyda, Michael and Sheehan, Jerry (eds.), [Modeling and Simulation: Linking Entertainment & Defense](#), National Academy Press, September 1997, ISBN 0-309-05842-2, 181 pages. Chaired this NRC Committee.
15. Durlach, Nathaniel and Mavor, Anne (eds.), [Virtual Reality: Scientific and Technological Challenges](#), Committee on Virtual Reality Research and Development, National Academy Press, Washington, DC, 1995. Sections written or with major contributions: Chapters - "Executive Summary", "Overview", "Computer Hardware and Software for the Generation of Virtual Environments", and "Networking and Communications", ISBN 0-309- 05135-5.

## Book Chapters

16. Michael Zyda, Alex Mayberry, Jesse McCree, and Margaret Davis "From Viz-Sim to VR to Games: How We Built a Hit Game-Based Simulation," in W.B. Rouse and K.R. Boff (Eds.) Organizational Simulation: From Modeling & Simulation to Games & Entertainment, New York: Wiley Press, 2005, pp., ISBN 0471681636.
17. Margaret Davis, Russell Shilling, Alex Mayberry, Jesse McCree, Phillip Bossant, Scott Dossett, Christian Buhl, Christopher Chang, Evan Champlin, Travis Wiglesworth and Michael Zyda "Researching America's Army," in Design Research: Methods and Perspectives, edited by Brenda Laurel, MIT Press, 1 October 2003, ISBN 0262122634, pp. 268-275.
18. Michael Zyda and Douglas Bennett, "The Last Teacher," in 2020 Visions, from the Summit & Press Conference on the Use of Advanced Technologies in Education and Training, US Department of Commerce, 17 and 27 September 2002.
19. Kay M. Stanney and Michael Zyda "Virtual Environments in the 21st Century," in Handbook of Virtual Environments - Design, Implementation, and Applications, Lawrence Erlbaum Associates, Publishers, Mahwah, NJ, 2002, pp. 1-14.
20. Zyda, Michael "Games on the 'Net!,'" Chapter 9 of Das Internet von morgen - Neue Technologien für neue Anwendungen, edited by Clemens Baack and Jorg Eberspacher, Huthig Verlag Press, Heidelberg, Germany, September 1999, pp. 117-127. (revised from the Proceedings of the Munchner Kreis Congress on the Internet of Tomorrow, held at the European Patent Office in Munich, 19 - 20 November 1998).
21. Zyda, Michael J., Monahan, James G. and Pratt, David R. "NPSNET: Physically-Based Modeling Enhancements to an Object File Format," chapter in Creating and Animating the Virtual World, Editors: Nadia Magnenat Thalmann and Daniel Thalmann, Publisher: Springer-Verlag Tokyo, 1992, pp. 35-52.

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22. Marc Spraragen, Peter Landwehr, Balakrishnan Ranganathan, Michael Zyda, Kathleen Carley, Yu-Han Chang and Rajiv Maheswaran (2013) Cosmopolis: A Massively Multiplayer Online Game for Social and Behavioral Research. *Journal of Artificial Societies and Social Simulation* **16** (1) 9.  
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23. Michael Zyda, "Computer Science in the Conceptual Age," CACM, Vol. 52, No. 12, December 2009, pp. 66-72.
24. Joerg Wellbrink, Michael Zyda and John Hiles "Modeling Vigilance Performance as a Complex Adaptive System," Journal of Defense Modeling and Simulation, Volume 1, No.1, 2004, January 2004, pp.29-42.
25. Michael Zyda, John Hiles, Alex Mayberry, Michael Capps, Brian Osborn, Russ Shilling, Martin Robaszewski and Margaret Davis "Entertainment R&D for Defense," IEEE CG&A, January/February 2003, pp.28-36.
26. Helmuth Trefftz, Ivan Marsic, and Michael Zyda "Handling Heterogeneity in Networked Virtual Environments," Presence, Vol. 12, No.1, January 2003, pp. 38-52. Revised from IEEE CG&A 2002.
27. Katherine L. Morse and Michael Zyda "Multicast Grouping for Data Distribution Management," Journal of Simulation Modeling Practice and Theory, Elsevier, Vol. 9, Issue 3-5, 15 April 2002, pp.121-141.
28. Russell L. Storms and Michael J. Zyda "Interactions in Perceived Quality of Auditory-Visual Displays," Presence, Vol. 9, No. 6, December 2000, pp.557-580.
29. Yun, X., Bachmann, E.R., McGhee, R.B., Whalen, R.H., Roberts, R.L., Knapp, R.G., Healey, A.J., and Zyda, M.J. "Testing and Evaluation of an Integrated GPS/INS System for Small AUV Navigation," IEEE Journal of Oceanic Engineering, Vol. 24, No. 3, July 1999, pp.396-404.
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  37. Cooke, Joseph M., Zyda, Michael J., Pratt, David R. and McGhee, Robert B. "NPSNET: Flight Simulation Dynamic Modeling Using Quaternions," Presence, Vol. 1., No. 4, pp. 404-420.
  38. Zyda, Michael J., Wilson, Kalin P., Pratt, David R., Monahan, James G. and Falby, John S. "NPSOFF: An Object Description Language for Supporting Virtual World Construction," Computers & Graphics, Vol. 17, No. 4, pp 457-464.
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  41. DeHaemer, Michael J. and Zyda, Michael J. "Simplification of Objects Rendered by Polygonal Approximations," Computers & Graphics, Vol. 15, No. 2, 1991, Great Britain: Pergamon Press, pp. 175-184. Paper received "Best Paper 1991" award from an international selection committee appointed by the editor of Computers & Graphics, 29 Sep 92. Also, one of the best papers of the decade in the journal's 2002 collection.
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  44. Zyda, Michael J., Fichten, Mark A., and Jennings, David H. "Meaningful Graphics Workstation Performance Measurements," Computers & Graphics, Vol. 14, No. 3, 1990, Great Britain: Pergamon Press, pp.519-526.
  45. Zyda, Michael J., McGhee, Robert B., McConkle, Corinne M., Nelson, Andrew H. and Ross, Ron S. "A Real-Time, Three-Dimensional Moving Platform Visualization Tool," Computers & Graphics, Vol. 14, No. 2, 1990, Great Britain: Pergamon Press, pp.321-333.
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  48. Zyda, Michael J. and Walker, Robert A. "Design Notes on a Single Board Multiprocessor for Real-Time Contour Surface Display Generation," Computers & Graphics, Vol. 12, No. 1, March 1988, Great Britain: Pergamon Press, pp. 91-97.
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51. Anderson, Scott J., Gardner, Bruce W., Wilson, Kent R., ... and Zyda, Michael J., "Correlation Between Air Pollution and Socio-Economic Factors in Los Angeles County," *Atmospheric Environment*, Vol. 12 (July 1978), pp. 1531-1535.

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52. Lin, J., Spraragen, M., & Zyda, M. (2012a). Computational models of emotion and cognition. *Advances in Cognitive Systems*, 2, 59-76. Retrieved from <http://cogsys.org/pdf/paper-3-2-39.pdf>
53. Lin, J., Spraragen, M., & Zyda, M. (2012b). Memory framework for complex emotion integration with cognition. Poster Collection of the First Annual Conference on Advances in Cognitive Systems (pp. 119-129). Palo Alto, CA. Retrieved from <http://cogsys.org/pdf/paper-3-2-91.pdf>
54. Marc Spraragen, Peter Landwehr, Balakrishnan Ranganathan, Michael Zyda, Kathleen Carley, Yu-Han Chang, and Rajiv Maheswaran. "Social and Behavioral Modeling in an Online Multiplayer Game," *Proceedings of AHFE 2012*, San Francisco, CA, July 2012
55. Jim Blythe, Aaron Botello, Joseph Sutton, David Mazzoco, Jerry Lin, Marc Spraragen and Michael Zyda "Testing Cyber Security with Simulated Humans that Plan," *Proceedings of the Twenty-Third Annual Conference on Innovative Applications of Artificial Intelligence (IAAI-11)*, 9-11 August 2011, San Francisco, pp.
56. Lin J, Spraragen M, Blythe J, Zyda M. "EmoCog : Computational Integration of Emotion and Cognitive Architecture," *Proceedings of the Twenty-Fourth International Florida Artificial Intelligence Research Society Conference*, 18-20 May 2011, pp.
57. Zyda M, Spraragen M, Ranganathan B, Arnason B, and P Landwehr. *Designing a Massively Multiplayer Online Game / Research Testbed Featuring AI-Driven NPC Communities*. *Proceedings of 6th International Conference on AI and Interactive Digital Entertainment*, Palo Alto CA 11-13 October 2010.
58. Zyda M, Spraragen M, Ranganathan B, Arnason B, and H Liu. *Information Channels in MMOGs: Implementation and Effects*. *Proceedings of 3rd Applied Human Factors and Ergonomics Conference*, Miami FL, 17-20 July 2010.
59. Lin J, Blythe J, Clark S, Davarpanah N, Hughston R & Zyda M "Unbelievable Agents for Large Scale Security Simulation," *Working Notes for the 2010 AAAI Workshop on Intelligent Security*. Atlanta, Georgia, 11-12 July 2010, pp20-25.
60. Michael Zyda, Dhruv Thukral, James Ferrans, Jonathan Englesma, and Mat Hans "Enabling a Voice Modality in Mobile Games through VoiceXML," in the *Proceedings of the ACM SIGGRAPH Sandbox Symposium*, August 2008, Los Angeles, pp.in the *Proceedings of the ACM SIGGRAPH Sandbox Symposium*, August 2008, Los Angeles, pp.143-147.
61. Michael Zyda, Devin Rosen & Bharathwaj Nandakumar "GOGS" USC GamePipe Online Game Server," in the *Proceedings of the ACM SIGGRAPH Sandbox Symposium*, August 2008, Los Angeles, pp.51-53.
62. Michael Zyda, Victor Lacour, and Chris Swain "Operating a Computer Science Game Degree Program," in the *Proceedings of the 2008 Game Development in Computer Science Education Conference*, Microsoft sponsored event held on Celebrity Cruise Lines, 28 Feb – 3 March 2008, pp.
63. Gurminder Singh and Michael Zyda, "Connected Immersion," in the *Proceedings of VR International*, part of HCI 2005, Las Vegas, July 2005.
64. Don McGregor, Andrzej Kapolka, Michael Zyda and Don Brutzman "Requirements for Large-Scale Networked Virtual Environments," *Proceedings of the 7th International Conference on Telecommunications ConTel 2003*, Zagreb, Croatia, 11-13 June 2003, pp. 353-358.

65. Russ Shilling, Michael Zyda and E. Casey Wardynski, "Introducing Emotion into Military Simulation and Videogame Design: America's Army Operations and VIRTE," in the Proceedings of the GameOn Conference, London, 30 November 2002, pp. 151-154.
66. Helmuth Trefftz, Ivan Marsic, and Michael Zyda "Handling Heterogeneity in Networked Virtual Environments," Proceedings of IEEE VR, Orlando, Florida, 25 - 27 March 2002, pp.7-14.
67. Eric R. Bachmann, Robert B. McGhee, Xiaoping Yun, and Michael J. Zyda "Inertial and Magnetic Posture Tracking for Inserting Humans Into Networked Virtual Environments," Proceedings of ACM Symposium on Virtual Reality Software & Technology (VRST 2001), Banff, Alberta, Canada, 15 - 17 November 2001, pp.9-16.
68. João Luís Marins, Xiaoping Yun, Eric R. Bachmann, Robert B. McGhee, and Michael J. Zyda "An Extended Kalman Filter for Quaternion-Based Orientation Estimation Using MARG Sensors," Proceedings of the 2001 IEEE/RSJ International Conference on Intelligent Robots and Systems, Maui, Hawaii, USA, Oct. 29 - Nov. 03, 2001, pp.2003-2011.
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76. Yun, X., Bachmann, E., McGhee, R.B., Whalen, R.H., Roberts, R.L., Knapp, R.G., Healey, A.J., and Zyda, M.J. "Testing and Evaluation of an Integrated GPS/INS System for Small AUV Navigation," Proceedings of the 10th International Symposium on Unmanned Untethered Submersible Technology (UUST), Durham, NH, September 7-10, 1997.
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85. Waldroup, Marianne S., Pratt, Shirley M., Pratt, David R., McGhee, Robert B., Falby, John S. and Zyda, Michael J. "Real-Time Upper Body Articulation of Humans in a Networked Virtual Environment," in Proceedings of the First ACM Workshop on Simulation and Interaction in Virtual Environments, University of Iowa, 13 - 15 July 1995, pp. 210-214.
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88. Zyda, Michael "Networked Virtual Environments," Proceedings of the 1995 IEEE Virtual Reality Annual Symposium, 11 - 15 March 1995, RTP, North Carolina, pp. 230-231.
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100. Zyda, Michael J. and Pratt, David R. "NPSNET: A 3D Visual Simulator for Virtual World Exploration and Experience," abstract in Computer Graphics, Vol. 25, No. 4, July 1991, pp. 383.
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## Invited Papers

105. Michael Zyda, Marc Spraragen & Balakrishnan Ranganathan "Testing Behavioral Models with an Online Game," IEEE Computer, April 2009, pp.103-105.
106. Michael Zyda "Creating a Science of Games," Communications of the ACM, July 2007, Vol. 50, No. 7, pp 27-29. Guest Editor of special issue of CACM on Creating a Science of Games.
107. Michael Zyda, Dhruv Thukral, Sumeet Jakatdar, Jonathan Englesma, James Ferrans, Mat Hans, Larry Shi, Fred Kitson, and Venu Vasudevan "Educating the Next Generation of Mobile Game Developers," IEEE Computer Graphics & Applications, March/April 2007, pp. 93-96.
108. Michael Zyda "Educating the Next Generation of Game Developers," IEEE Computer, June 2006, pp. 30-34.
109. Michael Zyda "From Visual Simulation to Virtual Reality to Games," IEEE Computer, September 2005, pp. 25-32.
110. Kay Stanney and Michael Zyda "Advances in Virtual Environments Technology: Musings on Design, Evaluation, & Applications," Preface to VR International 2005, part of HCI 2005, Las Vegas, July 2005.
111. Michael Zyda, Don Brutzman, Rudy Darken, John Hiles, Ted Lewis, Alex Mayberry, Russell Shilling, Joe Sullivan, Alex Callahan, and Margaret Davis "This Year in the MOVES Institute," in the Proceedings of IEEE Cyberworlds 2003, the International Conference on Cyberworlds, Singapore, 3 – 5 December 2003, pp. xxxiii-xl.
112. Michael Zyda "This Year in the MOVES Institute," Abstract in Proceedings of the 7th International Conference on Telecommunications ConTel 2003, Zagreb, Croatia, 11-13 June 2003, pp. 37-38.
113. Michael Zyda, Alex Mayberry, Casey Wardynski, Russell Shilling, and Margaret Davis "The MOVES Institute's America's Army Operations Game," Proceedings of the ACM SIGGRAPH 2003 Symposium on Interactive 3D Graphics, 28-30 April 2003, pp.217-218, color plate pp.252.
114. Michael Capps, Perry McDowell & Michael Zyda "A Future for Entertainment-Defense Collaboration," IEEE Computer Graphics & Applications, January/February 2001, pp. 2 - 8.

115. Michael Zyda "NPS MOVES - Entertainment Research Directions," in the Proceedings of the Summer Computer Simulation Conference, Vancouver, 16 - 20 July 2000, pp.
116. Michael Capps, Don McGregor, Don Brutzman, and Michael Zyda "NPSNET-V: A New Beginning for Dynamically Extensible Virtual Environments," IEEE Computer Graphics & Applications, September/October 2000 pp.12-15.
117. Capps, M., Watsen, K. and Zyda, M. "Cyberspace and Mock Apple Pie: A Vision of the Future of Graphics and VEs," IEEE Computer Graphics & Applications, November/December 1999, pp. 8-11.
118. Capps, M., Abrams, H., Anderson, D., Greenhalgh, C., Morse, K., Singhal, S., Watsen, K., and Zyda, M. "Developing Shared Virtual Environments," ACM SIGGRAPH 99, Course #34 Course Notes, 10 August 1999, in form of a printed book and on the course CD-ROM.
119. Zyda, M., Hiles, J., Rosenbaum, R., Roddy, K., Gagnon, T., and Boyd, M. "SimNavy – Phase 0 Building an Enterprise Model of the US Navy," in the Proceedings of the 1998 Technology Initiatives Game, Fort Belvoir, VA, 21- 25 September 1998.
120. Zyda, M. and Darken, R.P. "The Naval Postgraduate School's Moves Curriculum," IEEE Computer Graphics & Applications, May/June 1998, pp.
121. Zyda, M., Brutzman, D., Darken, R., McGhee, R., Falby, J., Bachmann, E., Watsen, K., Kavanagh, B. & Storms, R. "NPSNET - Large-Scale Virtual Environment Technology Testbed," Proceedings of the International Conference on Artificial Reality and Tele-Existence, Tokyo, Japan, 3 - 5 December 1997, pp. 18 - 26.
122. Zyda, Michael J. "Networking Large-Scale Virtual Environments," Proceedings of Computer Animation '96, 3-4 June 1996, Geneva, Switzerland, IEEE Computer Society Press, pp. 1-4. (an earlier version of this paper also appeared in the Proceedings of the Second International Conference on the Military Applications of Synthetic Environments and Virtual Reality, Stockholm, Sweden, 6-8 December 1995, pp. 119-125.)
123. Pratt, David R., Zyda, Michael and Kelleher, Kristen "Virtual Reality: In the Mind of the Beholder," IEEE Computer, July 1995, pp. 17 - 19 (editors notes for the special issue on virtual environments).
124. Macedonia, Michael R., Zyda, Michael J., Pratt, David R., Brutzman, Donald P. and Barham, Paul T. "Building Large-Scale Virtual Environments: A Network Software Architecture," Proceedings of Industrial Virtual Reality '95, Tokyo, Japan, 28 - 30 June 1995, pp.18-28.
125. Zyda, Michael J. and Pausch, Randy "Why a Pacific Rim Issue of PRESENCE at All?," Presence, Vol. 3, No. 1, pp. iii-iv, intro to special issue on Pacific Rim Virtual Reality and Telepresence, Winter 1994.
126. Macedonia, Michael R., Zyda, Michael J., Pratt, David R., Barham, Paul T. and Zeswitz, Steven "NPSNET: A Network Software Architecture for Large Scale Virtual Environments," Proceedings of the Fourth International Conference on Artificial Reality and Tele-Existence, 14-15 July 1994, Nikkei Hall, Otemachi, Tokyo, Japan (as one keynote speaker), pp. 99 - 129. Later revised for Presence.
127. Zyda, Michael J. "The Software Required for the Computer Generation of Virtual Environments," abstract in The Journal of the Acoustical Society of America, Vol. 92, No. 4, Pt. 2, October 1992, pp. 2345-2346.
128. Falby, John S., Zyda, Michael J., Pratt, David R. and Wilson, Kalin P. "Educational and Technological Foundations for the Construction of a 3D Virtual World," in the Proceedings of Virtual Reality '92, San Jose, 23 - 25 September 1992.
129. Zyda, Michael J., and Pratt, David R. "NPSNET Digest: A Look at A 3D Visual Simulator for Virtual World Exploration and Experimentation," in the Proceedings of the 1992 EFDPA Conference on Virtual Reality, Washington, DC, June 1-2, 1992, pp. 190-208.
130. Zyda, Michael J. and Pratt, David R. "NPSNET: A 3D Visual Simulator for Virtual World Exploration and Experimentation," 1991 SID International Symposium Digest of Technical Papers, Volume XXII, 8 May 1991, pp. 361-364.
131. Zyda, Michael J. and Pratt, David "3D Visual Simulation as Workstation Exhaustion," Proceedings of Ausgraph 90, Melbourne, Australia, 10 - 14 September 1990, pp. 313-328.



132. Zyda, Michael J. "3D Visual Simulation for Graphics Performance Characterization," NCGA '90 Conference Proceedings, Vol. I, 22 March 1990, pp. 705-714.
133. Zyda, Michael J. "CAD/CAM Workstation Graphics," Plus the Total Computer Magazine, Dataworld Corporation Press, Bombay, India, Vol. IV, No. 11, December 1987, pp. 57-74. (Reprinted from the NCGA Proceedings, May 1986).
134. Zyda, Michael J. "Teaching Computer Graphics," IRIS Universe, the IRIS Community Magazine, Winter/Spring 1988, pp. 14-17.
135. Zyda, Michael J. "Future Graphics Support for CAD/CAM," in Proceedings of the Workshop on Information System Support for Integrated Design and Manufacturing Processes, Monterey, California: April 1986. This paper is an early version of [17] presented at a small workshop.
136. Zyda, Michael J. "Workstation Graphics Capabilities for the 1990's and Beyond," Computer Graphics '86 Conference Proceedings, Technical Sessions Volume III, May 1986, p. 442.
137. Marshall, Garland R., Zyda, Michael J. et al., "Interactive Aids in Three-Dimensional Structure-Activity Studies," Abstract in 179th Proceedings of the American Chemical Society: National Meeting, Houston 1980.

### **Technical Reports**

138. John Hiles, Michael VanPutte, Brian Osborn and Michael Zyda "Innovations in Computer Generated Autonomy at the MOVES Institute," MOVES Institute Technical Report NPS-MV-02-002, December 2001.

## **National Academy Appointments**

Awarded a lifetime appointment as a National Associate of the National Academies, an appointment made by the Council of the National Academy of Sciences in November 2003, awarded in recognition of “extraordinary service” to the National Academies.

Appointed a member of the National Research Council Division on Earth and Life Sciences Committee on the Future US Workforce for Geospatial Intelligence, Feb 2011 – April 2012.

Appointed a member of the National Research Council Division of Engineering & Physical Sciences Tiger Standing Committee, October 2008 – October 2010.

Appointed a member of the National Research Council Laboratory Assessments Board, Soldier Systems Panel, June 2007 – June 2009.

Appointed a member of the National Research Council Behavioral and Social Sciences and Education Division Committee on Organizational Models from Individuals to Societies, March 2005 – 31 January 2007.

Appointed member of the National Research Council Mathematical Sciences and Their Application Board Committee on Defense Modeling, Simulation and Analysis, October 2004 – November 2006.

Appointed member of the National Research Council Naval Studies Board Committee for the review of FORCENet Implementation Strategies, 1 August 2003 – December 2004.

Appointed member of the National Research Council Aeronautics and Space Engineering Board Panel on The Review of NASA’s Revolutionize Aviation Program, 1 December 2002 – May 2004.

Appointed chair of the National Research Council Aeronautics and Space Engineering Board Panel on Computing, Information, and Communications Technology (CICT) and member of the parent NRC Committee for the Review of NASA’s Pioneering Revolutionary Technology Program, 15 May 2002 – 31 January 2004.

Appointed member of the National Research Council’s Aeronautics and Space Engineering Board’s Committee on Advanced Engineering Environments, 15 June 1998 - September 30, 2000.

Appointed chair of National Research Council, Computer Science and Telecommunications Board committee on “Modeling and Simulation: Linking Entertainment & Defense,” March 96 - September 97.

Appointed member of the National Research Council, Behavioral and Social Sciences Commission Committee on Virtual Reality Research and Development, 11 January 1993 - January 1995.

## **Patents**

US Provisional Application 61/833,822, Filing Date: 12 June 2013, “Dynamic advertising based on user data from social media profiles”.

US Provisional Application 61/826,709, Filing Date: 24 May 2013, “System on a Mobile Device that Enables Calling for Help During an Emergency Using Gestures”.

US Provisional Application 61/804,577, Filing Date: 22 March 2013, “System for Recording a Virtual Character’s Performance of the Physical Activity of a User”.

United States Patent Publication # US 2013/0052623 A1, Filing Date 26 October 2012, “System for Encouraging a User to Perform Substantial Physical Activity,” filed 23 Oct 2008. Inventors – Dhruv Thukral (Santa Monica, CA), Michael Zyda (Carmel, CA), Chang Wei-Chung (Tainan City, TW), Shu Fen Lin (Los Angeles, CA). A continuation of #7,980,997 & 8,317,657.

United States Patent #8,317,657 B2, Issue Date 27 November 2012, “System for Encouraging a User to Perform Substantial Physical Activity,” filed 23 Oct 2008. Inventors – Dhruv Thukral (Santa Monica, CA), Michael Zyda (Carmel, CA), Chang Wei-Chung (Tainan City, TW), Shu Fen Lin (Los Angeles, CA). A continuation of #7,980,997.

Zyda M, Arnason B, Ranganathan B, and M Spraragen. United States Utility Patent Application for “Information Channels in MMOGs”, US Patent Application No. 12/891,556, filed September 27, 2010, and US Provisional Application No. 61/308,705, filed February 26, 2010.

United States Patent #7,980,997 B2, Issue Date 19 July 2011, “System for Encouraging a User to Perform Substantial Physical Activity,” filed 23 Oct 2008. Inventors – Dhruv Thukral (Santa Monica, CA), Michael Zyda (Carmel, CA), Chang Wei-Chung (Tainan City, TW), Shu Fen Lin (Los Angeles, CA).

United States Patent #7,089,148 B1, “Method and apparatus for motion tracking of an articulated rigid body,” granted 8 August 2006, filed 30 September 2004. Inventors - Bachmann; Eric R. (Oxford, OH); McGhee; Robert B. (Carmel, CA); Yun; Xiaoping (Salinas, CA); Zyda; Michael J. (Carmel, CA); McKinney; Douglas L. (Prunedale, CA). Division of application No. 10/020,719 filed on Oct. 30, 2001, now Pat. No. 6,820,025. Licensed by PNI Sensor Corporation December 2011 – present.

United States Patent #6,820,025, “Method and apparatus for motion tracking of an articulated rigid body,” granted 16 Nov 2004, filed 30 October 2001. Inventors - Bachmann; Eric R. (Oxford, OH); McGhee; Robert B. (Carmel, CA); Yun; Xiaoping (Salinas, CA); Zyda; Michael J. (Carmel, CA); McKinney; Douglas L. (Prunedale, CA). Licensed by PNI Sensor Corporation December 2011 – present.

## **Advisory Boards**

Member, Academy of Interactive Arts & Sciences, February 2003 – present.

Appointed member of the Board of Advisors for the Virginia Modeling and Simulation Center at Old Dominion University, May 2004 – May 2006.

Appointed as member of the US Army’s Distance Learning/Training Technology Applications Subcommittee of the Army Education Committee by US Army TRADOC, with the approval of the Secretary of the Army, with concurrence of the Secretary of Defense, November 2003 – November 2005.

Member, Board of Advisors, Georgia Institute of Technology Modeling and Simulation Research and Education Center, March 2000 – 2004.

Appointed to the Editorial Advisory Board of the journal Computers & Graphics, 1 August 96 – August 2002.

Member of the Technical Advisory Board of the Fraunhofer Center for Research in Computer Graphics, Providence, Rhode Island, December 95 – 30 September 2002.

Senior Editor for Virtual Environments, PRESENCE April 1994 to present.

Associate Editor of PRESENCE (with Nat Durlach) November 1993 to April 1994.

## Significant Software

29 September 2010 - USC Game Trainer Grand Prize Winner in White House Competition - a student developed game built jointly between the USC GamePipe Laboratory, the School of Cinematic Arts Interactive Media program and the School of Fine Arts Game Art & Design Program was the Grand Prize winner in the White House [Apps for Healthy Kids](#) competition, as well as the GE Healthymagination Student Award winner. The Trainer game was first shown at the GamePipe Laboratory's December 2009 Demo Day. It was built with funds donated from the Humana Innovation Center. I was the recipient of that donation from Humana and the PI on the game development project.

Immune Attack – immunology education game for advanced placement, high school biology, 2005 – 2006. With the Federation of American Scientists, and Brown University.

America's Army Operations – multiple award winning online game, October 1999 – March 2004. Awards including Action Vault's 2002 Debut Game of the Year, Surprise of the Year, and honorable-mention Multiplayer Game of the Year; Frictionless Insight's Best Business Model (Developer) at E3 2002; IGN Editors' Choice Award for first-person shooters 2002; IGN's Biggest Surprise of E3 2002; Gamespy's Best PC Action Game runner-up 2002; Penny Arcade's Best Misappropriation of Taxpayer Dollars Ever; Wargamers Best of Show, first-person/tactical shooters 2002; Well-Rounded Entertainment's Best of E3 2002; DoubleClick's Insight Awards, honorable mention, Best Multi-Channel Marketing Campaign 2002; Academy of Interactive Arts and Sciences, finalist, PC First Person Action Game of the Year February 2003; and Computer Gaming World's Editors' Choice January 2003. Served as the principal investigator and development director of the America's Army PC game funded by the Assistant Secretary of the Army for Manpower and Reserve Affairs. Took America's Army from conception to three million plus registered players and hence, transformed Army recruiting.

NPSNET I – IV – large-scale, networked virtual environment testbed, January 1990 – December 1996. First networked virtual environment to play across the multicast backbone of the Internet; first low-cost simulation system to work with SIMNET; first networked virtual environment to have fully articulated humans.

## Consulting and Other Positions

HappyNin' Games, Chairman – May 2009 – December 2011.

CiiNow – August 2010 - present

Cynergen, March 2010 – December 2011

e4e/Absolute Quality – January 2009 – February 2011.

Emsense, emotional state sensor for use in videogames, October 2004 – September 2011.

Vizzario Laboratories – May 2007 – present.

Virtual Heroes, Cary, North Carolina – June 2006 – April 2009. Company acquired by Applied Research Associates.

Big Stage, South Pasadena – July 2007 – December 2009.

NASA AMES Code T (Space Exploration), plan R&D on computing, information and communications technology for the return to the moon & subsequent trip to Mars, July 2004 – December 2004.

BBN and MaK Technologies, as Technical Advisor to the DARPA DARWARS Program, June 2003 – December 2003

Member Technical Advisory Board, Muse3d.com, San Mateo, California, December 2000 – April 2002

Member Technical Advisory Board, SpiritChannel.com, Covent Gardens, United Kingdom, March 2000 – July 2000

Speaker with Celebrity Speakers International, [www.speakers.co.uk](http://www.speakers.co.uk), London, United Kingdom, August 1999 - present

Advanced Telecommunications, Inc., San Diego, California, August 97 - December 97

For the Assistant Director, White House Office of Science and Technology Policy, March 97 - May 2000

TecMagik, Foster City, March 97 - September 97

Paramount Digital Entertainment, Los Angeles, California, January 97 - September 97

Minister of Industrial Development, Sabah Province, Malaysia, March 97

Consultant, Hitachi Plant Construction & Engineering, Tokyo, January 90 - July 96  
 SimGraphics Engineering, Pasadena, August 90 - June 91  
 Silicon Graphics International, Geneva, Switzerland, May 90 - December 91  
 Consultant, Silicon Graphics International, Geneva, Nihon Silicon Graphics KK, Tokyo, August 88 - March 89  
 Consultant, Stellar Computer, Boston, August 88 - November 88  
 Consultant, Digital Computer Limited (Tokyo), Technology and Knowledge for Tomorrow (Tokyo), January 87  
 Consultant, Mitsubishi Heavy Industries, Sharp Electric Co., Ishikawajima Harima Industries, Mitsubishi Electric Co., Teijin System Technology Co., Computer Graphics Labs Co., Toyo Lincs Co., Toshiba Co., Sumitomo Electronics Co., Digital Computer Limited, February 86  
 Consultant, Silicon Graphics, Inc., Mountain View, California, September 85 - December 86  
 Consultant, NASA AMES-Dryden Flight Research Facility, Edwards AFB, California, September 85  
 Executive Consultant, Japan Tech Services Corporation, Tokyo, Japan, January 85 - present  
 Consultant, Quadrex Corporation, Campbell, California; Japan Technical Services Corporation, Tokyo, Japan; Hitachi Works, Hitachi, Ltd., Hitachi-shi, Ibaraki-Ken, Japan, January 85 - June 85  
 Consultant, Tripos Associates, St. Louis, Missouri, April 83 - February 84  
 Consultant, Smith-Kline & French Laboratories, Philadelphia, Pennsylvania, September 81 - March 83  
 Consultant, Nautilus Computer Consulting, May 81 - March 83

## **Expert Witness**

Digital Reg vs Valve Software, April 2013 – May 2013. Expert for Barcelo, Harrison & Walker. Settlement reached.

Walker Digital vs Sony Computer Entertainment of America, Nov 2012 – present. Expert for eRise LLP.

Walker Digital vs Activision-Blizzard et. al., Dec 2011 – Jan 2013. Expert for Joint Defense Group of 11 companies - Miniclip Tech (US) Limited Inc. (Brown Rudnick LLP), Microsoft Corporation (Fish & Richardson P.C), Activision Blizzard, Inc (Gibson, Dunn & Crutcher LLP), Atari Inc. (Gibson, Dunn & Crutcher LLP), Cryptic Studios, Inc (Gibson, Dunn & Crutcher LLP), Electronic Arts Inc & Popcap Games, Inc (Gibson, Dunn & Crutcher LLP), Turbine Inc. & Cartoon Interactive Group Inc (Gibson, Dunn & Crutcher LLP), Zynga Inc (Gibson, Dunn & Crutcher LLP), Gaia Interactive Inc (Goodwin Procter LLP), Sony Computer Entertainment America LLC (K&L Gates LLP) and Yahoo! Inc (Kasowitz, Benson, Torres & Friedman LLP).

Walker Digital vs Valve Software, Expert for Valve Software through Barcelo, Harrison & Walker. Dec 2011 – 17 Feb 2012. Settlement reached.

Biax Corp. vs Nvidia Corporation, Sony Computer Entertainment America Inc, Sony Electronics, Inc. Expert for Sony March 2011 – May 2012. Deposition 2 June 2011. Summary judgement for Nvidia/Sony.

Nexon Corp. via Mitchell Silberberg LLP. Expert on the security of Nexon's Combat Arms & Maple Story online games. Work was to examine and report on hacker tools used to crash Nexon's online games and to level-up player characters.

PalTalk Holdings vs Sony Computer Entertainment America, Inc, Sony Online Entertainment, LLC, Sony Corporation, Sony Corporation of America, Activision Blizzard, Inc, Blizzard Entertainment, Inc, NCSoft Corporation, Jagex LTD, and Turbine, Inc. Expert for Sony, Activision and NCSoft through Latham & Watkins, Irella and Manella, and Ropes and Gray. October 2009 – September 2011. Settlement reached.

1<sup>st</sup> Media vs. Electronic Arts, Inc., Harmonix Music Systems Inc., Microsoft Corp., Viacom Inc., and Sony Computer Entertainment America, Inc. Expert for Viacom through Jenner & Block. June 2008 – February 2010.

Viacom International Inc., on behalf of itself, MTV Networks, and Harmonix Music Systems Inc. vs. Activision, on behalf of itself, Activision Publishing Inc., and RedOctane Inc.. Expert for Viacom through Omelveny & Meyers. June 2008 – November 2008.

Hochstein vs. Sony Computer Entertainment America (through Shook, Hardy & Bacon), expert witness on networked game patents, October 2004 – March 2008. Deposition 2007 approx.

Yahoo vs. Xfire (through Fenwick & West), expert witness on networked game patents, October – November 2005.

## **Miscellaneous**

12 March 2013 – USC Named Top School for Video Game Design for Fourth Straight Year – Princeton Review.

1 March 2012 - USC Named Top School for Video Game Design for Third Straight Year - GamePro Media and Princeton Review once again awarded USC the two top prizes in their "Top Schools for Video Game Design Study."

11 August 2011 – promoted to Senior Member IEEE.

6 May 2011 – Alumni Award - Outstanding Achievement in Technology Development in Computer Graphics, Virtual Environments & Games from the University of Massachusetts, Amherst.

1 March 2011 - USC Named Top School for Video Game Design for Second Straight Year - GamePro Media and Princeton Review once again awarded USC the two top prizes in their "Top Schools for Video Game Design Study."

2009 – present - appointed a member of the ACM's Distinguished Speakers Program <http://dsp.acm.org>

20 April 2009, promoted to Senior Member ACM.

25 June 2003, World Technology Network 2003 Finalist for the Information Technology Software (corporate) award for The MOVES Institute, elected member of the World Technology Network.

Received Recognition of Service Award, April 2003, from the Association for Computing Machinery for role as Symposium Chair of the 2003 Symposium on Interactive 3D Graphics.

29 January 2002, Received Pioneer Certificate from the Modeling & Simulation Professional Certification Commission. I am one of the 27 pioneers listed for modeling & simulation by this commission.  
[http://simprofessional.org/events/20020129\\_sanantonio.html](http://simprofessional.org/events/20020129_sanantonio.html)

Received a Research Recognition Award, 14 April 1998, from the Provost of the Naval Postgraduate School.

Received Recognition of Service Award, July 1996, from the Association for Computing Machinery for role as Program Co-Chair of the 1996 Virtual Reality Software & Technology Conference, Hong Kong.

Received Recognition of Service Award, April 1995, from the Association for Computing Machinery for role as Symposium Chair of the 1995 Symposium on Interactive 3D Graphics.

Received an Instruction Recognition Award, 19 October 1994, from the Superintendent and Provost of the Naval Postgraduate School.

Received Performance Award, 27 September 1993, from the Provost of the Naval Postgraduate School.

Received "Best Paper 1991" award from the journal *Computers & Graphics*, 29 September 1992.

Received Performance Award, 21 September 1992, from the Provost of the Naval Postgraduate School.

Received a Research Recognition Award, 31 March 1992, from the Provost of the Naval Postgraduate School.

Received an Instruction Recognition Award, 15 October 1991, from the Superintendent and Provost of the Naval Postgraduate School.

Received Performance Award, 1 October 1991, from the Provost of the Naval Postgraduate School.

Received Performance Award, 30 September 1990, from the Provost of the Naval Postgraduate School.

Received Recognition of Service Award, April 1990, from the Association for Computing Machinery for role as Symposium Chair of the 1990 Symposium on Interactive 3D Graphics.

Promoted to Full Member, October 1990, Sigma Xi, the Scientific Research Society.

Received Performance Award, 30 September 1989, from the Provost of the Naval Postgraduate School.

Received Letter of Commendation for Excellence in Teaching, 26 June 1989, from the Provost of the Naval Postgraduate School.

Received Performance Award, 30 September 1988, from the Provost of the Naval Postgraduate School.

Member Association for Computing Machinery, April 1977 to Present.

Member IEEE Computer Society, 1980 to Present.

Member First Place Team, 1980 ACM National Computer Programming Contest, Kansas City, Missouri.

Nominated for Distinguished Teaching Award, 1977 at the University of Massachusetts, Amherst.

## **Research Support**

### **Funding at USC**

Hospital Games, Lockheed, Summer 2012, \$50,000.

SAIC Analyst Game Gift, \$65,000.

SEA-VAK – funded by the National Reconnaissance Office, October 2011 – August 2012, \$600,000 (co-PI with three others at USC ISI).

Ground Truth: Tactics, funded by Sandia National Laboratories, May 2011 – December 2011, \$100,000.

AI-Based Scenario Generation & Virtual Human Simulation, DARPA National Cyber Range Initiative, 1 Feb 2010 – 1 August 2011, \$1.5M.

Massively Multiplayer Online Games (MMOG) – Social and Cultural Model Embedding Technologies, Office of Naval Research, Fall 2008 – Fall 2011, \$1.8M.

The Grasped World – Developing a Modeling & Simulation Infrastructure for the Study of Peace Maintenance & Globalization, funded by the Provost of the Naval Postgraduate School, Fall 2008 – Fall 2009, \$100,000.

Real-Time Graphics for Simulation, funded by the Naval Postgraduate School, Fall 2008 – Fall 2009, \$100,000.

Games for Fitness Course Support, funded by the Humana Innovation Laboratory, \$100,000 as an unrestricted gift, Spring 2009 – Spring 2010.

Designing Games for Fitness, Humana Innovation Laboratory, 2008 – 2009, \$125,000.

Improving Computer Science Undergraduate Education through the Use of Game Development Concepts, Microsoft Research, 2008 – 2009, \$100,000 as unrestricted gift.

A request to Microsoft Research to fund an assessment of the effectiveness of using game development curriculum to increase Computer Science enrollment and graduation rates at the USC Viterbi School of Engineering, Microsoft Research, 2007 – 2008, \$100,000 as unrestricted gift (with Ellis Horowitz and Gerard Medioni).

Game Technology Enhanced Simulation for Homeland Security Training, Sandia Labs, 2007 – 2009, \$120,000.

Networked and Context Aware Mobile Games, Motorola Research Labs, 2006-2007, \$100,000.

Serious Game Prototype, Lockheed Martin, 2007, \$25,000.

Immune Attack, A Serious Game for Immunology Education, NSF-ISE, 2005-2006, \$272,000.

### **Funding at the Naval Postgraduate School (1984 – 2004)**

Prior to January 2005, I was a Professor at the Naval Postgraduate School, Monterey, California (1984 – 2004). In 2000, I founded the MOVES Institute and grew that from approximately \$2.5M in 2000 to \$10M in research funding by 2004, with some 60+ research accounts. \$4M per year from 2000 – 2004 was the funding to develop and operate the America's Army Game. \$650-750K per year was seed funding for the MOVES Institute from the Navy Modeling and Simulation Management Office and ONR. The remainder of funding was from various sponsors for specific tasks from all across the US Department of Defense.

Before I founded the MOVES Institute, I operated the NPSNET Research Group from 1986 – 2000. A typical year for that group was about \$1.4M in research funding from various Department of Defense sponsors, with DARPA and the US Army being the largest sponsors.

2 May 2000 – 31 March 2004, \$15,000,000, “Army Game Project,” Awarded by the Assistant Secretary of the Army for Manpower and Reserve Affairs.

1 October 2001 - 30 September 2002, \$650,000, “The Modeling, Virtual Environments and Simulation (MOVES) Research Center”. Awarded by the Navy Modeling and Simulation Management Office.

1 April 2001 - 31 December 2004, \$1,170,000, “The Context Machine”. Awarded by the DARPA. With Co-PIs Michael Capps and Rudy Darken.

1 October 2000 - 30 September 2001, \$550,000, “The Modeling, Virtual Environments and Simulation (MOVES) Research Center”. Awarded by the Navy Modeling and Simulation Management Office.

1 January 2000 - 31 December 2002, \$140,000, “Inertial Motion Tracking Technology for Inserting Humans into a Networked Synthetic Environment”. Awarded by the Army Research Office, with Bob McGhee and Xiaoping Yun.

1 October 2000 – 30 September 2001, \$75,000, “Self-Learning Autonomous Agents for Distributed Simulations”. Awarded by the Defense Modeling and Simulation Office, with Michael van Putte and Brian Osborne.

1 October 99 - 30 September 2000, \$525,000, “The Modeling, Virtual Environments and Simulation (MOVES) Research Center”. Awarded by the Navy Modeling and Simulation Management Office.

1 October 98 - 30 September 1999 \$550,000, “The Modeling, Virtual Environments and Simulation (MOVES) Research Center”. Awarded by the Navy Modeling and Simulation Management Office.

- 1 January 99 - 31 December 1999, \$300,000, "Continued Joint Theater Level Simulation (JTLS) Federation Development". Awarded by Defense Modeling and Simulation Office.
- 1 March 98 - 1 July 1999, \$500,000, "Joint Theater Level Simulation (JTLS) with High Level Architecture (HLA)". Awarded by Defense Modeling & Simulation Office.
- 1 October 97 - 31 December 2000, \$840,000, "The Virtual Reality Transfer Protocol (vrtp)". Awarded from Advanced Network and Services, with Don Brutzman and Michael Capps.
- 1 January 1999 - 31 December 1999, \$30,000, "An Operating Plan for the Institute for Collaborative Environment Studies". Awarded from the Army Research Office.
- 1 May 98 - 30 September 1998, \$200,000, "Virtual Environment Integration, Performance Measurement & Education for the High Level Architecture". Awarded by the Defense Modeling & Simulation Office.
- 1 March 98 - 31 December 1999, \$140,000, "Inertial Motion Tracking Technology for Inserting Humans into a Networked Synthetic Environment". Awarded by the Army Research Office, with Bob McGhee.
- 1 October 97 - 30 September 1998 \$50,000, "Dial-A-Behavior Virtual Environment Network Protocol". Awarded by the Office of Naval Research, with Don Brutzman.
- 1 October 1996 - 30 September 1997, \$75,000, "Rapidly Configurable Virtual Worlds". Awarded by National Imagery Mapping Agency.
- 1 February 1996 - 31 January 1999, \$450,000, "Rapidly Reconfigurable Virtual Environment Network Protocols". Awarded by ONR, with Don Brutzman.
- 1 October 1995 - 30 September 1998, \$405,000, "NPSNET-Human: Inserting the Human into the Networked Synthetic Environment". Awarded by DARPA.
- 1 October 1994 - 30 September 1995, \$205,000, "NPSNET-Human: Inserting the Human into the Networked Synthetic Environment". Awarded by ARPA, with David Pratt.
- 1 October 1994 - 30 September 1995, \$50,000, "Inserting the Human into the Networked Synthetic Environment". Awarded by ARPA.
- 1 October 1994 - 30 September 1995, \$23,804, "Implementation of Dynamic Terrain". Awarded by Defense Modeling and Simulation Office, with David Pratt.
- 1 October 1994 - 30 September 1995, \$20,000, "1995 Symposium on Interactive 3D Graphics". Awarded by ARPA, with David Pratt.
- 1 October 1994 - 30 September 1995, \$20,000, "1995 Symposium on Interactive 3D Graphics". Awarded by the Army Research Laboratory, with David Pratt.
- 1 October 1994 - 30 September 1995, \$15,000, "1995 Symposium on Interactive 3D Graphics". Awarded by the Office of Naval Research, with David Pratt.
- 1 October 1993 - 31 December 1994, \$100,000, "Implementation of Dynamic Terrain". Awarded by Defense Modeling and Simulation Office, with David Pratt.
- 1 October 1994 - 30 September 1995, \$40,000, "NPSNET-Human: Inserting the Human into the Synthetic Environment - Year Two". Awarded by US Army Research Laboratory, Aberdeen, with David Pratt.
- 1 June 1994 - 31 December 1994, \$50,000, "NPSNET: Terrain and Command and Control (C2) Visualization - Year 1". Awarded by NRaD, San Diego, with David Pratt.
- 1 July 1994 - 31 December 1994, \$58,000, "Implementation of Dynamic Terrain in Distributed Interactive Simulation - Year 2". Awarded by US Army Topographics Engineering Center, with David Pratt.
- 1 October 1993 - 30 September 1994, \$100,000, "NPSNET: Autonomous Force Development & Issues in Designing Intelligent Computer-Aided Training Systems". Awarded by Headquarters, Department of the Army AI Center, Washington, D.C..
- 1 January 1994 - 30 September 1994, \$80,000, "NPSNET-WISE: Integrating the Infantry into a Virtual Environment". Awarded by US Army Research Laboratory, Aberdeen.
- 1 January 1993 - 31 December 1993, \$728,000, "NPSNET: A 3D Visual Simulator for Virtual World Exploration and Experimentation - Year Two". Awarded by DARPA/ASTO, Arlington, Virginia.
- 1 October 1992 - 30 September 1993, \$100,000, "Terrain Visualization and Intelligent Computer-Aided Training - Year 5". Awarded by Headquarters, Department of the Army AI Center, Washington, D.C..
- 1 October 92 - 30 September 1993, \$80,000, "NPSNET: Environmental and Sensor Studies". Awarded by USA STRICOM.
- 1 January 1992 - 31 December 1992, \$1,096,000, "NPSNET: A 3D Visual Simulator for Virtual World Exploration and Experimentation". Awarded by DARPA/ASTO, Arlington, Virginia.
- 1 October 1991 - 30 September 1992, \$100,000, "Terrain Visualization and Intelligent Computer-Aided Training - Year 4". Awarded by Headquarters, Department of the Army AI Center, Washington, D.C..



- 1 October 1991 - 30 September 1992, \$40,000, "NPSNET: Eagle Integration". Awarded by US Army TRADOC Analysis Command, Ft. Leavenworth, Kansas.
- 1 October 1991 - 30 September 1992, \$40,000, "NPSNET: A 3D Visual Simulator for Virtual World Exploration & Experimentation". Awarded from the Naval Postgraduate School's Direct Funding Program, reviewed by the Naval Ocean Systems Center, San Diego, California.
- 1 April 1992 - 31 December 1992, \$20,000, "NPSNET: Terrain Database Studies". Awarded by US Army STRICOM, Orlando, Florida.
- 1 October 1990 - 30 September 1991, \$100,000, "Terrain Visualization and Reasoning - Year 3". Awarded by Headquarters, Department of the Army AI Center, Washington, D.C..
- 8 May 1991 - 31 December 1991, \$60,000, "NPSNET: Low-Cost, Networkable 3D Visual Simulation". Awarded by US Army Project Manager Training Devices, Orlando, Florida.
- 1 March 1991 - 30 Sep 1991, \$10,000, "NPSNET: Terrain Database Standards for 3D Visual Simulation". Awarded by the US Army Engineer Topographic Laboratories, Fort Belvoir, Virginia.
- 1 October 1990 - 30 September 1991, \$140,000, "Inexpensive, Three-Dimensional Visual Simulation for the Command and Control Workstation of the Future - Year 3". Awarded from the Naval Postgraduate School's Direct Funding Program, reviewed by the Naval Ocean Systems Center, San Diego, California.
- 1 October 1989 - 30 September 1990, \$40,000, "Inexpensive, Real-Time 3D Terrain Visualization - Year Two". DARPA money awarded through the US Army Engineer Topographic Laboratories, Fort Belvoir, Virginia.
- 16 March 1990 - 30 September 1990, \$40,000, "Inexpensive, Three-Dimensional Visual Simulation for the Command and Control Workstation of the Future - Year 2". Awarded by the Naval Ocean Systems Center, San Diego.
- 1 September 1990 - 31 Dec 1990, \$20,000, "Development of a SIMNET-Compatible, Non-Line-of-Sight, 3D Visual Simulator". Awarded through US Army Test and Experimentation Command, Fort Ord, California.
- 23 March 1990 - 30 September 1990, \$50,000, "Terrain Visualization and Reasoning -- Year 2". Awarded through Headquarters, Department of the Army AI Center, Washington, D.C..
- 1 October 1989 - 30 September 1990, \$153,000, "Real-Time, Interactive Visual Simulation for the Future Command and Control Workstation - Year 2". Awarded from the Naval Postgraduate School's Direct Funding Program, reviewed by the Naval Underwater Systems Center, Newport, Rhode Island.
- 1 October 1989 - 30 Sept 1990, \$135,000, "Line-of-Sight and Visual Enhancements to the Moving Platform Simulator". Awarded through US Army Test and Experimentation Command, Fort Ord, California.
- 1 June 1989 - 30 Sep 1989, \$50,000, "Terrain Visualization and Reasoning". Awarded through Headquarters, Department of the Army AI Center, Washington, D.C..
- 1 June 1989 - 31 Dec 1989, \$40,000, "Inexpensive, Real-Time 3D Terrain Visualization". DARPA money awarded through the US Army Engineer Topographic Laboratories, Fort Belvoir, Virginia.
- 1 October 1988 - 30 Sep 1990, \$50,000, "The Integration of a High Resolution Digital Terrain Database with the Moving Platform Simulator". Awarded through the US Army Test and Experimentation Command, Fort Ord, California.
- 1 October 1988 - 30 Sep 1989, \$56,000, "Real-Time, Interactive Visual Simulation for the Future Command and Control Workstation", Awarded from the Naval Postgraduate School's Direct Funding Program, reviewed by the Naval Underwater Systems Center, Newport, Rhode Island.
- 1 October 1988 - 30 Sep 1989, \$78,000, "Inexpensive, Three-Dimensional Visual Simulation for the Future Command and Control Workstation". Awarded from the Naval Postgraduate School's Direct Funding Program, reviewed by the Naval Ocean Systems Center, San Diego.
- 1 October 1987 - 30 Sep 1988, \$102,205, "An Architecture for Interactive, Real-Time Graphics Between Networked Workstations -- Year 2". Awarded from the Naval Postgraduate School's Direct Funding Program, reviewed by the Naval Ocean Systems Center, San Diego.
- 1 June 1987 - 30 Sep 1988, \$103,000, "Real-Time Modeling and Animation Tools in Support of Three-Dimensional Simulation". Awarded through the US Army Combat Developments Experimentation Center, Fort Ord, California.
- 1 October 1986 - 30 Sep 1987, \$16,360, "An Architecture for Interactive, Real-Time Graphics Between Networked Workstations -- Year 1". Awarded by the Naval Ocean Systems Center, San Diego.
- 1 Oct 1986 - 30 Sep 1987, \$50,000, "High-Performance, Interactive Graphics for a Multinetwork Controller Monitoring Station". Awarded through the Naval Ocean Systems Center, San Diego, California.

- 1 Oct 1985 - 30 Sep 1986, \$35,000, "A Feasibility Study for Software Portability and Graphics Capability Enhancements for a Command and Control Workstation". Awarded through the Naval Ocean Systems Center, San Diego, California.
- 1 Oct 1985 - 30 Sep 1986, \$60,000, "An Equipment Proposal for the Instructional Use of Computer Graphics at the Naval Postgraduate School". Awarded by the Lab Council of the Naval Postgraduate School as part of the second year of the school-wide Laboratory Upgrade Initiative.
- 1 Oct 1985 - 30 Sep 1986, \$19,496, "The Use of VLSI Technology for the Real-Time Generation of Graphics Displays". Awarded by the Research Council of the Naval Postgraduate School.
- 1 Oct 1984 - 30 Sep 1985, \$38,113, "The Effects of Real-time Display Generation on the Architecture of Graphics Display Systems". Awarded by the Research Council of the Naval Postgraduate School.
- 1 Jun 1984 - 30 Sep 1984, \$52,400, "An Equipment Proposal for the Instructional Use of Computer Graphics at the Naval Postgraduate School". Awarded by the Lab Council of the Naval Postgraduate School.
- 1 Jul 1984 - 30 Sep 1984, \$56,786, "The Effects of Real-time Display Generation on the Architecture of Graphics Display Systems". Awarded by the Research Council of the Naval Postgraduate School.

## PhD Students

Powen Yao, TBD topic, PhD student in Computer Science, USC, expected graduation date 2016.

Tian Zhu, TBD topic, PhD student in Computer Science, USC, expected graduation date 2017.

Fotos Frangoudes, TBD topic, PhD student in Computer Science, USC, expected graduation date 2017.

Jerry Lin, "Emotion Generation Integration into Cognitive Architecture," PhD student in Computer Science, USC, expected graduation date August 2014.

Balakrishnan Ranganathan, "Architecting Online Games for Player Behavior Analysis," PhD student in Computer Science, USC, expected graduation date August 2014.

Marc Spraragen, "A Computational Architecture for Modeling the Effects of Emotion on Planning," PhD student in Computer Science, USC, June 2013.

Brian A. Osborn, "An Agent-Based Architecture for Generating Interactive Stories," PhD in Computer Science, Naval Postgraduate School, September 2002.

Michael VanPutte, "A Computational Model and Multi-Agent Simulation for Information Assurance," PhD in Computer Science, Naval Postgraduate School, June 2002, Dissertation Committee Chair.

Eric Bachmann "Inertial and Magnetic Angle Tracking of Human Limb Segments for Inserting Humans into Synthetic Environments," PhD in Computer Science, Naval Postgraduate School, December 2000.

Michael V. Capps "Fidelity Optimization in Distributed Virtual Environments," PhD in Computer Science, Naval Postgraduate School, June 2000.

Katherine L. Morse "An Adaptive, Distributed Algorithm for Interest Management," PhD in Information and Computer Science, University of California, Irvine, June 2000.

Abrams, Howard "Extensible Interest Management for Scalable Persistent Distributed Virtual Environments," PhD in Computer Science, December 1999.

Storms, Russell "Auditory-Visual Cross-Modal Perception Phenomena," PhD in Computer Science, Naval Postgraduate School, September 1998.

Pandzic, Igor S. "Facial Communication in Networked Collaborative Virtual Environments," PhD Thesis, March 1998, MIRALab, Centre Universitaire d'Informatique, Universit  de Geneve. Member of thesis jury.

Le Van Gong, Hubert "Paradigmes pour l'interop rabilit  entre environnements virtuels," PhD Thesis, December 1996, l'Universit  Paris VI au Laboratoire MASI, L'Universit  Pierre et Marie Curie, examinateur.

Macedonia, Michael R. "A Network Software Architecture for Large Scale Virtual Environments," PhD in Computer Science, Naval Postgraduate School, June 1995.

Brutzman, Donald P. "A Virtual World for an Autonomous Underwater Vehicle", PhD in Computer Science, Naval Postgraduate School, December 1994.

Amburn, Phil "Development and Evaluation of an Air-to-Air Combat Debriefing System Using a Head-Mounted Display," PhD Thesis, University of North Carolina, Chapel Hill, May 1994. I was a member of his PhD committee. The chair of the PhD committee was Frederick P. Brooks, Jr. of UNC.

MacPherson Jr., David Leonard "Automated Cartography by an Autonomous Mobile Robot Using Ultrasonic Range Finders", PhD Thesis, Naval Postgraduate School, September 1993. Member of PhD committee.

Pratt, David "A Software Architecture for the Construction and Management of Real-Time Virtual Worlds", PhD in Computer Science, Naval Postgraduate School, June 1993.

Delaney, Kevin J. "Classification of Short-Duration Non-Stationary Signals," PhD Thesis, Electrical and Computer Engineering Department, Naval Postgraduate School, Monterey, California, March 1992. Outside department member of the PhD committee.

Lott Jr., Gus K. "High Frequency (HF) Radio Signal Amplitude Characteristics, HF receiver Site Performance Criteria, and Expanding the Dynamic Range of HF Digital New Energy Receivers By Strong Signal Elimination," PhD Thesis, Electrical and Computer Engineering Department, Naval Postgraduate School, Monterey, California, June 1990. Outside department member of the PhD committee.

Sciomacco, Edward M. "Parametric Modeling and Estimation of Pulse Propagation on Microwave Integrated Circuit Interconnections," PhD Thesis, Electrical and Computer Engineering Department, Naval Postgraduate School, Monterey, California, June 1990. Outside department member of the PhD committee.

Ross, Ronald S. "Planning Minimum-Energy Paths in an Off-Road Environment with Anisotropic Traversal Costs and Motion Constraints," PhD Thesis, Computer Science Department, Naval Postgraduate School, Monterey, California, June 1989. Member of committee. I helped Ron in the early part of his thesis efforts. We have co-authored several papers. There is a substantial graphics component to this thesis.

Richbourg, Robert "Solving a Class of Spatial Reasoning Problems," PhD Thesis, Computer Science Department, Naval Postgraduate School, Monterey, California, June 1987. Member of committee. I helped Bob Richbourg

in the early part of his thesis efforts by putting an organization and structure to his work. We have co-authored several papers. There is a substantial graphics component to this thesis.

O'Dwyer, John Mark "Power Line Noise Models and Energy Detection in the High Frequency Radio Band," PhD Thesis, Electrical and Computer Engineering Department, Naval Postgraduate School, Monterey, California, June 1986. I was the minor department member of O'Dwyer's thesis committee. As all committee members, I read and commented upon his work.

## Biography - Michael Zyda

[Michael Zyda](#) is the Founding Director of the [USC GamePipe Laboratory](#), and a Professor of Engineering Practice in the USC Department of Computer Science. At USC, he founded the joint games program (now part of USC Games) and took that program from no program to the #1 Games program in the world in five years. His alums have shipped games played by over 660M players. From Fall 2000 to Fall 2004, he was the Founding Director of the [MOVES Institute](#) located at the Naval Postgraduate School, Monterey and a Professor in the Department of Computer Science at NPS as well. From 1986 until the formation of the MOVES Institute, he was the Director of the [NPSNET Research Group](#). Professor Zyda's research interests include computer graphics, large-scale, networked 3D virtual environments and games, agent-based simulation, modeling human and organizational behavior, interactive computer-generated story, computer-generated characters, video production, entertainment/defense collaboration, modeling and simulation, and serious and entertainment games. He is a pioneer in the following fields - computer graphics, networked virtual environments, modeling and simulation, and serious and entertainment games. He holds a lifetime appointment as a National Associate of the National Academies, an appointment made by the Council of the National Academy of Sciences in November 2003, awarded in recognition of "extraordinary service" to the National Academies. He is a member of the Academy of Interactive Arts & Sciences. He served as the principal investigator and development director of the [America's Army](#) PC game funded by the Assistant Secretary of the Army for Manpower and Reserve Affairs. He took America's Army from conception to three million plus registered players and hence, transformed Army recruiting. The creation of the America's Army game founded the serious games field. He co-holds two patents that form the basis for the 9-axis sensor in the Nintendo Wii U.

Professor Zyda was a member of the National Research Council's Behavioral and Social Sciences Commission Committee on "[Virtual Reality Research and Development](#)" and is one of the key authors of that report. Professor Zyda was the chair of the National Research Council's Computer Science and Telecommunications Board Committee on "[Modeling and Simulation: Linking Entertainment & Defense](#)". From that report, for the Deputy Assistant Secretary of the Army for Research and Technology, Professor Zyda drafted the operating plan and research agenda for the [USC Institute for Creative Technologies \(ICT\)](#).

Professor Zyda was a member of the National Research Council Aeronautics and Space Engineering Board Committee on [Advanced Engineering Environments](#). Professor Zyda was chair of the National Research Council's Aeronautics and Space Engineering Board Panel on Computing, Information, and Communications Technology (CICT) and member of the parent NRC Committee for the Review of NASA's Pioneering Revolutionary Technology Program. Professor Zyda was a member of the NRC's Aeronautics and Space Engineering Board Vehicle Systems Panel that is part of the Committee for the Review of NASA's Revolutionize Aviation Program. He was a member of the National Research Council Naval Studies Board Committee on FORCEnet Implementation Strategies. He was a member of the National Research Council Mathematical Sciences and Their Application Board Committee on Defense Modeling, Simulation and Analysis. He was a member of the National Research Council Behavioral and Social Sciences Commission Committee on Behavioral Modeling and Simulation – from Individuals to Societies. Professor Zyda was a member of the National Research Council Laboratory Assessments Board, Soldier Systems Panel. Professor Zyda was a member of the National Research Council Tiger Standing Committee study group on Modeling, Simulation and Games. Professor Zyda was a member of the National Research Council Division on Earth and Life Sciences Committee on the Future US Workforce for Geospatial Intelligence.

He has been a member of the Editorial Advisory Board of the journal Computers & Graphics. Professor Zyda has been a member of the Technical Advisory Board of the [Fraunhofer Center for Research in Computer Graphics](#), Providence, Rhode Island. He was a Member of the Board of Advisors for the Georgia Institute of Technology Modeling and Simulation Research and Education Center. He was a member of the US Army's Distance Learning/Training Technology Applications Subcommittee of the Army Education Committee, appointed by US Army TRADOC, with the approval of the Secretary of the Army, with concurrence of the Secretary of Defense.

Professor Zyda has consulted for the White House Office of Science and Technology Policy, NASA AMES, the Ministry of Industrial Development Sabah Province, Malaysia, Japan Tech Services Corporation, Tokyo, Hitachi Plant Construction & Engineering, Ohtsuka, SimGraphics Engineering, Pasadena, Silicon Graphics International, Geneva, Nihon Silicon Graphics KK, Advanced Telecommunications Inc., TecMagik, SpiritChannel.com, Muse3d.com, BBN, MaK Technologies, Sony Computer Entertainment, Viacom/MTV Games, e4e and Paramount Digital Entertainment, among others. He is a speaker with [Celebrity Speakers, International](#). He is an advisor to

CiiNow, Sugarcane Development and Ollie. He was the founder and Chairman of Happynin Games, an iOS game publisher and developer.

Professor Zyda began his career in Computer Graphics in 1973 as part of an undergraduate research group, [the Senses Bureau](#), at the University of California, San Diego. Professor Zyda received a BA in Bioengineering from the University of California, San Diego in La Jolla in 1976, an MS in Computer and Information Science from the University of Massachusetts, Amherst in 1978 and a DSc in Computer Science from Washington University, St. Louis, Missouri in 1984.

# **EXHIBIT 4**

## **Richard M. Goodin, PE**

5448 Apex Peakway • Suite 191 • Cary NC 27502-3924

rich@goodin.com • (919) 362-1396

**Goodin & Associates, Inc.**, Cary, NC. *February 1990 – Current.*

President/Chief Consultant - consulted on various projects including the following:

### Hardware:

- Developed an electronics package for an underwater rebreather. Responsibilities included system electronics architecture, board design on all system boards, board bringup, firmware architecture and gas control firmware implementation.
- Provided VGA expertise to design team designing new VGA core for client's graphics accelerators.
- Developed an FPGA based system on chip implementation for military applications. Responsibilities included system electronics architecture, board design on all system boards, FPGA synthesis, and board bringup.
- Architect and implement a 2D graphics and video accelerator for palmtop to light laptop use. Responsibilities included system architecture and system design in Verilog.
- Architected and implemented a high reliability 10GigE Fabric Link for an MPLS switch. Responsibilities included Verilog design and synthesis.
- Testing and analysis of extensions to current graphics architecture to meet Xbox graphics requirements.
- Developed a high performance 32 bit VGA module in synthesizable Verilog designed to provide VGA compatibility for 3D systems. Responsibilities included design, compatibility testing and synthesis. Eventually resold implementation to 6 companies with a variety of simulation, synthesis and verification requirements.
- Architected and assisted in design of a hardware add-on processor to accelerate OpenGL and DirectX 7 transform and lighting.
- CDRAM evangelist. Promoted and assisted adoption of Mitsubishi's CDRAM technology for use in graphics systems.
- Architected and assisted in design of a medium performance 3D accelerator chip using embedded DRAM technology.
- Participated in the simulation, testing and development of a high performance graphics accelerator for the DEC Alpha architecture.
- Architected and developed a Verilog based multiprocess hardware simulation environment for hardware verification.

### Software:

- Implemented 2D Windows 2000 and Windows XP drivers for Peritek hardware.
- Architected OpenGL and DirectX firmware for massively parallel MIMD implementation. Responsibilities include development of software architecture, software functional simulator and development of interface software for Verilog simulation.
- Implemented an OpenGL port for Voodoo graphics hardware optimized for game requirements.
- Participated in the architecture and development of Data General's Aview graphics library.
- Developed high speed anti-aliasing algorithms targeted at an Intel i860 based multiprocessor graphics accelerator.

07/05/13



Litigation:

- Software/non-infringement analysis in support of a non-infringement case in the areas of graphics rasterization.
- Software analysis in support of a case in the areas of chip to chip communication.
- Non-infringement analysis in support of a non-infringement case in the areas of sign printer/cutters.
- Infringement analysis in support of an infringement case in the areas of touchscreens, device, OS and user interface features of smartphones.
- Software analysis in support of an infringement case in the area of internet television.
- Software analysis in support of a non-infringement case in the area of texture compression.
- Software analysis in support of an infringement case in the areas of digital cameras and image processing.
- Software analysis in support of an infringement case in the areas of digital flat panel television.
- Software analysis in support of an infringement case in the area of digital imaging.
- Software analysis in support of an infringement case in the areas of video scaling, user interface and digital audio.
- Verilog analysis in support of an infringement case in the area of DMA devices.
- Analyzed Intel processor and chipset implementations in IHDL and VHDL to look for infringing implementations.
- Analyzed Intel and Via chipset implementations in VHDL and Verilog source to look for infringing implementations.

**Apple Computer**, Cupertino, CA. *November 2004 – October 2006.*

Senior Engineer:

Lead engineer responsible for architecture and implementation of Apple's proprietary EFI graphics extensions across Nvidia, ATI and Intel based platforms. Responsibilities included system architecture and driver design. Implemented Intel drivers for two generations of Intel graphics architectures. Represented Apple in negotiations with EFI group at Intel. Interfaced with driver developers at NVidia and ATI.

**Raydiant, Inc.**, Santa Clara, CA. *January 1999 – October 1999.*

Chief Scientist:

Lead hardware and software architect for advanced scalable PC graphics accelerator. Responsibilities included research and development of hardware acceleration of advanced graphics features and managing architecture group.

**Sun Microsystems**, Morrisville, NC. *April 1988 - January 1990.*

Member of Technical Staff/Architect:

- Co-architected and implemented the Renderman compliant, high-quality rendering component of Sun's SunVision visualization product.
- Co-architected Sun's XGL proprietary graphics library.
- Developed new approaches for the graphics library and windowing software for a multiprocessor, i860 based, visualization accelerator.
- Ported SunPHIGS to Sun's TAAC-1 application accelerator.
- Implemented NURBS curve and surface extensions to the TAAC-1 graphics library.

**Sun Microsystems**, Mountain View, CA. *January 1987 - March 1988.*

Software Manager

Managed a ten person group developing software for direct surface rendering accelerator.

**Quanta Corporation**, Salt Lake City, UT. *August 1985 - January 1987.*

Project Engineer/Graphics

Specifically hired for the purpose of developing a high performance, real-time 3D animation system for use in video production.

**Racore Corporation**, Salt Lake City UT. *March 1985 - August 1985.*

Chief Engineer

Conceived, designed, implemented and readied for production a very low cost LAN for the IBM PC family.

**Evans & Sutherland**, Salt Lake City, UT. *November 1981 - March 1985.*

Advanced Development

Worked directly with Vice President of Advanced Development to research and develop new graphics directions.

Project Engineer

Developed three software and two hardware products to integrate the PS300 graphics display system into the IBM environment.

**Sperry Univac GSD**, Salt Lake City, UT. *January 1979 - November 1981*

Project Engineer

Wrote communications, display and peripheral microcode for a sophisticated terminal featuring advanced windowing and virtual communications.

**Education:**

Bachelors of Electrical Engineering, University of Delaware, September 1976 – December 1978. Minor in Mechanical Engineering. Completed 4 year program in 2 ½ years.

**Professional:**

Senior Member IEEE

Senior Member ACM

Member AIPLA

Registered to practice before the United States Patent and Trademark Office

Licensed as a Professional Engineer in the state of North Carolina

# **EXHIBIT 5**

## Bruce MacDowell Maggs

Department of Computer Science  
Duke University  
Durham, NC 27708-0129  
bmm@cs.duke.edu

402 Lyons Road  
Chapel Hill, NC 27514  
(919) 929-3997

### Research Interests

Networks for parallel and distributed computer systems.

### Employment

#### *Duke University*

Pelham Wilder Professor of Computer Science, July 2011–present.  
Professor of Computer Science, January 2010–July 2011.  
Visiting Professor of Computer Science, September 2007–August 2008,  
July 2009–January 2010.

#### *Carnegie Mellon University*

Adjunct Professor of Computer Science, July 2009–July 2010.  
Professor of Computer Science, July 2004–July 2009.  
Professor of Electrical and Computer Engineering (by courtesy), July 2004–July 2009.  
Associate Professor of Computer Science, with tenure, July 1999–July 2004.  
Associate Professor of Computer Science, July 1997–July 1999.  
Assistant Professor of Computer Science, January 1994–July 1997.

#### *Akamai Technologies, Inc.*

Vice President for Research, January 1, 2000–present.  
Vice President for Research and Development, April 1, 1999–December 31, 1999.  
Senior Research Scientist, January 15, 1999–March 31, 1999.

#### *Massachusetts Institute of Technology*

Visiting Associate Professor of Computer Science, September 1998–January 1999.

#### *NEC Research Institute, Inc.*

Research Scientist (Permanent Status), October 1993–January 1994.  
Research Scientist (Provisional Status), September 1990–October 1993.

#### *Massachusetts Institute of Technology*

Postdoctoral Associate, September 1989–September 1990.

### Education

#### *Massachusetts Institute of Technology*

Ph.D., Computer Science, September 1989.  
Thesis title: *Locality in Parallel Computation*  
Thesis supervisor: Charles E. Leiserson

S.M., Electrical Engineering and Computer Science, June 1986.  
Thesis title: *Communication-Efficient Parallel Graph Algorithms*

S.B., Computer Science and Engineering, June 1985.  
Thesis title: *Computing Minimum Spanning Trees on a Fat-Tree Architecture*

#### *University of Illinois at Urbana-Champaign*

September 1981–May 1983.

## II. Publications

### Chapters in Books

- [1] “Parallel algorithms,” G. E. Blelloch and B. M. Maggs. In M. J. Atallah, editor, *Handbook of Algorithms and Theory of Computation*, CRC Press, Boca Raton, FL, November 1998, chapter 47.
- [2] “Parallel algorithms,” G. E. Blelloch and B. M. Maggs. In A. B. Tucker, Jr., editor, *The Computer Science and Engineering Handbook*, CRC Press, Boca Raton, FL, 1997, pp. 277–315.

### Refereed Journal Papers

- [1] “Enabling Content-Aware Traffic Engineering,” I. Poese, B. Frank, G. Smaragdakis, S. Uhlig, A. Feldmann, and B. Maggs. *ACM SIGCOMM Computer Communication Review*, Vol. 42, No. 5, October 2012.
- [2] “Posit: A Lightweight Approach for IP Geolocation,” B. Eriksson, P. Barford, B. Maggs, and R. Nowak, *SIGMETRICS Performance Evaluation Review*, Vol. 40, No. 2, September 2012, pp. 2–11.
- [3] “Simultaneous Source Location,” K. Andreev, C. Garrod, D. Golovin, B. Maggs, and A. Meyerson. *ACM Transactions on Algorithms*, Vol. 6, No. 1, December 2009.  
Originally appeared in the *Proceedings of the 7th International Workshop on Approximation Algorithms for Combinatorial Optimization Problems (APPROX)*, August, 2004.
- [4] “On the Performance Benefits of Multihoming Route Control,” A. Akella, B. M. Maggs, S. Seshan, A. Shaikh, and R. Sitaraman. *IEEE/ACM Transactions on Networking*, Vol. 16, No. 1, February 2008, pp. 91–104.  
Originally appeared as “A measurement-based analysis of multihoming,” in the *Proceedings of the ACM SIGCOMM 2003 Conference on Applications, Technologies, Architectures, and Protocols for Computer Communication (SIGCOMM)*, August, 2003.
- [5] “Globally distributed content delivery,” J. Dille, B. Maggs, J. Parikh, H. Prokop, R. Sitaraman, and B. Weihl. *IEEE Internet Computing*, September/October 2002, pp. 50–58.
- [6] “Protocols for asymmetric communication channels,” M. Adler and B. M. Maggs. *Journal of Computer and Systems Sciences*, Vol. 63, No. 4, December 2001, pp. 573–596.  
Originally appeared in the *Proceedings of the 39th Annual Symposium on Foundations of Computer Science (FOCS)*, October 1998, pp. 522–533.
- [7] “On the bisection width and expansion of butterfly networks,” C. F. Bornstein, A. Litman, B. M. Maggs, R. K. Sitaraman, and T. Yatzkar. *Theory of Computing Systems*, Vol. 34, No. 6, November 2001, pp. 491–518.  
Originally appeared in the *Proceedings of the 12th International Parallel Processing Symposium (IPPS)*, March 1998, pp. 144–150.
- [8] “On the benefit of supporting virtual channels in wormhole routers,” R. J. Cole, B. M. Maggs, and R. K. Sitaraman. *Journal of Computer and System Sciences*, Vol. 62, No. 1, February 2001, pp. 152–177.  
Originally appeared in the *Proceedings of the 8th ACM Symposium on Parallel Algorithms and Architectures (SPAA)*, June 1996, pp. 131–141.
- [9] “Improved routing and sorting on multibutterflies,” B. M. Maggs and B. Vöcking. *Algorithmica*, Vol. 28, No. 4, 2000, pp. 438–464.

Originally appeared in the *Proceedings of the 28th Annual ACM Symposium on the Theory of Computing* (STOC), May 1997, pp. 517–530.

- [10] “Sorting-based selection algorithms for hypercubic networks,” P. Berthomé, A. Ferreira, B. M. Maggs, S. Perennes, and C. G. Plaxton. *Algorithmica*, Vol. 26, No. 2, 2000, pp. 237–254. Originally appeared in the *Proceedings of the 7th International Parallel Processing Symposium* (IPPS), April 1993, pp. 89–95.
- [11] “Fast algorithms for finding  $O(\text{congestion} + \text{dilation})$  packet routing schedules,” F. T. Leighton, B. M. Maggs, and A. W. Richa. *Combinatorica*, Vol. 19, No. 3, 1999, pp. 375–401. Originally appeared in the *Proceedings of the 28th Hawaii International Conference on System Sciences* (HICSS), Volume 2, January, 1995, pp. 555–563.
- [12] “Simple algorithms for routing on butterfly networks with bounded queues,” B. M. Maggs and R. K. Sitaraman. *SIAM Journal on Computing*, Vol. 28, No. 3, June 1999, pp. 984–1003. Originally appeared in the *Proceedings of the 24th Annual ACM Symposium on the Theory of Computing* (STOC), May 1992, pp. 150–161.
- [13] “Tight analyses of two local load balancing algorithms,” B. Ghosh, F. T. Leighton, B. M. Maggs, S. Muthukrishnan, C. G. Plaxton, R. Rajaraman, A. W. Richa, R. E. Tarjan, and D. Zuckerman. *SIAM Journal on Computing*, Vol. 29, No. 1, February 1999, pp. 29–64. Originally appeared in the *Proceedings of the 27th Annual ACM Symposium on the Theory of Computing* (STOC), May 1995, pp. 548–558.
- [14] “On the fault tolerance of some popular bounded-degree networks,” F. T. Leighton, B. M. Maggs, and R. K. Sitaraman. *SIAM Journal on Computing*, Vol. 27, No. 5, October 1998, pp. 1303–1333. Originally appeared in the *Proceedings of the 33rd Annual Symposium on Foundations of Computer Science* (FOCS), October 1992, pp. 542–552.
- [15] “An experimental analysis of parallel sorting algorithms,” G. E. Blelloch, C. E. Leiserson, B. M. Maggs, C. G. Plaxton, S. Smith, and M. Zagha. *Theory of Computing Systems*, Vol. 31, No. 2, March/April 1998, pp. 135–167. Originally appeared as “A comparison of sorting algorithms for the Connection Machine CM-2,” in the *Proceedings of the 3rd Annual ACM Symposium on Parallel Algorithms and Architectures* (SPAA), July 1991, pp. 3–16.
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- [17] “Work-preserving emulations of fixed-connection networks,” R. R. Koch, F. T. Leighton, B. M. Maggs, S. B. Rao, A. L. Rosenberg, and E. J. Schwabe. *Journal of the ACM*, Vol. 44, No. 1, January 1997, pp. 104–147. Originally appeared in the *Proceedings of the 21st Annual ACM Symposium on Theory of Computing* (STOC), May 1989, pp. 227–240.
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- [20] “Randomized routing and sorting on fixed-connection networks,” F. T. Leighton, B. M. Maggs, S. B. Rao, and A. G. Ranade. *Journal of Algorithms*, Vol. 17, No. 1, July 1994, pp. 157–205.  
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- [21] “Packet routing and job-shop scheduling in  $O(\text{congestion} + \text{dilation})$  steps,” F. T. Leighton, B. M. Maggs, S. B. Rao. *Combinatorica*, Vol. 14, No. 2, 1994, pp. 167–180.  
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- [22] “A parallel algorithm for reconfiguring a multibutterfly network with faulty switches,” A. V. Goldberg, B. M. Maggs, and S. A. Plotkin. *IEEE Transactions on Computers*, Vol. 43, No. 3, March 1994, pp. 321–326.
- [23] “Fast algorithms for routing around faults in multibutterflies and randomly-wired splitter networks,” F. T. Leighton and B. M. Maggs. *IEEE Transactions on Computers*, Vol. 41, No. 5, May 1992, pp. 578–587.  
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- [24] “Fast algorithms for bit-serial routing on a hypercube,” W. A. Aiello, F. T. Leighton, B. M. Maggs, and M. Newman. *Mathematical Systems Theory*, Vol. 24, No. 4, 1991, pp. 253–271.  
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## Submitted for Journal Publication

- [1] “Designing overlay multicast networks for streaming”, K. Andreev, B. Maggs, A. Meyerson, and R. Sitaraman.  
Originally appeared in *Proceedings of the Fifteenth Annual ACM Symposium on Parallel Algorithms and Architectures (SPAA)*, June 2003.
- [2] “On hierarchical routing in doubling metrics,” H. T-H. Chan, A. Gupta, B. M. Maggs, and S. Zhou.

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## Refereed Conference and Workshop Papers Not Also Appearing in or Submitted to Journals

- [1] “Less pain, most of the gain: incrementally deployable ICN,” S. Fayazbaksh, Y. Lin, A. Tootonchian, A. Ghodsi, T. Koponen, B. Maggs, K.-C. Ng, V. Sekar, and S. Shenker, *Proceedings of the ACM SIGCOMM 2013 Conference* (SIGCOMM), August, 2013, to appear.
- [2] “Reliable content-distribution networks,” P. Aditya, M. Zhao, Y. Lin, A. Haeberlen, P. Druschel, B. Maggs, and B. Wishon, *Proceedings of the 9th USENIX Symposium on Networked Systems Design and Implementation* (NSDI), April 2012.
- [3] “Cutting the electrical bill for Internet-scale systems,” A. Qureshi, R. Weber, H. Balakrishnan, J. Guttag, and B. Maggs, *Proceedings of the ACM SIGCOMM 2009 Conference* (SIGCOMM), August, 2009.
- [4] “Holistic query transformations for dynamic Web applications,” A. Manjhi, C. Garrod, B. M. Maggs, T. C. Mowry, and A. Tomasic, *Proceedings of the 2009 IEEE 25th International Conference on Data Engineering* (ICDE), April 2009.
- [5] “Holistic application analysis for update-independence,” C. Garrod, A. Manjhi, B. Maggs, T. Mowry, and A. Tomasic, *Proceedings of the Second IEEE Workshop on Hot Topics in Web Systems and Technologies* (HotWeb 2008), October, 2008, pp. 1–6.
- [6] “Scalable query result caching for Web applications,” C. Garrod, A. Manji, A. Ailamaki, B. Maggs, T. Mowry, C. Olston, and A. Tomasic. *Proceedings of the 34th International Conference on Very Large Databases* (VLDB), August 2008.
- [7] “On the impact of route monitor selection,” Y. Zhang, Z. Zhang, Z. M. Mao, Y. C. Hu, and B. M. Maggs, *Proceedings of the Internet Measurement Conference 2007* (IMC), October 2007.
- [8] “Portcullis: protecting connection setup from denial-of-capability attacks,” B. Parno, D. Wendlandt, E. Shi, A. Perrig, B. Maggs, and Y.-C. Hu, *Proceedings of the ACM SIGCOMM 2007 Conference* (SIGCOMM), August, 2007.
- [9] “R-BGP: staying connected in a connected world,” N. Kushman, S. Kandula, D. Katabi, and B. M. Maggs, *Proceedings of the 4th USENIX Symposium on Networked Systems Design & Implementation* (NSDI), April 2007.
- [10] “Invalidation clues for database scalability services,” A. Manjhi, P. B. Gibbons, A. Ailamaki, B. M. Maggs, T. C. Mowry, C. Olston, A. Tomasic, and H. Yu. *Proceedings of the 2007 IEEE 23rd International Conference on Data Engineering* (ICDE), April 2007.
- [11] “Quorum placement in networks: minimizing network congestion,” D. Golovin, A. Gupta, B. M. Maggs, F. Oprea, and M. Reiter, *Proceedings of the 18th Annual ACM SIGACT-SIGOPS Symposium on Principles of Distributed Computing* (PODC), July, 2006.
- [12] “Simultaneous scalability and security for data-intensive Web applications,” A. Manjhi, A. Ailamaki, B. M. Maggs, T. C. Mowry, C. Olston, and A. Tomasic. *Proceedings of ACM SIGMOD 2006* (SIGMOD), June, 2006.
- [13] “Finding effective support-tree preconditioners,” B. M. Maggs, G. L. Miller, O. Parekh, R. Ravi, and S. L. M. Woo. *Proceedings of the 17th Annual ACM Symposium on Parallel Algorithms and Architectures* (SPAA), July 2005.



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- [15] “A scalability service for dynamic Web applications,” C. Olston, A. Manjhi, C. Garrod, A. Ailamaki, B. M. Maggs, and T. C. Mowry, *Proceedings of the 2nd Biennial Conference on Innovative Data Systems Research* (CIDR), January 2005.
- [16] “A methodology for estimating interdomain Web traffic demand,” A. Feldmann, N. Kammenhuber, O. Maennel, B. Maggs, R. De Prisco, and R. Sundaram. *Proceedings of the Internet Measurement Conference 2004* (IMC), October 2004.
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- [19] “Locating Internet routing instabilities”, A. Feldmann, O. Maennel, Z. Morley Mao, A. Berger, and B. Maggs. *Proceedings of the ACM SIGCOMM 2004 Conference* (SIGCOMM), August, 2004.
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- [25] “On balls and bins with deletions,” R. Cole, A. Frieze, B. M. Maggs, M. Mitzenmacher, A. W. Richa, R. K. Sitaraman, and E. Upfal, *Proceedings of the 2nd International Workshop on Randomization and Approximation Techniques in Computer Science* (RANDOM), October 1998, pp. 145–158.
- [26] “Randomized protocols for low-congestion circuit routing in multistage interconnection networks,” R. Cole, B. M. Maggs, F. Meyer auf der Heide, M. Mitzenmacher, A. W. Richa, K. Schröder, R. K. Sitaraman, and B. Vöcking. *Proceedings of the 29th Annual ACM Symposium on the Theory of Computing* (STOC), May 1998, pp. 378–388.
- [27] “Parallel Gaussian elimination with linear work and fill,” C. F. Bornstein, B. M. Maggs, G. Miller, and R. Ravi. *Proceedings of the 38th Annual Symposium on Foundations of Computer Science* (FOCS), October 1997, pp. 274–283.

- [28] “Exploiting locality for data management in systems of limited bandwidth,” B. M. Maggs, F. Meyer auf der Heide, B. Vöcking, and M. Westermann. *Proceedings of the 38th Annual Symposium on Foundations of Computer Science (FOCS)*, October 1997, pp. 284–293.
- [29] “Routing on butterfly networks with random faults,” R. Cole, B. Maggs, and R. Sitaraman. *Proceedings of the 36th Annual Symposium on Foundations of Computer Science (FOCS)*, October 1995, pp. 558–570.
- [30] “An algorithm for finding predecessors in integer sets,” B. Maggs and M. Rauch. *Proceedings of the 3rd Workshop on Algorithms and Data Structures (WADS)*. Vol. 709 of Lecture Notes in Computer Science, Springer-Verlag, August 1993, pp. 483–493.
- [31] “Approximate load balancing on dynamic and asynchronous networks,” W. Aiello, B. Awerbuch, B. Maggs, and S. Rao. *Proceedings of the 25th Annual ACM Symposium on the Theory of Computing (STOC)*, May 1993, pp. 632–641.
- [32] “Empirical evaluation of randomly-wired multistage networks,” D. Lisinski, T. Leighton, and B. Maggs. *Proceedings of the 1990 International Conference on Computer Design (ICCD)*, September 1990, pp. 380–385.

## Technical Reports

- [1] “Competitive analysis of call admission algorithms that allow delay,” A. Feldmann, B. M. Maggs, J. Sgall, D. D. Sleator, and A. Tomkins. Technical Report CMU-CS-95-102, School of Computer Science, Carnegie Mellon University, Pittsburgh, PA 15213, January 1995.

## Other Publications - Surveys and Position Papers

- [1] “A survey of congestion+dilation results for packet scheduling,” B. M. Maggs. *Proceedings of the 40th Conference on Information Science and Systems (CISS)*, March 2006.
- [2] “Real-time emulations of bounded-degree networks,” B. M. Maggs and E. J. Schwabe, *Information Processing Letters*, Vol. 6, No. 5, June 1998, pp. 269–276.
- [3] “A critical look at three of parallel computing’s maxims,” B. M. Maggs. *Proceedings of the 1996 International Symposium on Parallel Architectures, Algorithms, and Networks (I-SPAN ’96)*, June 1996, pp. 1–7.
- [4] “Parallel algorithms,” G. E. Blelloch and B. M. Maggs, *ACM Computing Surveys*, Vol. 28, No. 1, March 1996, pp. 51–54.
- [5] “Models of parallel computation: a survey and synthesis,” B. M. Maggs, L. R. Matheson, and R. E. Tarjan. *Proceedings of the 28th Hawaii International Conference on System Sciences (HICSS)*, Volume 2, January, 1995, pp. 61–70.
- [6] “The hidden cost of low bandwidth communication,” G. E. Blelloch, B. M. Maggs, and G. L. Miller. In U. Vishkin, ed., *Developing a Computer Science Agenda for High-Performance Computing*, ACM Press, 1994, pp. 22–25.
- [7] “Randomly wired multistage networks.” *Statistical Science*, B. M. Maggs. Vol. 8, No. 1, February, 1993, pp. 70–75.
- [8] “Beyond parallel random-access machines,” B. M. Maggs. In J. L. C. Sanz, ed., *Opportunities and Constraints of Parallel Computing*, Springer-Verlag, 1989, pp. 83–84.

## Patents

- U.S. Patent Number 7,296,082, “Method and System for Fault Tolerant Media Streaming over the Internet,” F. T. Leighton, D. M. Lewin, D. Shaw, and B. Maggs, November 13, 2007.
- U.S. Patent Number 7,111,061, “Global Load Balancing Across Mirrored Data Centers,” F. T. Leighton, A. E. Lewin (legal representative), R. Sundaram, R. S. Dhanidina, R. Kleinberg, M. Levine, A. M. Soviani, B. Maggs, H. S. Rahul, S. Thirumalai, J. G. Parikh, Y. O. Yerushalmi, D. M. Lewin, September 19, 2006.
- U.S. Patent Number 7,010,578, “Internet Content Delivery Service with Third Party Cache Interface Support,” D. M. Lewin, B. Maggs, and J. J. Kloninger, March 7, 2006.
- U.S. Patent Number 6,667,726, “Method and System for Fault Tolerant Media Streaming over the Internet,” F. T. Leighton, D. M. Lewin, D. Shaw, and B. Maggs, December 16, 2003.
- U.S. Patent Number 5,521,591, “Switching Networks with Expansive and/or Dispersive Logical Clusters for Message Routing,” S. A. Arora, T. F. Knight, Jr., F. T. Leighton, B. M. Maggs, and E. Upfal, May 28, 1996.

## III. Evidence of External Reputation

### Awards

- Daniel L. Slotnick Award for Most Original Paper for “Communication-efficient parallel graph algorithms,” C. E. Leiserson and B. M. Maggs, *Proceedings of the 1986 International Conference on Parallel Processing*, August 1986, IEEE, pp. 861–868.

### Distinguished Lecture Series Talks

- “Cutting the Electrical Bill for Internet-Scale Systems,”  
AT & T Labs Research (7/10)
- “Lessons in Engineering Self-Managing Networks,”  
Microsoft Research Silicon Valley (11/07)
- “Experimenting with a Content Delivery Network”  
Boston University (11/03),  
Johns Hopkins University (11/03)
- “Global Internet Content Delivery”  
University of Illinois at Chicago (12/02),  
IBM Silicon Valley Laboratory (5/02).
- “Some Problems Related to Content Delivery”  
University of Massachusetts, Amherst (10/01).

### Keynote Addresses at Conferences and Workshops

- “A First Look at a Commercial Hybrid Content Delivery System,”  
15th IEEE Global Internet Symposium (3/12).
- “Cutting the Electric Bill for Internet-Scale Systems,”  
Student Workshop, 6th International Conference on emerging Networking EXperiments and Technologies (CoNEXT) (11/10).

- “Challenges in Engineering the World’s Largest Content Delivery Network,”  
Second IEEE Workshop on Hot Topics in Web Systems and Technologies (10/08).
- “Engineering a Large Self-Managed Network,”  
Tag der Informatik, Rheinisch-Westfälische Technische Hochschule Aachen (12/07).
- “A Scalable Approach to Alleviating Database Bottlenecks”  
Third Annual Delis Workshop (1/07).
- “A Methodology for Estimating Interdomain Web Traffic”  
Heinz Nixdorf Symposium (1/06).
- “Lessons in Engineering Self-Managing Networks,”  
Microsoft Self-Managing Networks Summit, 2005: Making Networks Self-Aware  
(6/05).
- “A Comparison of Overlay Routing and Multihoming Route Control,”  
High Performance Switching and Routing Workshop, (04/04),
- “Designing Overlay Multicast Networks for Streaming”,  
Tenth International Colloquium on Structural Information and Communication Complexity (SIROCCO 2003) (6/03).
- “Some Problems Related to Content Delivery”  
ACM/IEEE International Symposium on Cluster Computing and the Grid (CC-Grid2001) (5/01),  
Third NYC Metro Area Distributed Systems Meeting (NMADS-3) (04/01),  
International Symposium on Parallel Architectures, Algorithms, and Networks (I-SPAN ’00) (12/00),  
Ninth IEEE International Symposium on High Performance Distributed Computing (HPDC) (8/00).
- “Global Internet Content Delivery”  
21st Annual ACM Symposium on Principles of Distributed Computing (PODC ’02) (7/02),  
INFORMATIK ’99, International Workshop on Communication and Data Management in Large Networks, Heinz Nixdorf Institute, University of Paderborn, Paderborn, Germany (10/99).
- “Multibutterflies: The Most Powerful Multistage Interconnection Networks Known”  
Computing: the Australasian Theory Symposium, Sydney, Australia (2/97).
- “Improved Routing and Sorting on Multibutterflies”  
Midwest Theory Day, Chicago, IL (12/96).
- “A Critical Look at Three of Parallel Computing’s Maxims”  
1996 International Symposium on Parallel Architectures, Algorithms, and Networks (I-SPAN ’96), Beijing, China (6/96).
- “What Makes a Good Routing Network?”  
International Workshop on Interconnection Networks, Centre International de Rencontres Mathématiques, Luminy, France (7/95).

### **One-Hour Plenary Session Invited Lectures at Conferences and Workshops**

- “Designing Overlay Multicast Networks for Commercial Streaming”  
Workshop on Network Management and Design, Institute for Mathematics and its Applications (IMA), University of Minnesota (5/03).

- “Challenges in Building a Reliable System of Tens of Thousands of Servers”  
Dependability in Real Life, Second High Dependability Computing Consortium Workshop (5/01).
- “Variations on Nested Dissection”  
Symposium on High Performance Computing and Networks, Fordham University (3/99).
- “Protocols for Asymmetric Communication Channels”  
Symposium on Parallel and Distributed Computing and Networks, National University of Singapore (7/98).
- “Multibutterflies: The Most Powerful Multistage Interconnection Networks Known”  
Workshop on Complexity Issues in Distributed and Parallel Computation, Fields Institute, Toronto, Canada (6/98).
- “Work-Preserving Network Emulations”  
2nd Workshop on Parallel Algorithms (WOPA), New Orleans, LA (5/91).

### **Invited Lectures in Academia and Industry**

- “A First Look at a Commercial Hybrid Content Delivery System,”  
Microsoft Research, Redmond, WA(10/11), University of Illinois (7/11), Technische Universität Berlin / Deutsche Telekom Laboratories, Berlin, Germany (6/11), Internet Multi-Resolution Analysis Reunion Conference, Lake Arrowhead, CA (6/11).
- “Cutting the Electric Bill for Internet-Scale Systems,”  
Technische Universität Berlin / Deutsche Telekom Laboratories, Berlin, Germany (12/10), LIP6 (Laboratoire d’Informatique de Paris 6), Paris, France (9/09), Max Planck Institute for Software Systems, Saarbrücken, Germany (9/09).
- “A Content Delivery Network’s Experiences with Denial of Service Attacks,” International Conference on Cyber Security, New York, NY (8/10).
- “Measurements and their Application in a Content Delivery Network,” Internet Multi-Resolution Analysis Culminating Retreat, Lake Arrowhead, CA (12/08).
- “Engineering a Large Self-Managed Network,”  
University of California at Irvine (1/08).
- “Work-Preserving Network Emulations”  
Army Fest: A Celebration of Arnold Rosenberg’s Distinguished Career, University of Massachusetts at Amherst (10/07).
- “R-BGP: Staying Connected in a Connected World”,  
KAIST Networking Seminar Series (KNSS 2007), Daejeon, Republic of Korea (9/07), Duke University, (3/09).
- “A Scalable Approach to Alleviating Database Bottlenecks”  
Duke University (10/06), LIP6 (Laboratoire d’Informatique de Paris 6), Paris, France (1/07).
- “A Methodology for Estimating Interdomain Web Traffic”  
Massachusetts Institute of Technology (2/05).
- “Using Akamai Traces to Drive End System Multicast Simulations”  
Workshop on Building Scalable Simulations of Complex Socio-Technical Systems, 5th Symposium of the Los Alamos Computer Science Institute (LACSI) (11/04).

- “Designing Overlay Multicast Networks for Streaming”  
 Arizona State University (4/04), University of California at Berkeley (4/04), Northeastern University (11/03), Technical University of Munich (9/03).
- “How Akamai Uses Consistent Hashing”  
 Special Session on Probabilistic Methods in Combinatorics and the Internet, 108th Annual Meeting of the American Mathematical Society (AMS), (1/02).
- “Content Delivery on September 11”  
 The Internet Under Crisis Conditions: Learning from the Impact of September 11, a Computer Science and Telecommunications Board Workshop, National Research Council (3/02).
- “Some Problems Related to Content Delivery”  
 Northeastern University (4/01), The College of William and Mary (4/01), University of California, San Diego (1/01), University of Southern California (9/00), University of Arizona (9/00), Arizona State University (9/00), University of California, Santa Barbara (5/00).
- “Global Internet Content Delivery”  
 Stanford University (5/02), Lucent Bell Laboratories (11/99), University of Michigan (11/99),
- “Using Internet Measurements to Direct Clients to Servers”  
 OPENSIG '99 Workshop, Open Signalling for ATM, Internet and Mobile Networks, Pittsburgh, PA (10/99).
- “Variations on Nested Dissection”  
 National Cheng Kung University, Tainan, Taiwan (7/99), Heinz Nixdorf Institute, University of Paderborn, Paderborn, Germany (12/98), Massachusetts Institute of Technology (9/98),
- “Protocols for Asymmetric Communication Channels”  
 Universidade Federal do Rio de Janeiro (3/00), Dagstuhl-Seminar on Parallel and Distributed Algorithms (7/99), Massachusetts Institute of Technology (10/98), Northeastern University (10/98), Cornell University (2/98).
- “Multibutterflies: The Most Powerful Multistage Interconnection Networks Known”  
 Special Session on Interconnection Networks, International Symposium on Parallel Architectures, Algorithms, and Networks (I-SPAN '00), (12/00), Department of Computer and Information Engineering, National Sun Yat-Sen University, Kaohsiung, Taiwan (7/98), Kent Ridge Digital Laboratories, National University of Singapore (7/98), AT&T Labs Research (2/98), Academia Sinica, Nankang, Taiwan (12/97), National Chiao Tung University, Hsinchu, Taiwan (12/97), University of Texas at Austin (8/97), Massachusetts Institute of Technology (5/97), India Institute of Technology, Bombay, India (1/97).
- “A Critical Look at Three of Parallel Computing’s Maxims”  
 University of Illinois at Chicago (12/96), Beijing University of Aeronautics and Astronautics (6/96), IBM Tokyo Research Laboratory (6/96).
- “What Makes a Good Routing Network?”  
 New York Academy of Sciences (1/96), Massachusetts Institute of Technology (11/95).
- “Reconfiguring Parallel Computers with Faulty Components,”  
 University of Waterloo, Waterloo, Canada (3/95), University of Aizu, Aizu-Wakamatsu, Japan (12/94), National Tsing Hua University, Hsinchu, Taiwan (12/94), Academia

Sinica, Nankang, Taiwan (12/94), The Johns Hopkins University (12/94), New Jersey Institute of Technology (4/94), University of Texas at Austin (12/93), University of Central Florida (10/93), Dagstuhl-Seminar on Parallel and Distributed Algorithms (9/93), Universität des Saarlandes, Saarbrücken, Germany (9/93), DIMACS Workshop on Parallel Algorithms for Unstructured and Dynamic Problems (6/93), Princeton University (4/93), Massachusetts Institute of Technology (4/93), University of Pennsylvania (2/93).

“Simple Algorithms for Routing on Butterfly Networks with Bounded Queues,”  
University of Maryland (4/92).

“A Comparison of Sorting Algorithms for the Connection Machine CM-2,”  
University of Massachusetts (3/93), New York University (11/92), University of Illinois (4/92), University of British Columbia (2/92).

“Asymptotically Optimal Schedules for Packet Routing,”  
SIAM Annual Meeting, Chicago, IL (7/90).

“Fault-Tolerant Routing Algorithms for Multibutterfly Networks,”  
NEC C & C Research Laboratories, Yokohama, Japan (8/91), ACM Symposium on Gigabit Networks, Washington, DC (7/91), SIAM Int. Conf. on Industrial and Applied Math., Washington, DC (7/91), University of Maryland (2/91), University of Illinois (1/91), Washington University, St. Louis (1/91), Harvard University (4/90), Cornell University (4/90), AT & T Bell Laboratories (3/90), Duke University (2/90), IBM Thomas J. Watson Research Center (2/90), Rice University (2/90), Bell Communications Research (2/90), NEC Research Institute (1/90), Yale University (12/89).

“Universal Packet Routing Algorithms,”  
Microelectronics Consortium of North Carolina (2/90), Fordham University (2/89), IBM Thomas J. Watson Research Center (2/89).

“Communication-Efficient Parallel Graph Algorithms,”  
Southern Methodist University (8/86), Massachusetts Institute of Technology (4/86).

## **Tutorials**

“Content Delivery Networks,” 7th Annual IEEE Consumer Communications & Networking Conference, Las Vegas, NV (1/10).

## **Summer School Lectures**

*School on Models and Algorithms for the WWW*, International Center for Mechanical Sciences (CISM), Udine, Italy, (6/02).

“Internet Content Delivery”

“Content Delivery on 9/11”

“Delivering Streaming Content on the Internet”

“Challenges in Building a Reliable System with Tens of Thousands of Servers”

“A Little Bit about Akamai’s Business”

“Akarouting: A Better Way to Go”

*School on the Foundations of Computer Science (ADFOCS)*, Max-Planck Institute, Saarbrücken, Germany, (9/01).

“Challenges in Building a Reliable System with Tens of Thousands of Servers”

“Delivering Streaming Content on the Internet”

*Short Course on Networking*, National Sun Yat-Sen University, Kaohsiung, Taiwan (7/99).

“Theory of Interconnection Networks I”

“Theory of Interconnection Networks II”

“Theory of Interconnection Networks III”

“Universal Routing Algorithms”

“Routing on the Internet”

“Streaming Media”

*Summer Institute on Parallel and Distributed Computing*, Academia Sinica, Nankang, Taiwan (7/98).

“Variations on Nested Dissection”

“Exploiting Locality for Data Management in Networks of Limited Bandwidth”

“On the Bisection Width and Expansion of Butterfly Networks”

“Protocols for Asymmetric Communication Channels”

“Multibutterflies: The Most Powerful Multistage Interconnection Networks Known”

*Summer School on Architectures and Programming Paradigms for Parallel Computers*, Padova Ricerche, Padova, Italy (6/96).

“Universal Routing Algorithms”

## Consulting

*Vinson & Elkins*

Consultant in GeoTag, Inc., v. Frontier Communications Corp. et al., for Bare Escentuals, Christian Dior Perfumes, Crabtree & Evelyn, Gold’s Gym, Panera, Sephora, and 7-Eleven, April 2013–present.

*Edwards Wildman Palmer*

Consultant in Joseph Robert Marchese d/b/a JDS Digital Security Systems, Inc., v. Milestone Systems, Inc., for Milestone Systems, February 2013–present

*Quinn Emanuel Urquhart & Sullivan*

Expert witness in Vasudevan Software, Inc., v. Microstrategy, Inc., for Microstrategy, January 2013–present.

*Weil Gotshal & Manges*

Expert witness in Soverain Software, LLC, v. eBay et al. for eBay, November 2012–present.

*Haltom & Doan*

Consultant in Portal Technologies, LLC, v. Yahoo!, Inc., for Yahoo!, October 2012–March 2013.

*McDermott Will & Emery*

Expert witness in Innovative Communication Technologies, Inc., v. ooVoo LLC, for ooVoo. September 2012–November 2012.

*Latham & Watkins*

Expert witness in Innovative Communication Technologies, Inc., v. Vivox, Inc., for Vivox. September 2012–November 2012.

*Wiley Rein*

Expert witness in Innovative Communication Technologies, Inc., v. Stalker Software d/b/a CommuniGate Systems, Inc., for Stalker. September 2012–November 2012.



*Weil Gotshal & Manges, et. al*

Expert witness in Site Update Solutions, Inc. v. Adobe Systems et al., for Adobe Systems, et al., April 2012–present.

*Haltom & Doan*

Expert witness in Droplets, Inc. v. Amazon.com, Inc., et al., for Yahoo!, April 2012–present.

*Quinn Emanuel Urquhart & Sullivan*

Expert witness in Finjan, Inc. v. McAfee, Inc., et al., for Symantec, October 2011–December 2012. Was deposed, testified at trial.

*Quinn Emanuel Urquhart & Sullivan*

Expert witness in DDB Technologies, LLC v. CSTV Networks, Inc., et al., for CSTV Networks, May 2012–present.

*Vinson & Elkins*

Expert witness in DDB Technologies, LLC v. Fox Sports Interactive Media, LLC, for Fox Sports, January 2012–present.

*Vinson & Elkins*

Expert witness in Realtime Data, LLC v. Morgan Stanley, et al., for Thomson Reuters, September 2011–September 2012. Was deposed.

*Banner & Witcoff*

Consultant in Augme Technologies, Inc. v. Pandora Media Inc., for Pandora, October 2011–February 2013.

*Fish & Richardson*

Expert witness in Eolas Technologies, Inc. v. Adobe Systems, Inc., et al., for Go Daddy, August 2011–February 2012. Was deposed.

*Weil, Gotshal & Manges*

Expert witness in Eolas Technologies, Inc. v. Adobe Systems, Inc., et al., for Yahoo! and Amazon, July 2011–February 2012. Was deposed.

*Banner & Witcoff*

Consultant in Jagex Ltd. v. Impulse Software, Eric Snellman, and Mark Snellman, for Jagex, June 2011–November 2011.

*Quinn Emanuel Urquhart & Sullivan*

Expert Witness in BackWeb Technologies, Ltd. v. International Business Machines Corporation, for IBM and Hewlett Packard, May 2011–November 2011. Testified at technical tutorial.

*O'Melveny & Myers*

Consultant in Interval Licensing LLC v. AOL, Inc., et al., for Apple, Google, Yahoo!, and America Online, April 2011–present.

*DLA Piper*

Expert witness in Eolas Technologies, Inc. v. Adobe Systems, Inc., et al., for Oracle, January 2011–April 2011. Was deposed.

*Hogan Lovells et al.*

Expert witness in DDB Technologies, LLC v. ESPN, Inc., et al., for ESPN, NFL, NHL, NBA, PGA, Yahoo!, and America Online, January 2011–May 2011. Testified in technical tutorial and at Markman hearing.

*O'Melveny & Myers*

Consultant in inter partes reexamination, for Apple, August 2010–June 2011.

*Novak, Druce + Quigg*

Consultant in TMC Patents v. Sun Microsystems, for Sun Microsystems, September 2009–January 2011.

*Wilmer Cutler Pickering Hale and Dorr*

Expert witness in Beneficial Innovations, Inc., v. AOL LLC, et al., for Google, September 2009–November 2010.

*Banner & Witcoff*

Expert witness in Zamora Radio LLC v. Last.fm et al., for Pandora Media, September 2009–November 2010.

*O'Melveny & Meyers*

Expert witness in private arbitration involving console-based video games, July 2008–April 2009. Was deposed, testified at arbitration hearing.

*Banner & Witcoff*

Expert witness in MOAEC, Inc., v. Pandora Media, Inc., et al., for Pandora, June 2008–April 2009. Was deposed.

*Jenner & Block*

Consultant in Adams vs. Dell, Inc., et al., for Dell, July 2008–April 2009.

*Banner & Witcoff*

Consultant in WebXchange, Inc., v. The Allstate Corporation, et al., for Allstate, April 2008–October 2009.

*Irell & Manella*

Consultant in Peer Communications Corp., v. eBay Inc., Skype Technologies SA, Skype, Inc., for Skype and eBay, March 2008–November 2008.

*Irell & Manella*

Expert witness in Net2Phone, Inc., v. eBay Inc., Skype Technologies SA, Skype, Inc., and John Does 1-10, for Skype and eBay, January 2008–September 2010. Was deposed, testified at evidentiary hearing.

*Banner & Witcoff*

Expert witness in Riparius Ventures LLC v. Ascalade Communications, Inc., Logitech International S.A., Koninklijke Philips Electronics N.V., U.S. Robotics and Cisco Systems, Inc., for Logitech, U.S. Robotics, and Cisco, Fall 2007–present.

*Banner & Witcoff*

Expert witness in Team Play, Inc., P&P Marketing, Inc., and Cosmodog, LTD. v. Stephen Boyer, d/b/a Skyboy Productions, for Team Play, September 2004–November 2004.

*Toshiba, Inc.*

Consultant, April 2005–August 2005.

*Banner & Witcoff*

Expert witness in Windy City Innovations, LLC, v. America Online, Inc., for America Online, August 2004–November 2005. Was deposed.

*Jenner & Block*

Consultant in IP Learn v. SkillSoft Corporation, for SkillSoft, January 2003–May 2003.

*Morrison & Forster*

Consultant in Yahoo!, Inc., v. NCR Corporation, for Yahoo!, February 2003–September 2003.

*Jenner & Block*

Helped defend against threat of patent litigation, January 2003–June 2003.

*Banner & Witcoff*

Expert witness in *Lexmark, Inc., v. Static Control Components*, for Lexmark, January 2003–November 2006. Was deposed, testified at preliminary injunction hearing.

*FreeMarkets, Inc.*

Helped defend against threat of patent litigation, October 2002–January 2003.

*Newport Opticom, Inc.*

Helped design multistage optical interconnection network, Fall 2001.

*Democratic National Committee*

Helped to architect the DNC's web-site infrastructure, Spring 2001.

*Thinking Machines, Inc.*

Supersort project. Improved the speed of the CM-2 library sort routine by a factor of ten, Summer 1990.

## **Technical Advisory Boards**

*Socure*, May 2013–present.

*Mushroom Networks*, February, 2007–present.

*Agami*, October, 2004–August 2008 (folded).

*Personity*, October, 2000–October, 2002 (acquired by Openwave Systems, Inc.).

*Eizel Technologies*, September, 2000–April, 2003 (acquired by Nokia Corp.).

*Kuokoa Networks*, July, 2000–November, 2002 (folded).

*LaunchCyte* <http://www.launchcyte.com>, May, 2000–October, 2002.

*Storm Systems*, February, 2000–June, 2000 (acquired by Redleaf).

## **IV. External Professional Activities**

Co-Chair NSF CISE Advisory Committee Subcommittee on Midscale Infrastructure

ACM SIGCOMM Awards Chair, June 2011–present.

Elected ACM Member at Large, May 2006. Term: July 1, 2006–June 30, 2010.

Mentor, NSF Future Internet Architecture Summit, October 2009.

Member of ISAT (DARPA Information Science and Technology Study Group), September 2004–October 2005.

Co-Chair of the Organizing Committee for the DIMACS Special Year on Massively Parallel Computation, September 1993–August 1994.

Member of the DIMACS Executive Committee, July 1993–June 1994.

## Editorial Positions

Associate Editor, *IEEE Transactions on Parallel and Distributed Systems*, November 2000–September 2002.

Guest Editor, Special Issue, “ACM Symposium on Parallel Algorithms and Architectures,” of *Theory of Computing Systems*, with Susanne E. Hambruch, Vol. 32, No. 3, May/June 1999.

Managing Editor and Co-Founder, *Journal of Interconnection Networks* (JOIN), August 1998–present.

Field Editor, *Discrete Mathematics and Theoretical Computer Science*, January 1996–October 2001.

Author of 65 referee reports for 24 journals.

## Steering Committees

Member of the Steering Committee for the ACM Workshop on Hot Topics in Computer Networks (HotNets), November 2008–present.

Member of the Steering Committee for the Internet Measurement Conference (IMC), October 2004–November 2010.

Member of the Steering Committee (Treasurer) for the ACM Symposium on Parallel Algorithms and Architectures (SPAA), May 1991–August 1996.

Member of the Steering Committee/Advisory Board for the Dartmouth Institute for Advanced Graduate Studies in Parallel Computation (DAGS/PC), May 1991–August 1993.

## Program Chair Service

Co-Chair of the Program Committee for the 3rd Workshop on Online Social Networks (WOSN 2010), June 2010.

Chair of the Program Committee for HotWeb 2006: the First IEEE Workshop on Hot Topics in Web Systems and Technologies (HOTWEB), November 2006.

Chair of the Program Committee for the 14th Annual ACM Symposium on Parallel Algorithms and Architectures (SPAA), August 2002.

Co-Chair of the Program Committee for the 1997 International Symposium on Parallel Architectures, Algorithms, and Networks (I-SPAN '97), December 1997.

Organizer of a DIMACS workshop on Graph Embeddings and Parallel Architecture, January 1992.

## Program Committee Service

Member of the Program Committee for the Eleventh USENIX Symposium on Networked Systems Design and Implementation (NSDI '14).

Member of the Program Committee for PAM 2013: Passive and Active Measurement Conference (PAM), March 2013.

Member of the Program Committee for the ACM CoNEXT Student Workshop, December, 2012.

Member of the Program Committee for the 20th IEEE International Conference on Network Protocols (ICNP), October, 2012.

Member of the Program Committee for the 12th IEEE International Conference on Peer-to-Peer Computing (P2P), September, 2012.

Member of the Program Committee for the ACM SIGCOMM 2012 Conference (SIGCOMM), August, 2012.

Member of the Program Committee for the 26th ACM International Conference on Supercomputing (ICS), June 2012.

Member of the Program Committee for the 38th International Colloquium on Automata, Languages and Programming (ICALP), July 2011.

Member of the Program Committee for the Eighth USENIX Symposium on Networked Systems Design and Implementation (NSDI '11), March-April 2011.

Member of the Program Committee for the 6th International Conference on emerging Networking EXperiments and Technologies (CoNEXT), November 2010.

Member of the Program Committee of the First ACM SIGCOMM Workshop on Green Networking, August 2010.

Member of the Program Committee of the 9th International Workshop on Peer-to-Peer Systems (IPTPS), April 2010.

Member of the Program Committee of the ACM SIGMETRICS 2010 Conference, June 2010.

Member of the Program Committee of the World Wide Web 2010 Conference (WWW), April 2010.

Member of the Program Committee for PAM 2010: the Eleventh Passive and Active Measurement Conference (PAM), April 2010.

Member of the Program Committee for the Sixth USENIX Symposium on Networked Systems Design and Implementation (NSDI '09), April, 2009.

Member of the Program Committee for the Seventh ACM Workshop on Hot Topics in Computer Networks (HotNets-VII), October, 2008.

Member of the Program Committee for the Second IEEE Workshop on Hot Topics in Web Systems and Technologies (HotWeb 2008), October, 2008.

Member of the Program Committee for the Sixteenth IEEE International Conference on Network Protocols (ICNP 2008), October, 2008.

Member of the Program Committee for the ACM SIGCOMM 2007 Conference (SIGCOMM), August, 2007.

Member of the Program Committee for the Twenty-Sixth Annual ACM SIGACT-SIGOPS Symposium on Principles of Distributed Computing (PODC 2007), August 2007.

Member of the Program Committee for PAM 2007: the Eighth Passive and Active Measurement Conference (PAM), April 2007.

Member of the Program Committee for the Internet Measurement Conference (IMC), October 2005.

Member of the Program Committee for the ACM SIGCOMM 2005 Conference (SIGCOMM), August 2005.

Member of the Program Committee of the World Wide Web 2005 Conference (WWW) - Performance and Reliability track, May 2005.

Member of the Program Committee for the Workshop on Real-World Large Distributed Systems (WORLDS), December 2004.

Member of the Program Committee for the Workshop on Combinatorial and Algorithmic Aspects of Networking (CAAN), August 2004.

Global Chair of the Program Committee for Topic 11: Routing and Communication in Interconnection Networks, European Conference on Parallel Computing (Euro-Par 2002), August 2002.

Member of the Program Committee for the Workshop on Performance and Architecture of Web Servers (PAWS-2001), June 2001.

Vice Chair of the Program Committee for the International Conference on High Performance Computing (HiPC 2001), December, 2001.

Vice Chair of the Program Committee for Topic 06: Complexity Theory and Algorithms, European Conference on Parallel Computing (Euro-Par 2001) August, 2001.

Member of the Program Committee for the 20th Annual ACM Symposium on Principles of Distributed Computing (PODC '01), August 2001.

Member of the Program Committee for the IEEE International Symposium on Cluster Computing and the Grid (CCGrid 2001), May 2001.

Member of the Program Committee for the 5th Annual International Computing and Combinatorics Conference (COCOON '99), July 1999.

Vice Chair of the Program Committee for Topic 15: Routing and Communication in Interconnection Networks, European Conference on Parallel Computing (Euro-Par 1999), August 1999.

Member of the Program Committee for the 1999 International Symposium on Parallel Architectures, Algorithms, and Networks (I-SPAN '99), June 1999.

Member of the Program Committee for the 2nd International Workshop on Discrete Algorithms and Methods for Mobile Computing and Communications (DIAL M for Mobility), October 1998.

Member of the Program Committee for the third Workshop on Randomized Parallel Computing (WRPC), March 1998.

Member of the Program Committee for Computing: The Australasian Theory Symposium (CATS), February 1998.

Member of the Program Committee for the 9th Annual ACM Symposium on Parallel Algorithms and Architectures (SPAA), June 1997.

Member of the Program Committee for the second Workshop on Randomized Parallel Computing (WRPC), April 1997.

Member of the Program Committee for the 8th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA), January 1997.

Vice-chair of the Program Committee for the 1996 International Symposium on Parallel Architectures, Algorithms, and Networks (I-SPAN '96), June 1996.

Member of the Program Committee for the Workshop on Randomized Parallel Computing (WRPC), April 1996.

Member of the Program Committee for the 6th Annual IEEE Symposium on Parallel and Distributed Algorithms (SPDP), October 1995.

Member of the Program Committee for the 9th International Parallel Processing Symposium (IPPS), April 1995.

Member of the Program Committee for the 1994 International Symposium on Parallel Architectures, Algorithms, and Networks (I-SPAN '94), December 1994.

Member of the Program Committee for the 5th Annual IEEE Symposium on Parallel and Distributed Processing (SPDP), October 1994.

Member of the Program Committee for the 26th Annual ACM Symposium on Theory of Computing (STOC), May 1994.

Member of the Program Committee for the 5th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA), January 1994.

Member of the Program Committee for the 5th Annual ACM Symposium on Parallel Algorithms and Architectures (SPAA), June 1993.

### **Grant Proposal Reviewing**

Member of NSF Proposal Review Panel, 2011.

Member of NSF Proposal Review Panel, 2010.

Member of NSF Proposal Review Panel, 2007.

Member of NSF Proposal Review Panel, 2005.

Member of NSF SBIR Review Panel, 2004.

Member of NSF Proposal Review Panel, 2002.

Member of NSF Proposal Review Panel, 2001.

Reviewer of 9 grant proposals for 3 funding agencies (prior to NSF panel review process).

### **V. Contracts and Grant Support**

PI USAF Award FA8750-11-1-0262 *A Massive Data Approach to Geolocation*. October 2011 - September 2012: \$225,000. October 2012 - October 2013: \$199,999.

PI USAF Award FA8750-10-2-0193 *Mapping the Whole Internet with Passive Measurements*, July 2010 - July 2011. \$50,000.

Co-PI NSF NeTS Grant CNS-0520192 *NeTS ProWiN: Self-Managing Wireless Networks: Bringing Order to Chaotic Wireless Deployments*, September 2005–August 2009, \$750,000.

Co-PI NSF Grant CNF-0433540 *Cybertrust Center: Security Through Interaction Modeling (STIM)*, October 2004–September 2008, \$5,208,090.

PI NSF NeTS Grant CNF-0435382 *NeTS-NR: A Measurement-Driven Approach to Internet Protocol and Systems Design*, September 2004–August 2010, \$1,244,525.

Claude Worthington Benedum Foundation *Center for Appalachian Network Access (CANA)*, June 2003–June 2005, \$125,000.

Appalachian Regional Commission *Center for Appalachian Network Access (CANA)*, June 2003–December 2004, \$125,000.

IL (Ike) Morris *Center for Appalachian Network Access (CANA)*, May 2004, \$100,000.

MountainTop Technologies *Center for Appalachian Network Access (CANA)*, \$15,000.

Co-PI NSF Grant CCR-0205523 *ITR: Scalable Molecular Electronics*, September 2002–August 2004, \$1,500,000.

Coauthor of proposal NSF-CNPq Collaborative Research Grant CCR-9900304 : *Parallel Elimination Orders with Applications in Operations Research and Scientific Computing*, September 1999–August 2002, \$199,094.

PI ARPA Contract N00014-95-1-1246, *Algorithmic methods for communication, computation, and memory management in scalable HPC systems*, July 1995–July 1998, \$1,192,374.

NEC Research Institute Fellowship, February 1995–June 1995, \$22,762.

National Science Foundation Young Investigator Award CCR-94-57766, 1994–1998, \$205,530.

## **VI. Teaching**

### **Duke University**

COMPSCI 296.3 Algorithms in the Real World, Spring 2010, 2011.

COMPSCI 230 (formerly COMPSCI 102) Discrete Mathematics for Computer Science, Fall 2007, 2009, 2010, 2011, 2012.

COMPSCI 514 (formerly COMPSCI 214) Computer Networks and Distributed Systems, Spring 2008, 2012, 2013.

### **Carnegie Mellon University**

15-410 Operating System Design and Implementation, Spring 2007, 2006, 2005, 2004, with David Eckhardt.

15-853 Algorithms in the Real World, Fall 2005, 2003, 2002, 2000, with Guy Blelloch.

15-213 Introduction to Computer Systems, Spring 2003 (with Seth Goldstein), 2001 (with Guy Blelloch).

15-441 Computer Networking, Fall 2001 (with Srini Seshan), Spring 2009 (with Peter Steenkiste).

15-251 Great Theoretical Ideas in Computer Science, Spring 2000, with Steven Rudich.

15-299 Mathematical Foundations of Computer Science, Spring 1998.

15-740 Basic Computer Systems, Fall 1997, 1996, 1995, with Randy Bryant.

15-211 Fundamental Structures of Computer Science I, Spring 1997 (with Guy Blelloch, Gary Miller, and Danny Sleator), 1996 (with Avrim Blum and Danny Sleator), 1995 (with Avrim Blum), 1994 (with Avrim Blum, Jim Morris, and Danny Sleator).

15-840(A) Advanced Topics in Computer Systems: Introduction to Parallel Computer Architecture, Fall 1994, with Adam Beguelin.

15-850(A) Advanced Topics in Theory: Advanced Parallel Algorithms, Fall 1994, with Gary Miller.

### **Massachusetts Institute of Technology**

18.996 Topics in Theoretical Computer Science: Internet Research Problems, Spring 2002, with Tom Leighton, Ravi Sundaram, and Shang-Hua Teng

6.046/18.410 Introduction to Algorithms, Fall 1998, with Shafi Goldwasser.

6.849/18.436 Advanced Parallel and VLSI Computation, Spring 1993, with Tom Leighton.

6.84s Parallel Algorithms and Architectures, Summer 1989, 1988, 1987, teaching assistant.

6.848/18.435 Theory of VLSI and Parallel Computation, Fall 1986, teaching assistant.



## Princeton University

CS 597E Parallel Algorithms and Architectures, Fall 1992.

CS 597E Parallel Algorithms and Architectures, Spring 1991, with Bob Tarjan.

## Southern Methodist University

CS 3358 Data Structures, Summer 1986.

## VIII. Advising

### Current Ph. D. Students

Bala Chandrasekaran, Duke University.

Yin Lin, Duke University.

### Graduated Ph. D. Students

S. L. (Maverick) Woo, Carnegie Mellon University (Co-Chair with Guy Blelloch), *Heterogeneous Decomposition of Degree-Balanced Search Trees and Its Applications*, May 2009.

Charlie Garrod, Carnegie Mellon University (Co-Chair with Chris Olston), *Putting the “Scalability” into Database Scalability Services*, August 2008, Visiting Assistant Professor, Swarthmore College.

Amit Manjhi, Carnegie Mellon University (Co-Chair with Todd Mowry and Chris Olston), *Increasing the Scalability of Dynamic Web Applications*, March 2008, Google, Inc.

Shuheng Zhou (ECE), Carnegie Mellon University (Co-Chair with Greg Ganger), *Routing, Disjoint Paths, and Classification*, July 2006, Assistant Professor, University of Michigan.

Konstantin Andreev (Math/ACO), Carnegie Mellon University, *Approximation Algorithms for Network Design and Graph Partitioning Problems*, December 2005, Openheimer Funds.

Hal Burch, Carnegie Mellon University (Co-Chair with Gary Miller), *Measuring an IP Network in situ*, May 2005, Google, Inc.

Kunwadee (Kay) Sripanidkulchai (ECE), Carnegie Mellon University (Co-Chair with Hui Zhang), *A Measurement Driven Approach to Designing Peer-to-Peer Systems*, May 2005, IBM Research.

Claudson Bornstein, Carnegie Mellon University (Co-Chair with Gary Miller), *Nearly Optimal Gaussian Elimination*, August 1998. Professor Adjunto (Associate Professor), Universidade Federal do Rio de Janeiro.

Andréa Richa, Carnegie Mellon University (Chair), *On Distributed Network Resource Allocation*, June 1998. Associate Professor, Arizona State University.

Anja Feldmann, Carnegie Mellon University (Co-Chair with Danny Sleator), *On-line Call Admission for High-Speed Networks*, September 1995. Professor, Deutsche Telekom Laboratory/Technical University of Berlin.

Ramesh Sitaraman, Princeton University (Principal Reader), *Communication and Fault Tolerance in Parallel Computers*, January 1993. Professor, University of Massachusetts, Amherst. (Technically, Bob Tarjan was Ramesh’s advisor.)

## Graduated Masters Students

Kyle Moses, Duke University, *Improving IP-based Geo-Location through Internet Topology and Geospatial Datasets*, March 2013.

Jannie Tan, Duke University, *TCP-plb: TCP with Packet Level Load-Balancing*, April 2012.

Jack Lin (5th-year Masters) Carnegie Mellon University, *Detecting BGP Misconfigurations*, December 2003.

## Ph.D. Thesis Committees Served On

Ingmar Poesse, Technische Universität Berlin, April 2013.

Xin Liu, Duke University, July 2012.

Souvik Sen, Duke University, July 2012.

Eduardo Cuervo, Duke University, May 2012.

Yang Liu, Duke University, December 2011.

Bernhard Ager, Technische Universität Berlin, June 2011.

Ionut Constandache, Duke University, March 2011.

Mukesh Agrawal, Carnegie Mellon University, February 2011.

Tudor Dumitras, Carnegie Mellon University, December 2010.

Michael Dinitz, Carnegie Mellon University, May 2010.

Shoba Venkataraman, Carnegie Mellon University, September 2008.

David McWherter, Carnegie Mellon University, August 2008.

Nils Kammenhuber, Technical University of Munich, June 2008.

Florin Oprea, Carnegie Mellon University, March 2008.

Asad Samar, Carnegie Mellon University, August 2006.

Ningning Hu, Carnegie Mellon University, April 2006.

Takayuki Osogami, Carnegie Mellon University, May 2005.

Adam Wierman, Carnegie Mellon University, February 2005.

Sanjay Rao, Carnegie Mellon University, August 2004.

Eugene Ng, Carnegie Mellon University, December 2003.

Harald Räcke, University of Paderborn, Germany, December 2003.

Nikhil Bansal, Carnegie Mellon University, December 2003.

Geoff Atkinson, Carnegie Mellon University (MATH/ACO), April, 2003.

Christian Scheideler, University of Paderborn, Germany, June 2000.

Carl Burch, Carnegie Mellon University, April 2000.

Girija Narlikar, Carnegie Mellon University, February 1999.

Ye Zhang, Carnegie Mellon University (Architecture), January 1999.

Berthold Vöcking, University of Paderborn, Germany, December 1998.

Daniel Tunkelang, Carnegie Mellon University, November 1998.

Margaret Reid-Miller, Carnegie Mellon University, May 1998.

Rajaraman Rajmohan, University of Texas at Austin, August 1997.

Jonathan Hardwick, Carnegie Mellon University, July 1997.

Ville Leppänen, University of Turku, Finland, November 1996.

Keith Gremban, Carnegie Mellon University, April 1996.

Louxin Zhang, University of Waterloo, Canada, (External Examiner), February 1995.

## **IX. University Service at Duke University**

Chair, Pamela and Jack Egan Professorship in Entrepreneurship Search Committee, April 2011–April 2012.

Patent Policy Committee, April 2011–present.

Entrepreneurship Program for Undergraduates Committee, August 2011–April 2012.

Faculty Recruiting Committee, 2010, 2011, 2012.

## **IXb. University Service at Carnegie Mellon**

CSD Admissions Committee, Spring 2006, 2007.

Herbert A. Simon Visiting Scholar Committee, December 2005–July 2009.

SCS Review Committee, October 2005–May 2007.

CSD Teaching Track Recruiting Committee, Spring 2005, 2006.

Distinguished Lecture Series Chair, June 2005–June 2007.

Newell Award Committee, May 2004.

CSD Speakers Club, October 2003–July 2009.

Innovation Review Panel, Innovation Transfer Office, February 2003, June 2002.

University Committee on Tenure Appointments, November 2001–November 2003.

CSD Faculty Recruiting Committee, October 1997–May 1998, January 2009–May 2009.

CSD Doctoral Review Committee, September 2002–August 2007, January 2000–December 2001, May 1997–August 1998.

SCS/ACM Distinguished Dissertation Committee, May 2001–August 2007, May 1997–August 1997.

CSD ACM Thesis Award Committee, May 1995–August 1995.

## **X. Philanthropic and Volunteer Activities**

Member of the Board, Andrew Carnegie Society, July 1, 2005–July 30, 2007.

Member of the Board, Mentoring Partnership of Southwestern Pennsylvania, December 2003–February 2006.

Co-Founder of CANA (Center for Appalachian Network Access) <http://www.canacenter.org>, June 2003–present.

Big Brother to Jerome Kelley, Big Brothers and Big Sisters of Greater Pittsburgh, January 1997–June 2005. 2004 Big Brother of the Year, Greater Pittsburgh.

## **XI. Personal Information**

Born May 9, 1963. U.S. citizen. Avid runner, infielder, and hockey player. Fraternity house manager and President of Tau Beta Pi chapter in college. High school track letterman and student senator.

Photographed the world's longest slide rule for the *Guinness Book of World Records*.

Created Avatar, an interactive multi-player dungeons and dragons game, with A. Shapira and C. D. Sides. Since 1979 this program has recorded over one million user hours on the PLATO system at the University of Illinois.

# **EXHIBIT 6**

<b>POSITION</b>	Principal of Hoffman Alvary & Company LLC
<b>EDUCATION</b>	B.A., History, 1984 - Rutgers College M.B.A., Accounting, 1987 - Rutgers Graduate School of Management
<b>PROFESSIONAL AND BUSINESS HISTORY</b>	<p>1996 – Present: Principal Hoffman Alvary &amp; Company LLC, Newton, MA</p> <p>1994 - 1996: Price Waterhouse LLP, Manager/Senior Manager, Dispute Analysis and Corporate Recovery Services, New York</p> <p>1988 - 1994: Executive Consultant, Peterson Consulting Limited Partnership, New York</p> <p>1987 - 1988: Staff Accountant, Ernst &amp; Whinney, New York</p> <p>1984 - 1985: Paralegal, Anderson, Russell, Kill &amp; Olick, Washington, D.C. and New York</p> <p><u>Dispute Analysis Consulting</u> - Accounting and financial analysis assistance in connection with litigation matters focusing on intellectual property infringements, contract breaches, business interruption and construction delay claims. Work has included the calculation of lost profits and other economic damages, forensic and investigative accounting and evaluation of royalties. This assistance has been provided to a broad range of industries including: computer software, banking, insurance, pharmaceutical, steel and other manufacturers as well as service organizations. Served as expert witness on damages and accounting related issues.</p> <p><u>Other Consulting</u> – Engagements related to intangibles have included preparation of valuations in connection with purchases, sales and donations, royalty auditing and development of patent and intellectual property licensing strategies. Other consulting assistance has included business valuations, evaluations of real estate appraisals, and implementation of accounting systems and assistance with the operation and management of bankrupt or troubled companies.</p>
<b>PROFESSIONAL AND BUSINESS AFFILIATIONS</b>	<p>Certified Public Accountant - Registered to Practice by the State of New York</p> <p>Certified Management Accountant</p> <p>Accredited in Business Valuation by the AICPA</p> <p>Accredited Senior Appraiser – Business Valuation</p> <p>Member, American Institute of Certified Public Accountants</p> <p>Member, New York State Society of Certified Public Accountants</p> <p>Member, Institute of Certified Management Accountants</p> <p>Member, American Society of Appraisers</p> <p>Member, Licensing Executive Society</p>

**Philip Green**

**Testimony – January 2008 – Present**

\*Flashpoint Technologies, Inc. v. Vivitar, Inc. - American Arbitration Association, Boston, Massachusetts  
- Testimony before Arbitrator

SoundBite Communications, Inc. v. URS, Inc. – Federal Court, District of Massachusetts – Deposition

\*Auction Management Solutions, Inc. v. Manheim Auto Auctions, Inc. et al. – Federal Court, District of Georgia – Deposition

The Boston Company Asset Management LLC v. Munder Capital Management et al., - Superior Court, Suffolk County Massachusetts, Deposition

\*Jacob v. Lahive & Cockfield et al., Superior Court, Suffolk County Massachusetts, Deposition

\*DxDy Telecommunications, Inc. v. Teligence, Inc. et al. – Federal Court, District of Washington – Deposition.

\*Communication Transaction Solutions, Inc. v. Verifone Holdings, Inc. – Superior Court, Santa Clara California – Deposition

\*NewRiver, Inc. v. Newkirk Products, Inc. – Federal Court, District of Massachusetts – Deposition and Trial before Judge Young

\*Tech 7 Systems, Inc. v. Vacation Acquisition, LLC – Federal Court, District of Columbia – Deposition

\*Advanced Cable Ties, Inc. v. Bay State Cable Ties LLC – Federal Court, District of Massachusetts – Trial before Judge Saylor

\*Cordance Corporation v. Amazon.com, Inc. – Federal Court, District of Delaware – Deposition and Trial before Judge Thyne

Richard Williamson as Liquidating Trustee for Lipper Convertibles LP v. Kenneth Lipper – FINRA, New York – Testimony before Arbitration Panel

\*Lightlab Imaging, Inc. v. Axsun Technologies, Inc. and Volcano Corporation – Superior Court, Suffolk County Massachusetts – Deposition

\*Certain Digital Television and Certain Products Containing Same and Methods of Using Same, Inv. No. 337-TA-617 Enforcement Proceeding – International Trade Commission – Deposition and Trial before Judge Charneski

\*Zamora LLC v. CBS Radio, Inc. Pandora, Inc., Real Networks, Inc. et al. – Federal Court – District of Florida – Deposition

McNamee v. McNamee – Probate and Family Court, Suffolk County Massachusetts – Deposition and Trial before Judge Moriarity

\*Certain Video Display, Components Thereof, and Products Containing Same, Inv. 337-TA-687 - International Trade Commission – Deposition

\*Liquidnet Holdings, Inc. v. Pulse Trading, Inc., et al. – Federal Court, Southern District of New York - Deposition

\*ePlus, Inc. v. Lawson Software, Inc. – Federal Court, Eastern District of Virginia – Deposition

Transched Systems Limited v. Versyss Transit Systems et al. – Superior Court, New Castle County Delaware – Deposition and Trial before Judge Carpenter

Wayne Spiegel v. Fort Point Commercial Company, Inc. – Superior Court, Suffolk County Massachusetts – Deposition

\*Certain Large Scale Integrated Circuit Semiconductor Chips and Products Containing the Same, Inv. No. 337-TA-716, International Trade Commission – Deposition

\*Hon Hai Precision Industry Company, Ltd. v. TPV Technology Ltd., et al. – Federal Court – Eastern District of Texas – Deposition

\*Mondis Technology Limited v. TPV Technology Ltd. et al. Federal Court – Eastern District of Texas – Deposition

\*Atlantic Research Marketing Systems, Inc. v. LaRue Tactical, Inc. – Federal Court – District of Massachusetts – Deposition

SMH Fine Foods v. Boston Baking, Inc., et al – Superior Court, Suffolk County Massachusetts – Deposition

\*comScore v. The Nielsen Companies – Federal Court – Eastern District of Virginia – Deposition

\*Cooper Notification, Inc. v. Federal Signal Corp., et. al. – District of Delaware – Deposition

INC Research Holdings, Inc. v Shareholder Representative Services, LLC – Court of Chancery of the State of Delaware – Deposition

\*Uniloc USA, Inc. v. Microsoft Corporation – Federal Court – District of Rhode Island – Deposition and Trial Before Judge Young

\*Lee Valley Tools, et. al. v. Industrial Blade Company, et. al. – Federal Court – Western District of New York – Deposition

\*Certain Universal Serial Bus Portable Storage Devices, Including USB Flash Drives and Components Thereof, Inv. No. 337-TA-788 – International Trade Commission - Deposition

\*Atlantic Research Marketing Systems, Inc. v. Troy Industries, Inc. et. al. – Federal Court – District of Massachusetts – Deposition

\*Ambato Media LLC v. Garmin International Inc., et al. – Federal Court – Eastern District of Texas – Deposition and Trial before Judge Gilstrap

\*Certain Digital Televisions and Components Thereof .-Inv. No. 337-TA-789 – International Trade Commission – Deposition

\*Pacific Coast Marine Windshields Incorporated v. Malibu Boats, Inc. – Federal Court – Middle District of Florida – Deposition

\*AIA Engineering Limited. v. Magotteaux, Intc. et al. – Federal Court – Middle District of Tennessee – Trial before Judge Haynes

\*Certain Digital Photo Frames and Image Display Devices and Components Thereof – Inv. No. 337-TA-807 – International Trade Commission – Deposition



\*Certain Silicon Microphone Packages And Products Containing Same – Inv. No. 337-TA-825 – International Trade Commission – Deposition and Trial Before Judge Pender

Thomas Bochnowski and Edward Muhlner v. Global Rescue Corp. – JAMS Arbitration – Hearing before Judge Van Gestel

\*Realtime Data, LLC d/b/a IXO v. Bloomberg LLP, et al. – Federal Court – Southern District of New York - Deposition

\*Certain Consumer Electronics and Display Devices and Products Containing Same – Inv. No. 337-TA-836 – International Trade Commission – Deposition

ECi, Inc. et al v. MWAI, Inc. – Chancery Court of the State of Delaware – Deposition and Trial before Judge Parsons

\*EdiSync Systems, LLC v. Saba Software, Inc., – Federal Court – District of Colorado – Deposition

\*Mondis Technology Limited v. TPV Technology Ltd. et al. – JAMS Arbitration – Hearing before Judge Daniel Weinstein

\*Keurig Corporation v. Sturm Foods, Inc. – Federal Court – District of Delaware – Deposition

\*Blake v. PCGS et al. – Federal Court – District of Massachusetts – Trial before Judge Young

\*Smartphone Technologies LLC v. Apple Inc. and LG Electronics, Inc. – Federal Court - Eastern District of Texas – Deposition

\*Endo Pharmaceuticals, Inc. v. Mylan Pharmaceuticals, Inc. – Federal Court – District of Delaware – Deposition

\*Galderma Laboratories Inc. et al v. Amneal Pharmaceuticals, LLC et al. - Federal Court - District of Delaware – Deposition

\*Ventria Bioscience v. Daichang Yang - Superior Court of the State of California, County of Sacramento – Deposition

\*In the Matter of Certain Electronic Devices, Including Wireless Communication Devices, Tablet Computers, Media Players, and Televisions, and Components Thereof, Investigation No. 337-TA-862, International Trade Commission – Deposition and Trial before Judge Shaw

\*Alcon Pharmaceuticals LTD et al v. Apotex Inc. et al., Federal Court – District of Delaware, Deposition

\*GeoTag, Inc. v. Frontier Communications Corp., et. al., Federal Court – Eastern District of Texas – Deposition

### **Publications Within the Past Ten Years**

“Evaluating Reasonable Royalties After ResQNet,” Philip Green and Rachel C. Hughey, IP Law 360, October 14, 2010

“The 25% Rule is Dead - Now What?” Philip Green and Creighton G. Hoffman, IP Law 360, January 26, 2011

# **EXHIBIT 7**

# AZER BESTAVROS

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Boston, MA 02215  
617-353-9726

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Wayland, MA 01778  
508-647-2255

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Fascimile: 617-353-6457

## EDUCATION

<b>Ph.D. Harvard University, Division of Applied Sciences,</b>	in Computer Science.	<i>June 1992</i>
<b>S.M. Harvard University, Division of Applied Sciences,</b>	in Computer Science.	<i>June 1988</i>
<b>M.Sc. Alexandria University, Egypt,</b>	in Computer Science and Automatic Control.	<i>June 1987</i>
<b>B.Sc. Alexandria University, Egypt,</b>	<i>summa cum laude</i> in Computer Engineering.	<i>June 1984</i>

## ACADEMIC EXPERIENCE

### Boston University

FOUNDING DIRECTOR	<i>Hariri Institute for Computing and Computational S &amp; E</i>	<i>12/10 – present</i>
PROFESSOR	<i>Department of Computer Science</i>	<i>09/07 – present</i>
PROFESSOR AND CHAIRMAN	<i>Department of Computer Science</i>	<i>09/03 – 08/2007</i>
ASSOCIATE PROFESSOR AND CHAIRMAN	<i>Department of Computer Science</i>	<i>09/00 – 08/2003</i>
ASSOCIATE PROFESSOR	<i>Department of Computer Science</i>	<i>09/98 – 08/2000</i>
ASSISTANT PROFESSOR	<i>Department of Computer Science</i>	<i>09/91 – 08/1998</i>

Research: Networking; Internet/Web Protocols and Services; and Real-Time Systems.  
Projects: Cloud computing architectures; Economics-inspired networking protocols and services; Security of system/network control planes; Internet/Web measurement and characterization; Web caching and Content Distribution Networks; Scalable streaming media delivery; End-to-end QoS management; Resource management in mobile, ad-hoc networks; Virtualization services and programming support for embedded sensor networks; Formal verification of Internet/Web protocols; Compositional analysis of Cyber-Physical Systems; Statistical scheduling and load-shedding protocols for distributed systems; Concurrency management in real-time databases. Teaching: introductory computer science; computer architecture I/II; parallel computing; fundamentals of computing systems; real-time systems; Internet architecture and protocols; and sensor networks.

### Harvard University

RESEARCH FELLOW	<i>Department of Computer Science</i>	<i>09/87 – 09/1991</i>
TEACHING FELLOW	<i>Department of Computer Science</i>	<i>09/88 – 09/1991</i>
RESEARCH ASSISTANT	<i>Robotics Laboratory</i>	<i>06/88 – 09/1988</i>

Research: Formal modeling and verification of embedded real-time systems. Projects: Implementation of motion control API for 6-DOF robot; Compiler optimizations for massively parallel Monte-Carlo simulations. Teaching: Programming languages and compilers; VLSI; and parallel computing models, languages, and environments.

### Alexandria University

RESEARCH ASSISTANT	<i>Department of Computer Science</i>	<i>09/84 – 06/1987</i>
TEACHING ASSISTANT	<i>Department of Computer Science</i>	<i>09/84 – 06/1987</i>
INSTRUCTOR	<i>Center for Scientific Computing</i>	<i>09/85 – 06/1986</i>

Research: Fault-tolerant distributed systems. Teaching: Networking; information and control theory; computer architecture; and probability and statistics.

## VISITING AND AFFILIATED APPOINTMENTS

<b>Founding Faculty</b> , Center for Reliable Information Systems & Cyber Security, BU <i>RISCS promotes research and education on trustworthy systems and on information assurance.</i>	<i>09/06 – present</i>
<b>Faculty Affiliate</b> , Division of Systems Engineering, School of Engineering, BU <i>The SE division promotes research on information, decision, and control sciences.</i>	<i>09/08 – present</i>
<b>Faculty Member</b> , The Center for Information and Systems Engineering, BU <i>CISE promotes interdisciplinary research involving systems engineering methodologies.</i>	<i>09/02 – present</i>
<b>Faculty Member</b> , Center of Computational Sciences, BU <i>CCS promotes collaborative research and education in computational sciences.</i>	<i>09/92 – present</i>
<b>Visiting Professor</b> , Microsoft Innovation Laboratories, CMIC, Cairo, Egypt <i>Research on collaborative ad-hoc networked information and retrieval systems.</i>	<i>Fall 2008</i>
<b>Visiting Professor</b> , Institut Eurécom, Sophia-Antipolis, France <i>Research on networking protocols for scalable P2P and ad-hoc content distribution.</i>	<i>Fall 2008</i>
<b>Visiting Professor</b> , Telefonica Research Laboratories, Barcelona, Spain <i>Research on distributed systems, P2P, and content distribution networks.</i>	<i>Fall 2008</i>
<b>Visiting Professor</b> , BBN Technologies, Cambridge, Massachusetts <i>Research on information security, advanced networking, and distributed systems.</i>	<i>Fall 2007</i>
<b>Visiting Professor</b> , Harvard University, Cambridge, Massachusetts <i>Research on scalable content service and distribution.</i>	<i>Fall 1999</i>

## PROFESSIONAL EXPERIENCE

<b>Consultant</b> , Patent and Intellectual Property Litigations, Various Law Firms <i>Retained as expert witness in patent infringement and validity litigations and trials.</i>	<i>04/00 – present</i>
<b>Consultant</b> , Raytheon BBN Technologies, Cambridge, MA <i>Verification of safety and security of distributed systems.</i>	<i>02/08 – present</i>
<b>Consultant</b> , Sycamore Networks, Chelmsford, MA <i>Edge caching services for mobile and wireless networks.</i>	<i>07/08 – 06/2010</i>
<b>Advisory Board Member</b> , BU Office of Technology Development, Boston, MA <i>Assisting OTD in technology evaluation of prospective investment opportunities.</i>	<i>04/00 – 12/2005</i>
<b>Technical Advisory Board Member</b> , Pivia Inc., Cupertino, CA <i>Reviewing Pivia's technical and strategic directions in dynamic Web caching.</i>	<i>10/00 – 12/2003</i>
<b>Technical Advisory Board Member</b> , Quarry Technologies, Inc., Cambridge, MA <i>Reviewing Quarry's lineup of high-end enterprise networking solutions.</i>	<i>04/00 – 12/2003</i>
<b>Technical Advisory Board Member</b> , PeopleStreet.com Inc., Cambridge, MA <i>Reviewing PeopleStreet technical and strategic directions in active contact management.</i>	<i>08/00 – 02/2002</i>
<b>Consultant</b> , Adero Inc., Charlestown, MA <i>Reviewing Adero's load measurement architecture.</i>	<i>03/00 – 09/2000</i>
<b>Senior Scientific Adviser</b> , Allaire Corporation, Cambridge, MA <i>Reviewing architectures for profiling and personalization in scalable application servers.</i>	<i>03/00 – 04/2001</i>
<b>Consultant</b> , Network Appliance (formerly WebManage Inc.), Sunnyvale, CA <i>Reviewing NTAP NetCache content distribution architecture.</i>	<i>10/99 – 12/2000</i>
<b>Co-Founder/Principal Officer</b> , Commonwealth Network Technologies, Boston, MA <i>Middleware support for scalability, load-balancing, and QoS on clustered servers.</i>	<i>01/98 – 10/1999</i>
<b>Technology Consultant</b> , Bowne Internet Solutions, Boston, MA <i>Reviewing proposed designs and architectures for on-line banking and e-commerce applications.</i>	<i>06/98 – 02/2000</i>
<b>Chief Technology Officer</b> , Open Sesame, Inc. Boston, MA <i>Personalization Solutions for 1-1 E-commerce.</i>	<i>01/98 – 05/1998</i>
<b>Software Technology Consultant</b> , Charles River Analytics, Cambridge, MA <i>Reviewing the design of scalable personalization and push-caching services for the Web.</i>	<i>01/97 – 01/1998</i>
<b>Member of Technical Staff (MTS)</b> , AT&T Bell Laboratories, N.J. <i>Designed, analyzed and simulated new RAID architectures using Rabin's IDA algorithm.</i>	<i>06/89 – 09/1989</i>
<b>Consultant</b> , World Health Organization, Eastern Mediterranean Regional Office <i>Laid out and supervised the design of database systems for the WHO libraries.</i>	<i>01/87 – 09/1987</i>

<b>Consultant</b> , Chemonics International, Washington D.C. (Cairo office) <i>Evaluated computer monitoring systems and training courses for USAID projects in Egypt.</i>	06/85 – 01/1987
<b>System Administrator</b> , Awad & Partners Architectural Firm, Alexandria, Egypt <i>Designed and implemented site control, cost-time estimation/scheduling, and CAD software.</i>	06/84 – 06/1987
<b>Investigator</b> , The Institute for Oceanographical Research, Alexandria, Egypt <i>Assessed remote sensing and data acquisition embedded systems for coastal erosion research.</i>	06/85 – 06/1986
<b>Instructional Consultant</b> , Maritime Transport Academy, Alexandria, Egypt <i>Developed and taught a 2-course series on computing for maritime engineers.</i>	09/84 – 06/1985
<b>System Programmer</b> , Arabic Software Inc., Alexandria, Egypt <i>Designed and implemented bilingual accounting and inventory software packages.</i>	06/83 – 09/1983

## PROFESSIONAL SOCIETIES AND AFFILIATIONS

◦ Member of the ACM and many of its Special Interest Groups	01/86 – present
◦ Member of the IEEE Computer Society and many of its Technical Committees	01/87 – present
◦ Founding Member of the BU Sensor Networking Consortium	01/05 – present
◦ Member of the BU Clean Energy Initiative	01/09 – present
◦ Member of the Harvard Graduate Society	01/88 – present
◦ Member of the IEEE Communication Society	01/92 – 12/2002
◦ Member of the International Society on Computer Applications (ISCA)	01/92 – 12/1999
◦ Member of the Association of Egyptian American Scholars	09/91 – 08/1998
◦ Member of the Association of Egyptian Engineers	06/84 – 08/1991

## HONORS AND AWARDS

◦ Recipient of over \$20M in peer-reviewed research awards from government and industry	09/92 – present
◦ Senior Common Room Member, Leverett House, Harvard University	09/93 – present
◦ Elected Chair of the IEEE Computer Society Technical Committee on the Internet	01/07 – 12/2012
◦ Recipient of BU Ignition Award for Tech Innovation (with Reynolds and Kfoury)	02/2013
◦ Best Paper Award, ACM/IFIP/Usenix International Middleware Conference	12/2012
◦ Selected as one of 8 academic candidates to the CRA Board of Directors	01/2012
◦ Selected as one of 10 academic candidates to the CRA Board of Directors	01/2011
◦ Selected as Distinguished Speaker of the IEEE Computer Society DVP 2010-12 program	03/2010
◦ Inaugural ACM Sigmetrics Test of Time Award for best paper in last 15 years	06/2010
◦ Best Paper Award, IEEE/IFIP Mediterranean Workshop on Ad-Hoc Networking	06/2010
◦ Winner of the United Methodist Scholar/Teacher Award for 2010	01/2010
◦ CMIC Academic Fellow Award, Microsoft	06/2008
◦ CS Nominee for The Metcalf Excellence in Teaching Award, Boston University	10/2008
◦ Best Paper Award, IEEE/ACM Distributed Computing in Sensor Systems Conference	06/2008
◦ Best Paper Award, Inaugural ACM Wireless Network Security Conference	04/2008
◦ Elevated to Senior Member of the IEEE Computer Society	06/2008
◦ Recipient of BU Grant for Undergraduate Teaching and Scholarship (GUTS) Award	01/2008
◦ Elevated to Senior Member of the Association for Computing Machinery	01/2007
◦ Selected as Distinguished Speaker of the IEEE Computer Society DVP 2004-06	02/2004
◦ Author of the most referenced Web-related academic publications on WebBib database	08/1999
◦ IEEE Distinguished Award for Service to the Real-Time Research Community	08/1999
◦ ACM Service Award for Chairmanship of the ACM SIGPLAN LCTES'98	06/1998
◦ Compaq Award for R&D in CS for work on characterizing Web reference locality	11/1997
◦ Listed in the 1997/98 International Who's Who of Information Technology	01/1997
◦ CS Nominee for The Gitner Award for Distinguished Teaching, Boston University	10/1995
◦ CS Nominee for The Neu Family Award for Excellence in Teaching, Boston University	10/1995

- Harvard University GSAS Class Marshal for the 1992 Commencement 06/1992
- ARO/AFOSR/ONR award recipient to participate in the 1992 SE Research Review 05/1992
- Harvard University GSAS/DAS Graduate Fellowship 09/87 – 09/1991
- Recipient of the Dennis Devlin Microsoft Student Award 07/1990
- Harvard University Nominee for the IBM Predoctoral Fellowship 03/89 & 03/1990
- Alexandria University Graduate Fellowship for Academic Excellence 09/84 – 06/1987
- Egyptian National Undergraduate Fellowship for Academic Excellence 09/79 – 06/1984
- Honorary Award from the Syndicate of Egyptian Engineers 10/1984
- Certificate of Recognition from the CS Students Society, Alexandria University 04/1983
- Sadat Award for ranking third over 27,357 students in Egypt's nationwide diploma exam 08/1979

## CITATIONS

As of January 2013, the Microsoft Academic Index lists over 7,400 citations by over 7,000 different authors to 252 papers authored or co-authored by “Bestavros” (excluding self citations) with an H-Index of 39 and a G-Index of 82. [<http://academic.research.microsoft.com/Author/1648575.aspx>]

As of January 2013, Google identified over 12,600 citations to 483 articles authored or co-authored by “Bestavros”, with an H-Index of 48, and with 28 articles having in excess of 100 citations each and 116 articles having in excess of 10 citations each. Articles authored or co-authored by “Bestavros” appear as prior art in over 600 patents. [<http://scholar.google.com/citations?user=S5B0QmMAAAAJ>]

As of July 2012, the Computer Science Index of Scientific Literature (CiteSeer) lists over 3,900 citations to 180 papers authored or co-authored by “Bestavros” (excluding self citations) with an H-Index of 24, and ranks “Bestavros” in the top 10% of the 10,000 most-cited CS authors. [<http://citeseerx.ist.psu.edu/stats/authors>]

As of its last update in June 2004, the index of research papers on Web technologies (WebBib) lists over 500 citations to core papers of which “Bestavros” was an author or co-author (excluding self citations) and ranks “Bestavros” third out of all 1,086 authors in its databases. [<http://www.cs.wpi.edu/~webbib/Authorref.html>]

## GRANTS AND SPONSORED RESEARCH (PARTIAL LIST)

- [\$200,000] National Science Foundation.** (Co-PI) One of two Investigators 09/13 – 08/2015  
*Title: Holistic Cloud Security: Verifiable Computation and Databases*  
*Program: Secure and Trustworthy Cyberspace (SaTC)*
- [\$110,000] Draper Laboratories.** (PI) One of two Investigators 07/13 – 06/2014  
*Title: Invariant-Based Characterization of Binary Program Control Flow Graphs*  
*Program: Independent Research and Development Program (IRAD)*
- [\$1,000,000] National Science Foundation.** (Co-PI) One of six Investigators 01/12 – 12/2014  
*Title: A Cyber-Physical Infrastructure for the "Smart City"*  
*Program: CISE/CPS Cyber-Physical Systems Program*
- [\$38,000] Google.** (Co-PI) One of two Investigators 01/12 – 12/2014  
*Title: Generalized Centrality Measures with Applications to Information Networks*  
*Program: Google Faculty Research Award*
- [\$3,000,000] National Science Foundation.** (PI/PD) One of eight Investigators 09/10 – 08/2015  
*Title: Towards Trustworthy Interactions in the Cloud.*  
*Program: CISE/CNS Trustworthy Computing Program*
- [\$100,000] AFRL BBN Subcontract.** (PI/PD) One of two Investigators 04/10 – 03/2011  
*Title: Cross-Domain Identity Management and Entitlement.*  
*Program: Cross-Domain Innovation & Science (award returned due to DFAR restrictions)*
- [\$60,000] AFRL BBN Subcontract.** (PI/PD) Sole Investigator 01/10 – 12/2010  
*Title: Delegation of Authority Web Services.*  
*Program: Cross-Domain Innovation & Science (award returned due to DFAR restrictions)*

- [**\$199,810**] **National Science Foundation.** (PI/PD) Sole Investigator 09/09 – 08/2011  
 Title: *Towards a Marketplace for Colocation of Cloud Services*  
 Program: CISE/CNS EAGER Program
- [**\$165,352**] **National Science Foundation.** (PI/PD) Sole Investigator 09/09 – 08/2010  
 Title: *US-Middle East: Regional Workshop On Emerging Networking Research*  
 Program: OISE International Planning and CISE Programs
- [**\$400,000**] **National Science Foundation.** (Co-PI) One of three Investigators 09/08 – 08/2011  
 Title: *Genericity in Network Software*  
 Program: CISE/CNS Software for Real Systems Program
- [**\$1,999,573**] **National Science Foundation.** (Co-PI) One of five Investigators 11/07 – 10/2011  
 Title: *Event-Driven Sensing for Enterprise Reconfigurability and Optimization*  
 Program: ENG/EFRI Emerging Frontiers in Research and Innovation
- [**\$99,999**] **National Science Foundation.** (PI/PD) One of three Investigators 09/07 – 08/2010  
 Title: *Leveraging Type Systems for High-Assurance Cyber-Physical Systems*  
 Program: CISE/CNS EHS/CPS Computing Systems Research
- [**\$199,000**] **National Science Foundation.** (PI/PD) Sole Investigator 06/07 – 05/2008  
 Title: *NSF Research Infrastructure PI Meeting Supplemental Funding*  
 Program: CISE/CNS Major Research Infrastructure Program
- [**\$300,000**] **National Science Foundation.** (PI/PD) One of two Investigators 09/05 – 08/2009  
 Title: *Towards Trusted Adaptation Dynamics in Computing Systems and Networks*  
 Program: CISE/CNS Cybertrust Program
- [**\$390,000**] **National Science Foundation.** (Co-PI) One of two Investigators 09/05 – 08/2009  
 Title: *Expressive Resource Specification and Discovery in Configurable Networks*  
 Program: CISE/CNS Networking Technology and Systems
- [**\$6,000**] **National Science Foundation.** (PI/PD) Sole Investigator 10/05 – 09/2006  
 Title: *Internet Flows as First Class Values: Support for Dependable Internet Services*  
 Program: Research Experiences for Undergraduates
- [**\$25,000**] **National Science Foundation.** (PI/PD) Sole Investigator 09/05 – 08/2006  
 Title: *IEEE ICNP Travel Awards for Graduate Students and Minorities*  
 Program: CISE/CNS Networking Technology and Systems
- [**\$37,000**] **Fortress Technologies.** (PI/PD) Sole Investigator 06/05 – 08/2006  
 Title: *Performance Profiling of End-Host Intrusion Detection Systems*  
 Program: University Collaboration Program
- [**\$25,000**] **Microsoft Research.** (PI/PD) Sole Investigator 09/04 – 08/2005  
 Title: *BU/CS Industrial Affiliates Program*  
 Program: Microsoft University Relations
- [**\$25,000**] **Sprint Research Labs.** (Co-PI) One of two Investigators 06/05 – 12/2005  
 Title: *Cellular Network IP Traffic Measurement and Characterization*  
 Program: Sprint Advanced Technology Labs, IP Group
- [**\$6,000**] **National Science Foundation.** (PI/PD) Sole Investigator 10/04 – 09/2005  
 Title: *Internet Flows as First Class Values: Support for Dependable Internet Services*  
 Program: Research Experiences for Undergraduates
- [**\$65,000**] **Microsoft Research.** (PI/PD) Sole Investigator 09/03 – 08/2004  
 Title: *BU/CS Industrial Affiliates Program*  
 Program: Microsoft University Relations
- [**\$1,665,496**] **National Science Foundation.** (PI/PD) One of five Investigators 10/02 – 09/2007  
 Title: *Internet Flows as First Class Values: Support for Dependable Internet Services*  
 Program: Advanced Network Infrastructure and Research
- [**\$1,662,307**] **National Science Foundation.** (PI/PD) One of five Investigators 09/02 – 08/2007  
 Title: *Sensorium: RI for Managing Spatio-Temporal Objects in Video Sensor Networks*  
 Program: CISE Educational and Integrative Activities
- [**\$60,000**] **Microsoft Research.** (PI/PD) Sole Investigator 09/02 – 08/2003  
 Title: *BU/CS Industrial Affiliates Program*  
 Program: Microsoft University Relations

- [**\$60,000**] **Sprint Research Labs.** (Co-PI) One of four Investigators 07/02 – 06/2003  
 Title: *IP Network Characterization, Analysis, and Evaluation*  
 Program: *Sprint Advanced Technology Labs, IP Group*
- [**\$25,000**] **Microsoft Research.** (PI/PD) Sole Investigator 09/01 – 08/2002  
 Title: *BU/CS Industrial Affiliates Program*  
 Program: *Microsoft University Relations*
- [**\$719,968**] **National Science Foundation.** (Co-PI) One of three Investigators 09/01 – 08/2005  
 Title: *A Control Theoretic Approach to the Design of Internet Traffic Managers*  
 Program: *Advanced Network Infrastructure and Research*
- [**\$1,505,938**] **National Science Foundation.** (PI/PD) One of three Investigators 06/00 – 05/2005  
 Title: *Diagnosis and Control of Network Variability by Massively Accessed Servers*  
 Program: *Advanced Network Infrastructure and Research*
- [**\$25,000**] **Microsoft Research.** (PI/PD) Sole Investigator 09/00 – 08/2001  
 Title: *BU/CS Industrial Affiliates Program*  
 Program: *Microsoft University Relations*
- [**\$14,494**] **National Science Foundation.** (PI/PD) One of three Investigators 08/99 – 07/2000  
 Title: *BU/NSF Workshop on Internet Measurement, Instrumentation and Characterization*  
 Program: *Advanced Network Infrastructure and Research*
- [**\$20,000**] **Microsoft Research.** (PI/PD) Sole Investigator 01/97 – 12/1998  
 Title: *Large-scale WWW Services on the NT Platform*  
 Program: *University Research Program*
- [**\$590,087**] **National Science Foundation.** (PI/PD) One of three Investigators 07/97 – 06/2000  
 Title: *Commonwealth: Architecture and Protocol for Scalable WWW Service*  
 Program: *CISE Experimental Software Systems*
- [**\$325,000**] **National Science Foundation.** (Co-PI/Co-PD) One of six Investigators 07/97 – 06/2002  
 Title: *National Computational Science Alliance: Computer Science Team B*  
 Program: *NSF/PACI*
- [**\$855,800**] **National Science Foundation.** One of six Investigators 07/96 – 06/2001  
 Title: *Parallel and Distributed Systems: Real-time, Multimedia, and High Performance*  
 Program: *CISE Research Infrastructure Program*
- [**\$97,574**] **National Science Foundation.** (PI/PD) One of three Investigators 01/96 – 12/1997  
 Title: *Real-time, Multimedia and High Performance Computing in Distributed Systems*  
 Program: *CISE/CDA Research Instrumentation Program*
- [**\$1,476,322**] **National Science Foundation.** One of eight Investigators 01/96 – 12/1998  
 Title: *Mariner: Metacenter-Affiliated Resource In the New England Region*  
 Program: *CISE/ASC Metacenter Regional Alliances*
- [**\$523,778**] **Department of Education.** (Co-PI) One of eight Investigators 09/95 – 08/1998  
 Title: *High Performance Communication and Multimedia Computing*  
 Program: *GAANN Fellowships for Strategic Areas of Computer Science*
- [**\$218,608**] **Army Research Office.** (PI/PD) Sole Investigator 08/94 – 07/1997  
 Title: *Real-Time Computer Monitoring and Control Methodologies*  
 Program: *University Basic Research*
- [**\$99,807**] **National Science Foundation** (PI/PD) Sole Investigator 09/93 – 12/1996  
 Title: *Cleopatra: A Programming Environment for Embedded Time-critical Systems*  
 Program: *Research Initiation Award (currently CAREER) Program*
- [**\$25,000**] **GTE Laboratories.** (PI/PD) Sole Investigator 07/93 – 06/1995  
 Title: *Speculative Concurrency Control for Distributed Real-time Database Systems*  
 Program: *University Support Program*
- [**\$397,697**] **National Science Foundation.** (Co-PI) One of six Investigators 09/92 – 08/1995  
 Title: *Undergraduate Curriculum in Massively Parallel Computing*  
 Program: *CISE Educational Infrastructure Program*



## SERVICE ACTIVITIES

**Membership in Editorial Boards and Steering Committees:**

– Editorial Board Member of IEEE Internet Computing	06/07 – present
– Steering Committee Member of the IEEE TC on Security and Privacy in Complex IS	05/11 – present
– Chair of the IEEE Computer Society Technical Committee on the Internet	01/07 – 12/2012
– Editorial Board Member of the International Journal of Embedded Systems	03/04 – 12/2012
– Editorial Board Member of the ICST Transactions on Real-World Web	03/09 – 12/2012
– Guest Editor of Journal of Mathematical Structures in Computer Science	01/11 – 06/2012
– Guest Editor of EURASIP Journal on Wireless Communications and Networking	09/09 – 08/2010
– Steering Committee Member of HotWeb Conference	09/05 – 08/2009
– Editor of the Newsletter of the IEEE Technical Committee on Real-Time Systems	01/92 – 12/2008
– Executive Steering Committee Member of the IEEE TC on Real-Time Systems	12/02 – 12/2008
– Steering Committee Member of the IASTED TC on Measurement and Simulation	09/00 – 08/2007
– Steering Committee Member of the International Web Caching Workshop	06/01 – 08/2005
– Steering Committee Member of ACM SIGPLAN Workshop on Tools for Embedded Systems	06/99 – 05/2004
– Advisory Committee Member of IEEE Conference on Industrial Technology & Automation	09/00 – 06/2001
– Steering Committee Member of BU/NSF IMIC Workshop	06/99 – 08/1999

**Service to the Research Community:**

– Co-Chair, Massachusetts Green HPC Initiative, Educational and Outreach Taskforce	05/10 – present
– Evaluator of promotion cases in major institutions in US, Canada, India, and Israel	09/02 – present
– Site visitor for a number of major award competitions of the National Science Foundation	04/97 – present
– Panelist for dozens of programs of the National Science Foundation	02/96 – present
– Session Chair and/or Panelist in over a dozen conferences and workshops	09/91 – present
– Reviewer for dozens of IEEE/ACM journal publications and conference proceedings	04/88 – present
– Member of the 2012 MGHPCC Research Seed Fund Award Committee	09/11 – present
– Chair, ACM Sigmetrics Test of Time Award Nomination and Selection Committee	04/11 – 06/2011
– External Review Committee for CS Department at University of Texas, Arlington	03/09 – 06/2009
– Host and Maintainer of the Archives of IEEE Technical Committee on Real-Time Systems	01/92 – 12/2008
– External Review Committee for CS Department at Purdue University	03/05 – 12/2005
– Web/Internet Area Editor of the ACM Crossroads student magazine	02/03 – 01/2004
– Area Editor of the Journal for Undergraduate Science Research, Harvard University	09/94 – 08/1997

**Organization of Professional Meetings:**

– Chair of the NSF US/Mideast Trustworthy Systems and Networks Workshop	09/11 – present
– Chair of the 2012 New England Faculty Summit on Cyber Security	01/12 – 06/2012
– Chair of the 2011 New England Faculty Summit on Cyber Security	01/11 – 06/2011
– Co-Chair of the Workshop on Holyoke Green HPC Educational & Outreach Opportunities	01/10 – 04/2010
– PC Chair of the Conference on Wireless Algorithms, Systems, & Applications	09/08 – 08/2009
– General and PC Chair of the NITRD High-Confidence Software and Systems Workshop	01/07 – 07/2007
– General and Program Chair of the BU/NSF RI/MRI/CRI PI Meeting	08/06 – 06/2007
– General Chair of the first IEEE HotWeb Conference	11/05 – 12/2006
– Workshop Chair of 2006 CRA Snowbird Conference	01/06 – 08/2006
– General Chair of the IEEE International Conference on Network Protocols	02/04 – 11/2005
– General Chair of the fourth IEEE Workshop on Wireless Applications & Services	09/03 – 08/2004
– General Chair of the sixth International Web Caching Workshop	06/00 – 06/2001
– PC co-Chair of the sixth International Web Caching Workshop	06/00 – 06/2001
– Workshop Chair of 2000 CRA Snowbird Conference	01/00 – 07/2000
– General Chair of the 1999 IEEE Real-Time Technology and Applications Symposium	06/98 – 06/1999
– PC Chair of the 1998 ACM SIGPLAN Workshop on Tools for Embedded Systems	09/97 – 06/1998
– PC Chair of the 1998 IEEE Real-Time Technology and Applications Symposium	06/97 – 06/1998
– PC Chair of the 1997 IEEE International Workshop on Real-Time Databases	06/96 – 07/1997

- PC Chair of the WIP Track of the 1997 IEEE Real-Time Systems Symposium 06/97 – 12/1997
- PC Chair of the WIP Track of the 1996 IEEE Real-Time Systems Symposium 06/96 – 12/1996
- Publicity Chair for the 1996 IEEE Workshop on Real-Time Databases 08/95 – 03/1996
- Publicity Chair for the 1995 IEEE Real-Time Systems Symposium 01/95 – 12/1995

**Service on Technical Program Committees (partial list):**

- 2013 WWW Workshop on Simplifying Complex Networks for Practitioners 12/12 – 06/2013
- 2013 IEEE International Conference on Cloud Engineering 03/12 – 02/2013
- 2013 IEEE INFOCOM Conference on Computer and Communications 06/12 – 02/2013
- 2012 International Conference on Web Information System Engineering 01/12 – 09/2012
- 2012 IEEE INFOCOM Conference on Computer and Communications 06/11 – 02/2012
- 2011 IEEE MCIS Conference on Information Systems 05/11 – 09/2011
- 2011 IEEE INFOCOM Conference on Computer and Communications 05/10 – 02/2011
- 2011 ACM Multimedia Systems conference 03/10 – 09/2010
- 2010 IEEE INFOCOM Conference on Computer and Communications 05/09 – 02/2010
- 2010 ACM Multimedia Systems conference 03/09 – 02/2010
- 2009 IEEE INFOCOM Conference on Computer and Communications 05/08 – 04/2009
- 2009 World Wide Web Conference 09/08 – 03/2009
- 2009 Workshop on Privacy and Security in Pervasive e-Health Environments 01/09 – 05/2009
- 2008 ACM PODC Symposium on Principles of Distributed Computing 09/07 – 09/2008
- 2008 ACM Sigmetrics Conference on Measurement and Modeling of Computer Systems 07/07 – 02/2008
- 2008 IEEE INFOCOM Conference on Computer and Communications 05/07 – 04/2008
- 2008 LA-WEB Latin American Web Congress 05/08 – 12/2008
- 2007 IEEE/W3C Web Congress 01/07 – 07/2007
- 2007 ACM Sigmetrics Conference on Measurement and Modeling of Computer Systems 09/06 – 07/2007
- 2007 World Wide Web Conference 08/06 – 06/2007
- 2007 IEEE Global Internet Symposium 06/06 – 05/2007
- 2007 LA-WEB Latin American Web Congress 05/07 – 10/2007
- 2006 IEEE Real-Time Systems Symposium 01/06 – 12/2006
- 2006 Workshop on Architectures and Algorithms for Internet Delivery 01/06 – 12/2006
- 2006 ACM/Usenix International Conference on Virtual Execution Environments 09/05 – 06/2006
- 2006 IEEE International Conference on Parallel and Distributed Systems 09/05 – 06/2006
- 2006 IASTED International Conference on Modeling and Simulation 09/05 – 03/2006
- 2005 IEEE Real-Time Systems Symposium 01/05 – 12/2005
- 2005 Web Caching and Content Delivery Workshop 11/04 – 06/2005
- 2005 World Wide Web Conference 09/04 – 06/2005
- 2005 Workshop on Architectures and Algorithms for Internet Delivery 01/05 – 06/2005
- 2005 IASTED International Conference on Modeling and Simulation 09/04 – 03/2005
- 2004 International Conference On Principles Of Distributed Systems 06/04 – 06/2005
- 2004 IEEE Real-Time Systems Symposium 01/04 – 12/2004
- 2004 Workshop on Broadband Advanced Sensor Networks 03/04 – 10/2004
- 2004 BIRS Workshop on Combinatorial and Algorithmic Aspects of Networking 01/04 – 07/2004
- 2004 IEEE INFOCOM Conference on Computer and Communications 03/03 – 06/2004
- 2004 IEEE Real-Time and Embedded Technology and Applications Symposium 08/03 – 03/2004
- 2004 IASTED International Conference on Modeling and Simulation 09/03 – 03/2004
- 2004 ACM SIGKDD Workshop on Fractals, Power Laws, and Data Mining Tools 04/03 – 03/2004
- 2003 IEEE Workshop on Internet Applications 08/02 – 08/2003
- 2003 IEEE ICDCS Workshop on Data Distribution in Real-Time Systems 11/02 – 05/2003
- 2003 IASTED International Conference on Modeling and Simulation 09/02 – 03/2003
- 2003 IEEE Symposium on Computer and Communication 09/02 – 04/2003
- 2002 IEEE Global Internet Symposium 09/01 – 06/2002
- 2002 Workshop on Caching, Coherence, and Consistency 03/02 – 06/2002

– 2002 Euromicro Conference On Real-Time Systems	05/01 – 06/2002
– 2002 IEEE Symposium on Computer and Communication	03/01 – 06/2002
– 2002 IASTED International Conference on Modeling and Simulation	09/01 – 03/2002
– 2001 International Conference on Industrial Technology and Automation	01/01 – 12/2001
– 2001 IEEE Real-Time Systems Symposium	01/01 – 12/2001
– 2001 IEEE Global Internet Symposium	02/01 – 09/2001
– 2001 IEEE/IFIP Dependable Systems and Networks	12/00 – 09/2001
– 2001 ACM Sigmetrics Conference on Measurement and Modeling of Computer Systems	06/00 – 06/2001
– 2001 Euromicro Conference On Real-Time Systems	05/00 – 05/2001
– 2001 IEEE Symposium on Computer and Communication	01/00 – 03/2001
– 2000 IEEE Real-Time Systems Symposium	01/00 – 12/2000
– 2000 IEEE IC3N Conference	01/00 – 09/2000
– 2000 Euromicro Conference on Real-Time Systems	03/99 – 06/2000
– 2000 IEEE International Conference on Data Engineering	03/99 – 11/1999
– 1999 Joint 24th IFAC/IFIP Conference on Real-Time Programming	06/98 – 03/1999
– 1999 Workshop on e-Commerce and Web-based Information Systems	07/98 – 03/1999
– 1999 Workshop on Active and Real-time Databases	07/98 – 03/1999
– 1998 IEEE Real-Time Systems Symposium	01/98 – 12/1998
– 1999 Workshop on Parallel and Distributed Real-Time Systems	05/98 – 09/1998
– 1998 ACM CIKM Workshop on Real-time Databases	06/98 – 09/1998
– 1998 ACM Sigmod Conference on Management of Data	02/97 – 02/1998
– 1997 IEEE Real-Time Systems Symposium	01/97 – 12/1997
– 1997 Real-Time Applications Workshop	09/96 – 06/1997
– 1997 Second Real-Time Education Workshop	09/96 – 06/1997
– 1997 Euromicro 9th Workshop on Real-Time Systems	09/96 – 06/1997
– 1997 International Workshop on Active and Real-Time Databases	09/96 – 06/1997
– 1997 IEEE Real-Time Technology and Applications Symposium	06/96 – 06/1997
– 1997 IEEE ICDE Workshop on Research Issues in Data Engineering	05/96 – 01/1997
– 1996 IEEE Real-Time Systems Symposium	01/96 – 12/1996
– 1996 ACM CIKM Workshop on Active and Real-Time Databases	05/96 – 11/1996
– 1996 HICSS Conference on Parallel & Distributed RT Systems	09/95 – 03/1996
– 1996 IEEE Workshop on Real-Time Databases	09/95 – 03/1996
– 1994 IEEE Real-Time System Symposium	01/94 – 12/1994
– 1994 ACM Sigplan RTLCTS Workshop	01/94 – 06/1994

**Service to Boston University:**

– Co-Chair, Council on Educational Technology and Learning Innovation	09/12 – present
– Member, University Leadership Research Council	01/12 – present
– Executive Committee Member, Computational Science Building Programming	10/11 – present
– Committee Member, BU Information Technology Governance on Research Computing	01/10 – present
– Executive Committee Member, BU Center for Information and Systems Engineering	06/05 – present
– Tenure-track Faculty Mentor, Boston University, CS Dept	09/10 – present
– Founder and Coordinator of the Computing Alumni Network, Boston University, CS Dept	06/01 – present
– Technical Reports Coordinator, Boston University, CS Dept	09/92 – present
– CS Representative at various CAS development, recruiting, and advising events	09/92 – present
– Member, BU Faculty Council Committee on Scholarly Activities and Libraries	09/10 – 08/2012
– Committee Member, BU/CAS United Methodist Scholar/Teacher Award Committee	01/11 – 06/2011
– Founder and Coordinator of the Industrial Affiliates Program, Boston University, CS Dept	09/00 – 08/2011
– Committee Member, BU Information Technology Governance on Education Technology	01/10 – 06/2011
– Committee Member, BU Faculty Council Committee on Planning	09/08 – 08/2010
– Chair of Ad-Hoc Committee for the Development of BU MCS Core Curriculum	11/06 – 12/2008
– Founder and Maintainer of the Faculty Intranet, Boston University, CS Dept	09/00 – 08/2007

– Member of Whitaker Oversight Committee, Boston University	01/03 – 12/2004
– Member of Provost Ad-Hoc Committee on BU Science Library Development	09/04 – 06/2005
– Chair, New Building Planing Committee, Boston University, CS Dept	01/01 – 06/2003
– Faculty Advisor and Sponsor of the Video Game Creator Consortium student group	09/03 – 08/2004
– Member of Dean Advisory Council, Boston University, CAS	09/02 – 09/2003
– Maintainer of Department's Web pages, Boston University, CS Dept	01/94 – 08/2000
– Chair, Faculty Recruitment Committee, Boston University, CS Dept	09/98 – 06/1999
– DWE Systems Committee Member (Chair since 1995), Boston University, CS Dept	09/92 – 06/2000
– Educational Technologies Committee Member, Boston University	01/97 – 01/1999
– Faculty Advisor and Sponsor of the ACM Student Chapter at Boston University	06/93 – 05/1999
– Chair, Natural Sciences Curriculum Committee, Boston University, CAS	09/97 – 06/1998
– Faculty Recruitment Committee Member, Boston University, CS Dept	12/97 – 06/1998
– Natural Sciences Curriculum Committee Member, Boston University, CAS	08/95 – 06/1997
– MCS On-line Classrooms Project Coordinator, Boston University, CS Dept	09/97 – 06/1998
– Systems Curriculum Development Committee Chair, Boston University, CS Dept	09/96 – 02/1997
– CS Curriculum Review Committee Member, Boston University, CS Dept	09/95 – 06/1996
– Equipment Committee Member, Boston University, CS Dept	09/92 – 09/1996
– Faculty Recruitment Committee Member, Boston University, CS Dept	12/93 – 06/1994
– Faculty Recruitment Committee Member, Boston University, MET, CS Dept	12/93 – 06/1994
– CS Colloquium Series Coordinator, Boston University, CS Dept	09/92 – 06/1994

#### Other Service, Volunteer Work and Extracurricular Activities:

– Volunteer educational/outreach services to Wayland K-12 Public Schools, Wayland, MA	09/08 – present
– Editor of the Coptic Network Society Newsletter and Maintainer of its archives	01/92 – 12/2011
– Collegial Tutor and Choir Member, St. Mark Coptic Orthodox Church, Natick, MA	03/90 – 08/2002
– Curator of the Senior Common Room, Leverett House, Harvard University	09/95 – 06/1998
– Computer Science Resident Tutor, Leverett House, Harvard University	08/94 – 06/1998
– Graduate Representative, Harvard University Presidential search committee	09/90 – 03/1991
– Member of the Committee on Graduate Education, Harvard University	06/90 – 06/1991
– Resident Host, Dana-Palmer historic guest house, Harvard University	01/90 – 07/1994
– Moderator of Egypt-Net Digest and maintainer of its software systems	01/88 – 06/1992
– Vice President, Graduate Student Council, Harvard University	02/89 – 06/1991
– Resident Advisor, Graduate Residence Halls, Harvard University	09/88 – 06/1990
– Treasurer, Graduate Dormitory Council, Harvard University	09/87 – 09/1988
– Scientific Officer, Computer Science Students Society, Alexandria University	01/81 – 01/1984

#### INVITED LECTURES, TALKS, AND COLLOQUIA (PARTIAL LIST)

○ <b>Rochester Institute for Technology</b> , Rochester, NY	December 2012
“Mechanisms for Efficient Cloud Markets” Host: L. Reznik & K. Xiong	
○ <b>WISE'12 Keynote Address</b> , Paphos, Cyprus	November 2012
“Mechanisms for Efficient Cloud Exchanges” Host: A. Delis	
○ <b>Advanced Cyber Security Center Annual Symposium</b> , Boston, MA	November 2012
“Towards a Secure Cloud Exchange Market” Host: W. Guenther	
○ <b>Qatar Foundation Annual Research Forum</b> , Doha, Qatar	October 2012
“QNRS Cloud Strategy Review and Recommendations” Host: I. Ilyas	
○ <b>Bentley College, Joint CIS/IDCC/IPM Seminar</b> , Waltham MA	October 2012
“Mechanisms for Efficient Cloud Exchanges” Host: R. Galliers	
○ <b>Universidade Federal de Minas Gerais, CS Dept</b> , Belo Horizonte, Brazil	September 2012
“Mechanisms for Efficient Cloud Markets” Host: V. Almeida & W. Meira	
○ <b>National Lab for Scientific Computing, LNCC</b> , Petropolis, Brazil	September 2012
“Cyber-Enabled Discovery and Innovation” Host: A. Ziviani	

- **Koc University, CE Dept**, Istanbul, Turkey *June 2012*  
     “Towards a Trustworthy Marketplace for Cloud Resources” Host: O. Ozkasap
- **University of Southern California, CS Dept**, Los Angeles, CA *February 2012*  
     “*In Clouds We Trust: Mechanisms for Efficient Cloud Markets*” Host: S. Teng
- **Worcester Polytechnic Institute, CS Dept**, Worcester, MA *January 2012*  
     “*Mechanism Design for Trustworthy Clouds*” Host: C. Wills
- **BU/CAS Discoveries Lecture Series**, Boston, MA *October 2011*  
     “*The Role of Social Media in Political Uprisings*” Host: G. Wilson
- **NIST Cloud Assumption Buster Workshop**, Gaithersburg, MD *October 2011*  
     “*An Economics Approach to Secure and Trustworthy Clouds*” Host: B. Newhouse
- **DIMACS Workshop on Advances in Cloud Computing**, Piscataway, NJ *December 2011*  
     “Towards a Trustworthy Marketplace for Cloud Resources” Host: A. Akella
- **Cloud Control Conference**, Boston, MA *July 2011*  
     “*CloudCommons: Overview of Research in Cloud Security*” Host: B. Zvaifler
- **Financial Services Roundtable Technology Group**, Washington, DC *June 2011*  
     “*In Clouds We Trust*” Host: D. Schutzer
- **Nina Zolt Lecture and Discussion Series at BU**, Boston, MA *April 2011*  
     “*Time in CS: Gauge, Currency, and Illusion*” Host: S. Grossberg
- **MTTC 6th Conference on Clean Energy**, Boston, MA *November 2011*  
     “*Green Computing: Challenges and Opportunities*” Host: J. Kurose
- **InfraGard Professional Development Lecture Series**, Boston, MA *November 2011*  
     “*Trustworthy Interaction in the Cloud*” Host: T. Zlateva
- **University of British Columbia, ECE Dept**, Vancouver, Canada *October 2010*  
     “*Network and Cloud Resource Packing Games*” Host: S. Gopalakrishnan
- **University of Massachusetts, Lowell, CS Dept**, Lowell, MA *September 2010*  
     “*Network and Cloud Resource Packing Games*” Host: G. Chen
- **New Hampshire Chapter of IEEE-CS**, Nashua Community College, NH *September 2010*  
     “*Exciting CS Research and Career Opportunities*” Host: B. Bancroft
- **Institut Eurecom**, Sophia-Antipolis, France *June 2010*  
     “*Network and Cloud Resource Packing Games*” Host: P. Michiardi
- **Deutsche Telekom Labs, TU Berlin**, Germany *June 2010*  
     “*Network and Cloud Resource Packing Games*” Host: G. Smaragdakis
- **University of Texas, CS Dept**, San Marcos, TX *April 2010*  
     “*System and Network Resource Management Games*” Host: M. Guirguis
- **Boston University, Sociology Dept**, Boston, MA *February 2009*  
     “*Technology, Society, & Public Policy: Tussles in Cyberspace*” Host: L. Smith-Doerr
- **University of Notre Dame, CSE Dept**, South Bend, IN *December 2009*  
     “*System and Network Resource Management Games*” Host: K. Bowyer
- **Georgia Institute of Technology, CS Dept**, Atlanta, GA *November 2009*  
     “*System and Network Resource Management Games*” Host: M. Ammar
- **University of California, ECE Dept**, Riverside, CA *May 2009*  
     “*Virtualization Support for Video Sensor Networks*” Host: B. Bhanu
- **German University in Cairo**, Egypt *December 2008*  
     “*Resource Allocation in Clouds and P2P Overlays*” Host: A. ElNahas
- **Microsoft Innovation Labs**, Cairo, Egypt *December 2008*  
     “*Game-Theoretic Approaches to P2P Resource Allocation*” Host: T. Abbadi
- **Telefonica Research Labs**, Barcelona, Spain *November 2008*  
     “*Deconstructing the Current Models of CS publications*” Host: P. Rodriguez
- **Institut Eurecom**, Sophia-Antipolis, France *November 2008*  
     “*Implications Of Selfish Neighbour Selection*” Host: P. Michiardi
- **Amazon Research**, Seattle, WA *July 2008*  
     “*Game-Theoretic Approaches for Cloud Resource Management*” Host: A. Bradley
- **CRA 2008 Snowbird Conference**, Snowbird, UT *July 2008*  
     “*On the Instrumentation Needs of CISE Research*” Host: J. Fortes
- **Boston University, CISE**, Boston, MA *December 2007*  
     “*Thou Shalt Be A Selfish Overlay Neighbor*” Host: C. Cassandras
- **University of Toronto, CS Dept**, Toronto, Canada *October 2007*  
     “*Thou Shalt Be A Selfish Overlay Neighbor*” Host: J. Liebeherr

- **University of Massachusetts, Lowell, CS Dept**, Lowell, MA *October 2007*  
     “*Implications Of Selfish Neighbour Selection*” Host: J. Wang
- **Nortel Networks**, Billerica, MA *October 2007*  
     “*Selfish Neighbour Selection in Overlay Networks and P2P Systems*” Host: A. Onart
- **Workshop on High Confidence Medical Devices**, Cambridge, MA *July 2007*  
     “*Programming support for embedded sensor networks*” Plenary Talk
- **National Colloquium for Info Systems Security Education**, Boston, MA *June 2007*  
     “*Internet RoQ Attacks: Network Security is a Systems Challenge*” Plenary Talk
- **University of Notre Dame, CSE Dept**, South Bend, IN *April 2007*  
     “*If You Build It They Will Come: The snBench Architecture*” Host: A. Striegel
- **BBN Technologies**, Cambridge, MA *March 2007*  
     “*The Sensor Network Programming Workbench Architecture*” Host: R. Schantz
- **Boston University, ECE Dept**, Boston, MA *February 2007*  
     “*snBench: The Sensor Network Programming Workbench*” Host: M. Herbordt
- **University of Massachusetts, CS Dept**, Dartmouth, MA *December 2006*  
     “*Scalable and Practical Interoperability Checks in TRAFFIC*” Host: B. Mikolajczak
- **Wellesley College, CS Dept**, Wellesley, MA *November 2006*  
     “*Internet RoQ Attacks: Vulnerabilities and Countermeasures*” Host: P. Metaxas
- **BU Sensor Network Consortium**, Boston, MA *November 2006*  
     “*snBench: The Sensor Network Programming Workbench*” Host: Y. Paschalidis
- **Workshop on Aviation Software Systems**, Alexandria, VA *October 2006*  
     “*Compositional Verification of Distributed Embedded Systems*” Plenary Talk
- **VMware Lecture Series, VMware Research Lab**, Cambridge, MA *June 2006*  
     “*Friendly Virtual Machines*” Host: J. Austin
- **CRA 2006 Snowbird Conference**, Snowbird, UT *June 2006*  
     “*Deconstructing the Current Models of CS publications*” Host: A. Bernat
- **ISTS Distinguished Lectures, Dartmouth College**, Dartmouth, NH *May 2006*  
     “*Internet RoQ Attacks: Vulnerabilities and Countermeasures*” Host: D. Kotz
- **Purdue University, CS Dept**, West Lafayette, IN *October 2005*  
     “*Internet RoQ Attacks: Vulnerabilities and Countermeasures*” Host: S. Hambruch
- **Microsoft Research**, Redmond, WA *July 2005*  
     “*Friendly Virtual Machines*” Host: M. Peinado
- **Microsoft Research**, Redmond, WA *July 2005*  
     “*Internet RoQ Attacks: Vulnerabilities and Countermeasures*” Host: V. Padmanabhan
- **BU Sensor Network Consortium**, Boston, MA *May 2005*  
     “*The snBench Sensor Network Programming Architecture*” Host: Y. Paschalidis
- **Old Dominion University, CS Dept**, Norfolk, VA *April 2005*  
     “*Scalable Delivery of Streaming Media in Ad-Hoc Overlays*” Host: H. Wahab
- **University of Virginia, CS Dept**, Charlottesville, VA *April 2005*  
     “*Internet RoQ Attacks: Vulnerabilities and Countermeasures*” Host: J. Stankovic
- **Boston University, CISE**, Boston, MA *February 2005*  
     “*Internet RoQ Attacks: Vulnerabilities and Countermeasures*” Host: Y. Paschalidis
- **BBN Technologies**, Cambridge, MA *January 2005*  
     “*RoQ Attacks on Internet Resources*” Host: J. Redi
- **Harvard University, CS Dept**, Cambridge, MA *November 2004*  
     “*Exploiting the Transients of Adaptation for Internet RoQ Attacks*” Host: M. Welsh
- **University of Puerto Rico, IEEE CS Chapter**, Mayaguez, PR *November 2004*  
     “*Sensor Networks: The Dream, Reality, and Science in Between*” Host: M. Peres
- **University of Puerto Rico, CS Dept**, Mayaguez, PR *November 2004*  
     “*Practical, Efficient Construction of Network Caricatures*” Host: N. Santiago
- **University of Puerto Rico, CS Dept**, Mayaguez, PR *November 2004*  
     “*Characterization of Live Streaming Media Workloads*” Host: M. Rodriguez
- **University of North Carolina, CS Dept**, Chapel Hill, NC *October 2004*  
     “*Practical, Efficient Construction of Network Caricatures*” Host: K. Jeffay
- **North Carolina State University, CS Dept**, Raleigh, NC *October 2004*  
     “*Exploiting the Transients of Adaptation for Internet RoQ Attacks*” Host: K. Harfoush
- **University of Cambridge**, England, UK *October 2004*  
     “*Exploiting the Transients of Adaptation for Internet RoQ Attacks*” Host: J. Crowcroft

- **Microsoft Research, Cambridge**, England, UK *October 2004*  
     “*Practical, Efficient Construction of Network Caricatures*” Host: A. Donnelly
- **IHP Microelectronics**, Frankfurt Oder, Germany *October 2004*  
     “*RoQ Attacks on Internet Resources*” Host: P. Langendoerfer
- **Alexandria University, CS Dept**, Alexandria, Egypt *October 2004*  
     “*Practical, Efficient Construction of Network Caricatures*” Host: A. Khalil
- **University of Connecticut, CS Dept**, Storrs, CT *September 2004*  
     “*Exploiting the Transients of Adaptation for Internet RoQ Attacks*” Host: J. Cui
- **Rensselaer Polytechnic Institute (RPI)**, NY *April 2004*  
     “*RoQ Attacks on Internet Resources*” Host: B.Yener
- **UC Berkeley, ICIR/ICSI**, Berkeley, CA *October 2003*  
     “*Practical, Efficient Construction of Network Caricatures*” Hosts: R.Karp and S.Floyd
- **Boston University, CCS**, Boston, MA *September 2003*  
     “*Practical and Efficient Construction of Network Caricatures*” Host: C. Rebbi
- **IEEE ICDCS Workshop on Real-Time Data Distribution**, Providence, RI *May 2003*  
     “*Scalable Real-Time Streaming in Ad-Hoc Overlay Networks*” Host: L. DiPippo
- **Boston University, ECE Dept**, Boston, MA *December 2002*  
     “*Practical and Efficient Construction of Network Caricatures*” Host: M. Herbordt
- **International Workshop on Networked Group Communication**, Boston, MA *October 2002*  
     “*P2P: Fundamental Research or Illegal Activities?*” Host: B. Levine
- **Purdue University**, West Lafayette, IN *October 2002*  
     “*Inference and Labeling of Network-Induced Network Topologies*” Host: K. Park
- **ACM Workshop on Caching, Coherence, and Consistency**, Columbia U, NY *June 2002*  
     “*Caching Architectures for Scalable Streaming Media Delivery*” Plenary Talk
- **DIMACS Internet Measurement, Mapping and Modeling**, Rutgers U, NJ *February 2002*  
     “*Inference and Labeling of Metric Induced Network Topologies*” Host: D. Raz
- **US Personalization Summit**, New York, NY *November 2000*  
     “*Implications of Zipf’s Law on Web Profiling Technologies*” Plenary Talk
- **European Personalization Summit**, London, UK *September 2000*  
     “*Impact of Zipf’s Law on Personalization and ROI*” Plenary Talk
- **Association of Internet Professionals/MIT**, Cambridge, MA *May 2000*  
     “*Advances in Scalable Content Distribution*” Host: Gary Trojillo
- **Akamai Technologies Inc.**, Cambridge, MA *September 1999*  
     “*Connection Scheduling Strategies for Scalable Web Servers*” Host: C. Leiserson
- **Massachusetts Telecommunications Council**, Cambridge, MA *June 1999*  
     “*Commonwealth Scalable Web Server Architecture*” Host: Tanya Zalateva
- **Microsoft Explorer Conference**, Boston, MA *December 1998*  
     “*Towards Sites that Think: Personalization Strategies*” Host: A. Caglayan
- **Denver University**, Denver, CO *October 1998*  
     “*Distributed Connection Routing in the Commonwealth Architecture*” Host: D. Martin
- **Microsoft Research**, Redmond, WA *May 1998*  
     “*Distributed Packet Rewriting for Scalable Web Servers*” Host: D. Lommet
- **Bay Networks**, Billerica, MA *March 1998*  
     “*The Commonwealth Server Project at BU*” Host: J. Shaio
- **ACM, Greater Boston Chapter**, Cambridge, MA *January 1998*  
     “*Taming the WWW: From Measurements to Protocol Design*” Host: P. Govindara
- **Boston University, ECE Dept**, Boston, MA *November 1997*  
     “*Statistical Rate Monotonic Scheduling*” Host: B. Saleh
- **The Open Group**, Cambridge, MA *August 1997*  
     “*TCP Boston: Trading Off Bandwidth For Timeliness*” Host: R. Clark
- **The Mitre Corporation**, Bedford, MA *April 1997*  
     “*Taming the WWW: From Measurements to Protocol Design*” Host: B. Thursignham
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     “*Web Reference Locality: Characteristics and Applications*” Host: S. Baruah
- **Charles River Analytics**, Cambridge, MA *December 1996*  
     “*Server-initiated Replication and Prefetching for the Web*” Host: A. Kaglayan
- **Worcester Polytechnic Institute**, CS Dept., Worcester, MA *November 1996*  
     “*Towards Scalable WWW Services*” Host: C. Wills

- **DCI Internet Expo**, Hynes Convention Center, Boston, MA *September 1996*  
     “Middleware Services for the World Wide Web” Host: IEEE-CS, Boston Chapter
- **AT&T Research**, Bell Labs, Murray Hill, NJ *August 1996*  
     “Prefetching Techniques for the WWW” Host: Y. Freund
- **AT&T Research**, Bell Labs, Murray Hill, NJ *August 1996*  
     “Taming the Web through Measurements and Protocol Design” Host: A. Greenberg
- **University of Rhode Island**, CS and Statistics Dept., RI *July 1996*  
     “From Web Measurements to Web Protocol Design” Host: V. Wolfe
- **University of Pennsylvania**, CS Dept., Philadelphia, PA *May 1996*  
     “Locality of Reference Properties in WWW Information Systems” Host: I. Lee
- **University of Massachusetts at Amherst**, CS Dept., Amherst, MA *March 1996*  
     “Server-initiated Replication and Prefetching in DIS” Host: K. Ramamritham
- **Northeastern University**, CCS Dept., Boston, MA *February 1996*  
     “Information Dissemination for Large-scale Information Systems” Host: I. Matta
- **University of Maryland at College Park**, CS Dept., College Park, MD *December 1995*  
     “Exploiting WWW Locality of Reference” Hosts: U. Shankar and S. Tripathi
- **University of Texas at Arlington**, CSE Dept., Arlington, TX *October 1995*  
     “Speculative Data Dissemination and Service for the WWW” Host: R. ElMasri
- **University of Michigan at Ann Arbor**, EECS Dept., Ann Arbor, MI *August 1995*  
     “Speculative Concurrency for Real-Time Systems” Hosts: K. Shin and N. Soparkar
- **AT&T Bell Labs**, Dept. , Murray Hill, NJ *July 1995*  
     “Timeliness via Speculation for Real-Time Databases” Host: A. Biliris
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     “Speculative Execution Methodologies for Real-Time Systems” Host: A. Stoyenko
- **Tufts University**, CSE Dept., Cambridge, MA *April 1995*  
     “Physically-correct Specifications of Embedded Systems” Host: R. Jacob
- **Harvard University**, CS Dept., Cambridge, MA *May 1994*  
     “Timeliness via Speculation” Host: V. Milenkovic
- **GTE Laboratories**, Waltham, MA *January 1994*  
     “Performance Evaluation of RT Concurrency Control Protocols” Host: L. Bradley
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- **University of Connecticut**, CS Dept., Storrs, CT *November 1992*  
     “*CLEOPATRA*: A TRA-based Language and Environment” Host: R. Ammar
- **University of Rhode Island**, CS Dept., Providence, RI *February 1992*  
     “TRA-based Development of Embedded Real-Time Systems” Host: V. Wolfe
- **Boston University**, CS Dept., Boston, MA *June 1991*  
     “Time-constrained Reactive Automata” Host: A. Kfoury
- **University of California at Irvine**, CS Dept., Irvine, CA *March 1991*  
     “Time-constrained Reactive Automata” Host: N. Leveson
- **North American Philips Corporation**, Briarcliff Manor, NY *November 1990*  
     “Real-time Intelligent Control Systems” Host: D. Lyons
- **TIMS/ORSA National Joint Meeting**, Las Vegas, NV *May 1990*  
     “An Algorithm for Self-diagnosis in Distributed Systems”
- **AT&T Bell Labs**, Dept. 4531, Holmdel, NJ *December 1989*  
     “IDA: A Novel RAID Design” Hosts: R. Morris & W. Wong
- **AT&T Bell Labs**, Dept. 1122, Murray Hill, NJ *August 1989*  
     “IOTA-based Specification and Verification” Hosts: L. Miller & M. Wish
- **AT&T Bell Labs**, Dept. 1125, Murray Hill, NJ *July 1989*  
     “The IOTA Model of Computation” Hosts: M. Merrit & P. Zave
- **Boston University**, CS Dept., Boston, MA *February 1989*  
     “Self-diagnosis in Distributed Systems” Host: A. Heddaya



## PATENTS AND DISCLOSURES

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- [o] Vijay Basani, Krishna Mangiapudi, Lynne Murach, Leroy Karge, Vitaly Revsin, Azer Bestavros, Mark Crovella, and Domenic LaRosa. Method and apparatus for election of group leaders in a distributed network. United States Patent Number US 7,451,221, issued November 11, 2008 (Priority Date: March 3, 2005). Technology is licensed to Network Appliance Inc., 2008.
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- [o] Azer Bestavros and Alia Atlas. Statistical Rate Monotonic Scheduling. Invention Disclosure and Provisional Patent Application Filed by BU. Technology is licensed to Tripacific Software, Inc., 1999.

## PHD THESIS SUPERVISION

<b>Sanaz Bahargam</b> , PhD 2016 (exp), CS Dept, Boston University <i>Topic: Cloud Security</i>	(Main Advisor) 06/11 – present
<b>Richard Skowyra</b> , PhD 2014 (exp), CS Dept, Boston University <i>Topic: Security in P2P Overlays</i>	(Main Advisor) 06/09 – present
<b>Christine Bassem</b> , PhD 2014 (exp), CS Dept, Boston University <i>Topic: MANET Services</i>	(Main Advisor) 09/08 – present

<b>Vatche Ishakian</b> , PhD 2013, CS Dept, Boston University Title: <i>Strategic And Operational Services For Workload Management In The Cloud</i>	(Main Advisor)	09/08 – 12/2012
<b>Raymond Sweha</b> , PhD 2013, CS Dept, Boston University Title: <i>Optimizing On-Demand Resource Deployment For Peer-Assisted Content Delivery</i>	(Main Advisor)	01/06 – 12/2012
<b>Jorge Londono</b> , PhD 2010, CS Dept, Boston University Title: <i>Embedding Games: Distributed Resource Management with Selfish Users</i>	(Main Advisor)	09/05 – 05/2010
<b>Georgios Smaragdakis</b> , PhD 2008, CS Dept, Boston University Title: <i>Overlay Network Creation and Maintenance with Selfish Users</i>	(Main Advisor)	09/02 – 08/2008
<b>Hany Morcos</b> , PhD 2008, CS Dept, Boston University Title: <i>Service Provisioning in Mobile Networks Through Coordinated Resource Management</i>	(Main Advisor)	01/03 – 08/2008
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<b>Luis Aversa</b> MA 1998, CS Dept, Boston University Title: <i>Performance Evaluation of DPR Load-Balancing Policies for Clustered Web Servers</i>	(Main Advisor)	01/97 – 06/1998
<b>Naomi Katagai</b> MA 1998, CS Dept, Boston University Title: <i>Admission Control Policies for High-Performance Web Servers</i>	(Main Advisor)	01/97 – 06/1998
<b>Yukishiro Takahashi</b> MA 1998, CS Dept, Boston University Title: <i>Bandwidth Allocation Policies on ATM Networks</i>	(Main Advisor)	01/97 – 06/1998
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<b>Olivier Hartmann</b> MA 1997, CS Dept, Boston University Title: <i>Design and evaluation of aggregate congestion control protocols for TCP/IP</i>	(Main Advisor)	09/96 – 06/1997
<b>Felix Kozodoy</b> MA 1997, CS Dept, Boston University Title: <i>Analysis of Prefetching based on Web user access patterns</i>	(Main Advisor)	09/96 – 06/1997
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<b>Kyung-Suk Lhee</b> MA 1995, CS Dept, Boston University Title: <i>A Threaded Cleopatra Simulator</i>	(Main Advisor)	09/94 – 06/1995
<b>Martin Mroz</b> MA 1995, CS Dept, Boston University Title: <i>A Client-based Prefetching Implementation for the WWW</i>	(Main Advisor)	09/94 – 06/1995
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<b>Patrick Cai</b> MA 1995, CS Dept, Boston University Title: <i>Object-Oriented Animation on the World Wide Web</i>	(Main Advisor)	01/94 – 06/1995
<b>Benjamin Mandler</b> MA 1994, CS Dept, Boston University Title: <i>A Testbed for Simulating Concurrency Control for RTDB Systems</i>	(Main Advisor)	09/93 – 09/1994
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<b>Mohammad Makar</b> MA 1994, CS Dept, Boston University Title: <i>Design and Implementation of AIDA Network File System</i>	(Co-Advisor)	09/93 – 08/1994
<b>Nicholas Roosevelt</b> MA 1994, CS Dept, Boston University Title: <i>Implementation of Mermera on the CM-5</i>	(2 <sup>nd</sup> Reader)	09/93 – 06/1994
<b>Natalya Fridman</b> MA 1992, CS Dept, Boston University Title: <i>A Simulator for a Pipelined and Vector DLX Architecture</i>	(Main Advisor)	09/91 – 08/1992

## PUBLICATIONS

### Books, Theses, and Collections

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## Tutorials and Invited Presentations

- [200.T1] Azer Bestavros. Society and Technology: Internet Tussles. Guest Lecture in BU/CAS-SOC277: Technology, Society, and Public Policy, February 2013.
- [201.T2] Azer Bestavros. Big Data as a Driver of Cyber-Enabled Discovery and Innovation. BU Green House Workshop on Big Data, February 2013.
- [202.T3] Azer Bestavros. Modeling and Analysis of Web and Social Network Graphs. Guest Lecture in the BU ARTEMIS Program, August 2012.
- [203.T4] Azer Bestavros. Tussles in Cyberspace. Guest Lecture in BU/CAS-SOC277: Technology, Society, and Public Policy, February 2012.
- [204.T5] Azer Bestavros. Mobility Coordination for Improved Ad-Hoc Routing and Field Coverage. Plenary Talk at the INFORMS Northeastern Regional Conference, May 2011.
- [205.T6] Azer Bestavros. Graphs as Web and Social Network Models. Guest Lecture in the BU ARTEMIS Program, August 2011.
- [206.T7] Azer Bestavros. Tussles in Cyberspace. Guest Lecture in BU/CAS-SOC277: Technology, Society, and Public Policy, February 2010.
- [207.T8] Azer Bestavros. Cyber-Terrorism/Warfare – The Emergent Threat: Strategies for Survival. BU Discoveries Series Panel on Cyber Warfare, November 2009.
- [208.T9] Azer Bestavros. snBench: Virtualization and Programming Support for Video Sensor Networks. Plenary talk at the ONR/ARO/NSF Interdisciplinary Workshop on Distributed Video Sensor Networks, May 2009.
- [209.T10] Azer Bestavros. Programming Support for Embedded Sensor Networks. Plenary talk at the Workshop On High Confidence Medical Devices, Software, and Systems (HCMDSS) and Medical Device Plug-and-Play (MD PnP) Interoperability, July 2007.
- [210.T11] Azer Bestavros. Compositional Development and Verification of Distributed Embedded Systems. Plenary talk at the Workshop on Aviation Software Systems, June 2006.
- [211.T12] Azer Bestavros. Deconstructing the Current Models of CS publications. Plenary Talk at CRA 2006 Snowbird Conference, June 2006.
- [212.T13] Azer Bestavros. Caching Architectures for Scalable Streaming Media Delivery. Plenary Talk at ACM Workshop on Caching, Coherence, and Consistency, Columbia University, NY, June 2002.
- [213.T14] Azer Bestavros. Real-Time Database Technology and the Internet. Panelist at the 1997 International Workshop on Real-Time Databases, Burlington, Vermont, September 1997.
- [214.T15] Azer Bestavros. On the Platform for Privacy Preferences Standard. Panelist at the Inaugural Meeting of the World-Wide Web Consortium (W3C) Working Group on P3 Internet Architecture, MIT, Cambridge, MA, June 1997.
- [215.T16] Azer Bestavros and Stanley Sclaroff. Research Infrastructure for Parallel and Distributed Systems at Boston University: Real-Time, Multimedia, and High-Performance Networking and Computing. Invited presentation at NSF Infrastructure'97: A Workshop for the Principal Investigators of NSF/CISE Infrastructure Awards, Lexington, Kentucky, May 1997.
- [216.T17] Azer Bestavros and Mark Crovella. Tutorial on Performance Characteristics of WWW Information Systems. ACM Sigmetrics'98: Conference on Measurement and Modeling of Computer Systems, Wisconsin, June 1998.
- [217.T18] Azer Bestavros and Mark Crovella. Tutorial on Performance Characteristics of WWW Information Systems. ACM Sigmetrics'97: Conference on Measurement and Modeling of Computer Systems, Seattle, WA, June 1997.
- [218.T19] Azer Bestavros. Concepts of Real-Time Computing and Communications. Mariner Tutorial Series, November 9 1996.

- [219.T20] Azer Bestavros. Tutorial on Middleware Services for the World Wide Web. IEEE Engineering Solutions Conference, Boston, MA, September 11 1996.
- [220.T21] Azer Bestavros. Introducing computer science to non-concentrators. SUNY/NSF Curricula and Pedagogy for Introductory Computer Science: An Undergraduate Faculty Enhancement Workshop, Geneseo, NY, June 12 1995.
- [221.T22] Azer Bestavros. Parallel Computing: Models, Languages, and Architectures. Wellesley/NSF Forum for Parallel Curricula, March 1995.

## Editorials and Other Publications

- [222.U1] Evimaria Terzi, Azer Bestavros, Dora Erdos, and Vatche Ishakian. Towards Generalized Centrality Measures with Applications to Information Networks. NSF Workshop on Social Networking and Mobility in the Cloud, February 2012.
- [223.U2] Benyuan Liu, Azer Bestavros, Ding-Zhu Du, and Jie Wang. Editorial on Research Advances in Wireless Algorithms, Systems, and Applications. EURASIP Journal on Wireless Communications and Networking, August 2010.
- [224.U3] Rick Schantz, Jake Beal, Joe Loyall, Partha Pal, Kurt Rohloff, and Azer Bestavros. Research Challenges in Information Systems for the Next Generation Electric Grid. NITRD Workshop on New Research Directions for Future Cyber-Physical Energy Systems, June 2009.
- [225.U4] Azer Bestavros. Towards Safe and Scalable Compositional Analysis and Programming. Position Statement at NSF Workshop on High-Confidence Software Systems, October 2006.
- [226.U5] Azer Bestavros. If GENI is a Programmable Architecture then What (Real-Time) Instruction Set Architecture should GENI have? Position Statement at NSF Workshop on Real-Time GENI, February 2006.
- [227.U6] Azer Bestavros. Towards Trusted Adaptation Dynamics in Computing Systems and Networks. Position Statement at NSF Workshop on Next Generation Secure Internet, July 2005.
- [228.U7] Mina Guirguis, Azer Bestavros, and Ibrahim Matta. Adaptation = Vulnerability: Under RoQ Attacks. In *ACM SIGCOMM 2004 (Poster Session)*, Portland, Oregon, August 2004.
- [229.U8] Kanishka Gupta, Azer Bestavros, and Ibrahim Matta. Context-aware Real-time Scheduling. In *RTAS 2004: IEEE Real-Time and Embedded Technology and Applications Symposium (WIP Session)*, Toronto, Canada, May 2004.
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- [232.U11] Azer Bestavros, John Byers, Mark Crovella, Paul Barford, Ibrahim Matta, and Michael Mitzenmacher. BU/NSF Workshop on Internet Measurement Instrumentation and Characterization. NSF Workshop Report (Also available as Boston University Technical Report BUCS-TR-1999-019), December 1999.
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- [235.U14] Azer Bestavros. Real-time Computer Monitoring & Control Methodologies to Aid in the Study of Protein Interactions for Biosensor Applications. Final Report for Grant: DAAH04-94-G-0095, The US Army Research Office, In collaboration with ARO Natick Labs, January 1997.

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- [436.D2] Vatche Ishakian. *Strategic And Operational Services For Workload Management In The Cloud*. PhD thesis, Boston University, Computer Science Department, May 2013.
- [437.D3] Jorge Londono. *Embedding Games: Distributed Resource Management with Selfish Users*. PhD thesis, Boston University, Computer Science Department, May 2010.
- [438.D4] Georgios Smaragdakis. *Overlay Network Creation and Maintenance with Selfish Users*. PhD thesis, Boston University, Computer Science Department, August 2008.
- [439.D5] Hany Morcos. *Service Provisioning in Mobile Networks Through Coordinated Resource Management*. PhD thesis, Boston University, Computer Science Department, August 2008.
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PATENT AND INTELLECTUAL PROPERTY CONSULTING EXPERIENCE
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<b>Expert Witness</b> for Kasowitz, Benson, Torres & Friedman LLP, Atlanta, GA <i>Patent Infringement Litigations involving DN Lookup Tech vs. Cox Communications</i>	09/12 – 07/13
<b>Expert Witness</b> for Alston & Bird LLP, Charlotte, NC <i>Patent Infringement Litigations involving Nokia Corp. vs. HTC Corp.</i>	06/12 – 12/2012
<b>Expert Witness in Jury Trial</b> for Orrick, Herrington & Sutcliffe LLP, Menlo Park, CA <i>Patent Infringement Litigations involving Brocade vs. A10</i>	06/11 – 08/2012
<b>Expert Witness</b> for Rothwell, Figg, Ernst & Manbeck, Washington, DC <i>Patent Infringement Litigations involving MySpace and Facebook vs. WirelessInk.</i>	11/11 – 06/2012
<b>Expert Witness</b> for Rothwell, Figg, Ernst & Manbeck, Washington, DC <i>Patent Infringement Litigations involving Advance Publications, Inc.</i>	05/11 – 12/2011
<b>Expert Witness</b> for Duane Morris, LLP, New York, NY <i>Copyright Infringement Litigations involving MP3tunes and Capitol Records.</i>	01/10 – 09/2011
<b>Consultant</b> for Alston & Bird LLP, Charlotte, NC <i>Patent Infringement Litigations involving Nokia Corp. vs. Apple Inc.</i>	04/11 – 06/2011
<b>Expert Witness</b> for Rothwell, Figg, Ernst & Manbeck, Washington, DC <i>Patent Infringement Litigations involving the New York Times.</i>	04/10 – 02/2011
<b>Expert Witness</b> for Fish & Richardson P.C., Boston, MA <i>Patent Infringement Litigations involving Netcraft vs. AT&amp;T et al.</i>	10/09 – 04/2010
<b>Expert Witness</b> for Rothwell, Figg, Ernst & Manbeck, Washington, DC <i>Patent Infringement Litigations involving the Dow Jones.</i>	02/08 – 08/2009
<b>Expert Witness</b> for Goodwin Procter, LLP, Boston, MA <i>Patent Infringement Litigations involving Citrix On-Line.</i>	04/07 – 06/2009
<b>Expert Witness</b> for Denner Pellegrino, LLP, Boston, MA <i>Copyright Infringement Litigations involving RIAA and Arista vs. Does 1-21.</i>	04/07 – 12/2008
<b>Consultant</b> for Fish & Richardson P.C., Boston, MA <i>Network Measurement and Server Log Analysis Practices and Literature.</i>	05/06 – 01/2008
<b>Consultant</b> for Lowrie, Lando & Anastasi, LLP, Cambridge, MA <i>Compression Technologies for Network Communication Protocols and Architectures.</i>	06/07 – 08/2007
<b>Expert Witness</b> for Fein & O'Connor, P.C., Philadelphia, PA <i>RIAA Copyright Infringement Litigations.</i>	07/07 – 08/2007
<b>Expert Witness</b> for Banner & Witcoff, Ltd., Boston, MA <i>Patent Infringement/Invalidity Litigations involving RealNetworks vs. Ethos Technologies.</i>	03/03 – 12/2006
<b>Consultant</b> for Fish & Richardson P.C., Washington, DC <i>Patent Infringement/Invalidity Litigations involving comScore Networks vs. NetRatings.</i>	06/05 – 12/2006
<b>Expert Witness</b> for Choate, Hall & Stewart, Boston, MA <i>Patent Infringement/Invalidity Litigations involving Akamai vs. Speedera.</i>	04/04 – 04/2005
<b>Consultant</b> for Hughes & Luce, LLP, Dallas, TX <i>Software Industry Copyright and Reverse Engineering Practices.</i>	09/04 – 03/2005
<b>Consultant</b> for Mintz Levin Cohn Ferris Glovsky and Popeo P.C., Boston, MA <i>Software Copyright and Plagiarism Litigations</i>	03/04 – 10/2004
<b>Expert Witness</b> for Bingham McCutchen, LLP, East Palo Alto, CA <i>Patent infringement/invalidity litigations involving Cable &amp; Wireless vs. Akamai.</i>	11/02 – 12/2003
<b>Expert Witness in Jury Trial</b> for Banner & Witcoff, Ltd, Chicago, IL <i>Patent infringement/Invalidity litigations involving Akamai/MIT vs. Digital Island.</i>	04/01 – 12/2003
<b>Consultant</b> for Finnegan, Henderson, Farabow & Garrett Ltd, Washington, DC <i>Litigations involving Internet software practices involving Saber Inc. vs. American Airlines.</i>	06/02 – 08/2003
<b>Expert Witness</b> for Brobeck, Phleger & Harrison, LLP, Palo Alto, CA <i>Patent infringement/invalidity litigations involving Jupiter Media Metrix vs. NetRatings.</i>	12/01 – 08/2002

# **EXHIBIT 8**

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**Address:**

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**Johns Creek, GA 30022**

**Employment:**

- 1984-1989: Post Graduate Researcher (UC Berkeley),
- 1989-present: Full Professor of Electrical & Computer Engineering (Georgia Tech).

**Areas of Technical Interest** –Wireless Communications, Digital Signal & Video Processing, Computer Networks, Distributed Computing, Cellular Networks, Networking Protocols, Computer Engineering, Embedded Systems, Digital Signal Processing, RF & Baseband ASIC Design, Digital TV, Software Engineering, Image & Video Processing.

**Startup Companies:**

Director, **VP Technologies, Inc.** (1995- ): A startup commercialized through Georgia Tech's Advanced Technology Development Corporation (ATDC) focusing on digital IC development and interconnect/memory for military market. <http://www.vptinc.com>

Director, **Soft Networks, LLC** (2001-2007): A startup commercialized through Georgia Tech support focusing on software development tools and compilers for Cellular/WiFi/VOIP/telecommunication products. <http://www.soft-networks.com>

Director, **Elastic Video Inc.** (2007- 2009): A startup commercialized through Georgia Tech's VentureLab (<http://venturelab.gatech.edu>) development image and video processing software for wireless & IP networking.

**Recent Cases (2007-2012)**

Case Name: Certain Personal Computers & Digital Display Devices  
Case No. **ITC No. 337-TA-606**  
Hewlett Packard vs. Acer  
Expert for Acer  
(Computer BIOS: 2007-2008)

Case Name: Funai v. JDA (Polariod, Vizio, TPV..)  
Case No. **ITC No. 337-TA-617**  
Expert for Joint Defense Team (Amtran, Vizio, Proview...)  
(Digital TV: 2007-2008)  
[Testified at trial]

Case Name: AsusTech v. IBM:  
Certain Computer Products & Computer Components,  
Case No: **ITC No. 337-TTA-628**  
Expert for Asus  
(Computer Peripherals & Switching Power Supplies: 2007-2008)

Case Name: Mformation v. Research in Motion:  
Case No: 5:08-cv-04990-JW (N.D. of California)  
Expert for Mformation  
(Mobile Device Management: 2010-2012)

Case Name: HTC v. IPCOM –  
Case No: 1:2008-cv-01897 (District of Columbia)  
Expert for IPCOM.  
(3G Standards: 2009 – 2012)

Case Name: Apple v. Kodak  
Case No. **ITC 337-TA-717 (ITC)**  
Expert for Kodak  
(Digital Image Processing & UI: 2008-2011)

Case Name: Harkabi v. Sandisk,  
Case No: 1:08-cv-08203-WHP  
Expert for Harkabi  
(Digital Rights Management for Flash Devices: 2010-2012)

Case Name: Yangaroo Inc. v. Destiny Media Technologies, Inc.  
Case No: 09-C-0462  
Expert for Yangaroo.  
(Digital Rights Management Streaming: 2010-2011)

Litigation: Verizon v. Cox:  
Technology: VOIP Patents (ED of Virginia 2:08-cv-00020)  
Expert for Cox  
(VOIP & Media Gateways Protocols: 2008-2010)

Case Name: Rambus v. Nvidia:  
Case Name: Certain Matter of Semiconductor Chips Having Synchronous  
Memory  
Case No. ITC **337-TA-661**  
Expert for Rambus  
(Memory Controllers for Flash: 2008-2010)

Case Name: Motorola v. Research in Motion (Settled)  
Case No: **ITC 337-TA-706.**  
Expert for Motorola  
(3G Standards and WiFi: 2008-2011)

Case Name: Mallinckrodt Inc. v. E-Z-EM and ACIST Medical Systems: Case No:  
2:07-CV-262(TJW)  
Expert for E-Z-EM and ACIST Medical Systems  
(Medical Signal Processing: 2009-2011)

Case Name: Sybase 365 v. Mobile 365 Inc.:  
Case No: 2:09CV387-RJD  
Expert for Sybase  
(Mobile Messaging & SMS: 2009-2010)

Case Name: Motorola v. Microsoft,  
Case No: **ITC 337-TA-752**  
Expert for Motorola  
(Peer to Peer Gaming: 2011-2013)

Case Name: Motorola v. Apple,  
Case No: **ITC 337-TA-745**  
Expert for Motorola  
(Mobile Applications & UI: 2011-2012)

Case Name: LG v. Vizio,  
Case No: **ITC 337-TA-742**  
Expert for Vizio  
(Digital TV UIs: 2011-2011)

Case Name: Innovative Sonic Ltd. vs. RIM  
Case No: 3:11-cv-00706-K-BF

Expert for Innovative Sonic Ltd  
(3G Standards – Encryption, HSDPA: 2010-2013)

Case Name: Interdigital v. ZTE, Huawei, Nokia (JDA)  
Case No: ITC 337-TA-800  
Expert for JDA  
(3G Standards – HSDPA: 2012-2013)

Case Name: Kodak v. Apple, HTC  
Case No: ITC 337-TA-831  
Expert for Kodak  
(Digital Image Processing & UIs: 2011-2012)

Case Name: Calypso v. T-Mobile  
Case No: 2:08-CV-441-JRG-RSP  
Expert for T-Mobile  
(Unified Communications: 2012-2013)

Case Name: TracBeam v. AT&T  
Case No: 6:11-cv-00096-LED  
Expert for AT&T  
(GPS Services: 2011-2012)

Case Name: BT v. Cox/Comcast  
Case No: 10-658 (SLR) Delaware  
Expert for Cox and Comcast  
(VOIP, Network Management: 2012- )

Case Name: Ericsson v. Samsung  
Case No: 337-TA-862 (ITC)  
Expert for Ericsson  
(RF Receivers, EDGE Standards: 2012- 2013)

Case Name: IPR – ContentGuard v. ZTE  
Expert for ZTE  
(DRM for Digital Devices: 2012-)

Case Name: Emblaze v. Apple  
Case No: 5:11-cv-01079-PSG  
Expert for Emblaze  
(Digital Video/Audio Streaming: 2012- )

Case Name: Emblaze v. Microsoft  
Case No: 3:12-cv-05422-JST  
Expert for Emblaze

(Digital Video/Audio Streaming: 2012 - )

Case Name: MMI v. RIM  
Case No: 2:10-cv-00113-TJW-CE  
Expert for MMI  
(Area: Mobile Devices/User Interfaces: 2012- )

Case Name: Wi-LAN v. RIM  
Case No: 12-20232-CIV (SD Fla)  
Expert for Wi-LAN  
(Area: Wireless Devices & Email)

Case Name: WiLAN v. RIM  
Case No: No: 3:13-cv-02431-K (N.D. Texas)  
Expert for Wi-LAN  
(Area: LTE/4G Wireless Protocols)

## Consulting

Ericsson (2010-2012): 3G Standards – HSDPA and Mobile Applications

## Earned Degrees

1. **B. Tech (Hons), Electronics & Electrical Comm. Engineering**  
*Indian Institute of Technology (IIT), Kharagpur, India*  
1984.
2. **Ph.D., Electrical Engineering & Computer Sciences (EECS)**  
*University of California (UC), Berkeley. CA*  
1989.

## Books

1. **VLSI Digital Signal Processors**  
*Madiseti, V.K.;*  
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2. **Quick-Turnaround ASIC Design in VHDL**  
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4. **VHDL: Electronics Systems Design Methodologies.**  
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5. **Platform-Centric Approach to System-on-Chip (SoC) Design.**  
*Madiseti, V. K., Arpnikanondt, A.*  
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## Edited Books & Collection of Papers

1. **Advances in Parallel & Distributed Simulation**  
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**2. Modeling, Analysis, Simulation of Computer & Telecommunications Systems**

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**3. Modeling & Simulations on Microcomputers**

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## **Editorship of Journals & Transactions**

**1. IEEE Design & Test of Computers**

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*Madisetti, V.K (Editor)*

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**2. IEEE Design & Test of Computers**

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**3. IEEE Transactions on Circuits & Systems II**

*Associate Editor: 1993-1995.*

**4. International Journal in Computer Simulation**

*Associate Editor: 1990-1993*

**5. International Journal in VLSI Signal Processing**

*Editorial Board: 1995 - Present*

## **Refereed Journal Publications**

**1. Multilevel range/NEXT performance in digital subscriber loops**

*Brand, G.; Madisetti, V.; Messerschmitt, D.G.;*

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Proceedings-Communications] ,Volume: 136 , Issue: 2 , April 1989  
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**2. Seismic migration algorithms on parallel computers**

*Madisetti, V.K.; Messerschmitt, D.G.;*  
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Signal Processing, IEEE Transactions on] ,Volume: 39 , Issue: 7 , July 1991  
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**3. Asynchronous algorithms for the parallel simulation of event-driven dynamical systems**

*Madisetti, V.K.; Walrand, J.C.; Messerschmitt, D.G.:*  
ACM Transactions on Modeling and Computer Simulation, v 1, n 3, July 1991,  
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**18. Virtual prototyping of embedded microcontroller-based DSP systems**

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*H.W.;*

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- 33. Adaptive mobility management in wireless networks**  
*Jeongwook Kim; Madisetti, V.K.;*  
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- 34. Efficient implementation of two-band PR-QMF filterbanks**  
*Hezar, R.; Madisetti, V.K.;*  
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- 35. On fast algorithms for computing the inverse modified discrete cosine transform**  
*Yun-Hui Fan; Madisetti, V.K.; Mersereau, R.M.;*  
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- 36. System on chip or system on package?**  
*Tummala, R.R.; Madisetti, V.K.;*  
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*Jatunov, L.A.; Madisetti, V. K.;*  
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- 43. Systematic Design of End-to-End Wireless Mobility Management Protocols,**  
*Argyriou, A.; Madisetti, V. K.;*  
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- 44. A Novel End-to-End Approach for Video Streaming Over the Internet,**  
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- 45. An Analytical Framework of RD Optimized Video Streaming with TCP,**  
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- 46. Modeling the Effect of Handoffs on Transport Protocol Performance,**  
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- 49. "The Design of an End-to-End Handoff Management Protocol",**  
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- 50. "A Soft-Handoff Transport Protocol for Media Flows in Heterogeneous Mobile Networks ",**  
*A. Argyriou, Madisetti, V. K.*  
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- 51. "Computationally Efficient SNR Estimation for Bandlimited WCDMA Systems"**  
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- 52. "Space-Time Codes for Wireless & Mobile Applications",**  
*M. Sinnokrot, Madiseti, V.K.*  
*DSP Handbook, Second Edition, 2009 (to be published)*
- 53. Next-Generation Applications on Cellular Networks**  
*V. Madiseti et al.*  
*Proceedings of IEEE, April 2012.*
- 54. Analysis of Massive Maintenance Data in a Computing Cloud**  
*A. Bahga, V. Madiseti*  
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## Peer Reviewed Conference Publications

- 1. Dynamically-reduced complexity implementation of echo cancelers**  
*Madiseti, V.; Messerschmitt, D.; Nordstrom, N.;*  
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- 2. Seismic migration algorithms using the FFT approach on the NCUBE multiprocessor**  
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- 6. High speed migration of multidimensional seismic data**  
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- 7. Performance of a fast analog VLSI implementation of the DFT**  
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- 8. Task scheduling in the Georgia Tech digital signal multiprocessor**  
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**2. Voice & Video over Mobile IP Networks <draft-madisetti-argyriou-voice-video-mip-00.txt>**

*Madisetti, V., Argyriou, A.*  
IETF Internet-Draft, Nov 20, 2002.

**3. Enhancements to ECRTTP with Applications to Robust Header Compression for Wireless Applications. <draft-madisetti-rao-suresh-rohc-00.txt>**

*Madisetti, V.; Rao, S., Suresh, N.*  
IETF Internet-Draft, June 30, 2003.

## **Ph.D. Students Graduated**

**1. Brian T. Kelley, 1992**

*VLSI Computing Architectures for High Speed Signal Processing*  
Member of Technical Staff, Motorola.

Winner of Dr. Thurgood Marshall Dissertation Fellowship Award

**2. Bryce A. Curtis, 1992**

*Special Instruction Set Multiple Chip Computer for DSP*  
Member of Technical Staff, IBM

**3. Jaejin Lee, 1994**

*Robust Multitrack Codes for the Magnetic Channel*  
Professor, Yonsei University, Korea

**4. Mohamed S. Ben Romdhane, 1995**

*Design Synthesis of Application-Specific IC for DSP*  
Director of IP, Rockwell.

**5. Shoab A. Khan, 1995**

*Logic and Algorithm Partitioning on MCMs*  
Professor, National University of Science & Technology, Pakistan

**6. Lan-Rong Dung, 1997**

*VHDL-based Conceptual Prototyping of Embedded DSP Architectures*  
Professor, National Chaio Tung University, Taiwan.

Winner of VHDL International Best PhD Thesis Award, 1997

- 7. Thomas W. Egolf, 1997**  
*Virtual Prototyping of Embedded DSP Systems*  
Distinguished Member of Technical Staff, Agere
- 8. Alvaro Marenco, 1997**  
*On Homomorphic Deconvolution of Bandpass Signals*  
Professor, Texas A&M University.  
  
Winner of GIT ECE Outstanding Teaching Assistant Award
- 9. Shahram Famorzadeh, 1997**  
*BEEHIVE: A Distributed Environment for Adaptive Signal Processing*  
Member of Technical Staff, Rockwell.
- 10. Timothy J. Klausutis, 1997**  
*Adaptive Lapped Transforms with Applications to Image Coding.*  
US Air Force/Univ. of Florida.
- 11. Lan Shen, 1998**  
*Temporal Design of Core-Based Systems*  
Member of Technical Staff, IBM
- 12. James DeBardelaben, 1998**  
*Optimization Based Approach to Cost Effective DSP Design*  
Research Scientist, Johns Hopkins University  
  
Georgia Tech ECE Faculty Award
- 13. Sangyoun Lee, 1999**  
*Design of Robust Video Signal Processors*  
Professor, Yonsei University  
  
US Army Sensors Lab Research Excellence Award, 1999
- 14. Rahmi Hezar, 2000**  
*Oversampled Digital Filters*  
Member of Technical Staff, Texas Instruments
- 15. Yong-kyu Jung, 2001**  
*Model-Based Processor Synthesis*  
Professor, Texas A&M University
- 16. Mustafa Turkboylari, 2002**  
*Handoff Algorithms for Wireless Applications*  
Member of Technical Staff, Texas Instruments
- 17. Yun-Hui Fan, 2002**  
*A Stereo Audio Coder with Nearly Constant Signal to Noise Ratio*  
Post-Doctoral Research Associate, Northeastern University
- 18. Subrato K. De, 2002**  
*Design of a Retargetable Compiler for DSP*

Member of Technical Staff, Qualcomm

US Army Sensors Lab Research Excellence Award, 1999

**19. Chonlameth Aripnikanondt, 2004**

*System-on-Chip Design with UML*

*Professor, King Mongkut's University, Thailand.*

US Army Sensors Lab Research Excellence Award, 1999

**20. Loran Jatunov, 2004**

*Performance Analysis of 3G CDMA Systems*

Senior Research Scientist, Soft Networks, LLC.

**21. Antonios Argyriou, 2005, Serving in Hellenic Army.**

**22. Pilho Kim, 2009, Scientist, VP Technologies, Inc.**

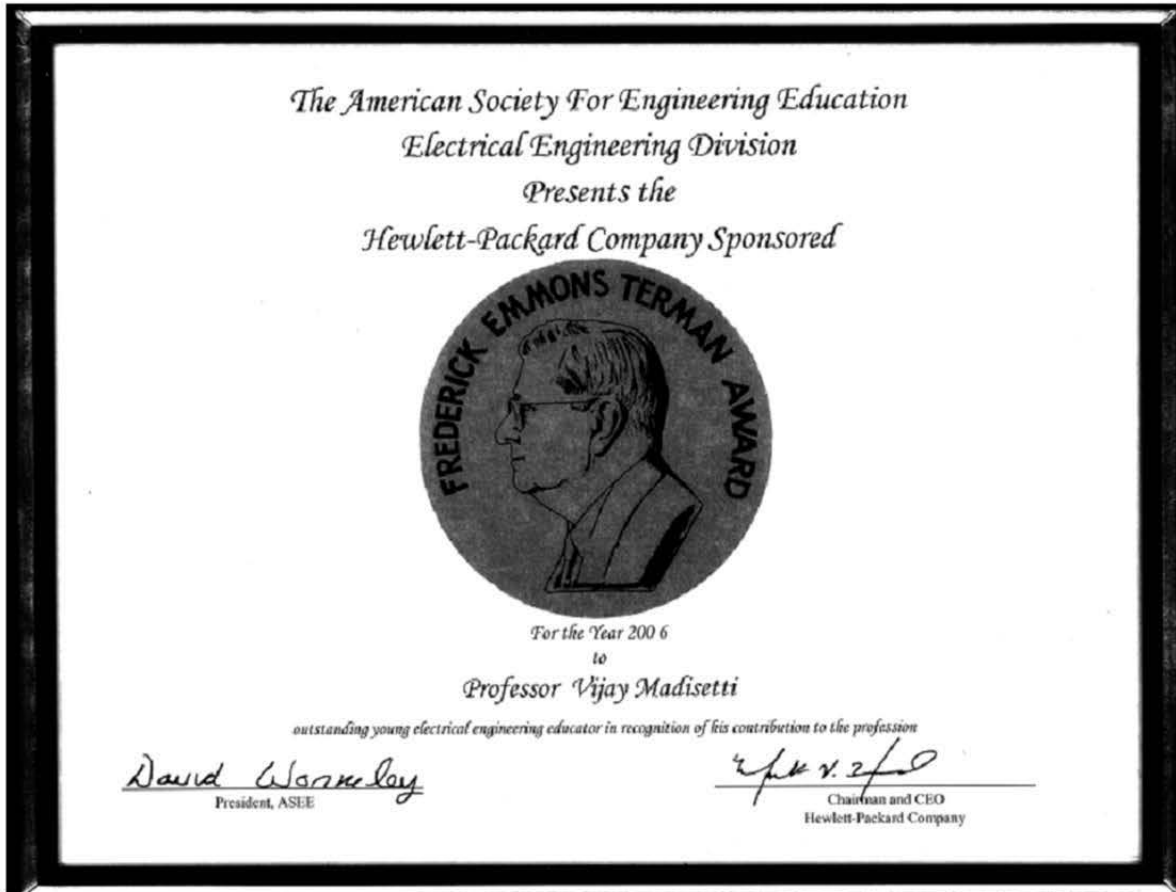
**23. M. Sinnokrot, 2009, Staff Engineer, Qualcomm.**

## **Awards & Honors**

1. **Jagasdis Bose National Science Talent Fellowship**, Indian Institute of Technology, Kharagpur, 1980-1984.
2. **General Proficiency Prize**, Indian Institute of Technology, Kharagpur, 1984.
3. **Demetri Angelakos Outstanding Graduate Student Award**, Univ. of California, Berkeley, 1989
4. **Ira Kay IEEE/ACM Best Paper Award** for Best Paper presented at IEEE Annual Simulation Symposium, 1989
5. **IBM Faculty Development Award** 1990
6. **Technical Program Chair**, IEEE Workshop on Parallel and Distributed Simulation. 1990.
7. **Technical Program Chair**, IEEE MASCOTS'94
8. **NSF RI Award**, 1990
9. **VHDL International Best PhD Dissertation Advisor Award**, 1997



10. Georgia Tech Outstanding Doctoral Dissertation Advisor Award, 2001.
11. ASEE 2006 Frederick Emmons Terman Medal, 2006.
12. Fellow of IEEE



# **EXHIBIT 9**

# Resume

of [Philip Greenspun](#)

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## Summary:

- Business experience: started six companies and buried three. As CEO, grew an open-source enterprise software company to \$20 million annual revenue in two years with \$10,000 in capital.
- Software product development experience: 20 years. Have had the same email address since 1976: [philg@mit.edu](mailto:philg@mit.edu). Have been developing open source software since 1982. List of engineering projects completed is available from <http://philip.greenspun.com/personal/resume-list>
- Pedagogy experience: Co-developed "[Software Engineering for Internet Applications](#)" with Hal Abelson at MIT; it has been a successful course at MIT and is being used by computer science departments at 10 other universities around the world.
- Non-profit experience: Started a 501c3 foundation in December 1998. The Foundation operated a prize program for high-school age Web developers and a one-year post-baccalaureate program in computer science; the annual budget was approximately \$1.5 million.
- Political experience: Testified before the U.S. Senate Commerce Committee and the Subcommittee on Patents, Copyrights and Trademarks of the Senate Judiciary Committee
- Writing experience: four computer science textbooks, one book about North America and its people, numerous journal and magazine articles.
- Photography experience: started [photo.net](#) in 1993, an online community for photographers. Work published in dozens of print magazines and books and used for advertising (see [separate photo resume](#)).
- Aviation experience: holder of Airline Transport Pilot certificate with multi-engine, single-engine seaplane, and helicopter ratings; holder of flight instructor certificate with instrument and helicopter ratings; have flown single-engine aircraft to Alaska (twice) and just about everywhere else in North America and the Caribbean; have flown three coast-to-coast trips in Robinson helicopters; flew the Canadair Regional Jet out of JFK for a subsidiary of a major airline
- Education: three MIT degrees (including a Ph.D., but you can't call me "Dr. Greenspun" because my brother is a real doctor).

## Employment Experience

### 2006-present: expert witness

I have served as a [software expert witness](#) and also as an expert witness in cases regarding [Internet software patents](#). I am qualified to serve as an [aviation expert witness](#) or a [relational database expert witness](#).

### 1997-present: various advisory and corporate boards

Serve as an independent member of various advisory and corporate boards, mostly for technology companies. Example: Joined corporate board of MIT materials science spin-off in late 2005 during \$550,000 seed capital phase. Stepped down when company secured \$10 million in venture capital in mid-2007.

### 1991-present: Computer Science and Artificial Intelligence Laboratory, Massachusetts Institute of

## **Technology.**

Teach and expand the MIT computer science curriculum, conduct research, and supervise student research.

### **1993-2000; 2006-2007: photo.net**

Started, programmed, financed, and managed this online learning community as a personal hobby. Spun it off in 2000 to a team of entrepreneurs who attempted to make it a profitable business. Took it back over in mid-2006 to clean up the content, software, and balance sheet (crippled with debt). With 600,000 registered users and 60 million page views per month, sold the company in April 2007 to NameMedia.

### **1997 through March 2000: ArsDigita Corporation**

Started, financed, and managed this company, which developed an open-source toolkit for building collaborative Internet applications. Grew the company profitably from 5 part-time people to 80 full-timers and revenue of \$20 million per year. Between January and March 2000, negotiated and closed a \$38 million venture capital investment from Greylock and General Atlantic Partners. Handed over the reins to a team of professional managers brought in by the venture capitalists.

### **February 1988 through August 1990: Isosonics Corporation**

Founded company to develop a product that stored digital data with consumer video recorders. Co-designed custom digital signal processor. Developed simulation environment, complete simulator for digital audio recorder (1.4 Mbits/second), microcode compiler on the Symbolics Lisp Machine. Used Lisp tools to develop error correction microcode and refine DSP architecture. Co-designed three phase locked loops. With partners, developed system for auditing television broadcasts nationwide by monitoring commercials and compiling reports for advertisers. We designed a single board that tunes a chosen channel, recognizes tagged advertisements and makes a record for each ad of time of broadcast, number of fields, video quality and color burst presence. Served as president of Isosonics from its inception until its dissolution.

### **April 1986 through November 1989: ConSolve Incorporated**

Co-founded this construction automation company. With partner, developed initial product, obtained financing (from PaineWebber Ventures), hired software development, marketing and support staff, established R&D partnership with Tektronix, obtained government contracts and sold software. Was active participant in all important planning, legal, and management activities. Wrote every line of code in the first system shipped to a customer (Caterpillar).

### **November 1984 through August 1985: ICAD, Inc.**

Co-founded company with three partners. With Patrick O'Keefe, developed Lisp software to automate mechanical engineering. The ICAD System was initially primarily intended for large steel structures, e.g., air-cooled heat exchangers, offshore oil rigs, coal-fired power plants, but has been extended to many general ME problems.



Company went public in January 1995 as Concentra with a market valuation of \$50 million and was subsequently acquired by Oracle Corporation.

#### **June 1983 through November 1984: Symbolics, Inc.**

Developed VLSI tools, including automatic layout functions and worked on the system architecture for the Ivory microprocessor (the base of all Symbolics products sold in the late 1980s). Wrote parts of the Symbolics operating system.

#### **June 1982 through June 1983: Hewlett-Packard Labs**

Wrote packet-switched network simulation software on Symbolics Lisp Machine. Helped architect, simulate and design prototype of HP's Precision Architecture RISC computer. The prototype took two man-years to complete and ran at VAX 11/780 speed in June 1983. This architecture became the basis of HP's computer product line for 15 years and then became the basis for the 64-bit generation of Intel processors.

#### **1978 to 1982**

Paid tuition and living expenses through MIT with employment and contract work for Wang Laboratories, Verbex Corporation, National Aeronautics and Space Administration, and other organizations.

### **Education (Massachusetts Institute of Technology)**

Ph.D. 1999 in electrical engineering and computer science. Thesis title: *Architecture and Implementation of Online Communities*.

S.M. 1993 in electrical engineering and computer science. Thesis title: *Site Controller: A system for computer-aided civil engineering and construction*.

S.B. 1982 in mathematics. Completed coursework for electrical engineering S.B. with emphasis on digital systems and signal processing. Took undergraduate and graduate computer science courses, with an emphasis on algorithms. Took graduate courses in microeconomics and neurophysiology.

### **Selected Publications**

[\*Software Engineering for Internet Applications\*](#) (online and MIT Press 2006), [\*Philip and Alex's Guide to Web Publishing\*](#) (Morgan Kaufmann; 1999), [\*Database Backed Web Sites\*](#) (Ziff Davis Press; 1997), [\*Travels with Samantha\*](#), a book about North America; [\*SITE CONTROLLER: A system for computer-aided civil engineering and construction\*](#); numerous journal articles; dozens of magazine articles. United States patents [5,172,363](#) (digital audio recorder circuit), [5,150,310](#) (location system), and [5,964,298](#) (computer-aided earthmoving system).

Most of my relevant publications are linked from <http://philip.greenspun.com/>.

### **Personal**

Birthdate: September 28, 1963. Some familiarity with French, Italian, and German.

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[philg@mit.edu](mailto:philg@mit.edu)

# **EXHIBIT 10**

# John P. Morgan

165 Beacon St. #26  
Somerville, MA 02143

☎ 760.782.7184

web, mobile, database, encryption  
software, security, legal, finance, aviation

✉ [johnpatrickmorgan@gmail.com](mailto:johnpatrickmorgan@gmail.com)  
<http://www.johnpmorgan.com>

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## Work History

- May 2011 – Present **Software Analyst, Independent Consultant.**  
Analyze the design, behavior, development process, communications, and source code of computer systems. Review development artifacts and compare systems to understand their origins, similarities, & differences.
- June 2009 – Feb 2012 **Software/Systems Engineer, GDC4S.**  
Designed and implemented internationally distributed high-security systems in support of the largest public key infrastructure in the world. Contributed to all phases of system lifecycle from architecture to retirement.
- May 2008 – Present **Flight Operations & Helicopter Pilot, Fair Weather Flying.**  
Oversee technology, marketing, sightseeing, flight & ground instruction, and management of the company's fleet of aircraft. Worked with FAA on the certification for two charter airlines and a helicopter flight school.
- July 2006 – May 2008 **Software Engineer, VMware, Inc.**  
Developed a suite of database-backed Web applications that interfaced to the company's legacy data store. Project resulted in a portal for generating a collection of reports for the company's sales and support staff.

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## Education

- Feb 2013 **Master of Science in Systems Engineering, Worcester Polytechnic Institute (WPI), Worcester, MA.**  
Program comprised of an interdisciplinary blend of software, design, architecture, and project management.
- May 2009 **B.S. Electrical & Computer Engineering, Franklin W. Olin College of Engineering, Needham, MA.**  
With concentration studying tech business & entrepreneurship through a partnership with Babson College.

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## Teaching Experience

- Jan 2011, 2012 **Relational Database Management Systems Course, Massachusetts Institute of Technology.**  
Co-developed and taught an intensive course on relational database systems and SQL programming at MIT.
- Feb 2010 – Present **Helicopter Pilot Ground School Course, East Coast Aero Club.**  
Co-developed and taught course on basics of helicopters, preparing hundreds of students for flight training.
- Fall 2007 **Computer Architecture Course, Franklin W. Olin College of Engineering.**  
Graded homeworks, evaluated lab assignments (Verilog), and held office hours as an ECE course assistant.

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## Select Projects

- Dec 2012 – Present **RiskLookout Risk Management and Analysis Platform, RiskLookout.com.**  
Created web application for tracking project traits and analyzing their impact on organizational performance.
- Aug 2012 – Nov 2012 **Combating Project Failure with High-Frequency Risk Assessment, Masters Capstone.**  
Authored paper on failures & failure detection in software projects via a frequent inventory of project traits.
- Feb 2011 – Present **Software & Intellectual Property Articles, philip.greenspun.com.**  
Co-authored a series of articles on the analysis and explanation of technology for the purpose of IP litigation.
- Feb 2011 – Jan 2012 **Data Access Control/Network Access Control, GDC4S.**  
Software technical lead for R&D project exploring attribute based access control for network & data security.
- Jan 2009 – Present **RapidBrief Online Pilot Briefing Service, RapidBrief.com.**  
Designed and implemented service for pilots to check weather and flight restrictions near their local airport.
- Sept 2008 – May 2009 **Unmanned Vehicle Design, Undergraduate Capstone: Aurora Flight Sciences/Office of Naval Research.**  
Created vehicle control and navigation software for autonomous boat participating in multi-UxV missions.



# **EXHIBIT 11**

**NATHANIEL POLISH, Ph.D.**  
**Daedalus Technology Group, Inc.**  
130 West 25<sup>th</sup> Street  
New York, NY 10001  
(212) 684-3890

**business  
experience  
1980-present**

**President**

**Daedalus Technology Group, Inc. successor to NPS ASSOCIATES** **NEW YORK, NY**  
Co-founded computer consulting firm. Employs up to twenty people as needed.

**clients  
include:**

Intellectual Property Consulting. Various anonymous clients. **NEW YORK, NY**  
**Consulting on patent valuation and strategy:** Act as an advisor on technical and intellectual property matters to various clients. Developed intellectual property for various companies. 2001-present.

SpekenHub. **NEW YORK, NY**  
**Predictive dialer deployment and operation:** During the 2012 election cycle assembled and ran a team of engineers to deploy, debug, and operate a large scale outbound calling server farm. This server farm supported hundreds of agents and millions of minutes of calling. 2012.

Risk Solutions International. **NEW YORK, NY**  
**Risk management:** Developed technology platform to allow for complex question and answer sessions with airport managers. The results of the sessions then generated planning documents used in risk management. Results were published as part of a Transportation Research Board research program. 2011-2013.

Smart Systems / Specialty Acquirer. **NEW YORK, NY**  
**Advanced Transit fare collection:** Founding member of board of directors. Advisor on technical and intellectual property matters. Developed intellectual property for the company. The company is engaged in the development and sale of advanced fare collection systems for mass transit using RFID technologies. 2004-present.

Skywi. **FORT WORTH, TX**  
**Wireless broadband:** Founding board of directors member. Advisor on technical and intellectual property matters. The company provides a variety of wireless broadband services to semi-rural customers using mesh networks. 2004-2009.

Placecorp. **NEW YORK, NY**  
**Wireless text messaging system:** Designed and developed a very large scale, multi-platform text messaging system. Acted as the lead technologist for a startup. In this capacity attended many venture capital meetings and developed all technical sections to the business plans. The system integrated advanced Interactive Voice Response (IVR) with email, paging, and SMS messaging. Oversaw and planned initial development of very small paging device to be manufactured in very high volume. 2000-2001.

Marketboy. **NEW YORK, NY**  
**Distributed market making system:** Provided a range of services in the areas of product definition, specification, and implementation strategy. Marketboy was a distributed system that allowed prospective purchasers and vendors to make bid and ask offers for proposed transactions. 2000.

Savos. **NEW YORK, NY**  
**Telephone to streaming audio bridge:** Developed, designed and deployed an industrial strength IVR system that allows users to access streaming media via their cell phones. The system supports up to 96 streams on a single chassis. Developed web based content management system and interface for customizable user preferences. 2000.

deliverENow.

NEW YORK, NY

**Online delivery system:** Developed a proof of concept prototype of online delivery system. This consisted of a stock clerk server written for Windows CE (Clio) with a CDPD network connection. It demonstrated how purchase and delivery information would be sent to an in-store stock person who prepares them for pickup by a member of the deliverENow courier network. Provided strategic technical advice. Served on board of advisors. Wrote technical specification of business and logistical components of the system. 2000.

Togglethis.

NEW YORK, NY

**Animation distribution system:** Developed critical components of initial version of email-delivered animation system. Components included MacroMedia Director Xtras as well as encryption functions. Developed tools to distribute and manage Togglethis's content, DTG built a custom UNIX email list-server. This server allowed Toggle administrators to create groups, upload episodes, and schedule the delivery of their content. Developed system architecture and language specification for the next version of the IC Engine, which drives the characters. 1998-1999.

JuniorNet.

BOSTON, MA

**Children's on-line service:** Designed, developed and lead the implementation of a large scale network system for delivery of children's entertainment and education content. Worked with the president and other key players to fit a technology strategy to corporate goals. System is required to serve from 200,000 to 1,000,000 subscribers and be supportable over three to five years. All project goals met within a \$1,000,000+ budget. 1997-2000.

One Click Charge.

NEW YORK, NY

Provide a wide range of consulting services starting with technology evaluation for the principal investor. Provided services in the areas of product definition, team formation and implementation strategy. Developed significant components of a substantial Internet micropayment and authentication system. 1998-2000.

Swatch.

WEEHAWKEN, NJ

**Ticketing system:** Implemented a radio frequency identification (RFID) based system for providing access to the 1998 Goodwill Games utilizing RFID tagged wristwatches. 1998-1999.

Instant Video Technologies, Inc./Burst.com

SAN FRANCISCO, CA

**Burstware** --. Designed and developed a series of products to deliver digital video and audio materials over wide-area internets using consumer grade computers. Products were designed to fit within the client's existing patent portfolio. 1995-1997.

**Technical evaluation** --. Provided technology strategy and evaluation services and acted as Technology Director. 1995-1997.

Assurenet.

BETHESDA, MD

**Internet Insurance system** --. Designed and developed a system for utilization of the Internet for the distribution and control of insurance agent support software. System can handle tens of thousands of simultaneous users. Member of Board of Directors. 1995-2002.

New Zealand Antarctic Project (NZAP) and US Antarctic Program (USAP).

ANTARCTICA

**Penguin Weighbridge** -- Designed, developed, and deployed system for tracking the comings and goings, weights, and Ids of Adelie penguins in their natural environment on three colonies on Ross Island, Antarctica. Systems run continuously for months in adverse conditions. 1994-present.

Electronic Digital Documents, Inc.

NEW YORK, NY

**Check Image Compression system** --. 1995-1999.

**Technology evaluation** --. 1995-1999.

American Veterinary Identification Devices, Inc.

NORCO, CA

**AVID reader** -- Designed and developed digital computer components of radio frequency identification system. Work involved imbedded microcontrollers and real-time digital signal

## Nathaniel Polish

processing in very noisy environment. Designed communications protocols including encryption and error checking schemes. Product in high volume (50,000 unit) production. 1988-1995.

Bannon & Co.

BEVERLY HILLS, CA

**Financial models** -- Developed detailed financial model of business with 49 separate operating entities in six separate operating companies under two holding companies. Models included projections and actuals on a quarterly basis over ten years. 1993.

**Technology valuation** -- Provided technology evaluation and valuation services for private placement memoranda for technology companies. 1993.

Amprobe Instrument, Inc.

LONG ISLAND, NY

**REMCON tester** -- Designed and implemented product life-cycle test fixture for a new and innovative solid state switch. Test fixture used by Underwriters Labs for approval. 1988.

Personal Computer Card Corporation

NEW YORK, NY

**Smart Cards** -- Designed smart card reader/writer system. Performed general design and component selection and wrote software for smart card communications. System design implemented in commercial product. 1987.

The Dun & Bradstreet Corporation

NEW YORK, NY

**Voice editing systems** -- Designed and built all parts of four generations of interactive voice editing systems. Editing systems produce output used in extensive, high quality speech synthesis system that is part of larger information delivery system. The systems are built on networks of computers in a variety of programming languages and systems. The system involved interactive user interfaces, screen windows, signal processing, and voice file systems. 1982-1991.

1997-2001 **Co-Founder, Director and CTO**  
I-RECALL, INC.

NEW YORK, NY

1996-1999 **Co-Founder, Director, CTO & Principal Product Designer**  
SOLILOQUY, INC.

NEW YORK, NY

**Natural language interfaces to databases:** Co-founded in 1996 a company to provide next generation interfaces to structured databases. Developed prototype system using speech recognition and speech synthesis to provide access to music and ecommerce databases. Raised \$1.5 million in angel investments. Company has raised a total of \$8 million through a variety of institutional and individual investors. Hired replacement CTO and exited company in 1999.

1991-1992 **President & Principal Product Designer**  
SIMPLICITY COMPUTING, INC.

NEW YORK, NY

Co-founded in 1991 a computer peripherals manufacturing company concentrating on portable products with international mass-market appeal. Main product: Simplicity Portable Drive, an IBMPC parallel port connected, portable disk storage system. Marketed domestically and in 25+ countries. Products marketed direct via telemarketers, trade shows, sales reps, and national advertising. Products distributed through dealers, distributors and national catalog houses. Company employed 10 people.

- Wrote business plan and raised \$350,000 startup funding
- Established marketing plans
- Directed marketing of products in trade shows, national advertisements and focus groups
- Managed employees
- Designed hardware and software for products
- Supervised hardware & software implementation teams. First units shipped less than six months from start of project.
- Supervised all aspects of manufacturing and testing process. Contracted with four manufacturing facilities and many suppliers for production.
- Supervised and established call-in customer support services

1989-1999 **President & CEO**  
MEASUREMENT & CONTROL PRODUCTS, INC.

NEW YORK, NY

**Nathaniel Polish**

Founded in August 1989 an electronic products development company. M&CP designs, develops, markets and sells its own products through retail, wholesale and catalog channels domestically and abroad. All manufacturing is contracted. Company was profitable in its first year of operation.

**Flagship product:**

**BitView** -- Hand held RS-232 data communications diagnostic monitor. Invented, developed and produced hardware and software. Developed and oversaw implementation of marketing strategies, budgets, and business plans. Product currently in third production run.

## Nathaniel Polish

### education

**1980-1993**    **COLUMBIA UNIVERSITY**    **NEW YORK, NY**  
Ph.D. in Computer Science, May 1993,  
Thesis: *Mixed Distance Measures for the Optimization of Concatenative Vocabularies in Speech Synthesis*.  
MPhil in Computer Science, December 1989.  
MS in Computer Science, December 1987.  
BA in Physics, Columbia College, May 1984.

### teaching positions

**1997**    **COLUMBIA UNIVERSITY**    **NEW YORK, NY**  
Adjunct Professor, Computer Science.  
Advanced undergraduate course: *Artificial Intelligence*.

**1989**    **COLUMBIA UNIVERSITY**    **NEW YORK, NY**  
Graduate Lecturer, Computer Science.  
Advanced undergraduate course: *Software Design*. Taught 68 advanced undergraduates. Supervised two teaching assistants. Students implemented full spreadsheet application under UNIX.

**1984-1985**    **CITY UNIVERSITY OF NEW YORK**    **NEW YORK, NY**  
Adjunct Professor, Experimental Psychology.  
Graduate-level course: *Computer Methods in Experimental Psychology*.

### publications and patents

**2009**    Silbernagl, Martin and Polish, Nathaniel. Learning Fare Collection System for Mass Transit. United States Patent 7,568,617. August 4, 2009.

**2009**    Silbernagl, Martin and Polish, Nathaniel. Learning Fare Collection System for Mass Transit. United States Patent 7,566,003. July 28, 2009.

**2002**    Beigel, Michael L.; Polish, Nathaniel; Frank, Steven R.; Malm, Robert E. Electronic identification system with improved sensitivity. United States Patent 6,472,975. October 29, 2002.

**2002**    Nathaniel Polish. Bilateral speech system. Speech dialogs for database access. United States Patent 6,430,531. August 6, 2002.

**1999**    Nathaniel Polish. System and method for distributing and managing digital video information in a video distribution network. United States Patent 5,963,202. October 5, 1999.

**1993**    Michael L. Beigel, Nathaniel Polish and Robert E. Malm. Multi-Mode Identification System. Fundamental RFID technology. United States Patent 5,235,326. August 10, 1993.

**1991**    Nathaniel Polish. Mixed Distance Measures for Synthetic Speech Evaluation. In *Proceedings of ICASSP-91*, Toronto, Canada, 1991.

**1988**    Nathaniel Polish. A Distributed Signal Processing Facility for Speech Research. In *Proceedings of AVIOS88*, San Francisco, CA. October 4-6 1988.

**1987**    Nathaniel Polish. Mixed Distance Measures for Optimizing Concatenative Vocabularies for Speech Synthesis: A Thesis Proposal. Columbia University Department of Computer Science technical report number CUCS-310-87, 1987.

**1983**    M. Morris, N. Polish, B. Zuckerman, and N. Kaifu. The Temperature of Molecular Gas in the Galactic Center Region. *The Astronomical Journal*, 88(8):1228-1235, August 1983.

## Nathaniel Polish

### research interests

Computer Speech, Distributed Systems, Interactive Environments.  
Software Engineering, Systems Engineering, Technology Policy.  
Knowledge-Based Approaches to Signal Processing.  
Computational Physics, Non-Linear Dynamics.

### professional societies

International Society for Electrical and Electronics Engineers (IEEE),  
Association of Computing Machinery (ACM),  
American Association for the Advancement of Science (AAAS).

### other interests

Foreign Policy, Political Science, Long Distance Bicycling, United States Space Program.

### grants

AT&T Special Projects Grant of \$25,000 for synthetic speech, 1986.

Financial support for Ph.D. work was provided by the New York State Science and Technology Foundation Center for Advanced Technology in Computers and Information Systems at Columbia University.

Santa Fe Institute Complex Systems Summer School, 2003. Month-long workshop in agent-based models, non-linear systems, and complexity.

### 1982-present

#### Technology development projects

Some technology development projects have included:

**Wildlife Tracking Systems** -- Implemented a remote monitoring system to track and weigh Adelie penguins on Ross Island, Antarctica. System was debugged on-site and made to function in adverse environmental circumstances. 1994-1997.

**Internet Systems** -- Implemented a LINUX Internet server with FTP and gopher services. Installed and Internet client for IBM/PC platform. 1994-1995.

**Image Compression Technology** -- Developed proof-of-concept system for a system to compress images of checks to very small file size. 1994.

**Biomedical Systems** -- Implemented a large biomedical system used in patient diagnostics.

Provided all necessary materials for Food and Drug Administration compliance. 1992-1993.

**Synthetic Speech Systems** -- Implemented and supported several generations of synthetic speech systems for commercial as well as research purposes. 1985-1999.

**Graphics** -- Developed high-speed drivers for several graphical devices and evaluated their applicability for interactive uses. Devices included: Vectrix, RAMTEK, Apple Lisa, and IBM Enhanced Graphic Adapter. 1983-1987.

**Voice Boards** -- Specified function requirements for several generations of high quality voice boards for Q-bus (PDP-11), Apple, MultiBus, and IBMPC bus. Developed high-speed drivers for each of the boards. 1982-1986.

**Video Disk and Touch Screens** -- Developed experimental interactive system utilizing computer controlled video disks and touch screens. 1982.

### 1994-present

#### Intellectual property projects

**A separate document detailing intellectual property projects is available on request.**

### tools

Languages commonly used:

Pascal 1980-1988

C 1985-present.

Other languages used: C++, Lisp, Java, and FORTRAN.

Assembler:

Intel 8048, 8051, 8088-pentium

Motorola 680xx (on Sun workstations)

TI 320xx signal processors

Zilog Z8, Z80

**Nathaniel Polish**

Protocols include:

TCP/IP, UDP, RPC and NFS

Operating systems commonly used: UNIX, MSDOS, Windows and p-system.

In circuit emulators.

Database tools.

**contact  
information**

Fax: (212)684-3875

Internet: polish@dtgroup.com

Office: (212)684-3890

Academic and business references available upon request.

November 2013.