

DANIEL ZAPPALA

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RESEARCH AREA

Networking and the Internet: Mesh and Ad Hoc Wireless Networks, Peer-to-Peer Networking, Multicast, Quality of Service

EDUCATION

6/90 – 8/97 Ph.D., Computer Science, University of Southern California
9/86 – 6/90 B.Sc., Electrical Engineering, Stanford University

EMPLOYMENT

8/04 – Associate Professor, Computer Science Department, Brigham Young University
Director, Internet Research Lab
9/97 – 8/04 Assistant Professor, Department of Computer and Information Science, University of Oregon
9/97 – 12/98 Consultant, Information Sciences Institute, University of Southern California
6/94 – 8/97 Research Assistant, Information Sciences Institute, University of Southern California
6/92 – 8/92 Summer Intern, Xerox Palo Alto Research Center
6/91 – 6/94 Research Assistant, Network and Distributed Systems Lab, Department of Computer Science, University of Southern California

PUBLICATIONS

- Brian Sanderson and Daniel Zappala, Reducing Source Load in BitTorrent, *The 18th International Conference on Computer Communications and Networks (ICCCN 2009)*, August, 2009. (conference)
- Daniel Scofield, Lei Wang and Daniel Zappala, HxH: A Hop-by-Hop Transport Protocol for Multi-Hop Wireless Networks, *The Fourth International Wireless Internet Conference (WICON 2008)*, November 2008. (conference)
- Jared Jardine and Daniel Zappala, A Hybrid Architecture for Massively Multiplayer Online Games, *The Seventh Annual Workshop on Network and Systems Support for Games (NetGames)*, October 2008. (conference)
- Manoj Pandey and Daniel Zappala, Hop-by-Hop Multicast Transport for Mobile Ad Hoc Wireless Networks, *The Fifth IEEE International Conference on Mobile Ad Hoc and Sensor Systems (MASS)*, October 2008, Pages 450-455. (conference, $60/250 = 24\%$)
- Manoj Pandey and Daniel Zappala, Scalable Multicast Routing for Ad Hoc Networks, *The Fourth International Workshop on Localized Communication and Topology Protocols for Ad Hoc Networks (LOCAN)*, October 2008, Pages 559-564. (workshop)
- Qiuyi Duan, Lei Wang, Charles D. Knutson and Daniel Zappala, Autonomous and Intelligent Radio Switching for Heterogeneous Wireless Networks, *The Fourth IEEE International Workshop Heterogeneous Multi-Hop Wireless and Mobile Networks (MHWMN)*, October, 2008, Pages 666-671. (workshop)
- Qiuyi Duan, Lei Wang, Charles D. Knutson and Daniel Zappala, Link Quality Prediction for Wireless Devices with Multiple Radios, *IEEE International Symposium on World of Wireless, Mobile and Multimedia Networks (WoWMoM)*, June 2008. (conference, $57/181 = 31\%$)
- Manoj Pandey, Roger Pack, Lei Wang, Qiuyi Duan and Daniel Zappala, To Repair or Not to Repair: Helping Routing Protocols to Distinguish Mobility From Congestion, *IEEE Infocom*, May 2007, Anchorage, Pages 2311 - 2315. (conference, $350+/1400+ = 25\%$)
- Manoj Pandey, Daniel Delorey, Qiuyi Duan, Lei Wang, Charles Knutson, Daniel Zappala, and Ryan Woodings, RIA: An RF Interference Avoidance Algorithm for Heterogeneous Wireless Networks, *IEEE WCNC*, March 2007, Hong Kong, Pages 4051 - 4056. (conference, $256/568 = 45\%$ networking track)

- Manoj Pandey and Daniel Zappala, A Scenario Based Evaluation of Mobile Ad Hoc Multicast Routing Protocols. *IEEE International Symposium on World of Wireless, Mobile and Multimedia Networks (WoWMoM)*, June 2005, Italy, Pages 31-41. (conference, 18/180 = 10%)
- Chris GauthierDickey, Virginia Lo, and Daniel Zappala. Using N-Trees for Scalable Event Ordering in Peer-to-Peer Games. *ACM NOSSDAV 2005*, June 2005, Skamania, Washington, Pages 87-92. (conference, 33/88 = 37%)
- Daniel Stutzbach, Daniel Zappala, and Reza Rejaie, The Scalability of Swarming Peer-to-Peer Content Delivery. *IFIP Networking 2005*, May, 2005, Waterloo, Ontario, Pages 15-26. (conference, 106/430 = 25%)
- C. GauthierDickey, D. Zappala, V. Lo, and J. Maas, Low Latency and Cheat-Proof Event Ordering for Peer-to-Peer Games. *The 14th ACM International Workshop on Network and Operating Systems Support for Digital Audio and Video (NOSSDAV)*, June 2004. (workshop, 24/95 = 25%)
- D. Zappala, V. Lo, and C. GauthierDickey. The Multicast Address Allocation Problem: A Theoretical Framework and Performance Evaluation. *Computer Networks*, Special Issue on the Global Internet, Elsevier Science, Volume 45, Issue 1, Pages 55 - 73, May 2004. (journal, 5/28 = 18%, best papers from Global Internet Symposium 2002)
- A. Farley, A. Proskurowski, D. Zappala, and K. Windisch, Spanners and Message Distribution in Networks. *Discrete Applied Mathematics*, Elsevier Science, Volume 137, Issue 2, Pages 159-171, March 2004. (journal)
- V. Lo, D. Zappala, D. Zhao, Y. Liu, and S. Zhao, Cluster Computing on the Fly: P2P Scheduling of Idle Cycles in the Internet. *Third International Workshop on Peer-to-Peer Systems*, February 2004. (conference, 27/145 = 19%)
- D. Zappala, Alternate Path Routing for Multicast. *IEEE/ACM Transactions on Networking*, Volume 12, Issue 1, Pages 30 - 43, February 2004. (journal)
- D. Zappala, C. GauthierDickey, and V. Lo, Modeling the Multicast Address Allocation Problem. *IEEE Globecom*, Seventh Global Internet Symposium, November 2002. (conference, 28/142 = 20%, top rated paper)
- V. Lo, D. Zappala, C. GauthierDickey, and T. Singer, A Theoretical Framework for the Multicast Address Allocation Problem. *IEEE Globecom*, *Seventh Global Internet Symposium*, November 2002. (conference, 28/142 = 20%)
- D. Zappala and D. Zhou, Performance Evaluation of Path Searching Heuristics for Multicast QoS Routing. *IEEE 11th International Conference on Computer Communications and Networks (ICCCN)*, October 2002. (conference, 80/300 = 27%)
- D. Zappala, A. Fabbri, and V. Lo, An Evaluation of Shared Multicast Trees with Multiple Cores. *Journal of Telecommunication Systems*, Kluwer Academic Publishers, March 2002. (journal, 14/169 = 8%, best papers from ICN'01)
- L. Zhang, S. Deering, D. Estrin, S. Shenker, and D. Zappala, RSVP: A New Resource ReSerVation Protocol. *IEEE Network*, September 1993. Re-published in *IEEE Communications Magazine*, 50th Anniversary Issue, 10 Landmark Articles from the IEEE Communications Society, 2002. (journal)
- D. Zappala, and A. Fabbri, Using SSM Proxies to Provide Efficient Multiple-Source Multicast Delivery. *IEEE Globecom*, *Sixth Global Internet Symposium*, November 2001. (conference, 18/74 = 24%, top rated paper)
- D. Zappala and A. Fabbri, An Evaluation of Shared Multicast Trees with Multiple Active Cores. *IEEE International Conference on Networking*, ICN'01, July 2001. (conference)
- A. Farley, V. Lo, A. Proskurowski, and D. Zappala, Issues in Scalable Multicast Protocols. Invited paper, *DIMACS Workshop on Multicasting: Architecture, Algorithms, and Applications*, May 2001. (workshop)
- D. Zappala and A. Fabbri, Deploying SSM Proxies for Efficient Multiple-Source Multicast Delivery. *Internet2 Network Research Workshop*, April 2001. (workshop)
- D. Zappala, Alternate Path Routing for Multicast. *IEEE Infocom 2000*, *Conference on Computer Communications*, March 2000. (conference, 192/717 = 27%)
- M. Livingston, V. Lo, K. Windisch, and D. Zappala, Cyclic Block Allocation. *First International Workshop on Networked Group Communication*, November 1999. (conference)
- S. Bajaj, L. Breslau, D. Estrin, K. Fall, S. Floyd, P. Haldar, M. Handley, A. Helmy, J. Heidemann, P. Huang, S. Kumar, S. McCanne, R. Rejaie, P. Sharma, S. Shenker, K. Varadhan, H. Yu, Y. Xu, and D. Zappala, Improving Simulation for Network Research. Department of Computer Science, University of Southern California, USC-CS-TR-98-702, March 1999. (technical report)

- S. Bajaj, L. Breslau, D. Estrin, K. Fall, S. Floyd, P. Haldar, M. Handley, A. Helmy, J. Heidemann, P. Huang, S. Kumar, S. McCanne, R. Rejaie, P. Sharma, S. Shenker, K. Varadhan, H. Yu, Y. Xu, and D. Zappala, Virtual InterNetwork Testbed: Status and Research Agenda. Department of Computer Science, University of Southern California, USC-CS-TR-98-678, July 1998. (technical report)
- D. Zappala, D. Estrin, and S. Shenker, Alternate Path Routing and Pinning for Interdomain Multicast Routing. Department of Computer Science, University of Southern California, USC-CS-TR-97-655, July 1997. (technical report)
- D. Zappala, and J. Kann, RSRR: A Routing Interface for RSVP. Internet Draft for RSVP Working Group, July 1998.
- D. Estrin, T. Li, Y. Rekhter, K. Varadhan, and D. Zappala, Source Demand Routing Protocol: Packet Format and Forwarding Specification, RFC 1940, May 1996.
- D. Zappala, RSVP Loop Prevention for Wildcard Reservations. RSVP Working Group Draft, February 1996.
- L. Breslau, D. Estrin, D. Zappala, and L. Zhang, Limited Distribution Updates to Reduce Overhead in Adaptive Internetwork Routing. Department of Computer Science, University of Southern California, USC-CS-TR-93-532, 1993. (technical report)
- L. Breslau, D. Estrin, D. Zappala, and L. Zhang, Exploiting Locality to Provide Adaptive Routing of Real-Time Flows in Global Internets. *4th IEEE ComSoc International Workshop on Multimedia Communication*, April 1992. (conference)

GRANTS AND INDUSTRIAL AWARDS

- NSF CNS, NeTS Small (PI: Daniel Zappala): Wifu: A Software Toolkit for Wireless Transport Protocols, 2009-2012, \$298,216.
- Office of Naval Research (PIs: Sean Warnick, Daniel Zappala), 2009-2010, \$79,501.
- Cisco Systems, University Research Program (URP) Award (PIs: Daniel Zappala, Kevin Almeroth): Building A Global Multicast Service, 2002-2003, \$100,000.
- NSF Special Projects (PIs: Virginia Lo, Arthur Farley, Andrzej Proskurowski, Daniel Zappala): Virtual Topologies for Multiparty Communication. 1999-2003, \$922,825.
- Intel Equipment Donation (PI: Daniel Zappala): Equipment for Network Research Lab. 2001, \$13,327.
- Intel/OCECS Faculty Fellowship (PIs: Virginia Lo, Daniel Zappala, Allen Malony): New Laboratory-based Courses in Networking and Operating Systems. 2000-2002, \$70,000.

SOFTWARE SYSTEMS

- *Treecalc: A Tool for Evaluating Multicast Routing. Primary Author.*
 - Treecalc is a simulator that compares different types of multicast trees based on delay, cost, traffic concentration, and router state. It was used in publications cited above for multiple cores and SSM proxies.
 - Code is available by request.
- *RSRR: A Routing Interface for RSVP. Primary Author.*
 - RSRR is the interface between RSVP (Internet resource reservation protocol) and multicast routing protocols; RSRR is implemented in *mrouted* (multicast routing daemon) and *RSVPd* (Resource Reservation Protocol daemon). *mrouted* is distributed with most Unix operating systems.
 - Code can be downloaded from Xerox at <ftp://parcftp.xerox.com/pub/net-research/ipmulti> and from ISI at <http://www.isi.edu/rsvp>.
- *RSVP: Resource Reservation Protocol. Member of Development Team.*
 - RVSP helps to provide Quality of Service connections in the Internet by making resource reservations on routers. It is a proposed standard within the IETF.
 - Primary author of RSVP code in SunOS 4.3 kernel, later ported to the BSD operating system kernels. For reference, code can be downloaded from <http://www.freebsd.org>.

- Member of the development team for the RSVP daemon distributed by ISI at <http://www.isi.edu/rsvp>. ISI's RSVP daemon is a reference implementation for various vendors; RSVP is currently implemented in most Cisco routers.
- *SDRP: Source Demand Routing Protocol. Primary Author.*
 - SDRP can be used to source route packets in the Internet, for example to avoid congestion.
 - Code and documentation can be downloaded from USC at <http://netweb.usc.edu/sdrp>.

SUPERVISED PH.D. STUDENTS

- *Brigham Young University*
 - Lei Wang, Fall 2006 - present.
 - Manoj Pandey, A Hop-by-Hop Architecture of Multicast Transport in Ad Hoc Wireless Networks, December 2009.
 - Qiuyi Duan, Autonomous and Intelligent Radio Switching, Brigham Young University, December 2008. (co-advisor).
- *University of Oregon*
 - Chris GauthierDickey, Fall 2002 - Spring 2004.
 - James Hiebert, Fall 2002 - Spring 2004.
 - Daniel Stutzbach, Fall 2001 - Spring 2004.

SUPERVISED M.S. STUDENTS

- *Brigham Young University*
 - Tim Larsen
 - Michael Heath
 - Roger Pack
 - Jared Jardine, The Hybrid Game Architecture: Distributing Bandwidth for MMOGs While Maintaining Central Control, October 2008.
 - Brian Sanderson, Reducing Seed Load in the BitTorrent File Sharing System, August 2008.
 - Robert Larsen, A BitTorrent Proxy, April 2008.
 - Daniel Scofield, Hop-by-Hop Transport Control for Multi-Hop Wireless Networks, April 2007.
 - Michael Simonsen, Design and Measurement of a Real-Time Peer-to-Peer Game, April, 2006.
- *University of Oregon*
 - Chris GauthierDickey, NEO: A Low-Latency and Cheat-proof Event Ordering Protocol for Peer-to-Peer Games, University of Oregon, June 2002.
 - Aaron Fabbri, Multiple-Source Multicast Using SSM Proxies, University of Oregon, June 2001.
 - Rayen Mohanty, Evaluation of Alternate Path Routing, University of Oregon, June 2000.
 - Prajna Dasgupta and Nita Viswanath, Real-Time Display of Multicast Routing State, University of Oregon, June 2000.
 - Tobias Brick, Muthu Muthiah, and Laxman Pulumati, VSAM: Visual SNMP Monitor, University of Oregon, June 2000.
 - Jiangbi Lin, Alternate Path Construction for Unicast and Multicast, University of Oregon, June 1999.

SUPERVISED UNDERGRADUATE STUDENTS

- *University of Oregon*
 - Nicholas Dale Trebon, Measuring the Performance of Multicast Proxies on the Internet, May 2002.

COURSES TAUGHT

◦ *Brigham Young University*

- 2009 – Fall CS 460 Computer Communications and Networking
- 2009 – Winter CS 360 Internet Programming
- 2008 – Fall CS 460 Computer Communications and Networking
CS 601R Wireless Mesh Networks
- 2008 – Winter CS 360 Internet Programming
- 2007 – Fall CS 460 Computer Communications and Networking
CS 660 Computer Networks
- 2007 – Winter CS 360 Internet Programming
- 2006 – Fall CS 460 Computer Communications and Networking
CS 660 Computer Networks
- 2006 – Winter CS 360 Internet Programming
CS 460 Computer Communications and Networking
- 2005 – Fall CS 460 Computer Communications and Networking
CS 660 Computer Networks
- 2005 – Spring CS 345 Operating Systems
- 2005 – Winter CS 460 Computer Communications and Networking
CS 601R Peer-to-Peer Networking

◦ *University of Oregon*

- 2004 – Spring Seminar on Peer-to-Peer Networking
- 2004 – Winter CIS 432/532 Introduction to Computer Networks
- 2003 – Fall CIS 610 Peer-to-Peer Networking
- 2003 – Spring CIS 632 Computer Networks
- 2003 – Winter CIS 415 Operating Systems
CIS 607 Seminar on Advanced Topics in Computer Networks
- 2002 – Fall CIS 432/532 Introduction to Computer Networks
- 2002 – Spring CIS 607 Seminar on Advanced Topics in Computer Networks
- 2002 – Winter CIS 632 Computer Networks
- 2001 – Fall CIS 415 Operating Systems
CIS 432/532 Introduction to Computer Networks
- 2001 – Spring CIS 632 Computer Networks
- 2001 – Winter CIS 432/532 Introduction to Computer Networks
CIS 607 Seminar on Multicast Routing
- 2000 – Spring CIS 632 Computer Networks
- 2000 – Winter CIS 415 Operating Systems
CIS 607 Seminar on Multicast Address Allocation
- 1999 – Fall CIS 410/510 Introduction to Computer Networks
CIS 607 Seminar on Advanced Topics in Computer Networks
- 1999 – Spring CIS 632 Computer Networks
CIS 607 Seminar on Multicast Address Allocation
- 1999 – Winter CIS 415 Operating Systems
CIS 607 Seminar on Multicast Routing
- 1998 – Fall CIS 410/510 Introduction to Computer Networks
- 1998 – Spring CIS 632 Computer Networks
- 1998 – Winter CIS 410/510 Introduction to Computer Networks

PROFESSIONAL SERVICE

- 2009: TPC for IEEE Infocom 2010, IEEE PerCom Workshop on Pervasive Wireless Networking 2010, IEEE Global Internet 2009, Reviewer for GENI (Global Environment for Network Innovations) Solicitation 2
- 2008: TPC for IEEE Infocom 2009 and IEEE Global Internet 2008
- 2007: TPC for IEEE Global Internet 2007 and IFIP Networking Conference 2008, Reviewer for Infocom 2008
- 2006: Reviewer for IEEE WCNC 2007, NTMS 2007 and Elsevier Science Computer Networks
- 2005: TPC for IFIP Networking Conference 2006, SIGCOMM 2005 Poster Committee, Reviewer for IEEE Wireless Communications Magazine and IEEE/ACM Transactions on Networks

- 2004: TPC for IFIP Networking Conference 2005, Infocom 2004 Travel Grant Committee, Reviewer for IPDPS 2005
- 2003: TPC for Conference on High Performance Computing 2004, Reviewer for Infocom 2004, IFIP Networking 2004, IEEE/ACM Transactions on Networks, and Elsevier Science Computer Networks
- 2002: TPC for ACM NOSSDAV 2003, Reviewer for ICC 2003
- 2001: TPC for ACM NOSSDAV 2002 and Globecom/Global Internet Symposium 2002, Organized and chaired Topology Generation/Masurement panel at Global Internet Symposium 2001, served on NSF CISE Research Infrastructure Panel
- 2000: TPC for Globecom/Global Internet Symposium 2001

UNIVERSITY SERVICE

- BYU Departmental Committees: Graduate Committee, Recruiting Committee, Computing Committee, Undergraduate Education, PhD Recruiting, External Funding
- UO Departmental Committees: Computer Resources, Faculty Hiring, Graduate Education, Undergraduate Education, CIT Minor, Constitution.