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, 6 pages. (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, 9 pages. (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)
- 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, Pages 60-65. (conference)
- 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, Pages 31-41. (conference)
- 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 Network and Operating System Support for Digital Audio and Video (NOSSDAV)*, 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. Maar, 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, Pages 134 - 139. (workshop, 24/95 = 25%)

- D. Zappala, V. Lo, and C. GauthierDickey. The Multicast Address Allocation Problem: Theory and Practice. *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, 6 pages. (conference, 27/145 = 19%)

- D. Zappala, Alternate Path Routing for Multicast. em 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, pages 2113-2117. (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, Pages 2108-2112 (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, Pages 248-254. (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, Pages 461-479. (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, Pages 1590-1594. (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. Varahdan, 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/Measurement 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.