

CURRICULUM VITAE

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Education

Ph.D. in Computer Science, University of Washington, August 1995
Advisors: Henry M. Levy and Edward D. Lazowska
Dissertation: *An Operating System Structure for Wide-Address Architectures*

Master of Science in Computer Science, University of Washington, May 1989
Advisor: Henry M. Levy

Bachelor of Arts, Dartmouth College, June 1985 (*cum laude*)
Double Major: Mathematics and Computer Science

Professional Appointments

Professor, Department of Computer Science, Duke University (effective July 2006).
Visiting Scholar, Renaissance Computing Institute (RENCI), 2011-2012.
Associate Professor, Department of Computer Science, Duke University (effective July 2002).
Visiting Scholar, Hewlett-Packard Laboratories, September 2003–June 2004.
Assistant Professor, Department of Computer Science, Duke University, September 1995–July 2002.
Senior Software Engineer, Digital Equipment Corporation, 1985–1994 (effective July 1987).

Research Summary and Background

My research deals with experimental software systems for efficient and reliable sharing of resources and information in computer networks ranging from clusters to the global Internet. Much of my recent research focuses on automated dynamic resource management for on-demand computing and storage utilities. Other research topics include network storage services, I/O prefetching, low-overhead network I/O, active storage, large-scale Internet services, Web caching and content delivery, self-organizing Internet service utilities, network emulation, grid computing environments, and multidisciplinary research efforts directed at managing, storing, and processing massive spatial data. My earlier work at the University of Washington dealt with distributed data sharing and data, cluster computing, and virtual memory models for wide-address (e.g., 64-bit) computers. My academic career is supplemented by several years of Unix kernel engineering experience with Digital Equipment Corporation overlapping with my graduate work.

Honors and Awards

IBM Faculty Partnership award, 2002; IBM Faculty Award: 2003, 2004, 2007-**2011**.
NetApp Faculty Fellowship, 2009.

Award papers: *Symposium on Operating System Design and Implementation (OSDI)*, 2000; *Usenix Technical Conference*, 2002.

National Science Foundation CAREER Young Investigator Research Initiation Award, 1996.

Intel Foundation Graduate Fellowship, 1993-1994.

Digital Equipment Corporation GEEP Fellowship, 1987-1989

Professional Activities

GENI Working Groups: NSF Global Environment for Network Investigations (GENI) project: *Services Working Group* (chair) 2007-2009; *Control Framework Working Group* (co-chair), 2009-2010. GENI Architecture Board voting member, 2011-

Program committees: 18th Network and Distributed System Security Symposium (NDSS 2012), ACM Cloud Computing Security Workshop (CCSW 2011), *Second ACM Symposium on Cloud Computing (SOCC 2011, program co-chair)*, *9th USENIX Symposium on File and Storage Technologies (FAST 2011)*, *First ACM Symposium on Cloud Computing (SOCC 2010)*; *International Conference on Testbeds and Research Infrastructures for the Development of Networks (TridentCom 2010, program co-chair)*; *International Conference on Autonomic Computing (ICAC 2010)*; *ACM Symposium on Operating Systems Principles (SOSP 2009, light committee)*, *Workshop on Automated Control for Datacenters and Clouds (ACDC09, program co-chair)*; *First Workshop on Hot Topics in Cloud Computing (HotCloud 2009)*; *Workshop on Power Aware Computing and Systems (HotPower 2009)*; *Workshop on Managed Multi-Core Systems (MMCS 2008)*; *Third Workshop on Machine Learning in Systems (SysML08)*, *Third Workshop on Economics of Networked Systems (NetEcon 2008)*, *USENIX Technical Conference 2008*, *USENIX/ACM Symposium on Networked System Design and Implementation (NSDI 2008)*, *USENIX Technical Conference 2007 (program co-chair)*, *Second Workshop on Machine Learning in Systems (program co-chair, SysML07)*, *First Workshop on Economics of Networked Systems (NetEcon 2006, program co-chair)*, *USENIX Technical Conference 2006*, *International Conference on Autonomic Computing 2006*, *WWW 2006 (deputy vice-chair for Performance, Reliability, and Scalability)*, *Supercomputing 2005 (program subchair for system software)*, *Third Workshop on Economics of Peer-to-Peer Systems (EconP2P 2005)*, *ACM SIGMETRICS 2004*, *International Conference on Autonomic Computing (ICAC-04)*, *IEEE International Symposium on High-Performance Distributed Computing (HPDC-13, 2004)*, *3rd USENIX Conference on File and Storage Technologies (FAST 2004)*, *First USENIX/ACM Symposium on Networked System Design and Implementation (NSDI 2004)*, *2003 Workshop on Network I/O (NICELI/SIGCOMM)*, *2003 Workshop on Hot Topics in Operating Systems (HotOS-IX)*, *2003 Conference on File and Storage Technologies (FAST program chair)*, *2002 Seventh International Workshop on Internet Content Caching and Distribution (program chair)*, *2002 Conference on File and Storage Technologies (FAST)*, *2001 IEEE International Conference on Distributed Systems (ICDCS)*, *2001 Sixth International Workshop on Web Caching and Content Delivery (WCW-6)*, *2001 World-Wide Web Conference (WWW10)*, *2000 World Wide Web Conference (WWW9)*, *1999 Seventh Workshop on Hot Topics in Operating Systems (HotOS-VII)*, *1999 World Wide Web Conference (WWW8)*, *1998 International Performance and Dependability Symposium (IPDS)*, *1997 ACM Symposium on Operating Systems Principles (SOSP)*.

Conference steering committees: *USENIX Conference on File and Storage Technologies (FAST)*, 2003-2007, *Workshop on Economics of Networked Systems (NetEcon, 2006-2007)*; *Workshop on Machine Learning in Systems (SysML)*, 2007-2008; *International Workshop on Internet Content Caching and Distribution (2002-2006)*.

Other conference organizing: 2004 *IEEE Computer Communications Workshop (CCW)*, 1999 *ACM Symposium on Operating Systems Principles (SOSP)*.

Reviewer for grant funding programs and leading conferences and journals in operating systems, distributed systems, Internet technologies, storage systems, and computer architecture.

Advisory Boards: Silverback Systems (2002-2006), Blue Stripe Software.

Consulting: Various clients. Expert witness: Latham and Watkins 2006-2008 (Veritas/Symantec Inc.), Kirkland and Ellis 2008-2009 (Limelight Networks), Quinn Emanuel 2010-2011 (Google), 2011-2012 (Motorola), Haynes and Boone 2011-2012 (AT&T).

Refereed Journal Publications

- L. Ramakrishnan, D. Gannon, D. Nurmi, R. Wolski, J. Chase. **Deadline-Sensitive Workflow Orchestration Without Explicit Resource Control.** *Journal of Parallel and Distributed Computing*, 71(3) pages 343-353, (Elsevier). March 2011.
- A. Yumerefendi and J. Chase. **Strong Accountability for Network Storage.** *ACM Transactions on Storage (TOS)*, 3(3), October 2007. Special issue: selected papers from the *Sixth USENIX Symposium on File and Storage Technologies (FAST)*.
- R. Sharma, C. Bash, C. Patel, R. Friedrich, and J. Chase. **Balance of Power: Dynamic Thermal Management for Internet Data Centers.** *IEEE Internet Computing*, 9(1): 42-49, January 2005.
- S. Anastasiadis, S. Gadde, and J. Chase. **Scale and Performance in Semantic Storage Management of Data Grids.** *Springer-Verlag International Journal on Digital Libraries, Special Issue on Semantic Web and Science Data Interoperation*, (2004) 00:1-15, September 2004.
- L. Toma, R. Wickremesinghe, L. Arge, J. Chase, J. Vitter, P. Halpin, and D. Urban. **Flow Computation on Massive Grids.** *Geoinformatica*, 7(4), December 2003.
- R. Wickremesinghe, L. Arge, J. Chase, and J. Vitter. **Efficient Sorting Using Registers and Caches.** *ACM Journal of Experimental Algorithmics (JEA)*, 7(1), December 2002.
- D. Anderson and J. Chase. **Failure-Atomic File Access in an Interposed Network Storage System.** *Cluster Computing: The Journal of Networks, Software Tools, and Applications*, 5(4):411-419, October 2002.
- R. Doyle, J. Chase, S. Gadde, and A. Vahdat. **The Trickle-Down Effect: Web Caching and Server Request Distribution.** *Elsevier Computer Communications*, 25(4): 345-356, March 2002.
- D. Anderson, J. Chase, and A. Vahdat. **Interposed Request Routing for Scalable Network Storage.** *ACM Transactions on Computer Systems (TOCS)*, 20(1): 25-48, February 2002.
- J. Chase, A. Gallatin, and K. Yocum. **End System Optimizations for High-Speed TCP.** In *IEEE Communications special issue on TCP Performance in Future Networking Environments*, 39(4):68-74, April 2001.
- W. Jin, J. Chase, X. Sun. **FastSlim: Prefetch-Safe Trace Reduction for I/O Cache Simulation.** *ACM Transactions on Modeling and Computer Simulation (TOMACS)*, (11)2, April 2001.
- S. Gadde, J. Chase, and M. Rabinovich. **Web Caching and Content Distribution: A View from the Interior** (extended version). In *Computer Communications*, 24(2):222-231, February 2001.
- M. Rabinovich, J. Chase, S. Gadde, **Not All Hits Are Created Equal: Cooperative Proxy Caching Over a Wide Area Network** (extended version). In *Journal of Computer Networks*, 30(2), October 1998.
- J. Chase, H. Levy, M. Feeley, and E. Lazowska. **Sharing and Protection in a Single Address Space Operating System.** In *ACM Transactions on Computer Systems (TOCS)*, November 1994.

Major Conference Publications

Works in this category are refereed standard-length conference papers (10-16 pages) presented in conferences with acceptance ratios below 30%.

- H. Lim, S. Babu, J. Chase. **Automated Control for Elastic Storage.** In *IEEE International Conference on Autonomic Computing (ICAC)*, June 2010.
- P. Shivam, V. Marupadi, J. Chase, T. Subramaniam, S. Babu. **Cutting Corners: Workbench Automation for Server Benchmarking.** In *USENIX Technical Conference*, June 2008.
- A. Yumerefendi and J. Chase. **Strong Accountability for Network Storage.** In the *Sixth USENIX Symposium on File and Storage Technologies (FAST)*, March 2007. Acceptance ratio: 19/98.

- L. Ramakrishnan, L. Grit, A. Iamnitchi, D. Irwin, A. Yumerefendi, J. Chase. **Toward a Doctrine of Containment: Grid Hosting with Adaptive Resource Control.** *Supercomputing* 2006. November 2006. Acceptance ratio: 54/239.
- P. Shivam, S. Babu, J. Chase. **Active and Accelerated Learning of Cost Models for Optimizing Scientific Applications.** *International Conference on Very Large Data Bases (VLDB)*, September 2006. Acceptance ratio:xx/yy.
- P. Ranganathan, D. Irwin, J. Chase. **Enclosure-Level Power Management for Dense Blade Servers.** *International Symposium on Computer Architecture (ISCA)*, June 2006. Acceptance ratio: 31/229.
- P. Shivam, S. Babu, J. Chase. **Learning Performance Models in Network Utilities.** In *IEEE International Conference on Autonomic Computing (ICAC)*, June 2006. Acceptance ratio: 26/120.
- J. Moore, J. Chase, P. Ranganathan. **Weatherman: Automated, Online, and Predictive Thermal Mapping and Management for Data Centers.** In *IEEE International Conference on Autonomic Computing (ICAC)*, June 2006. Acceptance ratio: 26/120.
- D. Irwin, J. Chase, L. Grit, A. Yumerefendi, D. Becker, K. Yocum. **Sharing Networked Resources with Brokered Leases.** In *USENIX Technical Conference*, June 2006. Acceptance ratio: 21/153.
- M. Karlsson, C. Karamanolis, J. Chase. **Controllable Fair Queuing for Meeting Performance Goals.** In *Performance 2005*, IFIP/Elsevier, October 2005.
- S. Anastasiadis, R. Wickremisinghe, J. Chase. **Lerna: An Active Storage Framework for Flexible Data Access and Management.** *Fourteenth International Symposium on High Performance Distributed Computing (HPDC-14)*, July 2005. Acceptance ratio: 24/153.
- J. Moore, J. Chase, P. Ranganathan. **Making Scheduling ``Cool'': Temperature-Aware Workload Placement in Data Centers.** In the *2005 USENIX Annual Technical Conference (USENIX '05)*, April 2005. Acceptance ratio: 24/118.
- I. Cohen, M. Goldszmidt, T. Kelly, J. Symons, and J. Chase. **Correlating Instrumentation Data to System States: A Building Block for Automated Diagnosis and Control.** In the *Sixth Symposium on Operating System Design and Implementation (OSDI)*, December 2004. Acceptance ratio: 27/193.
- W. Jin, J. Chase, and J. Kaur. **Interposed Proportional Sharing for a Storage Service Utility.** In the *Joint International Conference on Measurement and Modeling of Computer Systems (ACM SIGMETRICS/Performance)*, June 2004. Acceptance ratio: 33/265.
- D. Irwin, J. Chase, and L. Grit. **Balancing Risk and Reward in Market-Based Task Scheduling.** In the *Thirteenth International Symposium on High Performance Distributed Computing (HPDC-13)*, June 2004. Acceptance ratio: 24/153.
- M. Ripeanu, M. Bowman, J. Chase, I. Foster, and M. Milenkovic. **Globus and PlanetLab Resource Management Solutions Compared.** In the *Thirteenth International Symposium on High Performance Distributed Computing (HPDC-13)*, June 2004. Acceptance ratio: 24/153.
- S. Anastasiadis, R. Wickremisinghe, J. Chase. **Circus: Opportunistic Block Reordering for Scalable Content Servers.** In the *Third USENIX Conference on File and Storage Technologies (FAST)*, March 2004. Acceptance ratio: 18/72.
- K. Keeton, C. Santos, D. Beyer, J. Chase, J. Wilkes. **Designing for Disasters.** In the *Third USENIX Conference on File and Storage Technologies (FAST)*, March 2004. Acceptance ratio: 18/72.
- Y. Fu, J. Chase, B. Chun, S. Schwab, and A. Vahdat. **SHARP: An Architecture for Secure Resource Peering.** In the *19th ACM Symposium on Operating Systems Principles (SOSP)*, October 2003. Acceptance ratio: 22/128.
- J. Chase, L. Grit, D. Irwin, J. Moore, and S. Sprenkle. **Dynamic Virtual Clusters in a Grid Site Manager.** In the *Twelfth International Symposium on High Performance Distributed Computing (HPDC-12)*, June 2003. Acceptance ratio: 25/121.
- K. Yocum, J. Chase, and A. Vahdat. **Anypoint: Extensible Transport Switching on the Edge.** In the *Fourth USENIX Symposium on Internet Technologies and Systems (USITS)*, March 2003. Acceptance ratio: 19/75.

R. Doyle, O. Asad, J. Chase, and A. Vahdat. **Model-Based Resource Provisioning in a Web Service Utility**. In the *Fourth USENIX Symposium on Internet Technologies and Systems (USITS)*, March 2003. Acceptance ratio: 19/75.

A. Vahdat, K. Yocum, K. Walsh, P. Mahadevan, D. Kostic, J. Chase, D. Becker. **Scalability and Accuracy in a Large-Scale Network Emulator**. In the *Fifth Symposium on Operating System Design and Implementation (OSDI)*, December 2002. Acceptance ratio: 27/150.

R. Wickremesinghe, J. Vitter, J. Chase. **Distributed Computing with Load-Managed Active Storage**. In the *IEEE International Symposium on High-Performance Distributed Computing (HPDC-11)*, July 2002.

R. Braynard, D. Kostic, A. Rodriguez, J. Chase and A. Vahdat. **The Case for an Overlay Utility Service**. In *The Fifth IEEE Conference on Open Architectures and Network Programming (OPENARCH 2002)*. June 2002.

K. Magoutis, S. Addetia, A. Fedorova, M. Seltzer, J. Chase, A. Gallatin, R. Kisley, R. Wickremesinghe, and E. Gabber. **Structure and Performance of the Direct Access File System**. In *2002 USENIX Annual Technical Conference*. June 2002. *Best paper award*. Acceptance ratio: 25/105.

J. Chase, D. Anderson, P. Thakar, A. Vahdat, and R. Doyle. **Managing Energy and Server Resources in Hosting Centers**. In the *18th ACM Symposium on Operating System Principles (SOSP)*, October 2001. Acceptance ratio for *SOSP-18*: 17/85.

K. Yocum and J. Chase. **Payload Caching: High-Speed Data Forwarding for Network Intermediaries**. In the *2001 USENIX Technical Conference*, June 2001. Acceptance ratio for *USENIX-01*: 24/82.

D. Anderson, J. Chase, and A. Vahdat. **Interposed Request Routing for Scalable Network Storage**. In the *Fourth ACM/USENIX Symposium on Operating System Design and Implementation (OSDI)*, October 2000. Acceptance ratio for *OSDI-2000*: 24/111. This paper is one of four award papers selected for journal publication in a special issue of *ACM TOCS*.

D. Anderson and J. Chase. **Failure-Atomic File Access in an Interposed Network Storage System**. In the *Ninth IEEE International Symposium on High Performance Distributed Computing (HPDC-9)*, August 2000. Acceptance ratio for *HPDC-9*: 32/103.

D. Anderson, J. Chase, S. Gadde, A. Gallatin, K. Yocum, M. Feeley. **Cheating the I/O Bottleneck: Network Storage with Trapeze/Myrinet**. In *Proceedings of the 1998 USENIX Technical Conference*, June 1998. Acceptance ratio for *USENIX-98*: 23/87.

G. Cohen, J. Chase, D. Kaminsky. **Automatic Program Transformation with JOIE**. In the *1998 USENIX Technical Conference*, June 1998. Acceptance ratio for *USENIX-98*: 23/87.

G. Voelker, T. Kimbrel, M. Feeley, A. Karlin, J. Chase, H. Levy. **Cooperative Prefetching and Caching in a Globally-Managed Memory System**. In *Proceedings of the 1998 ACM Conference on Performance Measurement, Modeling, and Evaluation (SIGMETRICS)*, June 1998. Acceptance ratio for *SIGMETRICS-98*: 25/135.

M. Feeley, J. Chase, V. Narasayya, and H. Levy. **Integrating Coherency and Recovery in Distributed Systems**. In *Proceedings of the First USENIX Symposium on Operating System Design and Implementation (OSDI)*, November, 1994. Acceptance ratio for *OSDI-94*: 21/178.

E. Koldinger, S. Eggers, and J. Chase. **Architectural Support for Single Address Space Operating Systems**. In *Proceedings of the ACM Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS)*, October 1992. Acceptance Ratio for *ASPLOS-92*: 24/150+.

J. Chase, H. Levy, M. Baker-Harvey, and E. Lazowska. **Lightweight Shared Objects in a 64-bit Operating System**. In *Proceedings of the ACM Conference on Object-Oriented Programming Systems, Languages, and Applications (OOPSLA)*, October 1992. Acceptance Ratio for *OOPSLA-92*: 41/250.

M. Feeley, B. Bershad, J. Chase, and H. Levy. **Dynamic Node Reconfiguration in a Parallel-Distributed Environment**. In *Proceedings of the Third ACM Symposium on Principles and Practices of Parallel Programming (PPoPP)*, April 1991. Acceptance Ratio for *PPoPP-91*: 21/79.

J. Chase, F. Amador, E. Lazowska, H. Levy, and R. Littlefield. **The Amber System: Parallel Programming on a Network of Multiprocessors**. In *Proceedings of the 12th ACM Symposium on Operating System Principles (SOSP)*, December 1989. Acceptance Ratio for *SOSP-89*: 20/84.

Invited Papers and Book Chapters

J. Chase. **Demand Response for Computing Centers**. Invited chapter for *Green High-Performance Computing*. Wuchun Feng, editor. Taylor and Francis. Expected in 2012. (26 pages)

J. Chase. **Software Implementation of TCP**. Invited chapter for *High Performance TCP/IP Networking*. Mahbub Hassan and Raj Jain, editors. Prentice Hall, 2003. ISBN:0130646342. (29 pages)

J. Chase. **Single Address Space Operating Systems**. Invited entry for the *Encyclopedia of Distributed Computing*. Joseph E. Urban and Partha Dasgupta, editors. Kluwer Academic Press. September 1999. (3 pages)

J. Chase, D. Anderson, A. Gallatin, A. Lebeck, and K. Yocum. **Network I/O with Trapeze**. In the *1999 IEEE Symposium on High-Performance Interconnects (Hot Interconnects-7)*, August 1999. Invited for a special session on network storage. (7 pages)

Other Conference Publications

Works in this category are other papers published in refereed workshops and conferences, with a presentation unless otherwise indicated.

A. Mandal, Y. Xin, I. Baldine, P. Ruth, C. Heerman, J. Chase, V. Orlikowski, A. Yumerefendi. **Provisioning and Evaluating Multi-Domain Clouds for Hadoop-based Applications**. *2011 Workshop on Network Infrastructure Services for Cloud Computing (NetCloud)*, Athens, Greece, December 2011. (8 pages)

A. Brown, J. Chase. **Trusted Platform-as-a-Service: A Foundation for Trustworthy Cloud-Hosted Applications**. *2011 ACM Cloud Computing Security Workshop (CCSW 2011)*, Chicago IL, October 2011.

Y. Xin, I. Baldine, J. Chase, T. Beyene, A. Chakraborty. **Virtual Smart Grid Architecture and Control Framework**. *2nd IEEE Conference on Smart Grid Communications*, Brussels, Belgium, October 2011.

Y. Xin, I. Baldine, A. Mandal, C. Heerman, J. Chase, A. Yumerefendi. **Embedding Virtual Topologies in Networked Clouds**. *6th International Conference on Future Internet Technologies*, Seoul, Korea, June, 2011. (4 pages)

I. Baldine, Y. Xin, A. Mandal, C. Heerman, J. Chase, V. Marupadi, A. Yumerefendi, D. Irwin. **Networked Cloud Orchestration: A GENI Perspective**. *IEEE Workshop on Management of Emerging Networks and Services (MENS)*, Miami, Florida, December, 2010. (6 pages)

I. Baldine, Y. Xin, D. Evans, C. Heerman, J. Chase, V. Marupadi, A. Yumerefendi. **The Missing Link: Putting the Network in Networked Cloud Computing**. *International Conference on the Virtual Computing Initiative (ICVCI '09)*, a forum for participants in IBM's Virtual Computing Initiative. (6 pages)

A. Demberel, J. Chase, S. Babu. **Reflective Control for an Elastic Cloud Application: An Automated Experiment Workbench**. *First Workshop on Hot Topics in Cloud Computing (HotCloud '09)*, June 2009. (6 p)

H. Lim, S. Babu, J. Chase, S. Parekh. **Automated Control in Cloud Computing: Challenges and Opportunities**. *Workshop on Automated Control for Data Centers and Clouds (ACDC '09)*, June 2009. (6 p)

I. Constandache, A. Yumerefendi, and J. Chase. **Secure Control of Portable Images in a Virtual Computing Utility**. *First Workshop on Virtual Machine Security (VMSec)*, October 2008. (8 pages)

J. Chase, I. Constandache, A. Demberel, L. Grit, V. Marupadi, M. Saylor, A. Yumerefendi. **Controlling Dynamic Guests in a Virtual Computing Utility**. *International Conference on the Virtual Computing Initiative (ICVCI '08)*, a forum for participants in IBM's Virtual Computing Initiative, May 2008. This paper was selected for publication via ACM Digital Library. (8 pages)

- A. Yumerefendi, P. Shivam, D. Irwin, P. Gunda, L. Grit, A. Demberel, J. Chase, and S. Babu. **Toward an Autonomic Computing Testbed**. *Second Workshop on Hot Topics in Autonomic Computing (HotAC II)*. June 2007. (6 pages)
- J. Chase, L. Grit, D. Irwin, V. Marupadi, P. Shivam, A. Yumerefendi. **Beyond Virtual Data Centers: Toward an Open Resource Control Architecture**. *International Conference on the Virtual Computing Initiative (ICVCI '07)*, a forum for participants in IBM's Virtual Computing Initiative, May 2007. This paper was selected for publication via ACM Digital Library. (8 pages)
- L. Grit, D. Irwin, V. Marupadi, P. Shivam, A. Yumerefendi, J. Chase, and J. Albrecht. **Harnessing Virtual Machine Resource Control for Job Management**. In *Workshop on System-Level Virtualization for High-Performance Computing (HPCVirt)*. March 2007.
- P. Shivam, S. Babu, J. Chase. **Active Sampling for Accelerated Learning of Performance Models**. In the *First Workshop on Tackling Computer Systems Problems with Machine Learning (SysML)*, June 2006 (6 pages). Acceptance ratio: 8/20.
- J. Moore, J. Chase, P. Ranganathan. **ConSil: Low-Cost Thermal Mapping of Data Centers**. In the *First Workshop on Tackling Computer Systems Problems with Machine Learning (SysML)*, June 2006 (6 pages). Acceptance ratio: 8/20.
- D. Irwin, J. Chase, L. Grit, A. Yumerefendi. **Self-Recharging Virtual Currency**. In the *Third Workshop on Economics of Peer-to-Peer Systems (EconP2P 2005)*, August 2005 (6 pages).
- A. Yumerefendi and J. Chase. **The Role of Accountability in Dependable Distributed Systems**. In the *First Workshop on Hot Topics in Dependability (HotDep '05)*, June 2005 (6 pages). Acceptance ratio: 10/39.
- J. Moore, J. Chase, K. Farkas, P. Ranganathan. **Data Center Workload Modeling, Analysis, and Emulation**. In the *Eighth Workshop on Computer Architecture Evaluation Using Commercial Workloads (CAECW '05)*, February 2005 (8 pages). Invited.
- A. Yumerefendi and J. Chase. **Trust but Verify: Accountability for Internet Services**. In the *Eleventh ACM SIGOPS European Workshop*, September 2004 (6 pages, no presentation). Acceptance ratio: 37/99.
- K. Keeton, D. Beyer, J. Chase, A. Merchant, C. Santos, and J. Wilkes. **Lessons and Challenges in Automating Data Dependability**. In the *Eleventh ACM SIGOPS European Workshop*, September 2004 (6 pages). Acceptance ratio: 24/99.
- J. Moore, R. Sharma, R. Shih, J. Chase, C. Patel, and P. Ranganathan. **Going beyond CPUs: The Potential of Temperature-Aware Solutions for the Data Center**. In the *First Workshop on Temperature-Aware Computer Systems (TACS-1)*, June 2004 (8 pages).
- K. Yocum, E. Eade, J. Degeys, D. Becker, J. Chase, and A. Vahdat. **Toward Scaling Network Emulation using Topology Partitioning**. In the *11th International Symposium on Modeling, Analysis, and Simulation of Computer and Telecommunication Systems (MASCOTS)*, October 2003 (4 pages).
- P. Shivam and J. Chase. **On the Elusive Benefits of Protocol Offload**. In the *Workshop on Network-I/O Convergence: Experience, Lessons, Implications (NICELI)*, at SIGCOMM, August 2003 (6 pages).
- J. Chase, A. Vahdat, J. Wilkes. **Back to the Future: Dependable Computing = Dependable Services**. Extended abstract in the *Tenth ACM SIGOPS European Workshop*, September 2002. (4 pages, no presentation)
- A. Vahdat and J. Chase. **Self-Organizing Subsets: From Each According to His Abilities, to Each According to His Needs**. *First International Workshop on Peer-to-Peer Systems*, March 2002. (6 pages, no presentation)
- S. Gadde, J. Chase, and A. Vahdat. **Coarse-Grained Network Simulation for Wide-Area Distributed Systems**. In *Communication Networks and Distributed System Modeling and Simulation Conference (CNDS)*, January 2002. (8 pages)
- L. Arge, J. Chase, L. Toma, J.S. Vitter, R. Wickremesinghe, P. Halpin and D. Urban. **Flow Computation on Massive Grids**. In the *9th ACM Symposium on Advances in Geographic Information Systems (ACM-GIS)*, November 2001. Acceptance ratio for ACM-GIS-01: 29/95. (6 pages)

J. Chase. **Server Switching: Yesterday and Tomorrow**. In *Workshop on Internet Applications (WIAPP)*, July 2001. Acceptance ratio for *WIAPP-01*: 15/35. (10 pages)

R. Doyle, J. Chase, S. Gadde, and A. Vahdat. **The Trickle-Down Effect: Web Caching and Server Request Distribution**. In *Sixth International Workshop on Web Caching and Content Delivery (WCW-6)*, June 2001. Acceptance ratio for *WCW-6*: 21/61. This paper is one of 10 selected for journal publication. (10 pages)

R. Wickremesinghe, L. Arge, J. Chase, and J. Vitter. **Efficient Sorting Using Registers and Caches**. In *Fourth Workshop on Algorithm Engineering (WAE 00)*, September 2000. (12 pages) Invited for *ACM Journal of Experimental Algorithmics (JEA)*.

K. Yocum and J. Chase. **Experiences with Fast Forwarding in Myrinet**. In *Myrinet User Group Workshop*, September 2000. (10 pages)

S. Gadde, J. Chase, and M. Rabinovich. **Web Caching and Content Distribution: A View from the Interior**. In *Fifth International Workshop on Web Caching and Content Delivery (WCW-5)*, May 2000. Acceptance ratio for *WCW-5*: 16/36. (9 pages)

G. Berry, J. Chase, G. Cohen, L. Cox, and A. Vahdat. **Toward Automatic State Management for Dynamic Web Services**. In the *1999 Internet-2 Network Storage Symposium (NetStore-99)*, Seattle, WA, October 1999. (12 pages)

D. Anderson, J. Chase, and K. Yocum. **A Case for Buffer Servers**. In the *1999 Workshop on Hot Topics Operating Systems (HOTOS VII)*, Rio Rico AZ, May 1999. (5 pages, no presentation)

A. Gallatin, J. Chase, and K. Yocum. **Trapeze/IP: TCP/IP at Gigabit Speeds**. In the *1999 USENIX Technical Conference (Freenix Track)*, June 1999. (11 pages)

S. Gadde, J. Chase, and M. Rabinovich. **A Taste of Crispy Squid**. In the *1998 ACM Workshop on Internet Server Performance (WISP)*, June 1998. (8 pages)

M. Rabinovich, J. Chase, and S. Gadde. **Not All Hits Are Created Equal: Cooperative Proxy Caching Over a Wide Area Network**. In *Fourth International Workshop on World Wide Web Proxy Caching (WCW-4)*, April 1998. (10 pages)

K. Yocum, J. Chase, A. Gallatin, and A. Lebeck. **Cut-Through Delivery in Trapeze: An Exercise in Fast Messaging**. In *Proceedings of the Sixth IEEE International Symposium on High Performance Distributed Computing (HPDC-6)*, August 1997. Acceptance ratio for *HPDC-97*: 36/76. (10 pages)

S. Gadde, M. Rabinovich, and J. Chase. **Reduce, Reuse, Recycle: An Approach to Building Large Internet Caches**. In *Proceedings of the Sixth Workshop on Hot Topics in Operating Systems (HotOS- VI)*. May 1997. Acceptance ratio for *HotOS- VI*: 23/81. (6 pages)

R. Schmidt, J. Chase, and H. Levy. **Using Shared Memory for Read-Mostly RPC Services**. In *Proceedings of the 29th Hawaii International Conference on System Sciences (HICSS)*, January 1996. (9 pages)

J. Chase, M. Feeley, and H. Levy. **Some Issues for Single Address Space Systems**. In *Fourth IEEE Workshop on Workstation Operating Systems (WWOS)*, October 1993. Acceptance ratio for *WWOS-4*: 35/52. (5 pages)

J. Chase, H. Levy, and V. Issarny. **Supporting Distribution in a Single Address Space Operating System**. In *5th ACM SIGOPS European Workshop*, September 1992. Acceptance ratio for *EURO-SIGOPS-92*: 50/76. Also appeared in *ACM Operating Systems Review*, April 1993. (6 pages)

J. Chase, H. Levy, and A. Tiwary. **Using Virtual Addresses as Object References**. In the *IEEE 2nd International Workshop on Object Orientation in Operating Systems (IWoOOS)*, September 1992. (6 pages)

J. Chase, H. Levy, E. Lazowska, and M. Baker-Harvey. **Opal: A Single Address Space System for 64-Bit Architectures**. In *IEEE Workshop on Workstation Operating Systems (WWOS)*, April 1992. (5 pages)

Work-in-Progress Papers and Posters

Works in this category are short refereed summaries with no presentation. Works prior to 2001 are omitted.

L. Grit and J. Chase. **Weighted Fair Sharing for Dynamic Virtual Clusters**. Refereed poster at ACM SIGMETRICS, June 2008.

P. Shivam, A. Demberel, P. Gunda, D. Irwin, L. Grit, A. Yumerefendi, S. Babu, J. Chase. **Automated On-Demand Provisioning of Virtual Machines for Database Applications**. Refereed demo, *ACM International Conference on Management of Data (SIGMOD)*. June 2007.

Shirako project poster/demo at OSDI and Supercomputing, 2006.

P. Shivam, A. Iamnitchi, A. Yumerefendi, J. Chase. **Model-Driven Placement of Compute Tasks and Data in a Networked Utility**. February 2005. Poster at *International Conference on Autonomic Computing (ICAC '05)*, June 2005.

K. Keeton, D. Beyer, J. Chase, S. McCaughan, A. Merchant, C. Santos, and J. Wilkes. **Designing dependable data storage systems**. In *Hewlett-Packard Technical Conference*. June, 2004.

K. Magoutis, S. Addetia, A. Fedorova, M. Seltzer, J. Chase, A. Gallatin, R. Kiskey, R. Wickremesinghe, and E. Gabber. **Structure and Performance of the Direct Access File System**. Project statement and poster for the *18th ACM Symposium on Operating System Principles (SOSP)*, October 2001. Acceptance ratio for *SOSP-18* posters: 20/45.

R. Braynard, D. Kostic, A. Rodriguez, J. Chase and A. Vahdat. **OPUS: An Overlay Utility Service**. Project statement and poster for the *18th ACM Symposium on Operating System Principles (SOSP)*, October 2001. Accepted: 20/45.

S. Sprenkle and J. Chase. **Scaling Java-Based Dynamic Web Services**. Project statement and poster for the *18th ACM Symposium on Operating System Principles (SOSP)*, October 2001. Accepted: 20/45.

J. Chase and R. Doyle. **Balance of Power: Energy Management for Server Clusters**. Position summary (1 page) for the *8th Workshop on Hot Topics in Operating Systems (HotOS-VIII)*, May 2001. 60% of submissions were accepted for presentation or position summary.

K. Yocum, J. Chase, and A. Vahdat. **Anypoint Communication Protocol**. Position summary (1 page) for the *8th Workshop on Hot Topics in Operating Systems (HotOS-VIII)*, May 2001. 60% of submissions were accepted for presentation or position summary.

Internet Engineering Task Force (IETF) Drafts

IETF drafts are unrefereed working drafts produced to define or propose new Internet standards or issues for discussion within the IETF.

A. Romanow, C. Sapuntzakis, and J. Chase. **The Case for Remote Direct Memory Access (RDMA)**, *draft-csapuntz-caserdma-00.txt*. December, 2000.

J. Williams, J. Pinkerton, C. Sapuntzakis, J. Wendt, and J. Chase. **Upper Layer Protocol Framing for TCP**, *draft-williams-tcpulframe-01*. March 2001.

Submitted Work and Selected Technical Reports

Works in this category are selected papers of standard conference length (10 pages or more) reporting on significant research activities not reflected in the papers listed above. All works prior to 1997 are omitted.

J. Chase. **Authorization and Trust Structure in GENI: A Perspective on the Role of ABAC**. GENI working paper, groups.geni.net. (18 pages). June 2011.

J. Chase, I. Baldine, Y. Xin, A. Mandal, C. Heerman, A. Yumerefendi., D. Irwin. **Cloud Network Infrastructure as a Service: An Exercise in Multi-Domain Orchestration**. March 2010. (6 pages)

S. Babu, V. Thummala, S. Duan, P. Shivam, P. Franklin, J. Chase. **A Case for Automating Experiment-driven Management of Database Systems**. October 2008.

L. Grit and J. Chase. **Weighted Fair Sharing for Dynamic Virtual Clusters**. November 2007.

- P. Shivam, S. Babu, S. Duan, P. Gunda, A. Demberel, D. Irwin, J. Chase. **Experiment-Driven Query Processing for System Management**. October 2007.
- A. Yumerefendi, D. Irwin, V. Marupadi, M. Sayler, L. Grit, and J. Chase. **Robust Leasing for Networked Virtual Infrastructure**. October 2007.
- L. Grit, J. Chase, D. Irwin, A. Yumerefendi. **Adaptive Virtual Machine Hosting with Brokers**. May 2006.
- R. Wickremesinghe, P. Shivam, and J. Chase. **Adaptive Load Management for Web-based Data Services**, May 2004.
- M. Aguilera, J. Chase, M. Goldszmidt, M. Kallahala, C. Karamanolis, M. Karlsson, and M. Uysal. **Black-Cloud and Grey-Cloud Performance Control for Utilities**, May 2004.
- K. Yocum and J. Chase. **Explicit Rate Control for Anypoint Communication**, June 2004.
- J. Moore, J. Chase, K. Farkas, and P. Ranganathan. **A Sense of Place: Toward a Location-Aware Data Plane for Data Centers**, December 2003.
- J. Moore, L. Grit, D. Irwin, S. Sprenkle, and J. Chase. **Managing Mixed-Use Clusters with Cluster-on-Demand**. November 2002.
- D. Anderson and J. Chase. **Fstress: A Flexible Network File Service Benchmark**. September 2002.
- G. Cohen and J. Chase. **An Architecture for Safe Bytecode Insertion**, November 2000.
- K. Yocum, D. Anderson, J. Chase, S. Gadde, D. Gallatin, A. R. Lebeck. **Adaptive Message Pipelining for Network Memory and Network Storage**. *Duke University TR CS-1998-10*, March 1998.
- S. Gadde, J. Chase, and M. Rabinovich. **Directory Structures for Scalable Internet Caches**. *Duke University Computer Science Technical Report CS-1997-18*, November 1997.

Software

ORCA/Shirako. Leasing core and toolkit for an Open Resource Control Architecture (Orca Project). Released under Eclipse open-source license, June 2007. This release includes Cluster-on-Demand (COD) plug-in resource manager and Automat experimental portal software. My research group has developed and refined this software over a three-year period prior to initial release in 2007. <http://niel.cod.cs.duke.edu/orca>

The expanded ORCA control framework software was re-released in 2009 under MIT software license for use as a candidate control framework in NSF's Global Environment for Network Innovations (GENI) project. Users in GENI "Cluster-D" testbed projects using ORCA include VISE and DOME testbed groups (U. Mass Amherst), Kansei Wireless Testbed (The Ohio State University), RENCIs Breakable Experimental Network, and new partners for GENI Spiral-2 prototyping effort.

In 2011, the ORCA software with further extensions was demonstrated at Supercomputing 2011, and selected for the GENI Spiral 4 ExoGENI deployment on 15 campuses (<http://www.exogeni.net>).

Patents

Network with Shared Caching. Filed October 1997, awarded May 1999 (with S. Gadde and M. Rabinovich, assignee: AT&T Corporation).

System and Method for Adaptive Message Pipelining. Filed November 1998, awarded November 2000 (with K. Yocum, assignee: Duke University). License agreement with Open Invention Network LLC completed in January 2009.

Method, System and Computer Program Product for Hierarchical Load Balancing. Filed July 2001 (with R. Doyle, assignee: IBM Corporation).

Method of Designing Storage System. Filed November 2004 (with K. Keeton and J. Wilkes, assignee: Hewlett-Packard Company).

Configuration System and Method. Filed September 2005 (with K. Keeton, J. Wilkes, and A. Merchant, assignee: Hewlett Packard Company).

Institutional Service

Service for Duke University: Information Technology Advisory Council (ITAC) and Institutional Data Working Group, Spring 1995 - Spring 1997. Vice President for Information Technology (VP/IT) Search Committee, August-December 2001. Mass Storage Oversight Committee, July 2001 – present. Cluster Advisory Committee, July 2002 – present. OIT Senior Technology Architect Search Committee, November 2002. Steering Committee for CSEM (Computational Science, Engineering, and Medicine), 2003 – present. Duke faculty representative for RENCi, 2006-2008. Consultant to CSEM for computing/storage infrastructure, 2006 (informal). Duke representative for ORNL petascale proposal to NSF (2006, funded), Computing Advisory Committee (Fall 2007), CIO/VP-IT Review Committee (Chair, Fall 2007), Duke representative for RENCi Director Search Committee (2008-2009), Faculty Co-Director for Scalable Computing (2008-2011).

Service for Duke Department of Computer Science: Faculty Search Committee (Systems: 1995, 1996, 1998, 2000, 2002, 2003, 2005-2009; Algorithms: 1998), Graduate Admissions Committee (1996, adjunct in 1997 and 1998, 2002-2008 (**chair** in 2006 and 2007), 2010, **2011**). Undergraduate advisor (2000-2002, 2008-), Strategic Planning Committee (2002-2003), Director of Graduate Studies for Computer Science (2002-2008), various faculty review committees (chaired two junior faculty reappointment committees in 2008, one full professor promotion committee in 2009).

Panels and Presentations

Selected recent presentations. **2011:** multiple GENI events; U. Mass Amherst (September), Williams College (September), Cornell (September), NCSU trustworthy cloud computing meeting (September), Network Appliance technical lunch (April). **(2010:** GENI plenary demo (March), multiple GENI events, DoE-LBL (November), Cisco technical lunch (November). **2009:** multiple GENI events, IBM Virtual Computing forum (October), IBM Smarter Planet forum (November). **2008:** NSF GENI Engineering Conference (GEC2, February), IBM university

event (May), GENI steering forum at CNRI (June), GENI Engineering Conference (GEC3, October), NSF-EU GENI-FIRE International Collaboration Workshop (December), EU Future Internet Assembly meeting (December). **2007:** IBM university events (February, May, October). **2006:** Duke Frontiers (May), ICAC (June), SysML (July), IBM RTP (August), Harvard University (September), demo at Supercomputing (November), HP Labs (December). **2005:** Duke Frontiers (May); Network Appliance (May); University of Wisconsin-Madison (June), HPDC (July), NSF Grand Challenges workshop (September). **2004:** IBM University Partners Workshop (February); U. Kentucky (March); Duke Grid Workshop (April); Purdue University (April); *FAST* (April); HP Labs (April); *SIGMETRICS* (June), U. Chicago (June), UT Austin (September), IBM University Partners Workshop (October), Intel Autonomic Computing Seminar (October). **2003:** ORNL/ORAU cyberinfrastructure workshop (February); NSF CISE-RI workshop (August); Cornell (October); Opticomm (October), Veritas (November), HP Labs (November). **2002:** IBM Almaden (May), NSF CISE-RI Snowbird workshop (July), IBM Hawthorne (October), UCSD (November), PlanetLab workshop (December). **2001:** *WCW* (June), IBM RTP (July) *WIAPP* (July), HP Labs (August), *SOSP* (October), *IETF* (December), Cornell (December). **2000:** *WCW* (May), *OSDI* (October), NSF CISE Research Infrastructure PI workshop (July). **1999:** CMU (January), National Storage Industry (May), NCGNI/MCNC Internet-2 Workshop (May), Data General (July), IBM (July), *Hot Interconnects Symposium* (August), *Netstore Symposium* (October), Tandem Labs (October), Compaq Systems Research Center (October), University of Washington (October), Microsoft Research (October), *FreeBSDCon Symposium* (invited talk, October), University of Utah (October), HP Labs (October), University of Virginia (November).

Invited Panels: Two panels on GENI Control Frameworks at *GENI Engineering Conference*, November 2009; Rethinking File Systems (*HotStorage* workshop, October 2009); Green Clouds: Power Consumption as a First-Order Criterion? (*International Conference on Autonomic Computing*, June 2009); Clean-Slate Internet Architecture and Management (European Union Future Internet Assembly, December 2008); Critical Grid Research Issues: Perspective and Lessons from Large-Scale Grids, *Symposium on High Performance Distributed Computing* (HPDC, June 2004); Battle of the Network Stars, *Supercomputing 2003* (November 2003); Infrastructure as a Research Enabler (*NSF CISE-RI workshop*, August 2003); Content Distribution, *Workshop on Web Caching and Content Delivery* (*WCW*, May 2000); 64-bit Address Spaces, *Workshop on Workstation Operating Systems* (*WWOS*, March 1992); Virtual Memory Management, *Workshop on Workstation Operating Systems* (*WWOS*, October 1993).

Professional Affiliations

Member of the Association for Computing Machinery (ACM), and USENIX.

Teaching and Course Development

CPS 296, *Topics in Virtual Memory*, Spring 1995 (*developed*: a one-time graduate-level offering)

CPS 210, *Operating Systems* (graduate), Fall 1995, Fall 1996, Spring 1998 (with Lebeck and Yousif), Spring 2002, Spring 2003, Spring 2008, Spring 2009, Spring 2010.

CPS 212, *Distributed Information Systems* (graduate), Spring 1996, Spring 1997, Fall 1998, Fall 2000, Fall 2002, Fall 2007, Fall 2010 (*developed* and accepted by Duke University in 10/97 as a regular graduate-level distributed systems course).

CPS 114/214, *Networks and Distributed Systems* (combined graduate and undergraduate), Spring 2005, Spring 2007.

CPS 110, *Operating Systems* (undergraduate) Fall 1997, Spring 1998, Spring 1999, Spring 2000, Spring 2001, Fall 2008, Fall 2009, Spring 2011.

CPS 49S, *Six Centuries of Internetworking*, Fall 2001 (*developed*: a freshman seminar).

CPS 196, *Systems and Networks*, Spring 2006 (*developed*: new undergraduate introductory course in systems, to replace core curriculum course in operating systems).

CPS 49S, *The Global Commons: Conflict and Cooperation on the Internet*, Fall 2006 (*developed*: a freshman seminar).

CPS 300, *Introduction to Graduate Study in Computer Science*, Fall 2002, Fall 2004, Fall 2005, Fall 2006.

Research Supervision

PhD students completed qualifying requirements: Andrew Brown, Harold Lim.

Postdoctoral supervision: Stergios Anastasiadis (2003-2004), Wei Jin (2001), Adriana Iamnitchi (2004-2005).

Graduated PhD students:

1. Wei Jin, *Practical I/O Prefetching*, June 2000 (Shaw University).
2. Geoff A. Cohen, *Architecture, Implementation, and Applications of Bytecode Transformation*, May 2001 (Ernst and Young Business Innovations Center).
3. Darrell C. Anderson, *Virtualized Network Storage*, November 2002 (Google).
4. Ronald P. Doyle, *Model-Based Adaptive Resource Provisioning in a Web Service Utility*, November 2003 (IBM).
5. Kenneth G. Yocum, *Anypoint: A Network Communication Model for Internet Services*. December 2003 (UCSD, Research Scientist).
6. Rajiv Wickremesinghe, *Methods and Models for Reconfigurable Data-Intensive Computing*. December 2004 (Oracle).
7. Justin Moore, *Automated Cost-Aware Data Center Management*, May 2006 (Google).
8. David Irwin, *An Operating System Architecture for Network Server Infrastructure*, December 2007 (U. Mass Amherst, Research Scientist).
9. Laura Grit, *Extensible Resource Management for Networked Virtual Computing*, December 2007 (Amazon)
10. Piyush Shivam, *Proactive Experiment-Driven Learning for System Management*, December 2007 (Sun Microsystems). Co-advised with Shivnath Babu.
11. Aydan Yumerefendi, *System Support for Strong Accountability*, February 2009 (Blue Stripe Software).

Graduated terminal MS students:

1. Yong Gao, thesis: *A Shadowing Network File Service*, September 1996. Employed at Oracle Corporation.
2. Nnaemeka Egwuekwe, Jr, thesis: *Castalia: A Toolkit for Trap-Driven Simulation of Virtual Memory Paging Behavior*, December 1996. African-American, employed at Hewlett-Packard's Internet Security group.
3. Carmine Greco, thesis: *A Simple Shared Data Space for Web-Based Distributed Collaborative Applications*, April 1997. Employed at IBM's Emerging Internet Technologies group (RTP).
4. Jeffrey Scott Ransbottom, thesis: *DU-NET: An Implementation of User Level Communication in Digital Unix*, May 1997. Primary advisor was Alvin Lebeck. Employed by the United States Army.
5. Rung-Huang Tsai, project: *Method Logging for a Persistent Virtual Heap*, December 1997. Employed at Oracle Corporation.
6. Padmini Krishnan, project: *A Dynamic Web Service for I/O System Visualization*, December 1999. Employed at Cisco Systems.
7. Richard Kisley, project: *Structure, Implementation, and Performance of the Direct Access File System*, August 2001. Employed at IBM's Network Storage group.
8. Omer M. Asad, project: *DASH: Dynamic Resource Provisioning Infrastructure for Data Centers*, December 2002. Employed at Sun Microsystems.
9. Sara Sprenkle, project: *Using Leases for High Resource Efficiency in Resource Management*. January 2004. Continuing in PhD program at U. Delaware.
10. Vinay Bansal, project: *An Integration of the Globus Toolkit with SHARP*. April 2005. Employed at Cisco Systems.
11. Thileepan Subramaniam, project: *Improving File Server Benchmarking with a Managed Testbed*, May 2007. Employed at Riverbed Technology.
12. Kareem Dana, project: *Honest Shirking in Content Swarms*, May 2009. (Blue Stripe Software)
13. Matthew Saylor, project: *Open Resource Control with Cloud Middleware*, July 2009.
14. Varun Marupadi, project: *The Missing Link: Dynamic Virtual Networks*, September 2009. (Amazon)