

# Paul Barford

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## Research Interests

Computer networking with an emphasis on techniques for measuring and analyzing of Internet traffic characteristics and topological structure. Internet security including detection of traffic anomalies and identification of malicious attacks and intrusions.

## Education

**PhD. Computer Science** 2000  
Boston University, Boston, MA  
Dissertation: Modeling, Measurement and Performance of World Wide Web Transactions  
Adviser: Mark Crovella

**B.S. Electrical Engineering** 1985  
University of Illinois, Urbana-Champaign, IL

## Professional Experience

**Computer Science Department, Univ. of Wisconsin**, Madison, WI 2011 - present  
Professor, Director of the Wisconsin Advanced Internet Laboratory  
(Associate Professor: 2008 - 2011, Assistant Professor: 2001 - 2007)

**comScore, Inc.** Reston, VA 2014 - present  
Chief Scientist

**M.labs, Inc.** Madison, WI 2013 - 2014  
Co-founder, Chief Scientist - Mdot was acquired by comScore, Inc. in 2014

**Qualys, Inc.** Redwood Shores, CA 2010 - 2011  
Chief Scientist

**Computer Laboratory, University of Cambridge**, Cambridge, UK 2010 - 2011  
Visiting Professor

**Nemean Networks, LLC**, Madison, WI 2007 - 2010  
Founder, Chief Executive Officer - Nemean was acquired by Qualys, Inc. in 2010

**Computer Science Department, Boston University**, Boston, MA 1995 - 2000  
Research Fellow

**DeGeorge Financial, Inc.**, Cheshire, CT 1991 - 1995  
Director of Planning and Research

**Digital Equipment Corporation**, Maynard, MA 1987 - 1991  
Senior Engineer

**Mathematics Department, University of Illinois** Urbana-Champaign, IL 1985 - 1986  
Teaching Assistant

## Consulting Experience

|   |             |
|---|-------------|
| Technical Advisory Board member - Broadcast Interactive Media     | 2011 - 2014 |
| Board of Directors - National LambdaRail, Inc.                    | 2003 - 2010 |
| Technical Advisory Board member - epicRealm, Inc., Richardson, TX | 1999 - 2003 |
| Technical Advisory Board member - Netheartbeat, Inc., Austin, TX  | 2000 - 2001 |
| Infolibria, Inc. Waltham, MA                                      | 1998 - 1999 |

## Awards and Honors

|   |      |
|---|------|
| ACM Fellow  | 2016 |
| ACM SIGCOMM Global Access to the Internet for All Workshop, Best Paper Award  | 2016 |
| ACM CoNEXT, Best Short Paper Award  | 2014 |
| ACM Distinguished Scientist   | 2014 |
| University of Wisconsin Computer Science Department Carolyn Rosner Excellent Educator Award                             | 2014 |
| Madison Magazine's M List   | 2013 |
| Honorary professor - Kappa Eta Kappa, Delta Chapter   | 2013 |
| ACM SIGCOMM HotPlanet Workshop, Best Paper Award - Runner up  | 2013 |
| ACM SIGKDD, Best Paper Award  | 2012 |
| ACM SIGKDD, Best Video Award  | 2012 |
| IEEE Senior Member  | 2011 |
| UK Engineering and Physical Sciences Research Council, Visiting Fellowship  | 2010 |
| Wolfson College, University of Cambridge, Visiting Fellowship   | 2010 |
| IEEE COMSNETS, Best Paper Award   | 2009 |
| IEEE Symposium on Computers and Communications, selection for fast-track journal publication                            | 2006 |
| National Science Foundation CAREER Award  | 2004 |
| IEEE Communications Society William R. Bennett Prize in the Field of Communications Circuits and Techniques - Runner up | 2002 |
| ACM SIGCOMM, selection for fast-track journal publication   | 2000 |

## Professional Activities

### Memberships

|   |             |
|---|-------------|
| NSF/CISE AC Midscale Infrastructure Subcommittee                  | 2012 - 2014 |
| ACM SIGCOMM Nominating Committee                                  | 2009        |
| NSF/GENI Facility Architecture Working Group                      | 2006 - 2007 |
| NSF/GENI Instrumentation and Measurement Working Group (co-chair) | 2009 - 2012 |

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|---|-------------|
| ACM Internet Measurement Conference Steering Committee<br>ACM, IEEE | 2006 - 2012 |
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**Editorial Boards**

|   |             |
|---|-------------|
| Associate Editor, IEEE/ACM Transactions on Networking | 2007 - 2010 |
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**Program Chairs**

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| ACM SIGCOMM                                    | 2013 |
| ACM SIGMETRICS                                 | 2010 |
| ACM SIGCOMM First Workshop on Green Networking | 2010 |
| ACM Internet Measurement Conference            | 2006 |

**Program Committees**

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| ACM Internet Measurement Conference  | 2001, 2004 – 2007, 2009, 2010, 2014 – 2017 |
| ACM SIGMETRICS   | 2003, 2004, 2007, 2008, 2010, 2012, 2018   |
| ACM SIGCOMM  | 2004, 2007, 2011, 2013, 2014               |
| ACM SIGMETRICS Workshop on GreenMetrics  | 2009, 2010, 2012                           |
| ACM SIGCOMM Workshop on Green Networking   | 2010, 2011                                 |
| USENIX Security Symposium  | 2008, 2009                                 |
| ACM/USENIX Workshop on Steps to Reduce Unwanted Traffic on the Internet (SRUTI)          | 2005, 2007                                 |
| IEEE ICNP  | 2003, 2012                                 |
| Passive and Active Measurement Conference  | 2012, 2014                                 |
| USENIX Symposium on Networked Systems Design and Implementation (NSDI)                   | 2016                                       |
| ACM SIGCOMM Workshop on Hot Topics in Software Defined Networks (HotSDN)                 | 2014                                       |
| ACM/USENIX Workshop on Hot Topics in Networks (HotNets)                                  | 2005                                       |
| ACM/USENIX Workshop on Hot Topics in BotNets (HotBots)                                   | 2007                                       |
| ACM Computer and Communications Security Conference                                      | 2008                                       |
| ACM Workshop on Rapid Malcode (WORM)   | 2004                                       |
| ACM CoNEXT Conference  | 2006                                       |
| IEEE Workshop on Internet Applications   | 2003                                       |
| IEEE 6th International Computer Performance and Dependability Symposium                  | 2002                                       |
| USENIX 4th International Workshop on Networking Meets Databases (NetDB)                  | 2008                                       |
| International Teletraffic Congress (ITC28)   | 2016                                       |
| International Conference on Future Energy Systems  | 2012                                       |
| International Workshop on Green Communications   | 2011                                       |
| Asian Internet Engineering Conference (AINTEC)   | 2008                                       |
| Securecomm Conference  | 2009                                       |
| Workshop on Performance Evaluation of Next Generation Networks                           | 2009                                       |
| Workshop on Cyber Security Experimentation and Test                                      | 2009                                       |
| Workshop on Tackling Computer Systems Problems with Machine Learning Techniques (SysML)  | 2006                                       |
| Multiresolution Analysis of the Global Internet Workshop                                 | 2000                                       |
| Boston University Workshop on Internet Measurement, Instrumentation and Characterization | 1999                                       |

World Wide Web Consortium Workshop on Web Characterization 1998

### Organizing Committees

Institute for Computational and Experimental Research in Mathematics (ICERM)  
Workshop on Mathematics of Data Analysis in Cybersecurity 2014

NSF/DIMACS Workshop on Algorithms in the Field 2011

First NSF/GENI Workshop on Network Measurement 2009

Institute for Pure and Applied Mathematics (IPAM)  
Program on Internet Multiresolution Analysis: Foundations, Applications and Practice 2008

Workshop on Internet Signal Processing 2004

IEEE Opensig 2003

IEEE ICNP (tutorials co-chair) 2003

Institute for Pure and Applied Mathematics (IPAM)  
Workshop on Large Scale Networks: Topology, Routing, Traffic and Control 2002, 2003

Computer Science and Telecommunications Board of the National Research Council  
Study on Internet Under Crisis Conditions 2002

### Panelist

National Science Foundation 2002 – 2005, 2007 – 2010, 2012, 2014, 2017

### U.S. Patents

1. Matthew Malloy and Paul Barford. “System and Method for Transmitting Content Based on Co-location”, Patent pending, 2016.
2. Charles Thomas and Paul Barford. “System and Process for Detecting Content Blocking Software”, Patent pending, 2016
3. Paul Barford and Jeff Kline. “Method and System for Identifying Anomalous Content Requests”, Patent pending, 2016.
4. Matthew Malloy, Scott Alfeld and Paul Barford. “Fraudulent Traffic Detection and Estimation”, Patent pending, 2016.
5. Michael Brown, Rajesh Bashetty, Paul Barford, Kevin Springborn and Jon Koller. “Method and System for Data-Informed Online Advertisement Delivery”, Patent pending, 2015.
6. Joel Sommers, Paul Barford, Nick Duffield and Amos Ron. “Method and Apparatus for Detecting and Localizing an Anomaly for a Network”, US Patent #9,571,366.
7. Joel Sommers, Paul Barford, Nick Duffield and Amos Ron. “A Methodology and Apparatus for Providing a Measurement of Performance for a Network”, US Patent #8,073,945.
8. Paul Barford, Jonathon Giffin, Somesh Jha and Vinod Yegneswaran. “A Semantically-Aware Network Intrusion Signature Generator”, US Patent #8,065,722
9. Vinod Yegneswaran, Paul Barford and David Plonka. “Scalable Monitor for Malicious Network Traffic”, US Patent #8,015,605
10. Paul Barford and David Plonka, “Apparatus and Method for Classifying Network Packet Data”, US Patent #7,907,543

## Refereed Journal Publications and Book Chapters

1. Ram Durairajan and Paul Barford. “A Techno-Economic Framework for Broadband Deployment in Underserved Areas”, In *ACM SIGCOMM Computer Communications Review*, Vol. 47(2), April, 2017.
2. Brian Eriksson, Paul Barford, Bruce Maggs and Rob Nowak. “Posit: A Lightweight Approach for IP Geolocation”, In *ACM SIGMETRICS Performance Evaluation Review*, Vol. 40(2), September, 2012.
3. Paul Barford, Sem Borst and Mark Squillante: Editors. In *Queuing Systems, Theory and Applications*, Vol. 71(3), July, 2012.
4. Brian Eriksson, Gautam Dasarathy, Paul Barford and Rob Nowak. “Efficient Network Tomography for Internet Topology Discovery”, In *IEEE/ACM Transactions on Networking*, Vol. 20(3), pp. 931-943, June, 2012.
5. Brian Eriksson, Paul Barford, Joel Sommers and Rob Nowak. “Inferring Unseen Components of the Internet”, In *IEEE Journal of Selected Areas of Communications*, November, 2011.
6. Mariyam Mirza, Joel Sommers, Paul Barford and Jerry Zhu. “A Machine Learning Approach to TCP Throughput Prediction”, In *IEEE/ACM Transactions on Networking*, Vol. 18(4), pp. 1026-1039, October, 2010.
7. Joel Sommers, Paul Barford, Nick Duffield and Amos Ron. “Multi-objective Monitoring for SLA Compliance”, In *IEEE/ACM Transactions on Networking*, 18(2), pp. 652-665, April, 2010.
8. Jin-Yi Cai, Vinod Yegneswaran, Chris Alfeld and Paul Barford. “Honeynet Games: A Game Theoretic Approach to Defending Network Monitors”, In the *Journal of Combinatorial Optimization*, February, 2010.
9. Paul Barford, Yan Chen, Anup Goyal, Zhichun Li, Vern Paxson and Vinod Yegneswaran. “Employing Honeynets For Network Situational Awareness”, In *Series: Advances in Information Security*, Springer, 2009.
10. Joel Sommers, Paul Barford, Nick Duffield and Amos Ron. “A Geometric Method for Active Packet Loss Measurement”, In *IEEE/ACM Transactions on Networking*, Vol. 16(2), pp. 307-320, April, 2008.
11. Joel Sommers, Paul Barford, Albert Greenberg and Walter Willinger. “A SLA Perspective on Router Buffer Sizing”, In *ACM SIGMETRICS Performance Evaluation Review*, Vol. 35(4), pp.40-51, March, 2008.
12. Joel Sommers, Paul Barford and Walter Willinger. “In Vitro Calibration of Available Bandwidth Estimation Tools”, In *Elsevier Microprocessors and Microsystems Journal*, Vol. 31(4), pp. 222-235, June, 2007.
13. Paul Barford and Vinod Yegneswaran. “A Look Inside Botnets”, In *Series: Advances in Information Security*, Springer, pp. 171-191, February, 2007. ISBN: 0-387-32720-7.
14. Paul Barford and Joel Sommers. “Comparing Probe- and Router-based Packet Loss Measurement”, In *IEEE Internet Computing*, Vol. 8(5), pp. 50-56, September, 2004.
15. James Gast and Paul Barford. “Representing the Internet as A Succinct Forest”, In *IEEE Computer Networks*, Vol. 45(1), pp. 35-44, March, 2004.
16. Paul Barford and Larry Landweber. “Bench-style Network Research in an Internet Instance Laboratory”, In *ACM SIGCOMM Computer Communications Review*, Vol. 33(3), pp. 21-26, July, 2003.
17. Paul Barford and Mark Crovella. “Critical Path Analysis of TCP Transactions”, in *IEEE/ACM Transactions on Networking*, Vol. 9(3), pp. 238-248, June 2001.
18. Mark Crovella, Martin Reiser and Christoph Lindemann: editors, “Internet Performance Modeling,” In *Performance Evaluation*, Vol. 42(2-3), pp. 91-108, October, 2000.

19. Paul Barford and Mark Crovella. "Measuring Web Performance in the Wide Area," in *ACM SIGMETRICS Performance Evaluation Review*, Vol. 27(2), pp. 37-48, September 1999.
20. Paul Barford, Azer Bestavros, Mark Crovella and Adam Bradley. "Changes in Web Client Access Patterns: Characteristics and Caching Implications," in *World Wide Web*, Special Issue on Characterization and Performance Evaluation, Vol. 2, pp. 15-28, December, 1998.

## Refereed Conference and Workshop Publications

1. Matthew Malloy, Paul Barford, Enis Ceyhun Alp, Jon Koller and Adria Jewell. "Internet Device Graphs", In *Proceedings of the ACM SIGKDD Conference on Knowledge Discovery and Data Mining (KDD)*, Halifax Nova Scotia, August, 2017.
2. Scott Alfeld, Jerry Zhu and Paul Barford. "Explicit Defense Actions Against Test-Set Attacks", In *Proceedings of the Conference on Artificial Intelligence (AAAI)*, San Francisco, CA, February, 2017.
3. Sathiya Mani, Ram Durairajan, Paul Barford and Joel Sommers. "MNTP: Enhancing Time Synchronization for Mobile Devices," In *Proceedings of the ACM Internet Measurement Conference*, Santa Monica, CA, November, 2016.
4. Matt Malloy, Mark McNamara, Aaron Cahn and Paul Barford. "Ad Blockers: Global Prevalence and Impact," In *Proceedings of the ACM Internet Measurement Conference*, Santa Monica, CA, November, 2016.
5. Meena Syamkumar, Ram Durairajan and Paul Barford. "Bigfoot: A Geo-based Visualization Methodology for Detecting BGP Threats", In *Proceedings of the IEEE Symposium on Visualization for Cybersecurity (VizSec)*, Baltimore, MD, October, 2016.
6. Charles Thomas, Jeff Kline and Paul Barford. "IntegraTag: a Framework for High-Fidelity Web Client Measurement", In *Proceedings of ITC 28 Conference*, Wurzburg, Germany, September, 2016.
7. Aaron Cahn, Scott Alfeld, Paul Barford and S. Muthukrishnan. "What's in the Community Cookie jar", In *Proceedings of the IEEE/ACM Conference on Advances in Social Network Analysis and Mining (ASONAM '16)*, San Francisco, CA, August, 2016.
8. Ram Durairajan and Paul Barford. "A Techno-Economic Framework for Broadband Deployment in Underserved Areas", In *Proceedings of the ACM SIGCOMM Global Access to the Internet for All (GAIA Workshop)*, Florianopolis, Brazil, August, 2016.
9. Aaron Cahn, Scott Alfeld, Paul Barford and S. Muthukrishnan. "An Empirical Study of Web Cookies", In *Proceedings of the World Wide Web Conference (WWW '16)*, Montreal, CA, April, 2016.
10. Scott Alfeld, Jerry Zhu and Paul Barford. "Data Poisoning Attacks against Autoregressive Models", In *Proceedings of the Conference on Artificial Intelligence (AAAI)*, Phoenix, AZ, February, 2016.
11. Ram Durairajan, Sathiya Kumaran, Joel Sommers and Paul Barford. "Times Forgotten: Using NTP to understand Internet Latency", In *Proceedings of ACM Workshop on Hot Topics in Networks (HotNets)*, Philadelphia, PA, November, 2015.
12. Ram Durairajan, Paul Barford, Joel Sommers and Walter Willinger. "InterTubes: A Study of the US Long-haul Fiber-optic Infrastructure", In *Proceedings of ACM SIGCOMM*, London, UK, August 2015.
13. Mukta Gupta, Ram Durairajan, Meena Syamkumar, Paul Barford and Joel Sommers. "pfs: Parallelized, Flow-based Network Simulation", In *Proceedings of ACM SummerSim*, Chicago, IL, July 2015.
14. Matt Malloy, Scott Alfeld and Paul Barford. "Contamination Estimation via Convex Relaxations", In *Proceedings of IEEE International Symposium on Information Theory*, Hong Kong, June, 2015.
15. Ram Durairajan, Joel Sommers and Paul Barford. "Controller-agnostic SDN Debugging", In *Proceedings of ACM CoNEXT*, Sydney, Australia, December, 2014.

16. Oliver Hohlfeld, Enric Pujol, Florin Ciucu, Anja Feldmann and Paul Barford. “A QoE Perspective on Sizing Network Buffers”, In *Proceedings of the ACM Internet Measurement Conference*, Vancouver, BC, November, 2014.
17. Ram Durairajan, Joel Sommers and Paul Barford. “Layer 1-Informed Internet Topology Measurement”, In *Proceedings of the ACM Internet Measurement Conference*, Vancouver, BC, November, 2014.
18. Scott Alfeld and Paul Barford. “Targeted Residual Analysis for Improving Electric Load Forecasting”, In *Proceedings of the IEEE Energy Conference (Energycon '14)*, Dubrovnik, Croatia, May, 2014.
19. Paul Barford and Igor Canadi and Darja Krushevskaja and Qiang Ma and S. Muthukrishnan. “Adscape: Harvesting and Analyzing Online Display Ads”, In *Proceedings of the World Wide Web Conference (WWW '14)*, Seoul, South Korea, April, 2014.
20. Brian Eriksson, Ram Durairajan and Paul Barford. “RiskRoute: A Framework for Mitigating Network Outage Threats”, In *Proceedings of ACM CoNEXT*, Santa Barbara, CA, December, 2013.
21. Kevin Springborn and Paul Barford. “Impression Fraud in On-line Advertising via Pay-Per-View Networks”, In *Proceedings of the 22nd USENIX Security Symposium*, Washington, DC, August, 2013.
22. Mukta Gupta, Joel Sommers and Paul Barford. “Fast, Accurate Simulation for SDN Prototyping”, In *Proceedings of the ACM SIGCOMM Workshop on Hot Topics in Software Defined Networking (HotSDN)*, Hong Kong, August, 2013.
23. Ram Durairajan, Subadip Ghosh, Xin Tang, Paul Barford and Brian Eriksson “Internet Atlas: A Geographic Database of the Internet”, In *Proceedings of the 5th ACM SIGCOMM HotPlant Workshop Conference*, Hong Kong, August, 2013.
24. Joe Chabarek and Paul Barford. “Whats in a Name? Decoding Router Interface Names”, In *Proceedings of the 5th ACM SIGCOMM HotPlant Workshop Conference*, Hong Kong, August, 2013.
25. Joe Chabarek, Sujata Banerjee, Puneet Sharma, Jayaram Mudigonda and Paul Barford. “Networks of Tiny Switches (NoTS): In Search of Network Power Efficiency and Proportionality”, In *Proceedings of the 5th Workshop on Energy-Efficient Design*, Tel Aviv, Israel, June, 2013.
26. Joe Chabarek and Paul Barford. “EnergyAudit: Monitoring Power Consumption in Diverse Network Environments”, In *Proceedings of the 4th International Green Computing Conference (IGCC '13)*, Arlington, VA, June, 2013.
27. Dave Plonka and Paul Barford. “Assessing Performance of Internet Services on IPv6”, In *Proceedings of IEEE Symposium on Computers and Communications (ISCC 13)*, Split, Croatia, July, 2013.
28. Joel Sommers and Paul Barford. “Cell vs. WiFi: On the Performance of Metro Area Mobile Connections”, In *Proceedings of the ACM Internet Measurement Conference*, Boston, MA, November, 2012.
29. Igor Canadi, Paul Barford and Joel Sommers. “Revisiting Broadband Performance”, In *Proceedings of the ACM Internet Measurement Conference*, Boston, MA, November, 2012.
30. Qi Ding, Natallia Katenka, Paul Barford, Eric Kolaczyk and Mark Crovella. “Intrusion as (Anti)social Communication: Characterization and Detection”, In *Proceedings of the ACM SIGKDD Conference on Knowledge Discovery and Data Mining (KDD)*, Beijing, China, August, 2012.
31. Charles Thomas, Joel Sommers, Paul Barford, Dongchan Kim, Ananya Das, Roberto Segebre and Mark Crovella. “A Passive Measurement System for Network Testbeds”, In *Proceedings of Tridentcom*, Thessaloniki, Greece, June, 2012.
32. Scott Alfeld, Carol Barford and Paul Barford. “Toward an Analytic Framework for the Electrical Power Grid”, In *Proceedings of the Third International Conference on Future Energy Systems (e-Energy)*, Madrid, Spain, May, 2012.

33. Joel Sommers, Paul Barford and Ben Liblit. “A Router Primitive Approach for Building Diverse Network Services”, In *Proceedings of the International Conference on Communication Systems and Networks*, Bangalore, India, January, 2012.
34. Joel Sommers, Brian Eriksson and Paul Barford. “On the Prevalence and Characteristics of MPLS Deployments in the Open Internet”, In *Proceedings of the ACM Internet Measurement Conference*, Berlin, Germany, November, 2011.
35. Joe Chabarek and Paul Barford. “Power-Awareness Extensions for Network Testbeds”, In *Proceedings of the Fourth ICC Workshop on Green Communications*, Kyoto, Japan, June, 2011.
36. Dave Plonka and Paul Barford. “Flexible Traffic and Host Profiling via DNS Rendezvous”, In *Proceedings of the Workshop on Securing and Trusting Internet Names (SATIN '11)*, London, UK, April, 2011.
37. Mariyam Mirza, Paul Barford, Xiaojin Zhu, Suman Banerjee and Mike Blodgett. “Fingerprinting 802.11 Rate Adaptation Algorithms”, In *Proceedings of IEEE INFOCOM*, Shanghai, China, April, 2011.
38. Joel Sommers, Rhys Bowden, Brian Eriksson, Paul Barford, Matt Roughan and Nick Duffield. “Efficient Network-wide Flow Record Generation”, In *Proceedings of IEEE INFOCOM*, Shanghai, China, April, 2011.
39. Brian Eriksson, Paul Barford, Rob Nowak and Joel Sommers. “Ghost in the Machine: Inferring Unseen Components in the Internet Core”, In *Proceedings of IEEE INFOCOM (Mini-Conference)*, Shanghai, China, April, 2011.
40. Brian Eriksson, Paul Barford, Rhys Bowden, Nick Duffield, Joel Sommers and Matt Roughan. “BasisDetect: A Model-based Network Event Detection Framework”, In *Proceedings of the ACM Internet Measurement Conference*, Melbourne, Australia, November, 2010.
41. Brian Eriksson, Paul Barford, Joel Sommers and Rob Nowak. “A Learning-based Approach to IP Geolocation”, In *Proceedings of the Passive and Active Measurement Conference (PAM '10)*, Zurich, Switzerland, April, 2010.
42. Brian Eriksson, Gautam Dasarathy, Paul Barford and Rob Nowak. “Toward the Practical Use of Network Tomography for Internet Topology Discovery”, In *Proceedings of IEEE INFOCOM*, San Diego, CA, March, 2010.
43. Joel Sommers, Paul Barford and Mark Crovella. “Router Primitives for Programmable Active Measurement”, In *Proceedings of ACM SIGCOMM PRESTO Workshop*, Barcelona, Spain, August, 2009.
44. Mariyam Mirza, Kevin Springborn, Suman Banerjee, Mike Blodgett and Jerry Zhu. “On the Accuracy of TCP Throughput Prediction for Opportunistic Wireless Networks”, In *Proceedings of IEEE Conference on Sensor, Mesh and Ad Hoc Communications and Networks (SECON '09)*, Rome, Italy, June, 2009.
45. Jin-Yi Cai, Vinod Yegneswaran, Chris Alfeld and Paul Barford. “An Attacker-Defender Game for Honeynets”, In *Proceedings of the the 15th International Computer and Combinatorics Conference (COCON '09)*, Niagara Falls, NY, June, 2009.
46. Paul Barford, Nick Duffield, Amos Ron and Joel Sommers. “Network Performance Anomaly Detection and Localization”, In *Proceedings of IEEE INFOCOM*, Rio de Janeiro, Brazil, April, 2009.
47. Brian Eriksson, Paul Barford and Rob Nowak. “Estimating Hop Distance Between Arbitrary Host Pairs”, In *Proceedings of IEEE INFOCOM*, Rio de Janeiro, Brazil, April, 2009.
48. Archit Gupta, Pavan Kuppili, Aditya Akella and Paul Barford. “An Empirical Study of Malware Evolution”, In *Proceedings of the Conference on Communications Systems and Networks (COMSNETS '09)*, Bangalore, India, January, 2009.



49. Dave Plonka and Paul Barford. "Context-aware Clustering of DNS Query Traffic", In *Proceedings of ACM Internet Measurement Conference*, Vouliagmeni, Greece, October, 2008.
50. Brian Eriksson, Paul Barford and Rob Nowak. "Network Discovery From Passive Measurements", In *Proceedings of ACM SIGCOMM*, Seattle, WA, August, 2008.
51. Jeff Kline, Sangnam Nam, Paul Barford, Dave Plonka and Amos Ron. "Traffic Anomaly Detection at Fine Time Scales with Bayes Nets", In *Proceedings of the International Conference on Internet Monitoring and Protection (ICIMP '08)*, Bucharest, Romania, June, 2008.
52. Joe Chabarek, Joel Sommers, Paul Barford, Cristian Estan, Steve Wright and David Tsiang. "Power Awareness in Network Design and Routing", In *Proceedings of IEEE INFOCOM*, Phoenix, AZ, April, 2008.
53. Zesheng Chen, Chuanyi Ji and Paul Barford. "Spatial-Temporal Characteristics of Internet Malicious Sources", In *Proceedings of IEEE INFOCOM (Mini-Conference)*, Phoenix, AZ, April 2008.
54. Joel Sommers and Paul Barford. "An Active Measurement System for Shared Environments", In *Proceedings of ACM Internet Measurement Conference*, San Diego, CA, October, 2007.
55. Brian Eriksson, Paul Barford, Robert Nowak and Mark Crovella. "Learning Network Structure from Passive Measurements", In *Proceedings of ACM Internet Measurement Conference*, San Diego, CA, October, 2007.
56. Joel Sommers, Paul Barford, Nick Duffield and Amos Ron. "Efficient Network-wide SLA Compliance Monitoring", In *Proceedings of ACM SIGCOMM*, Kyoto, Japan, August, 2007.
57. Mariyam Mirza, Joel Sommers, Paul Barford and Jerry Zhu. "A Machine Learning Approach to TCP Throughput Estimation", In *Proceedings of ACM SIGMETRICS*, pp. 97-108, San Diego, CA, June, 2007.
58. Vinod Yegneswaran, Chris Alfeld, Paul Barford and Jin-Yi Cai. "Camouflaging Honeynets", In *Proceedings of IEEE Global Internet Symposium*, Anchorage, AK, May, 2007.
59. Joel Sommers, Paul Barford, Nick Duffield and Amos Ron. "A Framework for Multi-objective SLA Compliance Monitoring", In *Proceedings of IEEE INFOCOM (Mini-Conference)*, pp. 2436-2440, Anchorage, AK, May, 2007.
60. Paul Barford and Mike Blodgett. "Toward Botnet Mesocosms", In *Proceedings of the USENIX First Workshop on Hot Topics in Understanding Botnets (Hotbots '07)*, Cambridge, MA, April, 2007.
61. Lei Chen, Raghu Ramakrishnan, Paul Barford, Beechung Chen and Vinod Yegneswaran. "Composite Subset Measures", In *Proceedings of the 32nd International Conference on Very Large DataBases (VLDB '06)*, pp. 403-414, Seoul, Korea, September, 2006.
62. Mark Allman, Paul Barford, Balachander Krishnamurthy and Jia Wang. "Tracking the Role of Adversaries in Measuring Unwanted Traffic", In *Proceedings of the USENIX Second Workshop on Steps to Reducing Unwanted Traffic on the Internet (SRUTI '06)*, pp. 37-42, San Jose, CA, July, 2006.
63. Joel Sommers, Paul Barford and Walter Willinger. "A Proposed Framework for Calibration of Available Bandwidth Measurement Tools", In *Proceedings of IEEE Symposium on Computers and Communications (ISCC '06)*, pp. 709-718, Sardinia, Italy, June, 2006.
64. Yolanda Tsang, Mehmet Yildiz, Paul Barford and Robert Nowak. "On the Performance of Round Trip Time Network Tomography", In *Proceedings of IEEE Conference on Communications (ICC '06)*, pp. 483-488, Istanbul, Turkey, June, 2006.
65. Vikas Garg, Vinod Yegneswaran and Paul Barford. "Improving NIDS Performance Through Hardware-based Connection Filtering", In *Proceedings of IEEE Conference on Communications (ICC '06)*, pp. 2183-2188, Istanbul, Turkey, June, 2006.

66. Beechung Chen, Vinod Yegneswaran, Paul Barford, and Raghu Ramakrishnan. "Toward a Query Language for Network Attack Data", In *Proceedings of Second IEEE Workshop on Networks Meets Databases (NetDB '06)*, Atlanta, GA, April, 2006.
67. Joel Sommers, Paul Barford, and Walter Willinger. "SPLAT: A Visualization Tool for Mining Internet Measurements", In *Proceedings of Passive and Active Measurement Conference (PAM '06)*, pp. 31-40, Adelaide, Australia, March, 2006.
68. Paul Barford, Robert Nowak, Rebecca Willett, and Vinod Yegneswaran. "Toward a Model for Sources of Internet Background Radiation" In *Proceedings of Passive and Active Measurement Conference (PAM '06)*, pp. 211-220, Adelaide, Australia, March, 2006.
69. Vinod Yegneswaran, Paul Barford and Vern Paxson. "Using Honeynets for Internet Situational Awareness", In *Proceedings of the Fourth Workshop on Hot Topics in Networks (HotNets IV)*, pp. 17-22, College Park, MD, November, 2005.
70. Shilpi Agarwal, Joel Sommers and Paul Barford. "Scalable Network Path Emulation", In *Proceedings of the IEEE International Symposium on Modeling, Analysis and Simulation of Computer and Telecommunication Systems (MASCOTS '05)*, pp. 219-228, Atlanta, GA, September, 2005.
71. Joel Sommers, Paul Barford, Nick Duffield and Amos Ron. "Improving Accuracy in End-to-end Packet Loss Measurements", In *Proceedings of ACM SIGCOMM*, pp. 157-168, Philadelphia, PA, August, 2005.
72. Vinod Yegneswaran, Jon Giffin, Paul Barford, Somesh Jha. "An Architecture for Generating Semantic-Aware Signatures", In *Proceedings of the USENIX Security Symposium*, pp. 97-112, Baltimore, MD, August, 2005.
73. Rouming Pang, Vinod Yegneswaran, Paul Barford, Vern Paxson and Larry Peterson. "Characteristics of Internet Background Radiation", In *Proceedings of ACM Internet Measurement Conference*, pp. 27-40, Taormina, Italy, October, 2004.
74. Yolanda Tsang, Mehmet Yildiz, Paul Barford and Robert Nowak. "Network Radar: Tomography from Round Trip Time Measurements", In *Proceedings of ACM Internet Measurement Conference*, pp. 175-180, Taormina, Italy, October, 2004.
75. Joel Sommers and Paul Barford. "Self-Configuring Network Traffic Generation", In *Proceedings of ACM Internet Measurement Conference*, pp. 68-81, Taormina, Italy, October, 2004.
76. Joel Sommers, Vinod Yegneswaran and Paul Barford. "A Framework for Malicious Workload Generation", In *Proceedings of ACM Internet Measurement Conference*, pp. 82-87, Taormina, Italy, October, 2004.
77. Vinod Yegneswaran, Paul Barford and David Plonka. "On the Design and Use of Internet Sinks for Network Abuse Monitoring", In *Proceedings of the Symposium on Recent Advances in Intrusion Detection (RAID '04)*, pp. 146-165, Sophia Antipolis, France, September, 2004.
78. Vinod Yegneswaran, Paul Barford and Somesh Jha. "Global Intrusion Detection in the DOMINO Overlay System", In *Proceedings of Network and Distributed Systems Security Symposium (NDSS '04)*, pp. 79-95, San Diego, CA, February, 2004.
79. Jim Gast and Paul Barford. "Evaluating and Modeling Window Synchronization in Highly Multiplexed Flows", In *Proceedings of IEEE the 6th Workshop on Workload Characterization*, pp. 51-61, Austin, TX, October, 2003.
80. Vinod Yegneswaran, Paul Barford and Johannes Ullrich. "Internet Intrusions: Global Characteristics and Prevalence", In *Proceedings of ACM SIGMETRICS*, pp. 138-147, San Diego, CA, June, 2003.
81. Paul Barford, Jeff Kline, David Plonka, Amos Ron. "A Signal Analysis of Network Traffic Anomalies", In *Proceedings of ACM SIGCOMM Internet Measurement Workshop*, pp. 71-82, Marseilles, France, November, 2002.

82. Jim Gast and Paul Barford. "Resource Deployment based on Autonomous System Clustering", In *Proceedings of IEEE Global Telecommunications Conference (Globcom '02)*, pp. 2240-2244, Taipei, Taiwan, October, 2002.
83. Paul Barford, Azer Bestavros, John Byers and Mark Crovella. "On the Marginal Utility of Network Topology Measurements", In *Proceedings of ACM SIGCOMM Internet Measurement Workshop*, pp. 5-17, San Francisco, CA, November, 2001.
84. Paul Barford and David Plonka. "Characteristics of Network Traffic Flow Anomalies", In *Proceedings of ACM SIGCOMM Internet Measurement Workshop*, pp. 69-73, San Francisco, CA, November, 2001
85. Paul Barford and Mark Crovella. "Critical Path Analysis of TCP Transactions", In *Proceedings of ACM SIGCOMM*, pp. 127-138, Stockholm, Sweden, August, 2000.
86. Paul Barford and Mark Crovella. "A Performance Evaluation of Hyper Text Transfer Protocols," in *Proceedings of the ACM SIGMETRICS*, pp. 188-197, Atlanta, GA, May, 1999.
87. Paul Barford and Mark Crovella. "Generating Representative Web Workloads for Network and Server Performance Evaluation," in *Proceedings of the ACM SIGMETRICS*, pp. 151-160, Madison, WI, June 1998.
88. Mark Crovella and Paul Barford. "The Network Effects of Prefetching," in *Proceedings of the IEEE INFOCOM*, pp. 1232-1239, San Francisco, CA, April 1998.
89. Quinn Canfield, Paul Barford, Paul Kinzelman and Cary Trlica. "A System Simulation Environment," in *Proceedings of Computer Design: VLSI in Computers and Processors (ICCD '89)*, pp. 555-560, Cambridge, MA, 1989.

## National Reports

1. Paul Barford (Ed.). "GENI Measurement and Instrumentation Specification", Global Environment for Network Innovations Technical Document GDD-06-12, September, 2006.
2. Computer Science and Telecommunications Board, National Research Council. "The Internet Under Crisis Conditions: Learning from September 11," *National Academy Press*, November, 2002. ISBN: 0-309-08702-3.

## Posters, Abstracts and Invited Papers

1. Scott Alfeld, Jerry Zhu and Paul Barford. "Machine Teaching as Search", In *the Symposium on Combinatorial Search - short paper*, Tarrytown, NY, July, 2016.
2. Scott Alfeld, Jerry Zhu and Paul Barford. "Optimal Defense Actions Against Test-Set Attacks", In *the ICML Workshop on Reliable Machine Learning in the Wild - extended abstract*, New York, NY, July, 2016.
3. Ram Durairajan, Joel Sommers and Paul Barford. "Off: Bugspray for Openflow", In *Proceedings of the ACM HotSDN Workshop - poster session*, Chicago, IL, August, 2014.
4. Joel Sommers and Paul Barford. "Comparing Metro-area Cellular and WiFi Performance", In *Proceedings of ACM SIGMETRICS - poster session*, London, UK, June, 2012.
5. Dave Plonka and Paul Barford. "Network Anomaly Confirmation, Diagnosis and Remediation", In *Proceedings of the Allerton Conference on Communication, Control and Computing*, Monticello, IL, October, 2009.
6. Joel Sommers, Vinod Yegneswaran and Paul Barford. "Recent Advances in Network Intrusion Detection System Tuning". In *Proceedings of the 40th IEEE Conference on Information Science Systems*, pp. 1490-1495, Princeton, NJ, March, 2006.

7. Paul Barford, Somesh Jha and Vinod Yegneswaran. “Fusion and Filtering in Network Intrusion Detection”, In *Proceedings of the Allerton Conference on Communication, Control and Computing*, pp. 1546-1556, Monticello, IL, October, 2004.
8. Guido Appenzeller, Nick McKeown, Joel Sommers and Paul Barford. “Recent Results on Sizing Router Buffers”, In *Proceedings of the Network Systems Design Conference*, San Jose, CA, October, 2004.
9. Joel Sommers, Hyungsuk Kim and Paul Barford. “Harpoon: A Flow-Level Traffic Generator for Router and Network Tests”, In *Proceedings of ACM SIGMETRICS - poster session*, pp. 392-393, New York, NY, June, 2004.
10. Paul Barford and Larry Landweber. “Bench-style Network Research in an Internet Instance Laboratory”, In *Proceedings of SPIE ITCOM*, pp. 175-183, Boston, MA, August, 2002.
11. Paul Barford and Mark Crovella. “Critical Path Analysis of TCP Transactions”, In *Proceedings of ACM SIGCOMM Latin America*, San Jose, Costa Rica, April 2001.

## Other Publications

### Technical Reports

1. Paul Barford, Craig Partridge and Walter Willinger. “Internet Multi-Resolution Analysis: A Vision and Framework in Support of Representing, Analyzing and Visualizing Internet Measurements”, UW Technical Report #1646, September, 2008.
2. Jin-Yi Cai, Vinod Yegneswaran, Chris Alfeld, and Paul Barford. “Honeygames: A Game Theoretic Approach to Defending Network Monitors”, UW Technical Report #1577, December, 2006.
3. Joel Sommers, Paul Barford, Albert Greenberg and Walter Willinger. “An SLA Perspective on the Router Buffer Sizing Problem”, UW Technical Report #1569, July, 2006.
4. Joel Sommers, Vinod Yegneswaran and Paul Barford. “Toward Comprehensive Traffic Generation for Online IDS Evaluation”, UW Technical Report #1525, May, 2005.
5. Paul Barford and Joel Sommers. “On the Precision of Active Probes for Packet Loss”, UW Technical Report #1442, September, 2002.
6. Paul Barford, David Donoho, Georgina Flesia and Vinod Yegneswaran, “Characteristics of Network Delays in Wide Area File Transfers,” UW Technical Report #1443, July, 2002.
7. Paul Barford, Jin-Yi Cai and Jim Gast. “Cache Placement Methods Based on Client Demand Clustering,” UW Technical Report #1437, June, 2001.

### Position Papers and Notes

1. Paul Barford. “Information and Communication Technology and Innovation: How the US can Maintain its Technology Edge and Defend Against Technological Threats”, Position paper for The Tobin Project meeting on Sustainable National Security Strategy, October, 2011.
2. Paul Barford. “Measurement as a First Class Network Citizen,” Position paper for NSF Workshop on the Next Generation Secure Internet, July, 2005.
3. Vijayan Prabhakaran, Joseph Stanley and Paul Barford. “High Throughput Data Transfers using the Tornado Transport Protocol,” November, 2002.
4. Paul Barford and David Plonka. “Inferring Client Experience from Flow-based Measurements,” July, 2001.
5. Paul Barford. “Global Internet Measurement Infrastructure,” Position paper for NSF Large Scale Networking Workshop, March, 2001.

## Tutorials

1. Paul Barford and Vishal Misra “Measurement, Modeling and Analysis of the Internet,” Presented at:

- *IMA Workshop on Internet Measurement and Modeling* , Minneapolis, MN, January, 2004.
2. Paul Barford. “Internet-wide Measurement Infrastructures,” Presented at:
    - *IPAM Workshop on Large Scale Communications Networks* , Los Angeles, CA, March, 2002.
  3. Paul Barford. “Web Server Performance Analysis,” Presented at:
    - *ACM SIGMETRICS '99*, Atlanta, GA, April, 1999.
    - *IEEE Local Area Networks '99*, Lowell, MA, October, 1999.

### **Selected Invited Talks, Panels and Workshops**

1. Invited talk, DHS Summer Showcase, Washington DC, July, 2017.
2. Invited talk, INTERACT Conference, Lisbon, Portugal, May 2016.
3. Invited talk, Federal Communications Commission, Washington, DC, April, 2016.
4. Invited talk, Science of Security Speaker Series, University of Illinois, Urbana, IL, October, 2015.
5. Invited talk, Google Inc., Mountain View, CA, July, 2015.
6. Invited panelist, Asia Banking CEO RoundTable, Tokyo, Japan, November, 2014.
7. Invited talk, NANOG 61, Bellevue, WA, June, 2014.
8. Invited talk, Symantec Corp., Mountain View, CA, June, 2013.
9. Invited talk, Deutsche Telekom Labs, Berlin, Germany, March, 2013.
10. Distinguished lecture, NEC Corp., Princeton, NJ, September, 2012.
11. Invited talk, NSF Washington Area Trustworthy Computer Hour (WATCH), Arlington, VA, February, 2012.
12. Invited participant, The Tobin Project meeting on Sustainable Grand Strategy, Washington, DC, October, 2011.
13. Invited talk, Security Innovations Network Summit, Cambridge, MA, October, 2011.
14. Invited talk, Computer Laboratory, University of Cambridge, Cambridge, UK, November, 2010.
15. Invited panelist, IEEE INFOCOM, San Diego, CA, March, 2010.
16. Distinguished lecture, Computer Science Department, University of California - Irvine, Irvine, CA, February, 2010.
17. Distinguished lecture, Computer Science Department, University of Utah, Salt Lake City, UT, August, 2009.
18. Invited talk, Fifth Computer Network Defense Research & Technology Workshop, Annapolis Junction, MD, June, 2009.
19. Invited talk, DHS/SRI Infosec Technology Transition Council Workshop, Menlo Park, CA, February, 2009.
20. Invited talk, American Mathematical Society, Special Session on The Mathematics of Information and Knowledge, Washington, DC, January, 2009.
21. Invited talk, IPAM Workshop on Multiscale Representation, Analysis and Modeling of Internet Data Measurements, University of California, Los Angeles, CA, September, 2008.

22. Invited talk, DIMACS Workshop on Internet Tomography, Rutgers University, New Brunswick, NJ, May, 2008.
23. Invited talk, EU-US Cyber Trust Summit, Monticello, IL, April, 2007.
24. Invited talk, National Academy of Engineering, Japan-America Frontiers of Engineering Symposium, Tsukuba, Japan, November, 2006.
25. Invited talk, Cisco Systems Nerd Lunch, San Jose, CA, June, 2006.
26. Invited talk, Computer Science Department, Northwestern University, Evanston, IL, May, 2006.
27. Invited talk, Cisco Network Management Research Summit, Santa Clara, CA, January, 2006.
28. Invited talk, Computer Science Department, Massachusetts Institute of Technology, Cambridge, MA, October, 2005.
29. Invited talk, Computer Science Department, Boston University, Boston, MA, October, 2005.
30. Invited talk, Computer Science Department, California Institute of Technology, Pasadena, CA, September, 2005.
31. Invited talk, ARO/DHS Workshop on Malware Detection, Arlington, VA, August, 2005.
32. Invited talk, Microsoft Research Self-Managing Networks Summit, Kirkland, WA, June, 2005.
33. Invited talk, InfoSec Research Council, Arlington, VA, September, 2004.
34. Invited talk, EMC Corporation, Hopkinton, MA, June, 2004.
35. Invited talk, Intel Research, Berkeley, CA, June, 2004.
36. Invited talk, Computer Science Department, University of Michigan, Ann Arbor, MI, March, 2004.
37. Invited talk, Laboratoire d'Informatique de Paris (LIP6), Paris, France, February, 2004.
38. Invited talk, Computer Science Department, University of Maryland, College Park, MD, June, 2003.
39. Invited talk, Army Research Lab, Adelphi, MD, September, 2003.
40. Invited talk, AT&T Research Labs, Florham Park, NJ, December, 2002.
41. Invited talk, Microsoft Research Labs, Redmond, WA, December, 2002.
42. Invited talk, Computer Science Department, University of Washington, Seattle, WA, December, 2002.
43. Invited talk, Intel Research Labs, Hillsboro, OR, December, 2002.
44. Invited talk, Computer Science Department, University of Illinois, Urbana, IL, October, 2002.
45. Invited talk, Network Modeling and Simulation Workshop, Hanover, NH, July, 2002.
46. Invited talk, Sprint Labs, Burlingame, CA, November, 2001.
47. Invited talk, HP Labs, Palo Alto, CA, October, 2001.
48. Invited talk, ACM SIGCOMM Latin America, San Jose, Costa Rica, April, 2001.
49. Invited talk, Princeton University PACM Colloquium, Princeton, NJ, February, 2001.
50. Invited talk, Multiresolution Analysis of the Global Internet Workshop, Palo Alto, CA, October, 2000.
51. Invited talk, 15th IEEE Computer Communications Workshop, Captiva, FL, October, 2000.

52. Invited talk, The Global Internet: Measurement, Modeling and Analysis Workshop, Leiden, Holland, September, 2000.

## Grants and Gifts

1. "A Holistic Approach to Data Analytics Services in Cloud Environments", Laboratory for Telecommunication Sciences, P. Barford PI, \$578K, 2015 - 2017.
2. "Diverse Data Sets for PREDICT" Department of Homeland Security, P. Barford PI, \$765K, 2012 - 2017.
3. "Spatio-temporal Analysis of Current Power Generation and Potential Bioenergy Substitution in the GLBRC Region", UW-Madison BACTER Institute for Computational Biology, P. Barford co-PI, \$50K, 2011 - 2012.
4. "Information and Software Assurance: A Coordinated Approach to Cyber-Situation Awareness Based on Traffic Anomaly Detection", Army Research Office, P. Barford co-PI, \$800K, 2011 - 2015.
5. "Toward Strategies for Power Aware Networking", Engineering and Physical Sciences Research Council, UK, P. Barford PI, £100K, 2010 - 2011.
6. "TC: Medium: Collaborative Research: Wide-Aperture Traffic Analysis for Internet Security", National Science Foundation, P. Barford co-PI, \$1M, 2009 - 2014.
7. "CT-M: Meta-Environments for Experiments on Diverse Topics in Network Security", National Science Foundation, P. Barford PI, \$850K, 2008 - 2012.
8. "Instrumentation and Measurement for GENI", BBN, P. Barford PI, \$499K, 2008 - 2011.
9. "Collaborative Research: CT-T: Logic and Data Flow Extraction for Live and Informed Malware Execution", National Science Foundation, P. Barford PI, \$1.1M, 2007 - 2010.
10. "Virtual Center for Network and Security Data", Department of Homeland Security, P. Barford PI, \$336K, 2007 - 2012.
11. "Collaborative Research: CRI: CRD Synthetic Traffic Generation Tools and Resources: A Community Resource for Experimental Networking Research", P. Barford co-PI, \$60K, 2007 - 2008.
12. "Collaborative HoneyStream Analytics Exploitation System (CHAES)", Department of Homeland Security, P. Barford PI, \$30K, 2006 - 2007.
13. "Requirements Driven Resource Allocation in Next Generation Routers", Cisco Systems donation, P. Barford PI, \$175K, 2006.
14. "GENI Instrumentation and Measurement Systems (GIMS)", National Science Foundation, P. Barford PI, \$150K, 2006 - 2008.
15. "Cyber Threat Analytics", Army Research Office, P. Barford PI, \$100K, 2006 - 2007.
16. "NeTS-FIND: Design for Manageability in the Next Generation Internet", National Science Foundation, P. Barford PI, \$650K, 2006 - 2008.
17. "Infrastructure to Support Cyberforensics", Army Research Office, P. Barford PI, \$350K, 2005 - 2006.
18. "Self Directed Intrusion Detection", Army Research Office, P. Barford PI, \$30K, 2004 - 2005.
19. "Datasets for Network Security", Department of Homeland Security, P. Barford PI, \$274K, 2004 - 2007.
20. "Student Travel Grant Support for the First Workshop on Internet Signal Processing", National Science Foundation, P. Barford PI, \$10.5K, 2004.

21. "CAREER: A Multiresolution Approach to Network Anomaly and Intrusion Detection", National Science Foundation, \$501K, P. Barford PI, 2004 - 2009.
22. "An Integrated Program for Content Addressable Storage Research", EMC Corporation, \$590K, P. Barford PI, December, 2003 - 2004.
23. "Evaluating Buffer Behavior in High Performance Routers", Cisco Systems University Research Program, \$92K, P. Barford PI, 2003 - 2004.
24. "MRI: Acquisition of the GLOW Distributed Computing System at the University of Wisconsin - Madison", National Science Foundation, \$2M, P. Barford co-PI, 2003 - 2004.
25. "NMI: An Integrative Testing Framework for Grid Middleware and Grid Environments", National Science Foundation, \$1.8M, P. Barford co-PI, 2003 - 2005.
26. "Collaborative ITR: Modular Strategies for Internetwork Monitoring", National Science Foundation, \$1M, P. Barford co-PI, August, 2003-2007.
27. "NRT: Collaborative Research: A Unified Experimental Environment for Diverse Networks", National Science Foundation, \$4.4M, P. Barford co-PI, 2003 - 2007.
28. "Data Center Traffic Monitoring and Control". Intel Corporation. \$145K. P. Barford PI. 2003 - 2005.
29. "Distributed Storage Research in the Wisconsin Advanced Internet Lab," EMC Corporation, PI, \$1M, 2002.
30. "Distributed Anomaly Characterization and Detection," Army Research Office, P. Barford PI, \$320K, 2002-2005.
31. "The Wisconsin Advanced Internet Laboratory," Cisco Systems/TOSA Foundation, P. Barford PI, \$3.2M, 2002.
32. "The Wisconsin Advanced Internet Laboratory," Sun Microsystems, P. Barford PI, \$135k, 2002.
33. "The Wisconsin Advanced Internet Laboratory," Intel, P. Barford PI, \$50k, 2002.
34. "Network Measurement and Management," Fujitsu Labs America, P. Barford PI, \$25K, 2002.
35. "iSWORD: Instrumented Streaming Research and Testbed," National Science Foundation, P. Barford co-PI, \$800K, 2001 - 2004
36. "Particle Physics Data Grid Collaboratory Pilot," Department of Energy, P. Barford co-PI, \$1.5M, 2001 - 2004.

## **Student Supervision**

### **Current Students**

Ram Durairajan - 6th year PhD., UW Computer Science Department

Meenakshi Syamkumar - 3rd year PhD., UW Computer Science Department

Sathiya Kumaran - 3rd year PhD., UW Computer Science Department

### **Former Students**

Scott Alfeld (PhD. '17) - Assistant Professor, Amherst College

David Plonka (PhD. '13) - Scientist, Akamai

Joe Chabarek (PhD. '13) - Scientist, Amazon

Mariyam Mirza (PhD. '12) - Scientist, Akamai



Brian Eriksson (PhD. '10) - Scientist, Technicolor  
Joel Sommers (PhD. '07) - Associate Professor, Colgate University  
Chris Alfeld (PhD. '07) - Engineer, Google  
Vinod Yegneswaran (PhD. '06) - Scientist, SRI International  
James Gast (PhD. '03) - Senior Specialist, TDS Telecom  
Aaron Cahn (MS. '15) - Data scientist, comScore  
Mukta Gupta (MS. '14) - Engineer, Google  
Igor Canadi (MS. '13) - Engineer, Facebook  
Xin Tang (MS. '13) - Engineer, Amazon  
Subhadip Ghosh (MS. '12) - Engineer, Microsoft  
Dongchan Kim (MS. '12) - Engineer, Amazon  
Sanjay Bharadwaj (MS. '10) - Engineer, Oracle  
Charles Xie (MS. '09) - Engineer, Oracle  
Kevin Springborn - (MS. '07) - Engineer, Google  
Ramanathan Palaniappan (MS. '06) - Engineer, Amazon  
Shilpi Agrawal (MS. '04) - Engineer, VMWare  
Janani Thanigachalam (MS. '04) - Engineer, Oracle  
Badhri Varanasi (MS. '04) - Engineer, Oracle