

Nick Feamster

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Research Interests

My research focuses on networked computer systems, with an emphasis on network architecture and protocol design; network security, management, and measurement; routing; and anti-censorship techniques. The primary goal of my research is to design tools, techniques, and policies to help networks operate better, and to enable users of these networks (both public and private) to experience high availability and good end-to-end performance. The problems that I tackle often involve the intersection of networking technology and policy. I study problems in the pricing and economics of Internet interconnection, global Internet censorship and information control, the security and privacy implications of emerging technologies, and the performance of consumer, commercial, and enterprise networks. My research achieves impact through new design paradigms in network architecture, the release of open-source software systems, and data and evidence that can influence public policy discourse.

Education

Degree	Year	University	Field
Ph.D.	2005	Massachusetts Institute of Technology Cambridge, MA <i>Dissertation:</i> Proactive Techniques for Correct and Predictable Internet Routing <i>Sprowls Honorable Mention for best MIT Ph.D. dissertation in Computer Science</i> <i>Advisor:</i> Hari Balakrishnan Minor in Game Theory	Computer Science
M.Eng.	2001	Massachusetts Institute of Technology Cambridge, MA <i>Dissertation:</i> Adaptive Delivery of Real-Time Streaming Video <i>Advisor:</i> Hari Balakrishnan <i>William A. Martin Memorial Thesis Award</i> (MIT M.Eng. thesis award)	Computer Science
S.B.	2000	Massachusetts Institute of Technology Cambridge, MA	Electrical Engineering and Computer Science

Employment History

Title	Organization	Years
Professor	Princeton University	January 2015–Present
Professor	Georgia Institute of Technology	March 2014–December 2014
Associate Professor	Georgia Institute of Technology	March 2011–March 2014
Assistant Professor	Georgia Institute of Technology	2006–2011
Postdoctoral Research Staff	Princeton University	Fall 2005
Research Assistant	Massachusetts Institute of Technology	2000–2005
Intern/Consultant	AT&T Labs–Research	2001–2005
Technical Associate	Bell Laboratories	1999
Intern	Hewlett-Packard Laboratories	1999
Technical Staff	LookSmart, Ltd.	1997

Honors and Awards

National Awards

- ACM Fellow
- NSF Presidential Early Career Award for Scientists and Engineers (PECASE)
- Technology Review Top Innovators Under 35
- Alfred P. Sloan Fellowship
- NSF CAREER Award
- IBM Faculty Award

University Awards

- John P. Imlay Distinguished Lecture, Georgia Tech
- Hesburgh Teaching Fellow, Georgia Tech
- Georgia Tech College of Computing Outstanding Junior Faculty Research Award
- Georgia Tech Sigma Xi Young Faculty Award
- Georgia Tech Sigma Xi Best Undergraduate Research Advisor

Paper and Publication Awards

- USENIX “Best of the Rest” Paper Award for Best Paper in all USENIX Conferences (2016)
- USENIX Community Contribution Award, USENIX/ACM Symposium on Networked Systems Design and Implementation (2015)
- USENIX “Test of Time” Best Paper Award (2015)
- Internet Research Task Force Applied Networking Research Prize (2012, 2015)
- ACM SIGCOMM Community Award, ACM SIGCOMM Internet Measurement Conference (2013)
- Best Paper, Passive and Active Measurement Conference (2009)
- Best Student Paper, ACM SIGCOMM (2006)
- Best Paper, USENIX Symposium on Networked Systems Design and Implementation (2005)
- Best Student Paper, 11th USENIX Security Symposium (2002)
- Best Student Paper, 10th USENIX Security Symposium (2001)
- PRSA Bronze Anvil Award for *Wall Street Journal* Editorial Article

Thesis Awards

- George M. Sprowls honorable mention for best Ph.D. thesis in computer science, MIT
- MIT William A. Martin Memorial Thesis Award for Best EECS Masters Thesis

Other Honors

- Panelist for NSF/Discover Magazine Special Issue on The New Internet
- U.S. National Academy of Engineering Frontiers of Engineering Symposium
- U.S. National Academy of Science Kavli Frontiers of Science Symposium

Publications

Theses

- [1] Nick Feamster. *Proactive Techniques for Correct and Predictable Internet Routing*. PhD thesis, Massachusetts Institute of Technology, February 2006. Winner of the MIT George M. Sprowls Honorable Mention for Best MIT Ph.D. Dissertation in Computer Science.
- [2] Nick Feamster. Adaptive delivery of real-time streaming video. Master's thesis, Massachusetts Institute of Technology, May 2001. Winner of the MIT EECS William A. Martin Memorial Thesis Award.

Journal Publications

- [3] Gordon Chu, Noah Apthorpe, and Nick Feamster. Security and Privacy Analyses of Internet of Things Children's Toys. *IEEE Internet of Things Journal (IOT-J)*, November 2018.
- [4] Nick Feamster. Mitigating the Increasing Risks of an Insecure Internet of Things. *Colorado Tech Law Journal (CTLJ)*, March 2018.
- [5] Paul Pearce, Roya Ensafi, Frank Li, Nick Feamster, and Vern Paxson. Towards Continual Measurement of Global Network-Level Censorship. In *IEEE Security and Privacy*, January 2018.
- [6] Paul Pearce, Ben Jones, Frank Li, Roya Ensafi, Nick Feamster, and Vern Paxson. Global Measurement of DNS Manipulation. In *USENIX ;login.*, January 2018.
- [7] Ava Chen, Nick Feamster, and Enrico Calandro. Exploring the Walled Garden Theory: An Empirical Framework to Assess Pricing Effects on Mobile Data Usage. *Telecommunications Policy*, October 2017.
- [8] Gianni Antichi, Muzammil Shahbaz, Yiwen Geng, Noa Zilberman, Adam Covington, Marc Bruyere, Nick McKeown, Nick Feamster, Bob Felderman, and Michaela Blott. OSNT: Open source network tester. *Network, IEEE*, 28(5):6–12, 2014.
- [9] Nick Feamster, Jennifer Rexford, and Ellen Zegura. The Road to SDN. *ACM Queue*, 11(12):20, December 2013.
- [10] Sam Burnett and Nick Feamster. Making Sense of Internet Censorship: A New Frontier for Internet Measurement. *ACM SIGCOMM Computer Communications Review*, 43(3), July 2013.
- [11] Hyojoon Kim and Nick Feamster. Improving network management with software defined networking. *Communications Magazine, IEEE*, 51(2):114–119, 2013.
- [12] Mohammed Mukarram bin Tariq, Vytutas Valancius, Kaushik Bhandakar, Amgad Zeitoun, Nick Feamster, and Mostafa Ammar. Answering "What-If" Deployment and Configuration Questions with WISE: Techniques and Deployment Experience. *IEEE/ACM Transactions on Networking*, January 2013.
- [13] Srikanth Sundaresan, Walter de Donato, Nick Feamster, Renata Teixeira, Sam Crawford, and Antonio Pescapè. Measuring home broadband performance. *Communications of the ACM*, 55(9), September 2012.
- [14] Srikanth Sundaresan, Nazanin Magharei, Nick Feamster, and Renata Teixeira. Accelerating last-mile web performance with popularity-based prefetching. *ACM SIGCOMM Computer Communication Review*, 42(4):303–304, 2012.
- [15] Marshini Chetty and Nick Feamster. Refactoring Network Infrastructure to Improve Manageability: A Case Study of Home Networking. *ACM SIGCOMM Computer Communications Review*, 42(3), July 2012.
- [16] Murtaza Motiwala, Amogh Dhamdhare, and Nick Feamster. Towards a Cost Model for Network Traffic. *ACM SIGCOMM Computer Communications Review*, 42(1), January 2012.

- [17] Nick Feamster and Jennifer Rexford. Getting Students’ Hands Dirty With Clean-Slate Networking. *ACM SIGCOMM Computer Communications Review*, December 2011.
- [18] Nick Feamster, Lixin Gao, and Jennifer Rexford. A Survey of Virtual LAN Usage in Campus Networks. *IEEE Communications*, 49(7), July 2011.
- [19] T. Koponen, S. Shenker, H. Balakrishnan, N. Feamster, I. Ganichev, A. Ghodsi, P. B. Godfrey, N. McKeown, G. Parulkar, B. Raghavan J. Rexford, S. Arianfar, and D. Kuptsov. Architecting for Innovation. *ACM SIGCOMM Computer Communications Review*, 43(1), July 2011.
- [20] Ken Calvert, W. Keith Edwards, Nick Feamster, Rebecca Grinter, Ye Deng, and Xuzi Zhou. Instrumenting Home Networks. *ACM SIGCOMM Computer Communications Review*, 41(1), January 2011.
- [21] Bilal Anwer and Nick Feamster. Building a fast, virtualized data plane with programmable hardware. *ACM SIGCOMM Computer Communication Review*, April 2010.
- [22] Nick Feamster, Ramesh Johari, and Hari Balakrishnan. Stable Policy Routing with Provider Independence. *IEEE/ACM Transactions on Networking*, December 2007.
- [23] Nick Feamster and Jennifer Rexford. Network-Wide Prediction of BGP Routes. *IEEE/ACM Transactions on Networking*, June 2007.
- [24] Nick Feamster, Jaeyeon Jung, and Hari Balakrishnan. An Empirical Study of “Bogon” Route Advertisements. *ACM Computer Communications Review*, 35(1):63–70, November 2004.
- [25] Nick Feamster, Jay Borkenhagen, and Jennifer Rexford. Guidelines for Interdomain Traffic Engineering. *ACM Computer Communications Review*, 33(5):19–30, October 2003.

Books and Book Chapters

- [26] Andrew S Tanenbaum, David Wetherall, and Nick Feamster. *Computer Networks*. Prentice Hall, 2018. Sixth Edition revisions in progress.
- [27] Nick Feamster. *Who Will Control Speech Online? [Working Title]*. Princeton University Press, 2018. In progress.
- [28] Anirudh Ramachandran, Nick Feamster, and David Dagon. *Botnet Detection: Countering the Largest Security Threat*. Springer, 2008. *Chapter: Revealing Botnet Membership with DNSBL Counterintelligence*.

Conference Publications

- [29] Serena Zheng, Noah Apthorpe, Marshini Chetty, and Nick Feamster. User Perceptions of Smart Home IoT Privacy. In *ACM Conference on Computer Supported Cooperative Work (CSCW)*, Jersey City, NJ, November 2018.
Acceptance rate: 25%
- [30] Noah Apthorpe, Dillon Reisman Yan Shvartzshnaider, and Nick Feamster. Discovering Smart Home IoT Privacy Norms using Contextual Integrity. In *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies (IMWUT)*, Singapore, October 2018.
- [31] Philipp Winter, Anne Edmundson, Laura Roberts, Marshini Chetty, and Nick Feamster. How Do Tor Users Interact with Onion Services? In *USENIX Security Symposium*, Baltimore, Maryland, August 2018.
Acceptance rate: 19%
- [32] Arpit Gupta, Rob Harrison, Marco Canini, Nick Feamster, Jennifer Rexford, and Walter Willinger. Sonata: Query-Driven Streaming Network Telemetry. In *ACM SIGCOMM*, Budapest, Hungary, August 2018.
Acceptance rate: 18%

- [33] Anne Edmundson, Roya Ensafi, Nick Feamster, and Jennifer Rexford. Nation-State Hegemony in Internet Routing. In *Proceedings of the ACM SIGCAS Conference on Computing and Sustainable Societies (COMPASS)*, Menlo Park, CA, June 2018.
Acceptance rate: 40%
- [34] Josiah Chavula, Amreesh Phokeer, Agustin Formoso, and Nick Feamster. Insight into Africa's Country-Level Latencies. In *IEEE Africon*, Cape Town, South Africa, September 2017.
- [35] Paul Pearce, Ben Jones, Frank Li, Roya Ensafi, Nick Feamster, and Vern Paxson. Global Measurement of DNS Censorship. In *USENIX Security Symposium*, Vancouver, British Columbia, Canada, August 2017.
Acceptance rate: 16%
- [36] Yixin Sun, Anne Edmundson, Nick Feamster, Mung Chiang, and Prateek Mittal. Counter-RAPTOR: Safeguarding Tor Against Active Routing Attacks. In *IEEE Symposium on Security and Privacy (Oakland)*, San Jose, CA, May 2017.
Acceptance rate: 13%
- [37] Paul Pearce, Roya Ensafi, Frank Li, Nick Feamster, and Vern Paxson. Internet-Wide Detection of Connectivity Disruptions. In *IEEE Symposium on Security and Privacy (Oakland)*, San Jose, CA, May 2017.
Acceptance rate: 13%
- [38] Robert MacDavid, Rudiger Birkner, Ori Rottenstreich, Arpit Gupta, Nick Feamster, and Jennifer Rexford. Concise Encoding of Flow Attributes in SDN Switches. In *ACM Symposium on SDN Research (SOSR)*, Santa Clara, CA, April 2017.
Acceptance rate: 23%
- [39] Rudiger Birkner, Arpit Gupta, Nick Feamster, and Laurent Vanbever. SDX-Based Flexibility or Internet Correctness? Pick Two! In *ACM Symposium on SDN Research (SOSR)*, Santa Clara, CA, April 2017.
Acceptance rate: 23%
- [40] Benjamin Greschbach, Tobias Pulls, Laura Roberts, Philipp Winter, and Nick Feamster. FingerprintTor: DNS Fingerprinting Attacks on Tor. In *Network and Distributed Systems Security Symposium*, San Diego, CA, February 2017.
Acceptance rate: 16%
- [41] Amreesh Phokeer, David Johnson, Melissa Densmore, and Nick Feamster. A First Look at Mobile Internet Use in Township Communities in South Africa. In *ACM Symposium on Computing for Development (DEV)*, Seoul, Korea, November 2016.
Acceptance rate: 25%
- [42] Ava Chen, Nick Feamster, and Enrico Calandro. Exploring the Walled Garden Theory: An Empirical Framework to Assess Pricing Effects on Mobile Data Usage. In *Communications Policy Research South (CPRSOUTH)*, Zanzibar, Tanzania, September 2016.
- [43] Shuang Hao, Alex Kantchelian, Brad Miller, Vern Paxson, and Nick Feamster. PREDATOR: Proactive Recognition and Elimination of Domain Abuse at Time-Of-Registration. In *ACM Conference on Computer and Communications Security (CCS)*, Vienna, Austria, October 2016.
Acceptance rate: 16%
- [44] Nick Feamster. Revealing Utilization at Internet Interconnection Points. In *Conference on Communications, Information, and Internet Policy (TPRC)*, Washington, DC, September 2016.
- [45] Philipp Winter, Roya Ensafi, Karsten Loesing, and Nick Feamster. Identifying and Characterizing Sybils in the Tor Network. In *USENIX Security Symposium*, Austin, TX, August 2016.
Acceptance rate: 15%

- [46] Muhammad Shahbaz, Sean Choi, Ben Pfaff, Changhoon Kim, Nick Feamster, Nick McKeown, and Jennifer Rexford. PISCES: A Programmable, Protocol-Independent Software Switch. In *ACM SIGCOMM*, Florianopolis, Brazil, August 2016.
Acceptance rate: 17%
- [47] Yogesh Mundada, Nick Feamster, and Balachander Krishnamurthy. Half-Baked Cookies: Hardening Cookie-Based Authentication for the Modern Web. In *ACM Asia Conference on Computer and Communications Security (ASIACCS)*, Xi'an, China, June 2016.
Acceptance rate: 21%
- [48] Arpit Gupta, Robert MacDavid, Rudiger Birkner, Marco Canini, Nick Feamster, Jennifer Rexford, and Laurent Vanbever. An Industrial-Scale Software Defined Internet Exchange Point. In *USENIX Symposium on Networked Systems Design and Implementation (NSDI)*, Santa Clara, CA, March 2016.
Acceptance rate: 20%
Best of USENIX Paper Award.
USENIX Community Contribution Award.
- [49] Srikanth Sundaresan, Nick Feamster, and Renata Teixeira. Home or Access? Locating Last-Mile Downstream Throughput Bottlenecks. In *Passive and Active Measurement Conference (PAM)*, Heraklion, Crete, Greece, March 2016.
Acceptance rate: 32%
- [50] Sarthak Grover, Roya Ensafi, and Nick Feamster. A Case Study of Traffic Demand Response to Broadband Service-Plan Upgrades. In *Passive and Active Measurement Conference (PAM)*, Heraklion, Crete, Greece, March 2016.
Acceptance rate: 32%
- [51] Ben Jones, Nick Feamster, Vern Paxson, Nick Weaver, and Mark Allman. Detecting DNS Root Manipulation. In *Passive and Active Measurement Conference (PAM)*, Heraklion, Crete, Greece, March 2016.
Acceptance rate: 32%
- [52] Arpit Gupta, Nick Feamster, and Laurent Vanbever. FLANC: A Formal Logic for Authorizing Network Control. In *ACM SIGCOMM Symposium on SDN Research (SOSR)*, Santa Clara, CA, March 2016.
Acceptance rate: 25%
- [53] Ben Jones and Nick Feamster. Can Censorship Measurements Be Safe(r)? In *ACM SIGCOMM Workshop on Hot Topics in Networking (HotNets)*, Philadelphia, PA, October 2015.
Acceptance rate: 19%
- [54] Roya Ensafi, David Fifield, Philipp Winter, Nick Feamster, Nick Weaver, and Vern Paxson. Examining How the Great Firewall Discovers Hidden Circumvention Servers. In *ACM SIGCOMM Internet Measurement Conference (IMC)*, Tokyo, Japan, October 2015.
Acceptance rate: 26% **Internet Research Task Force Applied Networking Research Prize.**
- [55] Sam Burnett and Nick Feamster. Encore: Lightweight Measurement of Web Censorship with Cross-Origin Requests. In *ACM SIGCOMM*, London, England, August 2015.
Acceptance rate: 16%
- [56] Maria Konte, Roberto Perdisci, and Nick Feamster. ASwatch: An AS Reputation System to Expose Bulletproof Hosting ASes. In *ACM SIGCOMM*, London, England, August 2015.
Acceptance rate: 16%
- [57] Ben Jones, Roya Ensafi, Nick Feamster, Vern Paxson, and Nick Weaver. Ethical Concerns for Censorship Measurement. In *ACM SIGCOMM Workshop on Ethics in Networked Systems Research*, London, England, August 2015.

- [58] Muhammad Shahbaz and Nick Feamster. The Case for an Intermediate Representation for Programmable Data Planes. In *ACM SIGCOMM Symposium on SDN Research (SOSR)*, Santa Clara, CA, June 2015.
Acceptance rate: 19%
- [59] Bilal Anwer, Theophilus Benson, Nick Feamster, and Dave Levin. Programming Slick Network Functions. In *ACM SIGCOMM Symposium on SDN Research (SOSR)*, Santa Clara, CA, June 2015.
Acceptance rate: 16%
- [60] Hyojoon Kim, Arpit Gupta, Muhammad Shahbaz, Joshua Reich, Nick Feamster, and Russ Clark. Kinetic: Verifiable Dynamic Network Control. In *USENIX Symposium on Networked Systems Design and Implementation (NSDI)*, Oakland, CA, May 2015.
Acceptance rate: 19%
- [61] Marshini Chetty, Hyojoon Kim, Srikanth Sundaresan, Sam Burnett, Nick Feamster, and Keith Edwards. uCap: An Internet Data Management Tool for the Home. In *ACM Conference on Human Factors in Computing Systems (CHI)*, Seoul, Korea, April 2015.
Acceptance rate: 23%
- [62] Srikanth Sundaresan, Nick Feamster, and Renata Teixeira. Measuring the Performance of User Traffic in Home Wireless Networks. In *Passive and Active Measurement Conference (PAM)*, New York, NY, March 2015.
Acceptance rate: 27%
- [63] Josiah Chavula, Hussein Suleman, and Nick Feamster. Quantifying the Effects of Circuitous Routes on the Latency of Intra-Africa Internet Traffic: A Study of Research and Education Networks. In *6th International Conference on e-Infrastructure and e-Services for Developing Countries (Africomm)*, Kampala, Uganda, November 2014.
- [64] Abhinav Narain, Nick Feamster, and Alex C. Snoeren. Deniable Liaisons. In *SIGSAC Conference on Computer and Communications Security (CCS)*, pages 525–536, 2014.
Acceptance rate: 19%
- [65] Ben Jones, Tzu-Wen Lee, Nick Feamster, and Phillipa Gill. Automated Detection and Fingerprinting of Censorship Block Pages. In *ACM SIGCOMM Internet Measurement Conference (IMC)*, pages 299–304, Vancouver, British Columbia, Canada, October 2014.
Acceptance rate: 22%
- [66] Arpit Gupta, Muhammad Shahbaz, Laurent Vanbever, Hyojoon Kim, Russ Clark, Nick Feamster, Jennifer Rexford, and Scott Shenker. SDX: A Software Defined Internet Exchange. In *ACM SIGCOMM*, Chicago, IL, 2014.
Acceptance rate: 19%
- [67] Srikanth Sundaresan, Sam Burnett, Nick Feamster, and Walter De Donato. BISmark: A Testbed for Deploying Measurements and Applications in Broadband Access Networks. In *USENIX Annual Technical Conference*, Philadelphia, PA, June 2014.
Acceptance rate: 15%
- [68] Arpit Gupta, Matt Calder, Nick Feamster, Marshini Chetty, Enrico Calandro, and Ethan Katz-Bassett. Peering at the Internets Frontier: A First Look at ISP Interconnectivity in Africa. In *Proc. Passive and Active Measurement Conference*, Los Angeles, CA, March 2014.
Acceptance rate: 31%
- [69] Xinyu Xing, Wei Meng, Dan Doozan, Nick Feamster, Wenke Lee, and Alex Snoeren. Exposing Inconsistent Web Search Results with Bobble. In *Proc. Passive and Active Measurement Conference*, Los Angeles, CA, March 2014.
Acceptance rate: 31%

- [70] Marshini Chetty, Srikanth Sundaresan, Sachit Muckaden, Nick Feamster, and Enrico Calandro. Measuring Broadband Performance in South Africa. In *4th ACM DEV (Symposium on Computing for Development)*, Cape Town, South Africa, December 2013.
Acceptance rate: 33%
- [71] Yogesh Mundada, Anirudh Ramachandran, and Nick Feamster. SilverLine: Preventing Data Leaks from Cloud-Based Web Applications. In *Annual Computer Security Applications Conference (AC-SAC)*, New Orleans, LA, December 2013.
Acceptance rate: 19%
- [72] Shuang Hao, Matthew Thomas, Vern Paxson, Nick Feamster, Christian Kreibich, Chris Grier, and Scott Hollenbeck. Understanding the domain registration behavior of spammers. In *Proc. ACM SIGCOMM Internet Measurement Conference*, Barcelona, Spain, October 2013.
Acceptance rate: 23%
- [73] Sarthak Grover, Mi Seon Park, Srikanth Sundaresan, Sam Burnett, Hyojoon Kim, and Nick Feamster. Peeking behind the nat: An empirical study of home networks. In *Proc. ACM SIGCOMM Internet Measurement Conference*, Barcelona, Spain, October 2013.
Acceptance rate: 23%
- [74] Srikanth Sundaresan, Nick Feamster, Renata Teixeira, and Nazanin Magharei. Measuring and mitigating web performance bottlenecks in broadband access networks. In *Proc. ACM SIGCOMM Internet Measurement Conference*, Barcelona, Spain, October 2013.
Acceptance rate: 23%
- [75] Xinyu Xing, Wei Ming, Dan Doozan, Alex Snoeren, Nick Feamster, and Wenke Lee. Take this personally: Pollution attacks on personalized services. In *Proc. 22th USENIX Security Symposium*, Washington, DC, August 2013.
Acceptance rate: 16%
- [76] Vytautas Valancius, Bharath Ravi, Nick Feamster, and Alex C Snoeren. Quantifying the benefits of joint content and network routing. In *Proc. ACM SIGMETRICS*, Pittsburgh, PA, June 2013.
Acceptance rate: 11%
- [77] Cristian Lumezanu and Nick Feamster. Measuring common spam on email and Twitter. In *Proc. ACM SIGCOMM Internet Measurement Conference*, Boston, Massachusetts, November 2012.
Acceptance rate: 24%
- [78] Ethan Katz-Bassett, Colin Scott, David Choffnes, Italo Cunha, Vytautas Valancius, Nick Feamster, Harsha Madhyastha, T. Anderson, and A. Krishnamurthy. LIFEGUARD: Practical Repair of Persistent Route Failures. In *Proc. ACM SIGCOMM*, Helsinki, Finland, August 2012.
Acceptance rate: 14%
- [79] Cristian Lumezanu and Nick Feamster. #bias: Measuring Propagandistic Behavior on Twitter. In *International Conference on Weblogs and Social Media (ICWSM)*, Dublin, Ireland, June 2012.
Acceptance rate: 20%
- [80] Maria Konte and Nick Feamster. Re-wiring Activity of Malicious Networks. In *Proc. Passive and Active Measurement Conference*, Vienna, Austria, March 2012.
Acceptance rate: 30%
- [81] Hyojoon Kim and Theophilus Benson and Aditya Akella and Nick Feamster. Understanding the Evolution of Network Configuration: A Tale of Two Campuses. In *Proc. ACM SIGCOMM Internet Measurement Conference*, Berlin, Germany, November 2011.
Acceptance rate: 19%
- [82] Shuang Hao, Nick Feamster, and Ramakant Pandrangi. Monitoring the Initial DNS Behavior of Spammers. In *Proc. ACM SIGCOMM Internet Measurement Conference*, Berlin, Germany, November 2011.
Acceptance rate: 19%

- [83] Vytautas Valancius, Cristian Lumezanu, Nick Feamster, Ramesh Johari, and Vijay Vazirani. How Many Tiers? Pricing in the Internet Transit Market. In *Proc. ACM SIGCOMM*, Toronto, Ontario, Canada, August 2011.
Acceptance rate: 14%
- [84] Srikanth Sundaresan, Walter de Donato, Nick Feamster, Renata Teixeira, Sam Crawford, and Antonio Pescapè. Broadband Internet Performance: A View From the Gateway. In *Proc. ACM SIGCOMM*, Toronto, Ontario, Canada, August 2011.
Acceptance rate: 14%
**Internet Research Task Force Applied Networking Research Prize.
Communications of the ACM Research Highlight.**
- [85] Anirudh Ramachandran, Anirban Dasgupta, Nick Feamster, and Kilian Weinberger. Spam or Ham? Characterizing and Detecting Fraudulent "Not Spam" Reports in Web Mail Systems. In *8th Annual Collaboration, Electronic messaging, Anti-Abuse and Spam Conference (CEAS 2011)*, Perth, Australia, September 2011.
- [86] Bilal Anwer, Murtaza Motiwala, Mukarram bin Tariq, and Nick Feamster. SwitchBlade: A Platform for Rapid Deployment of Network Protocols on Programmable Hardware. In *Proc. ACM SIGCOMM*, New Delhi, India, August 2010.
Acceptance rate: 12%
- [87] Sam Burnett, Nick Feamster, and Santosh Vempala. Chipping Away at Censorship Firewalls with Collage. In *Proc. 19th USENIX Security Symposium*, Washington, DC, August 2010.
Acceptance rate: 15%
- [88] Manos Antonakakis and Roberto Perdisci and David Dagon and Wenke Lee and Nick Feamster. Building a Dynamic Reputation System for DNS. In *Proc. 19th USENIX Security Symposium*, Washington, DC, August 2010.
Acceptance rate: 15%
- [89] Vytautas Valancius, Nick Feamster, Jennifer Rexford, and Akihiro Nakao. Wide-Area Routing for Distributed Services. In *Proc. USENIX Annual Technical Conference*, Boston, MA, June 2010.
Acceptance rate: 17%
- [90] Roberto Perdisci, Wenke Lee, and Nick Feamster. Behavioral Clustering of HTTP-Based Malware. In *Proc. 7th ACM/USENIX Symposium on Networked Systems Design and Implementation (NSDI)*, San Jose, CA, April 2010.
Acceptance rate: 16%
- [91] Mohammed Mukarram bin Tariq, Murtaza Motiwala, Nick Feamster, and Mostafa Ammar. Detecting General Network Neutrality Violations with Causal Inference. In *4th International Conference on emerging Networking EXperiments and Technologies (CoNEXT)*, Rome, Italy, December 2009.
Acceptance rate: 17%
- [92] Mohammed Mukarram bin Tariq, Ahmed Mansy, Nick Feamster, and Mostafa Ammar. Measuring VLAN-Induced Sharing on a Campus Network. In *Proc. ACM SIGCOMM Internet Measurement Conference*, Chicago, Illinois, October 2009.
Acceptance rate: 22%
- [93] Italo Cunha, Renata Teixeira, Nick Feamster, and Christophe Diot. Techniques for Fast and Accurate Network Tomography. In *Proc. ACM SIGCOMM Internet Measurement Conference*, Chicago, Illinois, October 2009.
Acceptance rate: 22%
- [94] Shuang Hao, Nadeem Syed, Nick Feamster, Alexander Gray, and Sven Krasser. Detecting Spammers with SNARE: Spatio-temporal Network-level Automatic Reputation Engine. In *Proc. 18th USENIX Security Symposium*, Montreal, Quebec, Canada, August 2009.
Acceptance rate: 15%

- [95] Maria Konte, Nick Feamster, and Jaeyeon Jung. Dynamics of Online Scam Infrastructure. In *Proc. Passive and Active Measurement Conference*, Seoul, Korea, March 2009.
Acceptance rate: 20% **Best paper award.**
- [96] Anirudh Ramachandran, Srinivasan Seetharaman, Nick Feamster, and Vijay Vazirani. Fast Monitoring of Traffic Subpopulations. In *Proc. ACM SIGCOMM Internet Measurement Conference*, Vouliagmeni, Greece, October 2008.
Acceptance rate: 17%
- [97] Murtaza Motiwala, Megan Elmore, Nick Feamster, and Santosh Vempala. Path Splicing. In *Proc. ACM SIGCOMM*, Seattle, WA, August 2008.
Acceptance rate: 12%
- [98] Mohammed Mukarram bin Tariq, Amgad Zeitoun, Nick Feamster, and Mostafa Ammar. Answering What-If Deployment and Configuration Questions with WISE. In *Proc. ACM SIGCOMM*, Seattle, WA, August 2008.
Acceptance rate: 12%
- [99] David Andersen, Hari Balakrishnan, Nick Feamster, and Scott Shenker. Accountable Internet Protocol (AIP). In *Proc. ACM SIGCOMM*, Seattle, WA, August 2008.
Acceptance rate: 12%
- [100] Nick Feamster and Alexander Gray. Can Great Research Be Taught? Independent Research with Cross-Disciplinary Thinking and Broader Impact. In *ACM SIGCSE Technical Symposium on Computer Science Education (SIGCSE)*, Portland, OR, March 2008.
- [101] Anirudh Ramachandran, Nick Feamster, and Santosh Vempala. Filtering Spam with Behavioral Blacklisting. In *Proc. 14th ACM Conference on Computer and Communications Security (CCS)*, Alexandria, VA, October 2007.
Acceptance rate: 24%
- [102] Manas Khadilkar, Nick Feamster, Russ Clark, and Matt Sanders. Usage-Based DHCP Lease Time Optimization. In *Proc. ACM SIGCOMM Internet Measurement Conference*, San Diego, CA, October 2007.
Acceptance rate: 24%
- [103] Yiyi Huang, Nick Feamster, Anukool Lakhina, and Jim Xu. Exposing Routing Problems with Network-Wide analysis. In *Proc. ACM SIGMETRICS*, San Diego, CA, June 2007.
Acceptance rate: 17%
- [104] Feng Wang, Nick Feamster, and Lixin Gao. Measuring the contributions of routing dynamics to prolonged end-to-end internet path failures. In *Proc. IEEE Conference on Global Communications (GlobeCom)*, Washington, DC, November 2007.
Acceptance rate: 40%
- [105] Christopher P. Lee, Keshav Attrey, Carlos Caballero, Nick Feamster, Milena Mihail, and John A. Copeland. MobCast: Overlay Architecture for Seamless IP Mobility using Scalable Anycast Proxies. In *IEEE Wireless Communications and Networking Conference*, Hong Kong, March 2007.
Acceptance rate: 47%
- [106] Anirudh Ramachandran and Nick Feamster. Understanding the Network-Level Behavior of Spammers. In *Proc. ACM SIGCOMM*, Pisa, Italy, August 2006. An earlier version appeared as Georgia Tech TR GT-CSS-2006-001.
Acceptance rate: 12% **Best student paper award.**
- [107] Andy Bavier, Nick Feamster, Mark Huang, Larry Peterson, and Jennifer Rexford. In VINI Veritas: Realistic and controlled network experimentation. In *Proc. ACM SIGCOMM*, Pisa, Italy, August 2006.
Acceptance rate: 12%

- [108] Nick Feamster and Hari Balakrishnan. Correctness Properties for Internet Routing. In *Forty-third Annual Allerton Conference on Communication, Control, and Computing*, Monticello, IL, September 2005.
- [109] Nick Feamster, Ramesh Johari, and Hari Balakrishnan. The Implications of Autonomy for Stable Policy Routing. In *Proc. ACM SIGCOMM*, pages 25–36, Philadelphia, PA, August 2005.
Acceptance rate: 11%
- [110] Michael Freedman, Mythili Vutukuru, Nick Feamster, and Hari Balakrishnan. Geographic Locality of IP Prefixes. In *Proc. ACM SIGCOMM Internet Measurement Conference*, New Orleans, LA, October 2005.
Acceptance rate: 24%
- [111] Nick Feamster and Hari Balakrishnan. Detecting BGP Configuration Faults with Static Analysis. In *Proc. 2nd Symposium on Networked Systems Design and Implementation (NSDI)*, pages 43–56, Boston, MA, May 2005.
Acceptance rate: 22% **Best paper award.**
- [112] Matthew Caesar, Don Caldwell, Nick Feamster, Jennifer Rexford, Aman Shaikh, and Kobus van der Merwe. Design and Implementation of a Routing Control Platform. In *Proc. 2nd Symposium on Networked Systems Design and Implementation (NSDI)*, pages 15–28, Boston, MA, May 2005.
Acceptance rate: 22% **Test of time paper award (2015).**
- [113] Nick Feamster, Zhuoqing Morley Mao, and Jennifer Rexford. BorderGuard: Detecting Cold Potatoes from Peers. In *Proc. ACM SIGCOMM Internet Measurement Conference*, pages 213–218, Taormina, Sicily, Italy, October 2004.
Acceptance rate: 25%
- [114] Nick Feamster, Jared Winick, and Jennifer Rexford. A Model of BGP Routing for Network Engineering. In *Proc. ACM SIGMETRICS*, pages 331–342, New York, NY, June 2004.
Acceptance rate: 12%
- [115] Nick Feamster, David Andersen, Hari Balakrishnan, and M. Frans Kaashoek. Measuring the Effects of Internet Path Faults on Reactive Routing. In *Proc. ACM SIGMETRICS*, pages 126–137, San Diego, CA, June 2003.
Acceptance rate: 12%
- [116] Nick Feamster, Magdalena Balazinska, Greg Harfst, Hari Balakrishnan, and David Karger. Infranet: Circumventing Web censorship and surveillance. In *Proc. 11th USENIX Security Symposium*, San Francisco, CA, August 2002.
Acceptance rate: 17% **Best student paper award.**
- [117] Kevin Fu, Emil Sit, Kendra Smith, and Nick Feamster. Dos and don'ts of client authentication on the Web. In *Proc. 10th USENIX Security Symposium*, Washington, DC, August 2001.
Acceptance rate: 28% **Best student paper award.**
- [118] Susie Wee, John Apostolopoulos, and Nick Feamster. Field-to-frame transcoding with temporal and spatial downsampling. In *IEEE International Conference on Image Processing*, October 1999.
Acceptance rate: 45%
- [119] Nick Feamster and Susie Wee. An MPEG-2 to H.263 transcoder. In *SPIE Voice, Video, and Data Communications Conference*, Boston, MA, September 1999.

Workshop Publications

- [120] A. Hounsel, P. Mittal, and N. Feamster. CensorSeeker: Generating a Large, Culture-Specific Blocklist for China. In *USENIX Workshop on Free and Open Communications on the Internet (FOCI)*, Baltimore, Maryland, August 2018.
- [121] Trisha Datta, Noah Apthorpe, and Nick Feamster. A Developer-Friendly Library for Smart Home IoT Privacy-Preserving Traffic Obfuscation. In *ACM SIGCOMM Workshop on Internet of Things Security and Privacy*, Budapest, Hungary, August 2018.
- [122] Gunes Acar, Danny Huang, Frank Li, Arvind Narayanan, and Nick Feamster. Web-based Attacks to Discover and Control Local IoT Devices. In *ACM SIGCOMM Workshop on Internet of Things Security and Privacy*, Budapest, Hungary, August 2018.
- [123] Xiaohe Hu, Arpit Gupta, Arojit Panda, Nick Feamster, and Scott Shenker. Preserving Privacy at IXPs. In *Asia-Pacific Workshop on Networking (APNet)*, Beijing, China, August 2018.
- [124] Rohan Doshi, Noah Apthorpe, and Nick Feamster. Machine Learning DDoS Detection for Consumer Internet of Things Devices. In *IEEE Security and Privacy Deep Learning and Security Workshop (DLS)*, San Francisco, CA, May 2018.
- [125] Daniel Wood, Noah Apthorpe, and Nick Feamster. Cleartext Data Transmission in Consumer IoT Medical Devices. In *ACM Computer and Communications Security (CCS) Workshop on Security and Privacy in the Internet of Things*, Dallas, TX, November 2017.
- [126] Noah Apthorpe, Dillon Reissman, and Nick Feamster. A Smart Home is No Castle: Privacy Vulnerabilities of Encrypted IoT Traffic. In *Workshop on Data and Algorithmic Transparency (DAT)*, New York, NY, November 2016.
- [127] Arpit Gupta, Rudiger Birkner, Marco Canini, Nick Feamster, Chris Mac-Stoker, and Walter Willinger. Network Monitoring as a Streaming Analytics Problem. In *ACM SIGCOMM Symposium on Hot Topics in Networking (HotNets)*, Atlanta, GA, November 2016.
Acceptance rate: 27%
- [128] M. Awan, T. Ahmad, S. Qaisar, N. Feamster, and S. Sundaresan. Measuring Broadband Access Network Performance in Pakistan: A Comparative Study. In *IEEE Workshop on Network Measurements (WNM)*, Clearwater Beach, FL, October 2015.
- [129] Brandon Schlinker, Kyriakos Zarifis, Italo Cunha, Nick Feamster, and Ethan Katz-Bassett. PEERING: An AS for Us. In *SIGCOMM Workshop on Hot Topics in Networks (HotNets)*, Los Angeles, CA, 2014.
- [130] Sean Donovan and Nick Feamster. Intentional Network Monitoring: Finding the Needle without Capturing the Haystack. In *SIGCOMM Workshop on Hot Topics in Networks (HotNets)*, Los Angeles, CA, 2014.
- [131] Ben Jones, Sam Burnett, Nick Feamster, Sathya Gunasekaran, Sean Donovan, Sarthak Grover, Sathya, and Karim Habak. Facade: High-Throughput, Deniable Censorship Circumvention Using Web Search. *USENIX Workshop on Free and Open Communications on the Internet (FOCI)*, page 115, 2014.
- [132] Nick Feamster. Hidden Sources of Internet Latency. In *ISOC Workshop on Reducing Internet Latency*, London, England, September 2013.
- [133] Marshini Chetty, Enrico Calandro, and Nick Feamster. Latency Effects on Broadband Performance in South Africa. In *ISOC Workshop on Reducing Internet Latency*, London, England, September 2013.
- [134] B. Anwer, T. Benson, N. Feamster, D. Levin, and J. Rexford. A Slick Control Plane for Network Middleboxes. In *Open Network Summit*, Santa Clara, CA, April 2013.
Acceptance rate: 23%

- [135] N. Feamster, D. Levin, J. Rexford, S. Shenker, R. Clark, and J. Bailey. SDX: A Software Defined Internet Exchange. In *Open Network Summit*, Santa Clara, CA, April 2013.
Acceptance rate: 23%
- [136] Andreas Voellmy, Hyojoon Kim, and Nick Feamster. Procera: A Language for High-Level Reactive Network Control. In *ACM SIGCOMM Workshop on Hot Topics in Software Defined Networking (HotSDN)*, Helsinki, Finland, August 2012.
- [137] Jake Martin and Nick Feamster. User-driven dynamic prioritization in the home. In *ACM SIGCOMM Workshop on Measurements Up the Stack (W-MUST)*, Helsinki, Finland, August 2012.
- [138] Srikanth Sundaresan, Nick Feamster, Renata Teixeira, Anthony Tang, W. Keith Edwards, Rebecca Grinter, Marshini Chetty, and Walter de Donato. Helping Users Shop for ISPs with Internet Nutrition Labels. In *ACM SIGCOMM Workshop on Home Networking (HomeNets)*, Toronto, Ontario, Canada, August 2011.
- [139] Nick Feamster and Jennifer Rexford. Getting Students' Hands Dirty With Clean-Slate Networking. In *SIGCOMM Workshop on Network Education (NetEd)*, Toronto, Ontario, Canada, August 2011.
- [140] Yogesh Mundada, Anirudh Ramachandran, and Nick Feamster. SilverLine: Data and Network Isolation for Cloud Services. In *3rd USENIX Workshop on Hot Topics in Cloud Computing (HotCloud '11)*, June 2011.
- [141] Bilal Anwer, Ankur Nayak, Nick Feamster, and Ling Liu. Network I/O Fairness in Virtual Machines. In *ACM SIGCOMM Workshop on Virtualized Infrastructure, Services, and Architectures (VISA)*, New Delhi, India, September 2010.
- [142] Nick Feamster. Outsourcing Home Network Security. In *ACM SIGCOMM Workshop on Home Networking (HomeNets)*, New Delhi, India, September 2010.
- [143] Ken Calvert, W. Keith Edwards, Nick Feamster, Rebecca Grinter, Ye Deng, and Xuzi Zhou. Instrumenting Home Networks. In *ACM SIGCOMM Workshop on Home Networking (HomeNets)*, New Delhi, India, September 2010.
- [144] Bilal Anwer and Nick Feamster. Building a Fast, Virtualized Data Plane with Programmable Hardware. In *ACM SIGCOMM Workshop on Virtualized Infrastructure, Services, and Architectures (VISA)*, Barcelona, Spain, August 2009.
- [145] Ankur Nayak, Alex Reimers, Russ Clark, and Nick Feamster. Resonance: Dynamic Access Control for Enterprise Networks. In *ACM SIGCOMM Workshop on Research in Enterprise Networks (WREN)*, Barcelona, Spain, August 2009.
- [146] Sapan Bhatia, Murtaza Motiwala, Wolfgang Muhlbauer, Yogesh Mundada, Vytautas Valancius, Andy Bavior, Nick Feamster, Larry Peterson, and Jennifer Rexford. Trellis: A Platform for Building Flexible, Fast Virtual Networks on Commodity Hardware. In *3rd International Workshop on Real Overlays & Distributed Systems*, December 2008.
- [147] Vytautas Valancius, Nick Feamster, Ramesh Johari, and Vijay Vazirani. MINT: A Market for Internet Transit. In *ACM SIGCOMM CoNext Workshop on Re-Architecting the Internet*, December 2009.
- [148] Mohammed Mukarram bin Tariq, Murtaza Motiwala, and Nick Feamster. NANO: Network Access Neutrality Observatory. In *Proc. 7th ACM Workshop on Hot Topics in Networks (Hotnets-VII)*, Calgary, Alberta, Canada, October 2008.
Acceptance rate: 20%
- [149] S. Yardi, N. Feamster, and A. Bruckman. Photo-Based Authentication Using Social Networks. In *Proc. ACM SIGCOMM Workshop on Online Social Networks*, Seattle, WA, August 2008.

- [150] Anirudh Ramachandran and Nick Feamster. Authenticated Out-of-Band Communication over Social Links. In *Proc. ACM SIGCOMM Workshop on Online Social Networks*, Seattle, WA, August 2008.
- [151] Murtaza Motiwala, Nick Feamster, and Santosh Vempala. Path Splicing: Reliable Connectivity with Rapid Recovery. In *Proc. 6th ACM Workshop on Hot Topics in Networks (Hotnets-VI)*, Atlanta, GA, November 2007.
Acceptance rate: 18%
- [152] David G. Andersen, Hari Balakrishnan, Nick Feamster, and Scott Shenker. Holding the Internet Accountable. In *Proc. 6th ACM Workshop on Hot Topics in Networks (Hotnets-VI)*, Atlanta, GA, November 2007.
Acceptance rate: 18%
- [153] Anirudh Ramachandran, Atish das Sarma, and Nick Feamster. BitStore: An Incentive-Compatible Solution for Blocked Downloads in Bittorrent. In *ACM Joint Workshop on The Economics of Networked Systems and Incentive-Based Computing (NetEcon)*, San Diego, CA, June 2007.
- [154] Anirudh Ramachandran, Nick Feamster, and David Dagon. Revealing Botnet Membership with DNSBL Counter-Intelligence. In *2nd USENIX Workshop on Steps to Reducing Unwanted Traffic on the Internet (SRUTI)*, San Jose, CA, July 2006.
- [155] Anirudh Ramachandran, David Dagon, and Nick Feamster. Can DNSBLs Keep Up with Bots? In *3rd Conference on Email and Anti-Spam (CEAS)*, Mountain View, CA, July 2006.
- [156] Nick Feamster, Hari Balakrishnan, and Jennifer Rexford. Some foundational problems in interdomain routing. In *Proc. 3rd ACM Workshop on Hot Topics in Networks (Hotnets-III)*, San Diego, CA, November 2004.
- [157] Nick Feamster, Hari Balakrishnan, Jennifer Rexford, Aman Shaikh, and Kobus van der Merwe. The Case for Separating Routing from Routers. In *ACM SIGCOMM Workshop on Future Directions in Network Architecture*, pages 5–12, Portland, OR, September 2004.
- [158] Nick Feamster and Roger Dingledine. Location diversity in anonymity networks. In *ACM Workshop on Privacy in the Electronic Society*, Washington, DC, October 2004.
- [159] Nick Feamster, Magdalena Balazinska, Winston Wang, Hari Balakrishnan, and David Karger. Thwarting Web censorship with untrusted messenger discovery. In *3rd Workshop on Privacy Enhancing Technologies*, Dresden, Germany, March 2003.
- [160] Nick Feamster. Practical Verification Techniques for Wide-Area Routing. In *Proc. 2nd ACM Workshop on Hot Topics in Networks (Hotnets-II)*, pages 87–92, Cambridge, MA, November 2003.
- [161] Nick Feamster and Hari Balakrishnan. Towards a Logic for Wide-Area Internet Routing. In *ACM SIGCOMM Workshop on Future Directions in Network Architecture*, pages 289–300, Karlsruhe, Germany, August 2003.
- [162] David G. Andersen, Nick Feamster, Steve Bauer, and Hari Balakrishnan. Topology inference from BGP routing dynamics. In *Proc. ACM SIGCOMM Internet Measurement Workshop*, Marseille, France, November 2002.
Acceptance rate: 42%
- [163] Nick Feamster and Hari Balakrishnan. Packet loss recovery for streaming video. In *Proc. 12th International Packet Video Workshop (PV 2002)*, Pittsburgh, PA, April 2002.
- [164] Nick Feamster, Deepak Bansal, and Hari Balakrishnan. On the interactions between congestion control and layered quality adaptation for streaming video. In *11th International Packet Video Workshop*, Kyongju, Korea, May 2001.

Software

My research group regularly releases software and makes a practice of releasing source code with most published papers. As a supplement to the descriptions below, my research group's Github page is available at: <http://github.com/noise-lab/>.

Ongoing and Maintained Software

- *Sonata: Query-Driven Network Telemetry.* Sonata is a query-driven streaming network telemetry system that uses a declarative query interface to drive the joint collection and analysis of network traffic. It takes advantage of two emerging technologies—streaming analytics platforms and programmable network devices—to facilitate query-driven telemetry. Sonata allows operators to directly express queries for a range network telemetry applications using a high level declarative language. Under the hood, Sonata partitions each query into a portion that runs in the switch and another that runs on the streaming analytics platform, iteratively refines the queries to efficiently capture only the traffic that satisfies the respective queries. We have released Sonata open-source on Github (<https://github.com/Sonata-Princeton>); more details are available at the project page at <https://sonata.cs.princeton.edu/>.
- *Interconnection Measurement Project.* Participating Internet Service Providers have installed a common tool to measure traffic at their interconnects, the points where ISPs exchange traffic with the greater Internet. This effort includes multiple ISPs, providing direct information on the capacity and utilization of interconnect links. All data and visualizations are of ingress capacity and utilization. Across the 1,200+ links included in the data set, which represent the diverse and broadly substitutable routes available for Internet traffic flows, the Project reveals that capacity is roughly 50% utilized during peak periods, and that capacity continues to grow to address continued traffic growth. Further segmentation and analysis of the data is available, which will be regularly refreshed to provide a dynamic picture of how the Internet is evolving.
- *iSDX: An Industrial-Scale Software Defined Internet Exchange Point.* iSDX (Software-Defined IXP) Software brings the merits of SDN to interdomain routing. Today's networks can only forward traffic based on the destination IP prefixes and routes offered by their immediate neighbors. SDN can give direct control over packet-processing rules that match on multiple header fields and perform a variety of actions. Internet Exchange Points (IXPs) are a compelling place to deploy these changes, given their role in interconnecting many networks and their growing importance in bringing popular content closer to end users.

SDX does more than simply replace an IXP's switches with their OpenFlow counterparts. SDX's capabilities enable new applications, such as application-specific peering where two networks peer only for (say) streaming video traffic. We also developed new programming abstractions that allow participating networks to create and run these applications and a runtime that both behaves correctly when interacting with BGP and ensures that applications do not interfere with each other. Finally, we also ensured that the system scales, both in terms of table size and computational overhead. We are involved in several trial deployments of the SDX controller at various IXPs around the world, in collaboration with network operators. Software and more information is available through the Open Source SDN website, which is part of the Open Networking Foundation: <http://opensourcensdn.org/projects/isdx-a-software-defined-internet-exchange-point/>.
- *Project BISmark: An Application Platform for Home Networks.* Project BISmark (Broadband Internet Service Benchmark) is a platform for developing network management applications for home networks. The BISmark firmware is based on OpenWrt, an open-source operating system for home routers. Currently, BISmark includes a suite of passive and active network measurements that allows a home Internet user to continuously monitor various performance metrics, such as upstream and downstream throughput, latency, and packet loss. As of Spring 2013, BISmark is deployed in nearly 300 homes around the world in more than 20 countries. We are currently working both to expand the deployment and to extend the capabilities of the platform, to allow other researchers to use the platform for their own measurements.
See <http://projectbismark.net> for details.
- *MySpeedTest: A Tool for Mobile Performance Measurement.* Building on the success of BISmark, my students Sachit Muckaden, Abhishek Jain, and I have developed a tool to measure performance from mobile cellular handsets. The application collects a variety of data, including latency and throughput measurements to a variety of servers around the world, hosted by Measurement Lab. The application is now deployed on more than 4,000

handsets in over 130 countries. Some of the most significant deployments are in developing countries, and we are currently collaborating with ResearchICTAfrica, a policy organization in Africa, to study the performance of both fixed and mobile broadband across the continent. Software is available at <http://goo.gl/28tx3>.

Older Projects

- *Bobble: Bursting Online Filter Bubbles.* With students Xinyu Xing, Dan Doozan and colleague Wenke Lee, I have designed and developed Bobble, a Chrome extension that allows users to see how their Web searches appear from different vantage points. The filter bubble is a concept developed by Internet activist Eli Pariser in his book to describe a phenomenon in which websites use algorithms to predict what information a user may like to see based on the user's location, search history, etc. As a result, a website may only show information which agrees with the user's past viewpoints. A typical example is Google's personalized search results. To "pop" the bubbles created by Google search (also called de-personalization), our research group in the Georgia Tech Information Security Center is conducting ground-breaking research and developing software, Filter Bubble. Filter Bubble is a chrome extension that uses hundreds of nodes to distribute a user's Google search queries world wide each time the user performs a Google search. Using Filter Bubble, a user can easily see differences between his and others' Google search returns. The plugin has been installed by more than 100 users around the world and is available at <http://bobble.gtisc.gatech.edu/>.
- *Appu: Measuring Online Privacy Footprints.* With so many web applications and sites in the current time, it's hard for a user to keep track of where does her personal information reside. With Appu, we aim to make this job easier for the end user. Appu keeps track of personal information such as passwords, username, birthdate, address, credit card numbers, and social security number so that a user can find out all sites that store a particular bit of personal information. In the current beta release, Appu downloads personal information from sites where you have account and also tries to prevent password reuse across websites by warning users about it.
- *Transit Portal.* We developed software for the NSF-Sponsored GENI Project Office that (1) adds facilities and functions to the VINI testbed to enable experiments to carry traffic from real users; and (2) increases the experimental use of the VINI testbed by providing a familiar experiment management facility. The deliverables for this project all comprise software for supporting external connectivity and flexible, facile experimentation on the GENI testbed. The primary deliverables are a BGP session multiplexer—a router based on the Quagga software routing suite, software support for virtual tunnel and node creation, and integration of the above functionality with clearinghouse services developed as part of the ProtoGENI project.

This project contributed to the GENI design and prototyping through BGP mux development integration with ISPs; tunnel and topology establishment and management; ProtoGENI clearinghouse integration; and support for isolation and resource swapout. With researchers at Princeton, we have also built VINI, a large distributed testbed for specifying virtual network topologies and experimenting with routing protocols and architectures in a controlled, realistic emulation environment. This project has since been handed off to Professor Ethan Katz-Bassett at the University of Southern California and is still an actively maintained testbed. See <http://peering.usc.edu/> for more details.

- *Campus-Wide OpenFlow Deployment: Access and Information Flow Control for Enterprise Networks.* Resonance is a system for controlling access and information flow in an enterprise network. Network operators currently use access control systems that are coarse-grained (i.e., it is difficult to apply specialized policy to individual users) and static (i.e., it is difficult to quickly change the extent of a user's access). Towards fixing these problems, we have developed a system that allows network operators to program network policy using a controller that is distinct from the switch itself and can be programmed to implement network-wide policy. We have implemented and deployed this system in an operational network that spans two buildings on the Georgia Tech campus; the network sees regular use, and a deployment in Georgia Tech dormitories or the wireless network is planned for the near future. We first demonstrated the function of this network at the 7th GENI Engineering Conference in March 2010, and recently demonstrated a version on Resonance that facilitates various home network management tasks at the 2011 Open Network Summit. See <http://groups.geni.net/geni/wiki/BGPMux> for details.
- *rcc: router configuration checker.* Static configuration analysis tool for Border Gateway Protocol (BGP) routing configurations. Downloaded by over 100 network operators and many large, nationwide backbone ISPs around the world.

- *NANO: Network Access Neutrality Observatory*. The Network Access Neutrality Observatory (NANO) is a system to help users determine whether their traffic is being discriminated against by an access ISP. In contrast to existing systems for detecting network neutrality violations, NANO makes no assumptions about the mechanism for discrimination or the services that the ISP might be discriminated against. NANO has been released in collaboration with Google as part of the Measurement Lab project.
- *Infranet*. System for circumventing Web censorship firewalls (*e.g.*, those in China, Saudi Arabia, etc.). Available on Sourceforge. Featured in articles in *Technology Review*, *New Scientist*, and *Slashdot*. See <http://nms.lcs.mit.edu/projects/infranet/>.
- *The Datapository*. Originally the “MIT BGP Monitor”, the Datapository is growing to support multiple data feeds (*e.g.*, spam, end-to-end measurement probes, traceroutes, Abilene data, etc.). Currently used by researchers at Georgia Tech, Carnegie Mellon, University of Michigan, Princeton, MIT.
- *Secure BGP Implementation*. Implementation of S-BGP in the Quagga software router. Our implementation was considered by Randy Bush and Geoff Huston for their project to develop a certificate infrastructure for secure routing protocols.
- *SR-RTP*. Transport protocol for selective retransmission of packets in an MPEG video stream. Incorporated into “Oxygen TV” for MIT Project Oxygen. Some ideas incorporated into the OpenDivX video transport protocol.

Research Proposals and Grants

- [1] **Detecting and Controlling Unwanted Data Flows in the Internet of Things**
Sponsor: National Science Foundation
Investigator(s): N. Feamster (PI), S. Kpotufe, A. Narayanan
Amount: \$987,000 for 3 years.
Awarded: September 2018.
- [2] **Artificial Intelligence in the Public Interest (CITP Program)**
Sponsor: MacArthur Foundation
Investigator(s): N. Feamster, E. Felten (PI), A. Narayanan
Amount: \$750,000 for 3 years.
Awarded: September 2017.
- [3] **Global Internet Censorship Measurement Consortium**
Sponsor: Department of State
Investigator(s): N. Feamster (PI)
Amount: \$300,000 for 2 years.
Awarded: August 2017.
- [4] **Workshop on Self-Driving Networks**
Sponsor: National Science Foundation
Investigator(s): N. Feamster (PI), J. Rexford
Amount: \$49,900 for 1 year.
Awarded: July 2017.
- [5] **NeTS: Medium: From Packets to Insights: Programmable Streaming Analytics for Networks**
Sponsor: National Science Foundation
Investigator(s): N. Feamster, J. Rexford (PI)
Amount: \$1,000,000 for 4 years.
Awarded: June 2017.
- [6] **CITP Technology Policy Consortium on Internet of Things Security and Privacy**
Sponsor: Amazon, Microsoft, Comcast, Cisco, CableLabs, Hewlett Foundation
Investigator(s): N. Feamster (PI)
Amount: \$1.7M for 3 years
Awarded: Fall 2016.
- [7] **Interconnection Measurement Project**
Sponsor: Kyrio, Inc.
Investigator(s): N. Feamster (PI)
Amount: \$200,000 for 2 years.
Awarded: March 2016, March 2017.
- [8] **Securing the Internet of Things with Traffic Analysis and Software Defined Networking**
Sponsor: Siemens Corporation
Investigator(s): N. Feamster (PI)
Amount: \$142,000 for 1 year.
Awarded: November 2016
- [9] **Detecting Abnormal Activity on the Internet of Things**
Sponsor: Siebel Energy Institute
Investigator(s): N. Feamster (PI)
Amount: \$50,000 for 1 year.
Awarded: April 2016
- [10] **Towards a Science of Censorship Resistance**
Sponsor: National Science Foundation
Investigator(s): N. Feamster (PI), V. Paxson, P. Gill, J. Crandall, R. Dingledine

Amount: \$3,000,000 for 4 years.
Awarded: November 2015

- [11] **Software-Defined Security for the Internet of Things**
Sponsor: Google Faculty Research Award
Investigator(s): N. Feamster, J. Rexford
Amount: \$100,000 for 1 year.
Awarded: August 2015
- [12] **Traffic Demand Response to Service-Plan Increases**
Sponsor: Comcast Tech Research Fund
Investigator(s): N. Feamster
Amount: \$45,000 for 1 year.
Awarded: March 2015
- [13] **Software-Defined Networking**
Sponsor: AT&T Labs – Research Gift
Investigator(s): N. Feamster
Amount: \$25,000 for 1 year.
Awarded: March 2015
- [14] **A Software Defined Internet Exchange**
Sponsor: National Science Foundation
Investigator(s): N. Feamster (PI), J. Rexford, S. Shenker
Amount: \$500,000 for 3 years.
Awarded: August 2014
- [15] **Studying and Improving the Performance of Access Networks**
Sponsor: National Science Foundation
Investigator(s): N. Feamster (PI), A. Snoeren
Amount: \$281,364 for 3 years.
Awarded: August 2014
- [16] **EPICA: Empowering People to Overcome Information Controls and Attacks**
Sponsor: National Science Foundation
Investigator(s): W. Lee (PI), N. Feamster, H. Klein, M. Bailey, M. Chetty
Amount: \$750,000 for 4 years.
Awarded: August 2014
- [17] **An Open Platform for Internet Routing Experiments**
Sponsor: National Science Foundation
Investigator(s): N. Feamster, E. Katz-Bassett, D. Choffnes (PI)
Amount: \$361,617 for 3 years.
Awarded: August 2014
- [18] **An Open Observatory for the Internet's Last Mile**
Sponsor: National Science Foundation
Investigator(s): N. Feamster (PI), S. Banerjee, J. Cappos
Amount: \$399,879 for 3 years.
Awarded: June 2014
- [19] **Improving the Performance and Security of Home Networks with Programmable Home Routers**
Sponsor: Comcast
Investigator(s): N. Feamster (PI)
Amount: \$65,000 for 1 year
Awarded: September 2013
- [20] **Demand Characterization and Management for Access Networks**
Sponsor: Cisco Systems

Investigator(s): N. Feamster (PI) and R. Johari
Amount: \$99,766 for 1 year
Awarded: April 2013

- [21] **Personal Information Fusion with In Situ Sensing Infrastructure**
Sponsor: National Science Foundation
Investigator(s): N. Feamster (PI)
Amount: \$75,000 for 1 year.
Awarded: July 2012
- [22] **Characterizing and Exposing Bias in Social and Mainstream Media**
Sponsor: National Science Foundation
Investigator(s): N. Feamster (PI)
Amount: \$175,000 for 1 year.
Awarded: July 2012
- [23] **I-Corps: Helping Users and ISPs Manage Home Networks with BISmark**
Sponsor: National Science Foundation
Investigator(s): N. Feamster (PI)
Amount: \$50,000 for 1 year.
Awarded: June 2012
- [24] **Optimizing Network Support for Cloud Services: From Short-Term Measurements to Long-Term Planning**
Sponsor: National Science Foundation
Investigator(s): N. Feamster (PI), J. Rexford
Amount: \$574,996.00 for 4 years.
Awarded: April 2012
- [25] **Facilitating Free and Open Access to Information on the Internet**
Sponsor: National Science Foundation
Investigator(s): R. Dingedine, N. Feamster (PI), E. Felten, M. Freedman, H. Klein, W. Lee
Amount: \$1,500,000 for 4 years
Awarded: March 2011
- [26] **Measurement Infrastructure for Home Networks**
Sponsor: National Science Foundation
Investigator(s): K. Calvert, W.K. Edwards, N. Feamster (PI), R. Grinter
Amount: \$1,200,000 for 4 years
Awarded: February 2011
- [27] **Monitoring Free and Open Access to Information on the Internet**
Sponsor: Google Focus Grant
Investigator(s): N. Feamster and W. Lee
Amount: \$1,500,000 for 3 years
Awarded: February 2011
- [28] **GENI OpenFlow Campus Buildout**
Sponsor: GENI Project Office
Investigator(s): N. Feamster (PI), Russ Clark
Amount: \$64,675 for 1 year
Awarded: October 2010
- [29] **Architecting for Innovation**
Sponsor: National Science Foundation
Investigator(s): H. Balakrishnan, N. Feamster, B. Godfrey, N. McKeown, J. Rexford, S. Shenker (PI)
Amount: \$200,000 for 1 year
Awarded: September 2010

- [30] **Aster*x: Load-Balancing Web Traffic over Wide-Area Networks**
Sponsor: National Science Foundation
Investigator(s): N. Feamster (PI), Russ Clark
Amount: \$75,000 for 1 year
Awarded: August 2010
- [31] **Network-Wide Configuration Testing and Synthesis**
Sponsor: National Science Foundation
Investigator(s): N. Feamster (PI), A. Akella
Amount: \$500,000 for 3 years
Awarded: June 2010
- [32] **MEDITA - Multi-layer Enterprise-wide Dynamic Information-flow Tracking & Assurance**
Sponsor: National Science Foundation
Investigator(s): N. Feamster, A. Orso (PI), M. Prvulovic
Amount: \$900,000 for 3 years
Awarded: March 2010
- [33] **Campus Network Access and Admission Control with Openflow**
Sponsor: National Science Foundation
Investigator(s): N. Feamster (PI), R. Clark
Amount: \$300,000 for 3 years
Awarded: January 2010
- [34] **Studying DNS Traffic Patterns**
Sponsor: Verisign
Investigator(s): N. Feamster
Amount: \$30,000 for 1 year
Awarded: November 2009
- [35] **CI Fellowship for Cristian Lumezanu**
Sponsor: National Science Foundation
Investigator(s): C. Lumezanu, N. Feamster (PI)
Amount: \$140,000 for 1 year
Awarded: November 2009
- [36] **Military Network Protocol**
Sponsor: DARPA Subcontract
Investigator(s): N. Feamster
Amount: \$37,000 for 1 year
Awarded: November 2009
- [37] **Botnet Attribution and Removal: From Axioms to Theories to Practice**
Sponsor: Office of Naval Research
Investigator(s): W. Lee (PI), D. Dagon, J. Giffin, N. Feamster, K. Shin, F. Jahanian, M. Bailey, J. Mitchell, G. Vigna, C. Kruegel
Amount: \$7,500,000 for 5 years
Awarded: August 2009
- [38] **Taint-based Information Tracking in Networked Systems**
Sponsor: National Science Foundation Trusted Computing Program
Investigator(s): N. Feamster
Amount: \$450,000 for 3 years
Awarded: August 2009
- [39] **Towards a Market for Internet Connectivity**
Sponsor: Office of Naval Research
Investigator(s): N. Feamster (PI), R. Johari, V. Vazirani

Amount: \$350,000 for 1 year
Awarded: March 2009

[40] **Bringing Experimenters and External Connectivity to GENI**

Sponsor: GENI Project Office
Investigator(s): N. Feamster
Amount: \$320,000 for 3 years
Awarded: September 2008

[41] **Routing Without Recomputation**

Sponsor: Cisco Systems
Investigator(s): N. Feamster
Amount: \$96,019 for 1 year
Awarded: September 2008

[42] **CLEANSE: Cross-Layer Large-Scale Efficient Analysis of Network Activities to Secure the Internet**

Sponsor: National Science Foundation Cybertrust Program
Investigator(s): W. Lee (PI), N. Feamster and others
Amount: \$1,200,000 for 5 years
Awarded: September 2008

[43] **Virtual Center for Network and Security Data**

Sponsor: Department of Homeland Security
Investigator(s): N. Feamster
Amount: \$48,000 for 2 years
Awarded: March 2008

[44] **Sloan Research Fellowship**

Sponsor: Alfred P. Sloan Foundation
Investigator(s): N. Feamster
Amount: \$45,000 for 2 years
Awarded: February 2008

[45] **Enabling Security and Network Management Research for Future Networks**

Sponsor: National Science Foundation CRI-IAD Program
Investigator(s): N. Feamster (PI), Z. Mao, W. Lee
Amount: \$397,426 for 3 years
Awarded: February 2008

[46] **SMITE: Scalable Monitoring in the Extreme**

Sponsor: DARPA BAA 07-52: Scalable Network Monitoring
Investigator(s): N. Feamster (PI), W. Lee
Amount: \$250,000 for 2 years
Awarded: January 2008

[47] **Countering Botnets: Anomaly-Based Detection, Comprehensive Analysis, and Efficient Mitigation**

Sponsor: Department of Homeland Security BAA07-09
Investigator(s): W. Lee (PI), N. Feamster, J. Giffin
Amount: \$1,050,730 for 2 years
Awarded: January 2008

[48] **Spam Filtering Research**

Sponsor: IBM Faculty Award
Investigator(s): N. Feamster
Amount: \$ 7,500 (unrestricted gift)
Awarded: June 2007

- [49] **SCAN: Statistical Collaborative Analysis of Networks**
Sponsor: National Science Foundation NeTS-NBD Program
Investigator(s): N. Feamster (PI), A. Gray, J. Hellerstein, C. Guestrin
Amount: \$ 95,000 for 3 years.
Awarded: June 2007
- [50] **Towards an Accountable Internet Architecture**
Sponsor: National Science Foundation CyberTrust Program (Team Proposal)
Investigator(s): D. Andersen, H. Balakrishnan, N. Feamster (PI), S. Shenker
Amount: \$ 300,000 for 3 years.
Awarded: May 2007
- [51] **Fish4Phish: Fishing for Phishing in a Large Pond**
Sponsor: AT&T Labs—Research
Investigator(s): N. Feamster (PI), O. Spatscheck, K. van der Merwe
Amount: *Funding for summer intern.*
Awarded: February 2007
- [52] **Improving Network Operations with a View from the Edge.**
Sponsor: National Science Foundation CAREER Program
Investigator(s): N. Feamster (PI)
Amount: \$400,000 for 5 years.
Awarded: January 2007
- [53] **Equipment Donation for Network Operations Research**
Sponsor: Intel Corporation
Investigator(s): N. Feamster
Amount: \$30,000
Awarded: October 2006
- [54] **CABO: Concurrent Architectures are Better than One**
Sponsor: National Science Foundation NeTS-FIND Program
Investigator(s): N. Feamster (PI), L. Gao, J. Rexford
Amount: \$ 300,000 for 4 years
Awarded: June 2006
- [55] **Verification and Modeling of Wide-Area Internet Routing**
Sponsor: Cisco Systems University Research Program
Investigator(s): N. Feamster and H. Balakrishnan (PI)
Amount: \$ 95,500 for 1 year.
Awarded: June 2004

Service

Awards Committees

- ACM Doctoral Dissertation Awards Committee: 2016–2020
- Internet Research Task Force Applied Networking Research Prize: 2015–Present

Organizing Roles

- Founder, Chair, and Steering Committee, USENIX Workshop on Free and Open Communication on the Internet: 2011–Present
- Steering Committee, USENIX Symposium on Networked Systems Design and Implementation (NSDI): 2012–Present
- Steering Committee, ACM SIGCOMM Conference on SDN Research (SOSR): 2012–2016
- Program Committee Co-Chair, USENIX Symposium on Networked Systems Design and Implementation (NSDI): 2013
- Poster and Demo Committee Co-Chair, ACM SIGCOMM: 2009, 2013
- Program Committee Co-Chair, CoNext Student Workshop: 2006
- Co-organizer, NSF Workshop on Self-Running Networks: 2018
- Co-organizer, NSF/FCC Workshop on Quality of Experience on the Internet: 2016
- Co-organizer, NSF Workshop on Software Defined Infrastructure: 2016
- Co-organizer, Boston Freedom in Online Communications (BFOC) Day: 2013
- Panel Organizer, IEEE Computer and Communications Workshop (CCW): 2011
- Program Committee Co-Chair, ACM SIGCOMM Workshop on Hot Topics in Software Defined Networking (HotSDN): 2012
- Editor, IEEE Journal on Network and Systems Management
- Co-Organizer, DIMACS Workshop Series on Internet Security: 2007
- Organizer, Workshop on Internet Routing Evolution and Design: 2006
- Program Committee Co-Chair, ACM/USENIX Workshop on Networks meet Databases (NetDB): 2007
- Program Committee Co-Chair, Workshop on the Economics of Networked Systems (NetEcon): 2006

Program Committees

- IEEE Symposium on Security and Privacy: 2006, 2010, 2011, 2012, 2013
- ACM Conference on Computer and Communication Security (CCS): 2008, 2011
- ISOC Network and Distributed Security Symposium (NDSS): 2011, 2014
- ACM SIGCOMM: 2008, 2013, 2016
- ACM/USENIX Symposium on Networked Systems Design and Implementation (NSDI): 2009, 2012, 2015
- USENIX Technical Conference: 2007, 2009
- ACM SIGCOMM Internet Measurement Conference: 2006, 2008, 2012, 2013
- ACM SIGCOMM CoNext: 2006, 2007, 2014
- ACM SIGMETRICS: 2008, 2009, 2010
- Internet Research Task Force Applied Networking Research Workshop: 2016, 2017, 2018
- Research Conference on Communication, Information and Internet Policy (TPRC): 2014, 2015
- ACM SIGCOMM Workshop on Hot Topics in Networking (HotNets): 2012
- USENIX Workshop on Free and Open Communications on the Internet (FOCI): 2012–2015
- USENIX Workshop on Hot Topics in Security (HotSec): 2012
- First Workshop on Systems and Infrastructure for the Digital Home (HomeSys): 2012
- ACM SIGCOMM Workshop on Medical Communication (MedCOMM): 2012

- ACM SIGCOMM COMSNETS: 2012
- ACM SIGCOMM Workshop on Home Networks (HomeNets): 2011
- Program Committee USENIX Workshop on Large-Scale Exploits and Emergent Threats: 2009, 2010, 2011
- ACM SIGCOMM Poster and Demo Session: 2011
- ACM SIGCOMM Workshop on Internet Network Management: 2006, 2007, 2008, 2009, 2010
- USENIX Workshop on Hot Topics in Management of Internet, Cloud, and Enterprise Networks and Services (HotICE): 2011
- ACM SIGCOMM Workshop on Virtualized Infrastructure Systems and Architectures (VISA): 2010
- ACM SIGCOMM Workshop on Programmable Routers for Extensible Services of Tomorrow (PRESTO): 2008, 2009
- USENIX International Workshop on Real Overlays & Distributed Systems: 2008
- ACM SIGCOMM Workshop on Economics of Networked Systems (NetEcon): 2008
- International World Wide Web Conference (Security/Privacy Track): 2008
- IEEE LAN/MAN Workshop: 2008
- ACM SIGCOMM Student Poster Session: 2007
- ACM SIGMETRICS Workshop on Mining Internet Data (MineNet): 2007
- Conference on Email and Anti-Spam (CEAS): 2007
- USENIX Workshop on Steps to Reduce Unwanted Traffic on the Internet (SRUTI): 2007
- International World Wide Web Conference (Security/Privacy Track): 2007
- North American Network Operators Group (NANOG): 2006–2009
- IEEE Infocom Student Poster Session: 2006
- IEEE International Conference on Internet Surveillance and Protection: 2006
- Workshop on Data and Algorithmic Transparency (DAT): 2016

External reviewer for *IEEE/ACM Transactions on Networking*, *SIGCOMM* (2002, 2003, 2004, 2006, 2007), *SOSP* (2001, 2003), *ACM SIGPLAN Programming Language Design and Implementation (PLDI)* (2016), *Infocom* (2004, 2006), *HotNets* (2003), *HotOS* (2001), *USENIX Security Symposium* (2002), *ACM Computer Communication Review*, *IEEE Network Magazine*, *IEEE Journal on Selected Areas in Communications*, *Image Communication (EURASIP)*, *ASPLOS* (2004), *MobiSys* (2004), *USENIX* (2005, 2006), *NSDI* (2005, 2006), *IPTPS* (2005), *Workshop on Privacy Enhancing Technologies* (2006).

Public Policy Activities

Panels and Leadership Roles

- Panelist, State of the Net Conference: 2017
- Working Group Co-Chair, Association for Computing Machinery (ACM) Public Policy Council Internet of Things Working Group: 2016–Present
- Testified before General Accountability Office (GAO) panel on Internet of Things Security: 2016
- Community Member, Broadband Internet Technical Advisory Group (<http://bitag.org/>): 2014–Present
- Advisory Board, Center for Democracy and Technology: 2015–Present
- Acting Director, Princeton University Center for Information Technology Policy: 2015–2017
- Deputy Director, Princeton University Center for Information Technology Policy: 2017–Present
- Co-Editor, Broadband Internet Technical Advisory Group (BITAG) report on Security and Privacy Recommendations for the Internet of Things (IoT): 2016
- Co-Editor, Broadband Internet Technical Advisory Group (BITAG) report on Privacy and Data Retention: 2017–2018

- Commenter and contributor to FCC rulemaking on privacy and ISPs: 2016
- Commentor on FCC rulemaking on net neutrality: 2018
- Advisor to the Federal Communications Commission on Measuring Broadband America Project: 2010–2012

Public Writing and Influence

- **Internet Service Providers and Customer Privacy.** Over the past two years, through public comments and policy activities, I have served as a technical expert in the technology policy community on Internet data and privacy, through various activities.
 - Filed multiple public comments on the Federal Communications Commission (FCC) Privacy Rulemaking. **My comments are cited extensively in the final report, available on the FCC Website.** https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-148A1.pdf. (*My comments and inputs are cited more than 30 times in the rulemaking.*)
 - * My letter to FCC Chairman Tom Wheeler: <https://goo.gl/Q2UI3n>
 - * Public commentary on WC-106, the FCC’s notice of proposed rulemaking: <https://goo.gl/J2P397>, <https://goo.gl/AcU6Dg>, <https://goo.gl/qaPIuj>. I led a group of stakeholders from the research community to preserve a researcher exemption to the FCC’s privacy rulemaking, to ensure that researchers would continue to have access to data from Internet service providers to work on topics related to Internet security and performance.
 - I am the co-editor for the ongoing Broadband Internet Technical Advisory Group (BITAG) report on Internet Data Collection, Retention, and Privacy. This report is due out in Spring 2018. Press release here: <https://goo.gl/6rfH5v>.
- **Internet of Things Security and Privacy.** I have been actively involved in policymaking activities around security and privacy for the Internet of Things (IoT) at the state and federal levels over the past year. Activities include:
 - Co-editor of the Broadband Internet Technology Advisory Group (BITAG) report on security and privacy recommendations for the Internet of Things: <https://bitag.org/report-internet-of-things-security-privacy-recommendations.php>. In addition to the report itself, my colleague Jason Livingood and I presented to many policymakers in Washington, D.C., including the current chairwoman of the Federal Trade Commission, Maureen Ohlhausen.
 - Co-editor of the USACM documents (reply comments, etc.) on Internet of Things. (Several documents, such as a response to the NTIA’s request for comments, are forthcoming in early 2017.)

Activities as Acting Director of CITP

External Events

- Organizing IoT security and privacy hackathon in new Princeton Smart Home Lab facility on Prospect Street (2016). Hackathon due to take place in April 2017.
- Organized Internet speed test hackathon, co-organized with Comcast (November 2016)
- Organized CITP conference on Security and Privacy for the Internet of Things (IoT) (October 2016)
- Organized CITP conference on Internet Interconnection (March 2016)
- Organized CITP conference on Internet Censorship and Information Control (October 2015)
- Organized and hosted joint NSF/FCC conference on Internet Quality of Experience (October 2015)
- Hosted visits for several prominent guest speakers: Matt Devlin, Director of Global Policy at Uber; David Clark, Senior Research Scientist at MIT. (October 2015)
- Organizing first-ever CITP hackathon, in cooperation with Code for Princeton and New Jersey Bike and Walk Coalition. (hackathon in February 2016)

Fundraising Activities and Results

- Engaged in ongoing discussions with Ford Foundation, Open Society Foundation, and MacArthur Foundation in efforts to raise awareness and funding opportunities for CITP. (2016) Made face-to-face visits to MacArthur Foundation (June 2016) and Ford Foundation (February 2017).
- Secured funding on IoT cybersecurity from the Hewlett Foundation and other corporate partners, including Amazon, Cisco, and Comcast. Total funding for CITP IoT cybersecurity is currently \$1.7M, through a combination of gifts and in-kind donations. (2016)
- Secured \$100k funding from CableLabs to support CITP's ongoing work on measurement of Internet interconnection (2016).
- Secured \$300k donation from Microsoft for new CITP seed grant fund, to encourage collaboration between SEAS and WWS researchers. The initial seed grant program is now providing funding for four new cross-disciplinary projects. (2015)
- Secured endowment from Princeton alum Ron Lee: the Jerome Blum Memorial Fund, to support a CITP "on the road" speaker series, for tech policy events around the country. (Current funds transferred to date are approximately \$200k.) (2015)
- Gave outreach/CITP fundraising talks to Intel, Cisco, and Yahoo on SDX and censorship measurement. (November/December 2015)
- Delivered talk to Princeton Development office about CITP and met with development office to prepare materials for next capital campaign. (November 2015)
- With Joanna Huey, prepared CITP annual report, to be used in fundraising activities. (Fall 2015)

Internal Activities

- Reconstituted executive committee and created CITP Advisory Council (required by Nassau Hall, though none had previously existed), including Princeton alums Paul Misener, Nuala O'Connor, Anne-Marie Slaughter. (2016)
- Working with SEAS and external contractor (Sketchfolio) on a complete redesign of the CITP website. Expected launch is Summer 2017. (Fall 2016–Present)
- Organized and ran three-day tech policy "boot camp" for 15 Princeton undergraduates, who visited approximately ten different venues in Washington, DC (FCC, FTC, White House, Senator Booker's office, CRA, etc.) (November 2015, November 2016)
- Serving on organizing committee for WWS Fung Forum, whose focus for 2016 will be cybersecurity. (Fall 2015–Present)
- Working with Paul Frymer, director of LAPA, to host a joint CITP/LAPA fellow for 2016–2017.
- Blogging on Freedom to Tinker (three blog posts in 2015, four blog posts in 2016).
- Updating courses in the Technology and Society Certificate program (Fall 2015).

Teaching

Courses

Term	Year	Course Number & Title	Number of Students	Comments
Spring	2018	COS 461 Computer Networking	102	
Fall	2017	WWS 593C Online Speech and Information Control	12	
Fall	2017	COS 497 Security and Privacy in the Internet of Things	7	
Spring	2017	COS 461 Computer Networking	95	
Fall	2016	COS 432 Information Security	84	
Summer	2015	Software Defined Networking (Coursera)	50,000+	
Spring	2016	COS 461 Computer Networking	87	
Spring	2015	COS 461 Computer Networking	72	
Fall	2014	CS 4270/8803 Software Defined Networking	30	New Course
Fall	2014	OMS CS 6250 Computer Networking	223	Online MS
Fall	2014	CS 7001 Introduction to Graduate Studies	51	
Summer	2014	Software Defined Networking (Coursera)	50,000+	
Spring	2014	CS 6250 Computer Networking	50	
Spring	2014	OMS CS 6250 Computer Networking	300	Online MS
Fall	2013	CS 8001 Software Defined Networking	15	Flipped classroom
Fall	2013	CS 7001 Introduction to Graduate Studies	36	10k Blog Readers/Month
Summer	2013	Software Defined Networking (Coursera)	50,000+	First SDN Course
Spring	2013	CS 3251 Computer Networking	82	
Fall	2012	CMSC 330 Programming Languages (Univ. of Maryland)	100	
Fall	2011	CS 6250 Computer Networking	51	
Fall	2011	CS 4235 Computer Security	44	
Fall	2010	CS 6250 Computer Networking	92	
Spring	2010	CS 3251 Computer Networking I	53	
Spring	2010	CS 8803 NGN Next Generation Networking	50	New Course
Fall	2009	CS 7001 Introduction to Graduate Studies	39	
Spring	2009	CS 6262 Network Security	45	Updated Syllabus
Fall	2008	CS 4251 Computer Networking II	16	
Fall	2008	CS 7001 Introduction to Graduate Studies	44	
Spring	2008	CS 4251 Computer Networking II	14	New Syllabus
Fall	2007	CS 7001 Introduction to Graduate Studies	53	
Spring	2007	CS 7260 Internetworking Protocols and Architectures	29	
Fall	2006	CS 7001 Introduction to Graduate Studies	74	New Syllabus
Fall	2006	CS 8001 Networking Research Seminar	30	New Syllabus
Fall	2006	CS 1100 Freshman Leap Seminar	15	
Spring	2006	CS 7260 Internetworking Protocols and Architectures	27	New Syllabus

Other Highlights:

- Developing new ethics modules to teach ethics in undergraduate Princeton computer science courses across the curriculum, to start with Computer Networking (COS 461) and Information Security (COS 432). (2017)
- Developed new course at Woodrow Wilson School on Censorship and Free Expression Online for Woodrow Wilson School Masters in Public Policy program. (2017)
- Completely redesigned course format and assignments for Computer Networking (COS 461) including adding videos to course material, seven new modernized programming assignments, and new in-class activities. With help from Alan Kaplan and an undergraduate, integrated autograding and feedback facilities into programming assignments. (2017)
- Began revisions for a new edition of *Computer Networks*, undergraduate computer networking textbook; next edition due out late 2018. (2017)
- Guest lecture in Woodrow Wilson School of Public Policy graduate course on Security Studies (WWS 550): 2015, 2017

- Prepared and delivered a tutorial to the USENIX Large Installation Systems Administration (LISA) conference on Software Defined Networking in 2015 and 2016.
- Taught a computer science undergraduate honors course to 20 masters students at the University of Cape Town on Measuring Internet Performance in Summer 2016.
- Created the first-ever course on Software Defined Networking (SDN), and delivered it on Coursera to over 50,000 enrolled students.
- Tutorial on network measurement at African Network Operators Group (AfNOG) in Summer 2013.
- Guest lecture on Internet censorship in Georgia Tech CS 4001 in October 2011.
- Tutorial on software-defined networking at African Network Operators Group (AfNOG) in Summer 2011.
- Tutorials on BGP Multiplexer at GENI Experimenters Workshop and GENI Engineering Conference in Summer 2010.
- Tutorial on network security at African Network Operators Group (AfNOG) in Summer 2010.
- Tutorial on Internet routing at Simposio Brasileiro de Redes de Computadores (SBRC) in Summer 2008.
- Lecture for DIMACS Tutorial on Next-Generation Internet Routing Algorithms in August 2007.
- Guest lecture for MIT Course 6.829 (Computer Networking) in Fall 2005.

Curriculum Development

Integration of Ethics into the Computer Science Curriculum: Many aspects of computer science—ranging from the measurement of Internet censorship to the design of automated algorithms for decision-making—now require some understanding and consideration of ethics. To this end, I am working with experts in ethics to design several modules that teach ethics to undergraduates that are appropriate for the Princeton Computer Science curriculum’s courses. The initial plan is to incorporate these modules into Computer Networking (COS 461), and later to integrate them into Information Security (COS 432) and the new course on fairness in artificial intelligence. Some of these case studies will also be published in a quarterly column in *ACM Computer Communications Review (CCR)* and *USENIX ;login:*.

Assignment Development in Princeton Undergraduate Courses: The undergraduate Computer Networks (COS 461) and Information Security (COS 432) courses had assignments that had not been updated in many years. In each offering of the course in 2016 (Spring 2016 for COS 461 and Fall 2016 for COS 432), I worked with course staff to completely redesign and implement assignments that teach modern course topics. In the Computer Networks course, we modernized the assignments to use commonly used systems programming languages (Go, Python), as well as new Internet measurement assignments written in distributed programming analysis frameworks (e.g., Spark). In COS 432, we modernized the assignments to include hands-on activities on a variety of concepts, including Web security and network security.

Coursera and Online Masters Program Development: I have developed an online Coursera course for the topic of Software Defined Networking (SDN), an emerging topic in computer networking that is reshaping how networks are defined. In the course, students learn about the history of SDN and develop hands-on experience with tools to develop technologies and applications for SDN. The course had approximately 50,00 students enrolled, and had about 4,000 students actively participating on the forums and in lectures. Nearly 1,000 students successfully completed the programming assignments for the course, qualifying as a pass “with distinction”. The course reviewed extremely favorably from students, as we have documented here: <http://goo.gl/So7Uis>. Additionally, the success of the course was covered on many technical forums, including the Mininet blog (<http://goo.gl/ZqfL1N>), the Packet Pushers blog (<http://goo.gl/okzd44>), and the sFlow blog (<http://goo.gl/qSMCq0>). Based on its overwhelming success, the course will be offered again in May 2014.

Georgia Tech Online Masters Program: I served on the committee to develop a Master of Science in Computer Science degree based on Massive Open Online Course (MOOC) offerings and took an active role in ensuring the creation of the online degree at Georgia Tech. As of October 2013, I am currently working with Udacity and Georgia Tech to create the first online graduate course in computer networking, which will launch in January 2014 and become an integral part of the Georgia Tech online degree program.

CS 7001 Introduction to Graduate Studies: With Professor Alex Gray, I have developed a new course syllabus and structure to CS 7001 around the larger goal of introducing new students to *how to do great research* as soon as their first term at Georgia Tech. In contrast with previous terms, where CS 7001 consisted of faculty “advertisements” for their research and projects consisted of short “mini-projects” where little research could be accomplished in a short time span of 3 weeks, we have improved the syllabus by bringing in faculty members to talk about research philosophy, exciting new directions, etc. We have also given the students the option to do a research project that is a term-long project in conjunction with CS 8903; our goal is to give students the flexibility to select meaningful research problems based on their research assistantships while helping them learn the skills required for writing papers, finding and evaluating research ideas, and performing other tasks associated with doing great research. Alex Gray and I wrote a conference paper on our development of this course, which appeared at *ACM SIGCSE 2008*. We have developed a website for the course, greatresearch.org, which makes the material generally available for use at other universities and by other researchers. **The website and blog have more than 25,000 views since its launch in mid-August 2013, and it has been receiving about 10,000 views every month.**

CS 6250 Graduate Computer Networking: In Fall 2011, I redesigned the graduate computer networking course to focus more on current technologies and hands-on assignments. Conventional networking courses treat today’s protocols and mechanisms as fixed artifacts, rather than as part of a continually evolving system. To prepare students to think critically about Internet architecture, Jennifer Rexford and I created a graduate networking course that combines “clean slate” networking research with hands-on experience in analyzing, building, and extending real networks. My goal was to prepare students to create and explore new architectural ideas, while teaching them the platforms and tools needed to evaluate their designs in practice. The course, with offerings at both Georgia Tech and Princeton, focuses on network management as a concrete way to explore different ways to split functionality across the end hosts, network elements, and management systems. I have refined the course in Fall 2011 to include more hands-on assignments and refactored the course around networking problems in different types of networks: transit networks, home networks, content hosting networks, and mobile and wireless networks. **Our work on the course received the best paper at the ACM SIGCOMM Workshop on Networking Education (NetEd) in 2011.**

College of Computing Research Day and Seminar Series: In addition to the course itself, to fulfill some of the functions of the former 7001 course, Alex Gray and I financed and organized a college-wide seminar series and research day in Fall 2009 and again in Spring 2011. Throughout the term, faculty speakers from across the college gave one-hour talks about their research; we raised money from Yahoo to support this event. The research day brings together students and faculty from around the college to see talks, demonstrations, and posters from around the college to exchange ideas.

CS 8803 Next-Generation Networking: I developed a new graduate course that gives students practical experience with a variety of tools for next-generation networking, ranging from the Click software router to the OpenFlow switch framework. The course also teaches students about the state of the art in networking research—students read papers about research and industry trends and do a course project that incorporates aspects of these new technologies. This course relates to the larger nationwide effort on Global Environment for Network Innovations (GENI), which is building infrastructure for researchers to provide the next generation of networking protocols and technologies.

Postdoctoral Researchers

Completed

- **Philipp Winter.** *Fall 2015 - Spring 2017.*
Publications: [31], [40], [45]
First job: Research Scientist at Center for Applied Internet Data Analysis (CAIDA)
- **Roya Ensafi.** *Fall 2015 - Spring 2017.*
Publications: [5], [6], [33], [35], [37], [45]
First job: Assistant Professor at University of Michigan
- **Dave Levin.** *Fall 2012 - Fall 2014.*
Publications: [134]
First job: Assistant Professor at University of Maryland
- **Cristian Lumezanu.** *Fall 2010 - Fall 2012.*
Publications: [77], [83]
First job: Researcher at NEC Research Labs
- **Nazanin Magharei.** *Fall 2010 - Fall 2012.*
Publications: [74]
First job: Software Engineer at Cisco

Current

- **Danny Huang.** *Fall 2017 - Current.*
Publications: [122]
- **Paul Schmitt.** *Fall 2017 - Current*

Ph.D. Students

Graduated

- **Muhammad Shahbaz.** *Fall 2012 - Fall 2018.*
Publications: [8], [46], [58], [60], [66]
First job: Postdoc at Stanford University.
- **Arpit Gupta.** *Fall 2013 - Summer 2018.*
Publications: [32], [48], [52], [68], [127],
First job: Assistant Professor at UC Santa Barbara.
- **Annie Edmundson.** *Summer 2015 - Spring 2018.*
Publications: [31],[33],
First job: Squarespace.
- **Abhinav Narain.** *Fall 2011 - Summer 2017.*
Publications: [64]
First job: Mailchimp.
- **Yogesh Mundada.** *Fall 2007 - Summer 2016.*
Publications: [47], [71], [140]
First job: Software Developer at Samsara (IoT Startup). Now at Facebook.
- **Bilal Anwer.** *Fall 2008 - Fall 2015.*
Publications: [21], [86], [141], [144]
First job: Research Scientist at AT&T Labs – Research.

- **Hyojoon Kim.** *Fall 2009 - Summer 2015.*
Publications: [60], [61], [73], [81]
First job: Research Scientist at Princeton University.
- **Maria Konte.** *Fall 2007 - Summer 2015.*
Publications: [56], [80], [95]
First job: Research Scientist at Georgia Tech.
- **Xinyu Xing.** *Fall 2011 - Spring 2015.*
Publications: [69], [75]
First job: Assistant Professor at Penn State University
- **Shuang Hao.** *Fall 2007 - Fall 2014.*
Publications: [72], [82], [94]
First job: Assistant Professor at University of Texas – Dallas.
- **Sam Burnett.** *Fall 2008 - Spring 2014.*
Publications: [87], [73], [55]
First job: Google.
- **Srikanth Sundaresan.** *Fall 2008 - Spring 2014.*
Publications: [49], [62], [67], [74], [13], [84], [138]
First job: Research Scientist at UC Berkeley International Computer Science Institute. Now at Facebook.
- **Vytautas Valancius.** *Summer 2007 - Spring 2012.*
Publications: [76], [78], [83], [89], [147], [146]
First job: Google.
- **Murtaza Motiwala.** *Fall 2006 - Spring 2012.*
Publications: [16], [97], [151]
First job: Google.
- **Anirudh Ramachandran.** *Spring 2006 - Spring 2011.*
Publications: [28], [85] [101], [106], [150], [153], [154], [155]
First job: Founded Nouvou, security startup (sold). Now at Facebook.
- **Mukarram Bin Tariq.** *Spring 2007 - Spring 2010.*
Publications: [98], [92], [91], [148], [12]
First job: Google.

Current

- **Jordan Holland.** *Fall 2018 - Present.*
- **Austin Hounsel.** *Fall 2017 - Present..*
Publications: [120]
- **Noah Apthorpe.** *Fall 2015 - Present..*
Publications: [30], [121], [124], [125], [126]
- **Hooman Moghaddam.** *Fall 2015 - Present.*
Co-advised with Prateek Mittal.