

# ZACHARY SCOTT BISCHOF

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## RESEARCH INTERESTS

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Computer networks; Internet measurement; broadband networks; network reliability; distributed systems; content distribution; peer-to-peer systems; Internet-scale system design, deployment, and measurement.

## EDUCATION

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- **Ph.D., Computer Science** (December 2016)  
**Northwestern University**, Evanston, Illinois  
Advisor: Prof. Fabián E. Bustamante  
Dissertation: *Characterizing Broadband Services in a Broader Context: Vantage Points, Measurements, and Experimentation*
- **M.S., Computer Science** (September 2013)  
**Northwestern University**, Evanston, Illinois  
Advisor: Prof. Fabián E. Bustamante
- **B.S., Computer Engineering** (June 2009)  
Japanese Language & Culture Minor  
**Northwestern University**, Evanston, Illinois

## PROFESSIONAL EXPERIENCE

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- **IJ INNOVATION INSTITUTE** August 2017 – February 2020  
**Researcher** Tokyo, Japan
  - August 2017 to August 2019 funded by the Japan Society for Promotion of Science (日本学術振興会) Postdoctoral Fellowship, then hired as a Senior Researcher
  - Led multiple self-directed research projects on networked systems and Internet measurement
  - Studied the criticality of submarine network infrastructure and developed a system to help identify transmarine traffic
  - Supervised and collaborated with an intern on a project to identify and correct errors in the FCC's Measure Broadband America open dataset, which led to a publication and Best Open Dataset award at TMA 2020
- **NORTHWESTERN UNIVERSITY** January 2017 – August 2017  
**Adjunct lecturer & postdoctoral researcher** Evanston, IL
  - Taught *EECS 213: Intro to Computer Systems* (Course textbook: *Computer Systems: A Programmer's Perspective*)
  - Conducted research on measuring and improving broadband service reliability
  - Supervised and collaborated on a project that evaluated the design decisions of Google's Accelerated Mobile Pages (AMP) framework, which led to a publication in Mobicom 2019
- **INRIA** Summer 2015  
**Research intern** Paris, France
  - Supervised by Renata Teixeira
  - Developed a home network traffic prioritization system to differentiate between user- and automatically-generated network traffic by applying machine learning techniques
- **TELEFONICA RESEARCH** Summer 2013  
**Research intern** Barcelona, Spain
  - Supervised by Rade Stanojevic
  - Conducted research on how broadband user traffic demand varies across broadband markets, which led to a publication and nomination for the Best Paper award at IMC 2014

- IIJ INNOVATION INSTITUTE Summer 2012  
**Research intern** Tokyo, Japan
  - Supervised by Kenjiro Cho
  - Developed an automated video streaming performance test that monitored and recorded Quality of Experience metrics, which was later integrated into Dasu, a tool for monitoring ISP performance
- NORTHWESTERN UNIVERSITY, AQUALAB September 2009 - December 2016  
**Graduate research assistant** Evanston, IL
  - Advised by Prof. Fabián E. Bustamante
  - Conducted multiple research projects related to broadband networks, Internet measurement, distributed systems, and peer-to-peer systems
- NORTHWESTERN UNIVERSITY, EECS DEPARTMENT Evanston, IL  
**Teaching assistant**
  - Responsible for grading assignments, weekly recitations, helping design and develop course programming assignments and occasional lectures
  - Introduction to Computer Systems (CS 213): Spring '11, Spring '12
  - Operating Systems (CS 343): Fall '13, Fall '15
  - Distributed Systems (CS 345): Winter '13, Winter '14, Spring '15, Spring '16
  - Designed and developed original programming assignments for Distributed Systems course that had students implement the Kademia DHT and Vanish (distributed key sharding) in Go
- NORTHWESTERN UNIVERSITY 2007 to 2009  
**Undergraduate research assistant** Evanston, IL
  - Aided in research projects in the Database Systems Laboratory and AquaLab
  - Awarded a summer research grant (Northwestern Undergraduate Research Grant)
  - Extended SIDnet-SWANS for wireless sensor network simulations and experimentation
  - Contributed to the development of the *Network Early Warning System (NEWS)* and *NEWSight*, tools for collecting and visualizing crowd-sourced detected network events

## PUBLICATIONS

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### Journal articles

- Mario A. Sánchez, John S. Otto, Zachary S. Bischof, David R. Choffnes, Fabián E. Bustamante, Balachander Krishnamurthy, and Walter Willinger. “A Measurement Experimentation Platform at the Internet’s Edge.” In *IEEE/ACM Transactions on Networking (ToN)*, September 2014.
- Zachary S. Bischof, John S. Otto, and Fabián E. Bustamante. “Up, Down and Around the Stack: ISP Characterization from Network Intensive Applications.” In *ACM SIGCOMM Computer Communication Review (CCR)*, October 2012.
- Oliviu Ghica, Goce Trajcevski, Peter Scheuermann, Nikolay Valtchanov, and Zachary Bischof. “Controlled Multi-Path Routing in Sensor Networks Using Bezier Curves.” *The Computer Journal*, January 2010.

### Conferences

- Shucheng Liu, Zachary S. Bischof, Ishaan Madan, Peter K. Chan, and Fabián E. Bustamante. “Out of Sight, Not Out of Mind: A User-View on the Criticality of the Submarine Cable Network.” In *Proc. of ACM Internet Measurement Conference (IMC)*, October 2020.
- Arun Dunna, Zachary S. Bischof, and Romain Fontugne. “Sanitizing a view of consumer broadband in the united states.” In *Proc. of Network Traffic Measurement and Analysis Conference (TMA)*, June 2020. **Best Open Dataset Award.**
- Byungjin Jun, Fabián E. Bustamante, Sung Yoon Whang, and Zachary S. Bischof. “AMP up your mobile web experience: Characterizing the impact of Google’s Accelerated Mobile Project.” In *Proc. of the 25th Annual International Conference on Mobile Computing and Networking (Mobicom)*, October 2019.

- Zachary S. Bischof, Romain Fontugne, and Fabián E. Bustamante. “Untangling the world-wide mesh of undersea cables.” In Proc. of HotNets, November 2018.
- Zachary S. Bischof, Fabián E. Bustamante, and Nick Feamster. “Characterizing and Improving the Reliability of Broadband Internet Access.” In Proc. of the 46th Research Conference on Communications, Information, and Internet Policy (TPRC), September 2018.
- Zachary S. Bischof, Fabián E. Bustamante, and Rade Stanojevic. “The Utility Argument - Making a Case for Broadband SLAs.” In Proc. of Passive and Active Measurement Conference (PAM), March 2017.
- Zachary S. Bischof, John P. Rula, and Fabián E. Bustamante. “In and Out of Cuba: Characterizing Cuba’s Connectivity.” In Proc. of ACM Internet Measurement Conference (IMC), October 2015.
- Zachary S. Bischof, Fabián E. Bustamante, and Rade Stanojevic. “Need, Want, Can Afford: Broadband Markets and the Behavior of Users.” In Proc. of ACM Internet Measurement Conference (IMC), November 2014. **Nominated for best paper award.**
- Mario A. Sánchez, John S. Otto, Zachary S. Bischof, David R. Choffnes, Fabián E. Bustamante, Balachander Krishnamurthy, and Walter Willinger. “Dasu: Pushing Experiments to the Internet’s Edge.” In Proc. of the USENIX Symposium on Networked Systems Design and Implementation (NSDI), April 2013.
- Mario A. Sánchez, John S. Otto, Zachary S. Bischof, and Fabián E. Bustamante. “Trying Broadband Characterization at Home.” In Proc. of 14th Passive and Active Measurement Conference (PAM), March 2013.

### Peer-reviewed workshops

- John P. Rula, Zachary S. Bischof, and Fabián E. Bustamante. “Second Chance: A look at the features that matter in broadband networks.” In Proc. of SIGCOMM Workshop on Crowdsourcing and Crowdfunding of Big (Internet) Data (C2B(I)D), August 2015.
- Zachary S. Bischof, John S. Otto, and Fabián E. Bustamante. “Up, Down and Around the Stack: ISP Characterization from Network Intensive Applications.” In Proc. of ACM SIGCOMM Workshop on Measurements Up the STack (W-MUST), August 2012. **Won best paper award.**
- Zachary S. Bischof, John S. Otto, and Fabián E. Bustamante. “Distributed Systems and Natural Disasters: BitTorrent as a Global Witness.” In Proc. of CoNEXT Special Workshop on the Internet and Disasters (SWID), December 2011.
- Zachary S. Bischof, John S. Otto, Mario A. Sánchez, John P. Rula, David R. Choffnes, and Fabián E. Bustamante. “Crowdsourcing ISP Characterization to The Network Edge.” In Proc. of ACM SIGCOMM Workshop on Measurements Up the STack (W-MUST), August 2011.

### Posters and demos

- Sung Yoon Whang, Zachary S. Bischof, and Fabian E. Bustamante. “AMP up your mobile web experience: Benefits (and a hidden cost) of Accelerated Mobile Pages.” Poster at IMC, November 2017.
- Zachary S. Bischof and Fabián E. Bustamante. “A Time for Reliability: The Growing Importance of Being Always On.” Poster in Proc. of ACM SIGCOMM, August 2014.
- Angela H. Jiang, Zachary S. Bischof, and Fabián E. Bustamante. “A Cliq of Content Curators.” Poster in Proc. of ACM SIGCOMM, August 2014. **Winner of ACM Student Research Competition, Undergraduate Category.**
- Zachary S. Bischof, Mario A. Sánchez, John S. Otto, John P. Rula, and Fabián E. Bustamante. “Characterizing Broadband Services with Dasu.” Demonstration at USENIX NSDI, April 2013.
- Mario A. Sánchez, John S. Otto, Zachary S. Bischof, David R. Choffnes, Fabián E. Bustamante, and Walter Willinger. “Experiments at the Internet’s Edge with Dasu.” Demonstration at USENIX NSDI, April 2013.

- Mario A. Sánchez, John S. Otto, Zachary S. Bischof, and Fabián E. Bustamante. “Dasu - ISP Characterization from the Edge: A BitTorrent.” Poster in Proc. of ACM SIGCOMM, August 2011.
- Goce Trajcevski, Zachary Bischof, and Peter Scheuermann. “Range queries for mobile objects in wireless sensor networks.” Poster paper in Proc. of ACM SIGSPATIAL, November 2009.
- Oliviu Ghica, Goce Trajcevski, Peter Scheuermann, Zachary Bischof, and Nikolay Valtchanov. “SIDnet-SWANS: a simulator and integrated development platform for sensor networks applications.” Poster paper in Proc. of ACM SenSys, November 2008.

## Non-refereed

- Zachary S. Bischof, Fabián E. Bustamate, and Nick Feamster. “Characterizing and Improving the Reliability of Broadband Internet Access.” arXiv:1709.0934, September 2017.

## NOTABLE PROJECTS

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*(Listed roughly in reverse chronological order)*

- **Seawolf:** A system that helps identify transoceanic hops in network paths by leveraging data from submarine infrastructure maps, coordinated network measurements from RIPE Atlas, knowledge of network operator router naming schemes, and driving routers from automotive navigation systems (e.g., Google Maps). *Still under development.*
- **The impact of Google’s AMP:** Google’s Accelerated Mobile Project (AMP) is a recent effort started by Google with the goal of improving the mobile browsing experience. This project presents the first characterization of the performance impact and side effects of AMP on user experience. <http://aqualab.cs.northwestern.edu/projects/the-impact-of-google-amp/>
- **AlwaysOn:** An analysis of the reliability of broadband service providers in the US, including the design of an MPTCP-enabled home gateway and proxy to limit the impact of provider outages. This project also involved an effort to identify and correct errors in the FCC’s Measuring Broadband America publicly available metadata.
- **Mussel:** A background service to measure broadband service performance. Background service for monitoring broadband Internet performance. This project also included the development of Aquarium, a general purpose framework for developing software with network monitoring capabilities. <http://aqualab.cs.northwestern.edu/projects/broadband-in-a-broader-context/mussel/>
- **Namehelp:** An extensible local proxy DNS server that allows users to get the benefits of third-party DNS servers (e.g. Google Public DNS) while avoiding the performance penalty for CDN-hosted content normally incurred when using remote DNS. Worked on developing Namehelp’s network measurement functionality and developing a new client in Go. <http://aqualab.cs.northwestern.edu/projects/namehelp>
- **Dasu:** An extension to the Vuze BitTorrent client that characterizes multiple aspects of ISP performance (such as bandwidth, latency, and DNS performance) through the use of both active and passive measurements. Dasu is a dual-objective system providing ISP characterization (including the detection of network interference) and supporting Internet measurement experimentation. <http://www.aqualab.cs.northwestern.edu/projects/Dasu.html>
- **Edgescope:** Leveraging the view of a distributed Internet telescope. This project aims to leverage the network view of end systems located at the edge of the network. The datasets collected as part of this project covers hundreds of thousands of users located in hundreds of counties and thousands of networks worldwide. <http://aqualab.cs.northwestern.edu/projects/edgescope>

## PROFESSIONAL ACTIVITIES

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### Technical Program Committee (TPC) member

- Passive and Active Measurement (PAM), 2021
- ACM Internet Measurement Conference (IMC), 2019, 2020
- ACM/IRTF Applied Networking Research Workshop (ANRW), 2019, 2020
- International Teletraffic Congress (ITC) 30, 2018
- ACM SIGCOMM 2018 Workshop on IoT Security and Privacy (IoT S&P) 2018

### Other activities

- Reviews for periodicals/journals including ACM SIGCOMM Computer Communication Review (CCR), IEEE/ACM Transactions on Networking (ToN), and Elsevier Computer Networks (COMNET)
- Artifact Evaluation Committee member for CoNEXT 2019
- Shadow Technical Program Committee member for ACM IMC 2017, 2018
- Invited panelist at TPRC on the Hill (highlights of TPRC 46), US Capitol Hill, 2018
- Invited panelist at ACM SIGCOMM Workshop on Measurements Up and Down the Sack (W-MUST), 2012
- Co-organizer of Systems Reading Group (SRG) at Northwestern University, 2011-2013
- Coordinator for Graduate Research Seminar in CS & CE at Northwestern University, 2010-2011

## SKILLS AND EXPERTISE

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- Primary programming languages: C, Go, Python
- Other programming languages with previous extensive experience with: Assembly (IA-32, AMD64 and 8051), C++, Java, Javascript, Matlab/Octave, PHP, Racket/Scheme, VHDL
- Familiar with the following tools/frameworks: AWS, Click Modular Router, Docker, Hadoop, Jupyter, Kafka, OpenWRT, Pig, PlanetLab, PyTorch, QEMU, RIPE Atlas, Scapy, Scikit Learn, Spark, SQL, Weka
- Revision control: Mercurial, Git

## HONORS AND AWARDS

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- Best Open Dataset Award, Network Traffic Measurement and Analysis Conference (TMA), 2020
- Japan Society for the Promotion of Science (日本学術振興会) Postdoctoral Fellowship, 2017-2019
- Terminal Year Fellowship Award, Northwestern University, 2016
- Nominated for Best Paper Award, ACM Internet Measurement Conference (IMC), 2014
- Best Paper Award, ACM SIGCOMM Workshop on Measurement Up and Down the Sack (W-MUST), 2012
- Walter P. Murphy Graduate Fellowship; Northwestern University, 2009-2010
- Undergraduate Research Grant; Northwestern University, Summer 2007

## PERSONAL INFORMATION

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- US citizen
- Proficient in Japanese
- Long-time avid hockey player and goaltender