

# STEPHEN D. STROWES, PH.D.

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STATUS: US Resident (green card)  
EU (British) citizen

I work on network protocols, network measurement, and network monitoring. I study how the Internet evolves.

I enjoy leading long-running projects. I am currently a senior researcher at the RIPE NCC, where I take on on Internet measurement projects and outreach: internal and external collaborations, peer-reviewed publications, and public speaking.

Previously, I ran Yahoo's IPv6 program. This required complex project coordination to achieve IPv6 deployment, and network measurement to understand its effects. Formerly, I was a team lead at Boundary Inc., leading development of software agents to monitor network flows on hosts for upstream aggregation.

I am interested in research and leadership roles that will let me bring cutting-edge network protocols and network measurement into operational practice.

## WORK HISTORY

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- DEC/2016 Senior Researcher, RIPE NCC, Amsterdam, Netherlands  
-TO-  
PRESENT
- Research scientist, studying network growth and protocol usage on the Internet. Topics of interest include studying IPv6 deployment, IPv4 transfers and exhaustion, multipath traceroute behaviour, NTP leap second behaviour.
  - Transitioned RIPE Atlas daily archives from prototype to production service [25]. Initiated the company's first attempt at running IPv6-only services in our datacenters.
  - Outreach including authoring multiple RIPE Labs articles, talks at NOGs, and talks given to research groups with academic collaborators. Reviewed submissions for the Research and Academic Collaboration Initiative (RACI).
  - Started running the "NCC Sevens", a recurring lightning talk series to encourage cross-company collaboration.
  - Output from this role includes multiple papers [1, 2, 3, 4], articles [19], tech reports [26, 27, 28], and talks [32, 33].
- OCT/2013 Principal Network Engineer and IPv6 Program Manager, Yahoo Inc., Sunnyvale, USA  
-TO-  
OCT/2016
- Ran the IPv6 program from 2014; enabling IPv6 for hundreds of millions of users across many Yahoo properties. Promoted from Senior to Principal Network Engineer in 2015.
  - Highly dynamic cross-organisation role. Included elements of teaching, sharing industry trends, engaging product teams, collaborating with research and engineering teams, data analysis, and supporting deployment work.
  - Data analysis using HTTP access logs from Yahoo's CDN; some results are shared with the Internet Society's World IPv6 Launch project. I also perform active measurement of Yahoo's IPv4 inventory to help space conservation.
  - Enabled IPv6 on: Yahoo Search, Finance, Answers, Sports, Local, membership services, global help pages and other static content, redirection servers, geo platforms, advertising platforms, country-specific subdomains for each, Flickr image serving and uploads, Tumblr image serving, Yahoo Messenger, and common mobile endpoints.
  - Encouraged testing and monitoring of application code where possible. Crucially, Yahoo now has IPv6 support in internal cloud infrastructure, CI pipelines, mobile lab testing, and an IPv6-only wireless network.
  - Output includes a short paper [5], a paper on reverse DNS to AAAA mapping [29], and multiple talks [34, 35, 36, 37, 38]
- MAR/2012 Senior Engineer and Team Lead, Boundary, San Francisco, CA, USA  
-TO-  
OCT/2013
- I was team lead for Boundary's network monitoring agent, written in C and responsible for measuring network traffic via libpcap and exporting flow statistics over IPFIX.
  - Managed transition from a legacy agent to a clean implementation, reducing host utilisation and improving stability.
  - Implemented protocol-level metrics: TCP RTT monitoring, loss/retransmit counters, fragmentation detection, NTP time correction, and STUN reflection to determine public IP addresses per-agent.
  - Tens of thousands of agents deployed on customer hosts. Directly engaged customers to debug technical problems.
  - This position resulted in articles describing TCP timestamps in ACM Queue [20] and CACM [21].
- JUL/2008 Research Engineer (Intern), Nokia Research Center, Espoo, Finland  
-TO-  
OCT/2008
- I worked on a measurement platform for evaluation of IETF NAT traversal protocols (ICE, TURN, STUN).
  - A paper on this work was published at the ACM Internet Measurement Conference in 2010 [9].

- SEPT/2005    Research Associate, University of Glasgow, UK  
-TO-  
MAY/2007
- I was lead software developer on a collaborative research project with Imperial College London.
  - Built a publish/subscribe event bus and discovery services for battery-powered hardware in Java and C, interfaced via JNL. I integrated these with the policy management software developed by Imperial College London.
  - This project produced various publications [10, 11, 12, 13, 14, 15, 16, 30].

## EDUCATION

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- 2007        Ph.D. in Computing Science, **University of Glasgow**, U.K.  
-TO-  
2012
- Thesis: “Compact Routing for the Future Internet.” [17].
  - Advisor: Dr. COLIN PERKINS.
  - A mixture of graph theory, modelling of 14 years of BGP data, and distributed simulations written in Scala to evaluate new routing protocols and their behaviour on historical Internet topologies.
  - In addition to the thesis, this work resulted in two papers [6, 8].
- 2000        Masters in Computing Science, **University of Glasgow**, U.K.  
-TO-  
2005
- Dissertation: “Peer-to-Peer Audio Conferencing.” [18].
  - In addition to the dissertation, a technical report is available [31].

## SKILLS

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- **Networks:** strong on network protocols and measurement at layer 3 and up; experience with protocol design, and teasing apart concerns isolated in different layers. Very knowledgeable of standard network tooling, including ping(6), traceroute(6), ip(6)tables, tcpdump, telnet, nc, zmap, and so forth.
- **Programming languages:** most familiar with C, Python, Rust, and Perl. I’m familiar with standard APIs for building distributed systems, such as Scala’s remote actors, sockets libraries, and libraries such as libevent, libev.
- **Data processing:** recently, data processing with Apache Spark and Pig. Fluent in common UNIX tools (sed, AWK, make, *etc*), graph plotting in Gnuplot, typesetting documents in L<sup>A</sup>T<sub>E</sub>X and BibTeX, and distributed processing using GNU parallel. High-level statistical analysis using R.
- **Communication:** I have various written, peer-reviewed publications. I am experienced at giving talks, lecturing, and tutoring. When asked, I critically review the work of peers undertaking related research.

## PROFESSIONAL ACTIVITIES

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- **Peer review:** I served on the technical program committees for the IEEE Global Internet Symposium 2013. I have reviewed articles for TinyTOCs volumes 3 and 4, the ACM SIGCOMM Computer Communication Review quarterly magazine, and Elsevier Computer Networks. I am a reviewer for the RIPE NCC Academic Cooperation Initiative (RACI).
- **Speaking:** I give regular talks [34, 35, 36, 37], and have lectured on IPv6 [38].
- **Chairing:** I was session chair for the Glasgow Networks and Distributed Systems research seminar series from 2007 to 2008. I co-chair the “NCC Sevens”, a long-running RIPE NCC lightning talk series.
- **Teaching:** Between 2005 and 2012 I supervised Honours and Masters students, and was a lab tutor for undergraduate classes: Advanced Programming (Java & C); Networked Systems, Operating Systems, C programming.

I regularly attend key conferences in the field of networks and network measurement: ACM SIGCOMM, the ACM Internet Measurement Conference (IMC), and the ACM Passive and Active Measurement Conference (PAM). I also attend Internet Engineering Task Force (IETF) meetings.

## PUBLICATIONS

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### CONFERENCE AND WORKSHOPS PAPERS

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- [1] Q. Scheitle, O. Hohlfeld, J. Gamba, J. Jelten, T. Zimmermann, S. D. Strowes, and N. Vallina-Rodriguez, "A Long Way to the Top: Significance, Structure, and Stability of Internet Top Lists," in *Proceedings of the 2018 Internet Measurement Conference (IMC)*, Nov. 2018, **winner: Community Contribution Award**.
- [2] O. Gasser, Q. Scheitle, P. Pawel Foremski, Q. Lone, M. Korczynski, S. D. Strowes, L. Hendriks, and G. Georg Carle, "Clusters in the Expanse: Understanding and Unbiasing IPv6 Hitlists," in *Proceedings of the 2018 Internet Measurement Conference (IMC)*, Nov. 2018.
- [3] K. Kevin Vermeulen, S. D. Strowes, O. Fourmaux, and T. Friedman, "Multilevel MDA-Lite Paris Traceroute," in *Proceedings of the 2018 Internet Measurement Conference (IMC)*, Nov. 2018.
- [4] P. Gigis, V. Kotronis, E. Aben, S. D. Strowes, and X. Dimitropoulos, "Characterizing User-to-User Connectivity with RIPE Atlas," in *Proceedings of the Applied Networking Research Workshop*, ser. ANRW '17, 2017.
- [5] S. D. Strowes, "Diurnal and Weekly Cycles in IPv6 Traffic," in *Proceedings of the Applied Networking Research Workshop*, July 2016.
- [6] S. D. Strowes and C. Perkins, "Harnessing Internet Topological Stability in Thorup-Zwick Compact Routing," in *Proceedings of IEEE INFOCOM 2012 Mini Conference*, Mar. 2012.
- [7] M. Ellis, S. D. Strowes, and C. Perkins, "An Experimental Study of Client-Side Spotify Peering Behaviour," in *Proceedings of the 36th IEEE Conference on Local Computer Networks*, Oct. 2011.
- [8] S. D. Strowes, G. Mooney, and C. Perkins, "Compact Routing on the Internet AS-Graph," in *Proceedings of the 14th IEEE Global Internet Symposium 2011*, Apr. 2011.
- [9] S. Hätönen, A. Nyrhinen, L. Eggert, S. Strowes, P. Sarolahti, and M. Kojo, "An Experimental Study of Home Gateway Characteristics," in *Proceedings of the 10th ACM SIGCOMM Internet Measurement Conference (IMC)*, Nov. 2010.
- [10] S. Heeps, J. Sventek, N. Dulay, A. E. Schaeffer-Filho, E. Lupu, M. Sloman, and S. D. Strowes, "Dynamic Ontology Mapping for Interacting Autonomous Systems," in *Proceedings of the 2nd International Workshop on Self-Organizing Systems*, Sept. 2007.
- [11] S. L. Keoh, N. Dulay, E. Lupu, K. Twidle, A. E. Schaeffer-Filho, M. Sloman, S. Heeps, S. D. Strowes, and J. Sventek, "Self-Managed Cell: A Middleware for Managing Body-Sensor Networks," in *Proceedings of the 4th International Conference on Mobile and Ubiquitous Systems (MobiQuitous)*, Aug. 2007.
- [12] A. E. Schaeffer-Filho, E. Lupu, N. Dulay, S. L. Keoh, K. Twidle, M. Sloman, S. Heeps, S. D. Strowes, and J. Sventek, "Towards Supporting Interactions between Self-Managed Cells," in *Proceedings of the 1st International Conference on Self-Adaptive and Self-Organizing Systems (SASO)*, July 2007.
- [13] S. L. Keoh, K. Twidle, N. Pryce, A. E. Schaeffer-Filho, E. Lupu, N. Dulay, M. Sloman, S. Heeps, S. D. Strowes, J. Sventek, and E. Katsiri, "Policy-based Management for Body-Sensor Networks," in *Proceedings of the 4th International Workshop on Wearable and Implantable Body Sensor Networks (BSN)*, May 2007.
- [14] S. Heeps, N. Dulay, A. E. Schaeffer-Filho, E. Lupu, M. Sloman, S. D. Strowes, and J. Sventek, "The Autonomic Management of Ubiquitous Systems Meets The Semantic Web," in *Proceedings of the 2nd International Workshop on Semantic Web Technology For Ubiquitous and Mobile Applications (SWUMA)*, Aug. 2006.
- [15] S. D. Strowes, N. Badr, N. Dulay, S. Heeps, E. Lupu, M. Sloman, and J. Sventek, "An Event Service Supporting Autonomic Management of Ubiquitous Systems for e-Health," in *Proceedings of the 26th International Conference on Distributed Computing Systems Workshops (ICDCSW)*, July 2006.

## JOURNAL PAPERS

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- [16] E. Lupu, N. Dulay, M. Sloman, J. Sventek, S. Heeps, S. D. Strowes, K. Twidle, S. L. Keoh, and A. E. Schaeffer-Filho, "AMUSE: Autonomic Management of Ubiquitous e-Health Systems," *Concurrency and Computation: Practice and Experience*, vol. 20, no. 3, pp. 277 – 295, May 2007.

## THESES

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- [17] "Compact Routing for the Future Internet," Ph.D. Thesis, University of Glasgow, Feb. 2012.
- [18] "Peer-to-Peer Audio Conferencing," Masters Thesis, University of Glasgow, May 2005.

## MAGAZINE ARTICLES

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- [19] S. D. Strowes, "No Shortcuts to Long Prefixes," *GEANT CONNECT*, no. 26, Sept. 2017.
- [20] S. D. Strowes, "Passively Measuring TCP Round-trip Times," *ACM Queue*, vol. 11, no. 8, p. 50, 2013.
- [21] S. D. Strowes, "Passively Measuring TCP Round-Trip Times," *Communications of the ACM*, vol. 56, no. 10, pp. 57–64, 2013.

## EXTENDED ABSTRACTS

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- [22] S. D. Strowes and C. Perkins, "Randomness for Reduced-State Inter-Domain Forwarding," in *Trilogy Future Internet Summerschool*, Université catholique de Louvain, Louvain-la-Neuve, Aug. 2009.
- [23] S. D. Strowes and C. Perkins, "Deterministic, Reduced-Visibility Inter-Domain Forwarding," in *CoNEXT 2009 Student Workshop*, Dec. 2009.

## TECHNICAL REPORTS

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- [24] S. D. Strowes, "IPv6 Launchiversary: the View from RIPE Atlas and K-root," *RIPE Labs*, June 2018.
- [25] S. D. Strowes, "Here to Stay: RIPE Atlas Daily Archives," *RIPE Labs*, Feb. 2018.
- [26] S. D. Strowes, "Current Network Connectivity from Puerto Rico," *RIPE Labs*, Oct. 2017.
- [27] S. D. Strowes and C. Petrie, "BGP Even-More Specifics in 2017," *RIPE Labs*, July 2017.
- [28] S. D. Strowes and E. Aben, "Reviewing the 2016 Leap Second," *RIPE Labs*, Jan. 2017.
- [29] S. D. Strowes, "Bootstrapping Active IPv6 Measurement with IPv4 and Public DNS," *CoRR*, vol. abs/1710.08536.
- [30] S. D. Strowes, N. Dulay, S. Heeps, E. Lupu, A. E. Schaeffer-Filho, M. Sloman, and J. Sventek, "Wide-Area SMC Interaction, Implementation and Emulation," University of Glasgow Department of Computing Science, Tech. Rep. TR-2007-324, 2007.
- [31] S. D. Strowes and C. Perkins, "Orta – an Overlay for Real Time Applications," University of Glasgow Department of Computing Science, Tech. Rep. TR-2005-323, 2005.

## RECENT TALKS

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- [32] "Monitoring What You Don't Own," [vimeo], Sept. 2018.
- [33] "Time, NTP, & Leap Seconds," invited to the Netnod Spring meeting 2017. [youtube], Apr. 2017.
- [34] "IPv6 at Yahoo: growth and disparity," presented at the *IRTF & ISOC Workshop on Research and Applications of Internet Measurements (RAIM)*, Oct. 2015.
- [35] "IPv6 Transition at Yahoo," invited to the School of Computing Science, University of Glasgow, Aug. 2015.
- [36] "IPv6 Transition at Yahoo," invited to the International Computer Science Institute (ICSI), Berkeley, July 2015.

[37] “Who do you think you’re talking to?” invited to E8 Security, Redwood City, June 2015.

[38] “IPv6,” invited industry lecture, University of California, Berkeley, undergraduate class CS 168, Nov. 2014.