Curriculum Vitae of

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PROFESSIONAL AFFILIATIONS	Principal Research Scientist at Akamai Technologies.
	Research Affiliate in the Advanced Network Architecture Group at the MIT Computer Science and Artificial Intelligence Laboratory.
RESEARCH INTERESTS	Measurement and performance of the Internet. Content delivery and application acceleration over the Internet. Routing overlays. Request-routing in content delivery networks. Internet architecture. Design and performance of distributed systems. Quality of service of the Internet. Traffic engineering. Congestion controls. Stochastic models.

EMPLOYMENT EXPERIENCE

Nov 1999 – to date	Akamai Technologies, Principal Research Scientist. Measuring and analyzing the performance and architecture of the Internet, Internet Protocol version 4 and 6. Investigated the performance and improving the design of a new service that provides application acceleration and is based on a robust, global, routing overlay. Investigated and improved the routing of requests from web browsers to appropriate Akamai servers, where key criteria are the latency of file transfers for html content, and the bandwidth and loss for streaming media, which in turn depend on geography, Internet topology, server availability and transient traffic conditions.
Sept. 2001 – to date	MIT Computer Science and Artificial Intelligence Laboratory, Research Affiliate. Advise graduate students and collaborate in research in areas of internet architecture, internet measurements, overlay networks, traffic modeling, data analysis.
Jan. 2010 - Dec. 2012	Advisor to the European study project "Economics and Technologies for Inter-Carrier Services (ETICS). Reviewed the work of project participants and provided advice.
Jan 2001 – Dec 2007	Optodot Corporation, Staff Consultant System Architecture. Designed optical components that exploit recently discovered properties of organic non-polymeric free radical compounds. Wrote patents. Advised the CEO on strategic and tactical business directions for the company.
Sept. 1998 – Sept. 2000	MIT Laboratory for Information and Decision Systems, Visiting Scientist. In Spring of '99, taught the graduate course 6.262 Discrete Stochastic Processes. Advised graduate students.
June 1998 – Nov. 1999	Lucent Technologies, Bell Labs. Distinguished Member of Technical Staff PacketStar IP Switch Software & Systems Dept., and High Speed Networks Research Dept . Contributed to the design and traffic engineering of a next-generation router with exceptional quality of service features, the PacketStar 6400 Series IP Switch. Investigated the design and operation of IP over optical transport networks for a future generation of the PacketStar router and for optical switches. Chairperson of Bell Lab's Ph.D. recruiting team at M.I.T..
1996-June 1998	AT&T Labs, Principal Technical Staff Member AT&T Bell Laboratories, Member of Technical Staff,

1986 - 1996   Teletraffic and Performance Analysis Department.

Collaborated on a team that is investigating mechanisms for providing quality of service in IP enterprise networks. Scope includes a near-term design for a particular financial corporation based on currently available products, and a longer-term, two to three year, horizon.

Determined connection admission control and dimensioning rules for elastic data traffic, where the "load" is expressed in terms of file sizes and think-times, and the resulting flow of packets is dependent on the presence of other flows and on the actions of closed-loop feedback controls such as TCP.

Provided engineering guidelines and congestion control procedures for a new service that integrates a business customer's voice and data services over an Asynchronous Transfer Mode (ATM) access link.

Participated in an AT&T task force on the implementation of voice services over an ATM core network.

From 1990 to 1998, contributed to the formulation of AT&T's strategy on traffic controls and traffic engineering for new telecommunication services based on Broadband-Integrated Services Digital Network (B-ISDN) using ATM.

From 1992 to 1998, key U.S. delegate and associate rapporteur to the International Telecommunications Union (ITU) Study Group 2 on B-ISDN Traffic Engineering. Influence the ITU Recommendations on "User Demand Modeling for B-ISDN," "Network Grade of Service Parameters and Target Values for B-ISDN," "Methods for Traffic Controls for B-ISDN," "Cell Level Measurements Requirements," "Dimensioning Methods for B-ISDN," and "Framework for Resource Allocation on Dimensioning in B-ISDN." As of 1996, appointed to be the coordinator for the traffic engineering recommendations on B-ISDN/ATM.

From 1991 to 1996, key U.S. delegate to the ITU Study Group 13 on B-ISDN resource management. Active in the preparation of ITU Recommendation I.371 on "Traffic Control and Congestion Control in B-ISDN." Successfully led the U.S. effort in the ITU to obtain agreement on the Available Bit Rate and the Statistical Bit Rate (a.k.a. Variable Bit Rate) transfer capabilities. Authored corresponding text for the ITU Recommendation I.371. Was instrumental in obtaining a common format in the ATM Forum, T1S1, and the ITU for the resource management cell that supports the Available Bit Rate transfer capability.

Represented AT&T at the U.S. standards body T1S1 from 1991 through 1996 and at the ATM Forum from 1992 through 1993 regarding B-ISDN/ATM traffic controls and related topics. For the ATM Forum, co-authored contributions on the Available Bit Rate transfer capability and was a major contributor to the conformance definition that was adopted at the ITU and ATM Forum.

For dimensioning B-ISDN/ATM networks, determined basic properties and engineering guidelines for the effective bandwidth of connections given service priorities at network elements. (Joint work with W. Whitt, AT&T Labs.)

Assessed the efficacy of leaky-bucket and sliding-window traffic descriptors for variable bit rate (VBR) video teleconferencing over ATM networks. Determined statistical multiplexing gains. Evaluated the advantages of two-layer VBR video. (Joint work with A. Reibman and S. Morgan, AT&T Labs./Bell Laboratories.)

Determined conditions on general, algorithmic, traffic descriptors that provide the network operator with relevant information for connection admission control and resource management.

Evaluated the performance of overload-control mechanisms for several components of the 5ESS Switching System. Based on analytic models and simulation, designed enhanced controls. Derived load-service curves for the official 5ESS Switch Administration Guidelines.

1983-86   AT&T Bell Laboratories,
Network Architecture and Performance Center,
Member of Technical Staff.

For AT&T Communications, designed and evaluated AT&T's access networks to the newly divested Bell Operating Companies. Did fundamental work on the economics of shared private networks.

Investigated game-theoretic based pricing schemes for AT&T's shared private networks. Assessed the potential for sharing the capacity of 5ESS's between the AT&T's public switched network and the

Enhanced Private Switched Communication Service Network.

Developed a model that evaluates the competitive impact of providing special access to business customers. The model was incorporated into AT&T's Point-of-Presence Evaluation Tool.

Developed guidelines for the economical contracting of facility routes from the Bell Operating Companies.

1981-83	Research Assistant under Yu-Chi Ho, Harvard University and Fred C. Schweppe, M.I.T. Developed theory of real-time pricing mechanisms for the stable operation of electric power systems.
Summer '80	Summer Intern at Bell Telephone Laboratories. Developed algorithms and wrote the code to calculate the expected cost of the Trunk Implementation Plan
1979-83	Teaching Fellow, Harvard University, in courses on optimal control & estimation, on team theory and incentives, on differential equations, and on advanced calculus.
1977-78	Instructor of mathematics and physics, The International School of Geneva, Vaud, Switzerland. Taught high-school level mathematics and physics and was responsible for creating a structured, home environment for the male boarding students.
1974-77	Instructor of mathematics, The Fieldston School, N.Y., N.Y. Taught high-school level mathematics courses and was elected by the faculty to the four-member executive board, (1976-77), which represented faculty concerns to the headmaster

EDUCATION

Ph.D.	Harvard University, Applied Mathematics/Control Theory, June '83.
	Thesis title: Pricing Mechanisms in Coupled Dynamic Systems. Doctoral thesis investigates the use of pricing mechanisms to control large scale systems when the subsystems are owned and operated by autonomous decision makers. The results are applied to electric utilities to study the feasibility of independently owned bulk power generation.
M.S.	Harvard University, Applied Mathematics/Control Theory, June '80.
B.S.	Tufts University, Mathematics, summa cum laude, June '74.

AWARDS	Harvard-Danforth Center for excellence in teaching, June '82. Tufts University's mathematics prize, December '73. Phi Beta Kappa, December '73.

PUBLICATIONS

Publications are available on-line at: http://people.csail.mit.edu/awberger

Philipp Richter, Oliver Gasser, & Arthur Berger "Illuminating Large-Scale IPv6 Scanning in the Internet" *Proceedings of the ACM Internet Measurement Conference,* October 25-27, 2022, Nice, France.

John P. Rula, Philipp Richter, Georgios Smaragdakis, & Arthur W. Berger "Who's left behind?: Measuring Adoption of Application Updates at Scale" *Proceedings of the ACM Internet Measurement Conference*, October 27-29, 2020, Pages 710–723.

P. Richter, & A. W. Berger, "Scanning the Scanners: Sensing the Internet from a Massively Distributed Network Telescope" *Proceedings of the ACM Internet Measurement Conference,* Amsterdam, Netherlands, Oct. 21–23, 2019.

P. Richter, R. Padmanabhan, N. Spring, A. W. Berger, & D. Clark, "Advancing the Art of Internet Edge Outage Detection" *Proceedings of the ACM Internet Measurement Conference 2018,* Boston, USA, Oct. 31 - Nov. 2, 2018.

V. Giotsas, G. Smaragdakis, C. Dietzel, P. Richter, A. Feldmann, & A. W. Berger, "Inferring BGP Blackholing Activity in the Internet," *Proc. of the ACM Internet Measurement Conference 2017*, London, United Kingdon, November 1-3, 2017.

V. Giotsas, C. Dietzel, G. Smaragdakis, A. Feldmann, A. W. Berger, & E. Aben, "Detecting Peering Infrastructure Outages in the Wild," *Proc. of the ACM SIGCOMM 2017 Conference*, Los Angeles, USA, August 21-25, 2017.

P. Richter, G. Smaragdakis, D. Plonka, & A. W. Berger, "Beyond Counting: New Perspectives on the Active IPv4 Address Space," *Proc. of the ACM Internet Measurement Conference 2016,* Santa Monica, USA, November 14-16, 2016. Awarded best technical paper.

P. Foremski, D. Plonka, & A. W. Berger, "Entropy/IP: Uncovering Structure in IPv6 Addresses," *Proc. of the ACM Internet Measurement Conference 2016,* Santa Monica, USA, November 14-16, 2016.

B. Chandrasekaran, G. Smaragdakis, A. W. Berger, M. Luckie, & K.C. Ng, "A Server-to-Server View of the Internet," *The 11th International Conference on emerging Networking EXperiments and Technologies(CoNEXT) 2015*, Heidelberg, Germany, December 1-4 2015.

D. Plonka, & A. W. Berger, "Temporal and Spatial Classification of Active IPv6 Addresses," *Proc. of the ACM Internet Measurement Conference 2015*, Tokyo, Japan, October 28-30, 2015.

R. Beverly, & A. W. Berger, "Server Siblings: Identifying Shared IPv4/IPv6 Infrastructure via Active Fingerprinting," *Proc. of Active and Passive Measurement Conference 2015,* New York, New York, March 19-20, 2015.

A. W. Berger, N. Weaver, R. Beverly, & L. Campbell, "Internet Nameserver IPv4 and IPv6 Address Relationships," *Proc. of the ACM Internet Measurement Conference 2013*, Barcelona, Spain, October 23-25, 2013.

M. Heikkinen, & A. W. Berger, "Comparison of User Traffic Characteristics on Mobile-Access versus Fixed-Access Networks," *Passive and Active Measurement Conference 2012, Lecture Notes in Computer Science*, Volume 7192, Pages 32-412.

S. Bauer, R. Beverly, & A. W. Berger, "Measuring the State of ECN Readiness in Servers, Clients, and Routers," *Proc. of the ACM Internet Measurement Conference 2011,* Berlin, Germany, November 2-4, 2011, pp. 171-179.

R. Beverly, A. W. Berger, & G. Xie, "Primitives for Active Internet Topology Mapping: Toward High-Frequency Characterization," *Proc. of the ACM Internet Measurement Conference 2010*, Melbourne, Australia, November 1-3, 2010, pp. 165-171.

R. Beverly, A. W. Berger, Y. Hyun, & K. Claffy, "Understanding the Efficacy of Deployed Internet Source Address Validation Filtering," *Proc. of the ACM Internet Measurement Conference 2009*, Chicago, Illinois, November 4-6, 2009, pp. 356-369

P. Faratin, D. Clark, S. Bauer, W. Lehr, P. Gilmore, & A. W. Berger, "The Growing Complexity of Internet Interconnection," *Communications & Strategies,* No. 72, 4th quarter 2008, pp. 51-71.

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R. Beverly, S. Bauer, & A. W. Berger, "The Internet's Not a Big Truck: Toward Quantifying Network Neutrality," *Proceedings of the 8th Passive and Active Measurement Conference*, Louvain-la-neuve, Belgium, April 5-6, 2007, pp. 135-144.

R. Beverly, K. Sollins, & A. W. Berger, "SVM Learning of IP Address Structure for Latency Prediction," *SIGCOMM 2006 Workshop on Mining Network Data (MineNet-06)*, Pisa, Italy, Sept, 15 2006.

H. Rahul, M. Kasbekar, R. Sitaraman, & A. W. Berger, "Towards Realizing the Performance and Availability Benefits of a Global Overlay Network," *Passive and Active Measurement Conference*, Adelaide, Australia, March 30-31, 2006

S. Kandula, D. Katabi, M. Jacob, & A. W. Berger, "Botz-4-Sale: Surviving Organized DDoS Attacks That Mimic Flash Crowds," *Second Symposium on Networked Systems Design & Implementation (NSDI)*, Boston MA, May 2005.

J. Jung, S. E. Schechter, & A. W. Berger, "Fast Detection of Scanning Worm Infections," *Proc. Seventh Inter. Symposium on Recent Advances in Intrusion Detection (RAID)*, Sophia Antipolis, France, September 15-17, 2004.

A. Feldmann, O. Maennel, Z. M. Mao, A. W. Berger, & B. Maggs, "Locating Internet Routing Instabilities," *SIGCOMM 2004*, Portland Oregon, August 30 - September 3, 2004.

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J. Jung, A. W. Berger, & H. Balakrishnan "Modeling TTL-based Internet Caches," *IEEE INFOCOM* April 1-3, 2003.

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A. W. Berger & W. Whitt, "Workload Bounds in Fluid Models with Priorities," *Performance Evaluation*, Vol. 41, 2000, pp. 249-267.

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A. W. Berger, L. Bregman & Y. Kogan, "Bottleneck Analysis in Multiclass Closed Queueing Networks and its Application," *Queueing Systems,* Vol. 31, 1999, pp. 217-237.

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A. W. Berger, "Desirable Properties of Traffic Descriptors for ATM Connections in a Broadband ISDN," *The Fundamental Role of Teletraffic in the Evolution of Telecommunications Networks (Proc. of the 14th Inter. Teletraffic Congress),* Ed. J. Labetoulle and J. W. Roberts, Amsterdam: Elsevier, 1994, pp. 233-242.

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A. W. Berger, "Market-Clearing Prices in Coupled, Dynamic Systems," *Automatica,* Vol. 27, No. 4, July, 1991, pp. 743-747.

A. W. Berger, "Determination of Load Service Curves for Distributed Switching Systems: Probabilistic Analysis of Overload Control Schemes," *Proc. of the 13th International Teletraffic Congress,* June, 1991, Copenhagen, Denmark, pp. 435-440.

A. W. Berger, "Comparison of Call Gapping and Percent Blocking for Overload Control in Distributed Switching Systems and Telecommunications Networks," *IEEE Transactions on Communications,* Vol. 39, No. 4, April, 1991, pp. 574-580.

A. W. Berger, "Performance Analysis of a Rate-Control Throttle Where Tokens and Jobs Queue," *J. of Selected Areas in Communications,* Vol. 9, No. 2, Feb. 1991, pp. 165-170. An earlier version appeared in *Proc. of INFOCOM '90,* June 1990, San Francisco CA, pp. 30-38.

A. W. Berger, "Overload Control Using Rate Control Throttle: Selecting Token Bank Capacity for Robustness to Arrival Rates," *IEEE Transactions on Automatic Control,* Vol. 36, No. 2, Feb. 1991, pp. 216-219.

A. W. Berger, A. E. Eckberg, T. C. Hou, and D. M. Lucantoni, "Performance Characterization of Traffic Monitoring and Associated Control Mechanisms for Broadband Packet Networks," *GLOBECOM*, Dec. 1990, San Diego, CA.

A. W. Berger and W. Whitt, "A Multi-Class Input-Regulation Throttle," *Proc. of the 29th IEEE Conference on Decision and Control,* Dec. 1990, Honolulu Hawaii, pp. 2106-2111.

A. W. Berger, J. S. Kent & M. V. Stein, "Preventing Overload and Verifying Link Stability in an Implementation of the DPNSS Layer 2 Protocol," *GLOBECOM*, Nov. 1989. Dallas, Texas, pp. 175-179.

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A. W. Berger & F. C. Schweppe, "Real Time Pricing to Assist in Load Frequency Control," *IEEE Transactions on Power Systems,* Vol. 4, No. 3, 1989, pp. 920-926.

A. W. Berger, "Pricing Mechanisms in the Control of Linear Dynamic Systems," *Proc. of the 23rd Conference on Decision and Control,* Dec. 1984, Las Vegas, Nevada, pp. 632-633.

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S. A. Carlson & A. W. Berger "Electro-optic Reflective Modulators," U.S. Patent No. 6,950,228, issued September 27, 2005.

S. A. Carlson & A. W. Berger "Optical Shutter Assembly," U.S. Patent No. 6,757,094, issued June 29, 2004.

S. A. Carlson & A. W. Berger "Optical Switch Device," U.S. Patent No. 6,724,512, issued April 20, 2004.

S. A. Carlson & A. W. Berger, "Optical Shutter Assembly," U.S. Patent No. 6,583,916, issued June 24, 2003.

A. W. Berger, "Flexible Bandwidth Negotiation for the Block Transfer of Data," U.S. Patent No. 6,504,821, issued January 7, 2003

A. W. Berger & Y. Kogan, "Dimensioning Bandwidth and Connection Admission Control for Elastic Traffic in High-Speed Communication Networks," U.S. Patent No. 6,266,322, issued July 24,2001.

A. W. Berger & W. Whitt, "Traffic Management in Packet Communication Networks Having Service Priorities and Employing Effective Bandwidths," U.S. Patent No. 6,160,818, issued December 12, 2000.

A. W. Berger, R. A. Milito, & W. Whitt, "Efficient, Rate-Based Multiclass Access Control," U.S. Patent No. 5,274,664, issued December 28, 1993.

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A. W. Berger, "Connection Admission Control in Priority Queueing Systems," Contribution to ITU Study Group 2, March 3-13, 1998, document # D.148.

A. W. Berger, "Proposed Revisions to Draft Recommendation E.72x on Network Grade of Service Parameters and Target Values for B-ISDN," Contribution to ITU Study Group 2, March 3-13, 1998, document # D.150.

A. W. Berger, "Comments on Draft Recommendation E.74x on Measurement Requirements for the B-ISDN," Contribution to ITU Study Group 2, March 3-13, 1998, document # D.151.

A. W. Berger, "Comments on Draft Recommendation E.74x," Contribution to ITU Question 17/2 Rapporteur's meeting, September 15-19, 1997.

A. W. Berger, "Proposed Revisions to Draft Recommendation E.72x," Contribution to ITU Question 17/2 Rapporteur's meeting, September 15-19, 1997.

A. W. Berger, "Proposed Editorial Changes to ITU Recommendation E.735 on Framework for Traffic Control and Dimensioning in B-ISDN," Contribution to ITU Study Group 2, May 20-30, 1997, document # D.68.

A. W. Berger, "Proposed Text on ABR for ITU Recommendation E.736, Methods for Cell-Level Traffic Control in B-ISDN," Contribution to ITU Question 17/2 Rapporteur's meeting, January 6-10, 1997.

A. W. Berger, K. Fendick, & S. Mithal, "Proposed Algorithm for ABR Conformance Definition," Contribution to ITU Question 8/13 Rapporteur's meeting, September 30 – October 4, 1996, and U.S. T1S1, September 16-20, 1996, document # T1S1.5/96-147.

A. W. Berger, K. Fendick, & S. Mithal, "Proposed Enhancements to ABR Source/Destination Reference Behaviors," Contribution to ITU Question 8/13 Rapporteur's meeting, September 30 – October 4, 1996, and U.S. T1S1, September 16-20, 1996, document # T1S1.5/96-148.

A. W. Berger, K. Fendick, & S. Mithal, "Response to Technical Concerns on ABR," Contribution to ITU Question 8/13 Rapporteur's meeting, September 30 – October 4, 1996, and U.S. T1S1, September 16-20, 1996, document # T1S1.5/96-149.

A. W. Berger, "On Approval of ITU Recommendation I.371 on B-ISDN Traffic Control and Congestion Control in B-ISDN," Contribution to ITU Study Group 13, April 29 – May 10, 1996, document # D.1099 (PLEN).

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