

Nicholas G. Duffield

CONTACT

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POSITIONS HELD

Texas A&M University , TX, USA. Department of Electrical & Computer Engineering Full Professor, with tenure, 2014 to date Director, Texas A&M Engineering Big Data Initiative, 2015 to date	2014 to date
DIMACS–Rutgers University , NJ, USA Research Professor	2013-2014
AT&T Labs–Research , Florham Park, NJ, USA Distinguished Member of Technical Staff, 2003–2013; Lead Member of Technical Staff, 1998–2003; Principal Member of Technical Staff, 1997–1998; Senior Member of Technical Staff, 1995–1997	1995–2013
Dublin City University , Ireland. School of Mathematical Sciences Assistant Lecturer (equiv. tenured Asst. Prof.) 1993–1995; Research Fellow, 1991–1993	1991–1995
Dublin Institute for Advanced Studies , Ireland. School of Theoretical Physics Research Scholar	1989–1991
University of Heidelberg , Germany, Department of Applied Mathematics Royal Society European Science Exchange Fellow	1988–1989
University College Dublin , Ireland, Department of Mathematical Physics Research Assistant and Senior Tutor	1986–1988
IBM , London UK, Oslo Norway Internships 1979, 1980, 1981	1979–1981

EDUCATION

University of London, UK , Queen Mary College, Dept. of Physics PhD, 1987. “A rigorous treatment of dynamics and stability for H. Froehlich’s model of Bose condensation far from equilibrium”. Advisor: Geoffrey L. Sewell.	1983–1986
University of Cambridge, UK , Christ’s College MMath (Part III Maths), awarded with distinction, 1983 BA, Natural Sciences, Physics and Theoretical Physics, 1982 Bachelor Scholarship 1983; Open Entrance Scholarship 1979, re-awarded 1981	1979–1983

CAREER HIGHLIGHTS

- Honors: IEEE Fellow 2005; AT&T Fellow 2007; IET Fellow 2016; ACM SIGMETRICS Test of Time 2012,13
- Funding: \$650k (from total \$12.1M) from NSF, DARPA, Google, Intel since return to academia in 2014
- Editorial: Chief Editor for Big Data, *Frontiers in ICT*, 2014 to date; Associate Editor, *IEEE/ACM Transaction on Networking*, 2007-2011 & Editor-at-Large since 2014
- Service: Elected member of ACM SIGMETRICS Board of Directors 2015–2019
- Teaching: Created two graduate courses Data Science
- Advising: Mentor/Thesis Advisor/Thesis Committee Member to 40 graduate students/interns/postdocs
- Publications: 157 refereed papers in Computer Networking & Data Science (SIGCOMM, SIGMETRICS, IMC, IEEE/ACM ToN, IEEE T-IT, VLDB, SODA, PODS, SIAM J Comp, JACM, TALG, KDD, CIKM, ICDM)
- Patents: Inventor or co-inventor on 53 US Patents
- Standards: Charter Chair of IETF Working Group on Packet Sampling; Editor or author of 4 IETF RFCs
- Citations: H-Index: 60, with more than 14,000 citations (Google Scholar)

RESEARCH INTERESTS

- General: Foundations and applications of Data Science & Computer Networking
- Disciplines: Computer science, probability, statistics, algorithms, machine learning
- Domains: Data streaming and summarization; Computer network measurement, management and resilience; Resource engineering, including transportation and hydrology

AWARDS AND HONORS

- IET Fellow, 2016
- ACM Sigmetrics 2013 Test of Time Award for [C59], joint with A. Greenberg, M. Roughan, Y. Zhang
- ACM Sigmetrics 2012 Test of Time Award for [C61], joint with T. Bu, F. Lo Presti, D. Towsley
- AT&T Fellow, 2007. Citation: "For fundamental contributions to sampling, analysis and inference from network measurements that have had broad impact on AT&T and the industry."
- IEEE Fellow, 2005. Citation: "For contributions to the measurement, analysis and management of telecommunications networks."
- AT&T Research Excellence Award, 2003
- Elected Member IFIP Working Group 7.3 (Computer System Modeling), 2002
- British Telecom Short-Term Research Fellowship, 1995-96 (declined)
- European Science Exchange Fellowship of the Royal Society, London, 1988-89
- Conference papers fast-tracked to IEEE/ACM Transactions on Networking [J14, J21, J29, J40]

CURRENT OTHER AFFILIATIONS AND EXTERNAL APPOINTMENTS

- Professor by Courtesy, Texas A&M Department of Computer Science and Engineering, 2015 to date
- Member, Texas A&M Center for Geospatial Science, Applications & Technology (GEOSAT), 2017 to date
- Associate Member, Oxford-Man Institute of Quantitative Finance, 2015 to date
- Member, ACM Sigmetrics Board of Directors, 2015–2017
- Chief Editor for Big Data, *Frontiers in ICT*, 2014 to date
- Editor-at-Large, *IEEE/ACM Transactions on Networking*, 2014 to date

RECENT VISITING APPOINTMENTS

- Visiting Researcher, Alan Turing Institute (for Data Science), London, UK, 7/17/2017–7/28/2017
- Visiting Researcher, University of Warwick (Computer Science), Warwick, UK, 7/3/2017–7/14/2017
- Visiting Researcher, Intel Research, Santa Clara, CA, 6/20/2016–7/15/2016
- Visiting Practitioner, Oxford–MAN Institute of Quantitative Finance, Oxford, UK, 7/1/2015–7/31/2015

UNIVERSITY SERVICE

- Director, Texas A&M Engineering Big Data Initiative, 2015 to date
- Chair, Big Data Faculty Search Committee, College of Engineering, Texas A&M University, 2016 to date
- Chair, Texas A&M Engineering Experimental Station Advisory Board Big Data subcommittee, 2015–2017
- Texas A&M Senior Personnel to NSF South Region Big Data Innovation Hub, 2015 to date
- Co-organizer, Big Data Workshop, Texas A&M University, 2015, 2016, 2017
- Co-organizer, Texas A&M Conf. on Advances in Big Data Modeling, Computation & Analytics, 2016
- Convener, Texas A&M Seed Grant Program for Interdisciplinary Big Data Research, 2016
- Member, Faculty Search Committee, Texas A&M Dept. of Electrical and Comp. Engineering, 2015–2017
- Member, Faculty Search Committee, Texas A&M College of Geosciences, 2016–2017
- Member, Graduate Curriculum and Assessment Committee, Texas A&M Department of ECE, 2016
- Mentor, Texas A&M Bridge to Doctorate Program, 2016

EXTERNAL SERVICE, REVIEW & EDITORIAL

- TPC, WWW 2018
- TPC, IEEE BigData 2017
- TPC, IFIP WG 7.3 Performance 2017
- TPC, IEEE BigGraphs Workshop, 2016
- Scientific PC, 9th Bernoulli/IMS World Congress in Probability and Statistics, 2016
- TPC, Workshop on MAThematical performance Modeling and Analysis, MAMA 2000-2017
- TPC, International Workshop on Traffic Monitoring Analysis (TMA), 2015
- TPC, IEEE International Conference on Network Protocols, ICNP 2014
- Associate Editor, IEEE/ACM Transactions on Networking, 2007-2011
- TPC Co-Chair, IFIP Performance 2013
- PhD External Examiner, UPC Barcelona, 2013
- TPC, International Teletraffic Congress 2011
- Area TPC Chair, IEEE Infocom 2009
- Guest Co-Editor, IEEE JSAC Special Issue on Price-Based Access Control & Economics of Networks, 2006
- TPC, ACM Sigmetrics 2005
- TPC, ACM Sigmetrics/Performance 2004
- TPC, ACM Internet Measurement Conference 2004
- TPC, Performance 2002
- TPC, IEEE Infocom 2002, 1999
- TPC, IEEE Workshop on IP Operations and Management (IPOM) 2002–2004
- Chartering Chair, IETF Packet Sampling Working Group, 2002
- TPC, SPIE Conference on Technologies, Protocols, and Services for the NGI, 2001
- TPC, ITC Specialist Seminar on IP Traffic Measurement, Modeling and Management, 2000
- PhD External Examiner, University of Adelaide, 1993
- TPC, 6th IFIP Workshop on Performance Modeling and Evaluation of ATM Networks, 1998
- TPC, AT&T Services and Infrastructure Performance Symposium, 1997
- TPC, IEEE/DIMACS Workshop on Performance of Realtime Applications on the Internet, 1996

SELECTED INVITED PRESENTATIONS SINCE 2010

- National University of Singapore, 2017
- University of Utah, Salt Lake City, UT, 2017
- Tulane University, New Orleans, LA, 2017
- Keynote, IEEE BigGraphs Workshop, Washington, DC, 2016
- Yale University, New Haven, CT, 2016
- Intel Research, Santa Clara, CA, 2016
- University of Southern California, CA, 2016
- Informatics Institute, University of Florida, FL, 2016
- University of Texas at Austin, TX, 2015
- Keynote, IPCCC, Austin, TX, 2014
- Rice University, Houston, TX, 2014
- Heilbronn Annual Conference, Bristol, UK, 2014
- University of Rochester, Rochester, NY 2014
- Temple University, Philadelphia, PA, 2014
- Big Data Lecture Series, University of Illinois at Urbana Champaign, IL, 2014
- Eminent Scholar Seminar Series, Texas A&M University, College Station, TX, 2014
- The Technion, Haifa, Israel, 2014
- Cornell NYC Tech, New York, NY, 2014
- Colorado State University, Fort Collins, CO, 2014
- Pacific Northwest National Laboratory, Richland, WA, 2014
- Washington State University, Pullman, WA, 2014
- Speaker and Panelist, Big Data in the Mathematical Sciences, Warwick University, UK, 2013
- Keynote, International Teletraffic Congress (ITC 25), Shanghai, China, 2013
- Facebook, Menlo Park, CA, 2013
- Google, Mountain View, CA, 2013
- Lehigh University, Bethlehem, PA, 2013
- Hamilton Institute, Ireland, 2013
- Microsoft Research, Redmond, WA, 2012
- International Workshop on Network Science, Hamilton Institute, Ireland, 2011
- Statistics of Networks Workshop, Newton Institute, Cambridge, UK, 2010

RESEARCH FUNDING

Government Agency Funding

- [G1] *NeTS: Small: Collaborative Research: Distributed Approximate Packet Classification*, National Science Foundation, Award 1618030, 9/1/2016-8/31/2019. PIs Nick Duffield (Texas A&M) & Minlan Yu (Yale). Total \$350,996 / Duffield \$198,346.
- [G2] *DEDUCE: Distributed Enclave Defense Using Configurable Edges*. DARPA, 7/1/2015-6/30/2018, Applied Communication Sciences. Texas A&M Subaward, PI: Nick Duffield. Total \$11,500,000 / Duffield \$389,872
- [G3] *MINC: Multicast-based Inference of Network-internal Characteristics*. DARPA and Air Force Research Laboratory agreement F30602-98-2-0238. PI Don Towsley (University of Massachusetts), Vern Paxson (Lawrence Berkeley Laboratory), N. Duffield (AT&T Labs Research). 1998-2001. Total US\$ 918,738 / Duffield non-funded collaborator.
- [G4] *MEASURE*. European Union under ESPRIT Grant LTR 20.113. Dublin Institute for Advanced Studies, University of Cambridge, and Telia. 1996-1999. Total € 1,515,000 / Duffield: proposal co-author, awarded after my departure to AT&T.
- [G5] *Economies of Scale in Queueing Networks*. Forbairt, Ireland under 1995 Basic Research Grant SC/95/424, 1995-1997. PI Duffield (Dublin City University). IRL 10,000.
- [G6] *MU-DELTA*. Mentec Computer Systems and EOLAS, Ireland, 1993-1995. PI John T. Lewis (Dublin Institute for Advanced Studies), co-PI N. Duffield (Dublin City University) IRL 105,000.

Industrial Gifts

- [G7] *Approximation Methods for Massive Graph Analytics*, Intel Corporation, 2016, PI N.G. Duffield, \$30,000
- [G8] *Traffic Measurement from High-level Names in Software Defined Networking*, Google Faculty Research Award, 2015. PI N.G. Duffield, co-PI Minlan Yu (University of Southern California). \$79,992.

Texas A&M

- [G9] *Understanding Multi-Scale Hydrology: Fusion of BIG DATA from Ground Networks and Space-Based Satellites*, Texas A&M Big Data Seed Grant, January 2016, PI: Binayak Mohanty (Texas A&M Biological and Agricultural Engineering); co-PI: N. Duffield. Total \$50,000 / Duffield \$25,000
- [G10] *Improving Understanding of Travel Behavior and Transportation Systems through Big Data Analytics*, Texas A&M Big Data Seed Grant, January 2016, PI: Shawn Turner (Texas A&M Transportation Institute) co-PI: N. Duffield. Total \$50,000 / Duffield \$25,000
- [G11] *Boosting Attack Identification through Correlated System & Network Monitoring*. Texas A&M Cybersecurity Seed Grant, January 2016, PI: N. Duffield, co-PI: Guofei Gu (Texas A&M Computer Science and Engineering). Total \$50,000 / Duffield \$25,000

COURSES TAUGHT AT TEXAS A&M

- ECEN 689 Special Topics in Data Science for Communications Networks
 - Fall 2014, 11 students, mean evaluation score 4.56/5.00
 - Fall 2015, 11 students, mean evaluation score 4.43/5.00
- ECEN 489/689 Special Topics in Data Mining and Analysis
 - Spring 2015, 42 students, mean evaluation score 4.20/5.00 (including as CSCE 489/689)
 - Spring 2016, 35 students, mean evaluation score 4.70/5.00
 - Fall 2017, 33 students, mean evaluation score
- ECEN 758 / CSCE 676 / STAT 639 Data Mining and Analysis
 - Fall 2018, subject to Board of Regents approval
- ECEN 748 Data Stream Algorithms and Applications
 - Spring 2019, subject to Board of Regents approval

COURSES TAUGHT 1995 AND EARLIER

- Topology and Metric Spaces, 1994–1995 (4th yr. Mathematics, Dublin City University)
- Queueing Systems, 1994 (graduate, Dublin City University)
- Linear Algebra, 1993–1995 (2nd yr. Electrical Engineering, Dublin City University)
- Accounting Mathematics, 1991–1995; Mathematics for Scientists. (1st yr. service, Dublin City University)
- Quantum Mechanics, 1991 (graduate, Dublin Institute of Technology)

RESEARCH MENTORING

Postdoc:

- Francesco Lo Presti, AT&T Labs (now Prof., University of Rome), 1998–2001

PhD Thesis Advisor:

- Paul Farrell, Dublin City University, 1999;
- Mahmood Etehad, Texas A&M Mathematics, in progress
- Hanzi Mao, Texas A&M CSE, in progress
- Yunhong Xu, Texas A&M ECE, in progress

PhD Thesis Committee

- Meng Lu, Texas A&M ECE, 2016
- Rafael Wanderley De Holanda, Texas A&M Petroleum Engineering, in progress
- Meng Lu, Texas A&M ECE, in progress
- Yingyezhe Jin, Texas A&M ECE, in progress
- Myungjin Lee, Purdue (now Asst. Prof., Edinburgh), 2012
- Haakon Ringberg, Princeton (now Google), 2009
- Yu Gu, UMass (now Amazon), 2008
- Tian Bu, UMass (now Bell Labs), 2002

MS/ME/MSc Thesis Advisor:

- Liangzhen Xia, Texas A&M ECE, in progress
- Bowen Li, Texas A&M ECE, in progress
- Tom Corcoran, Dublin City University (now Ericsson), 1994

MS/ME Thesis Committee

- Daniel Tomkins, Texas A&M CSE, in progress
- Yuanfei Sun, Texas A&M ECE, in progress
- Austin Taghavi, Texas A&M ECE, in progress

- Weizhi Li, Texas A&M ECE, in progress
- Tianjian Wang, Texas A&M ECE, in progress
- Nitin Kashyap, Texas A&M Industrial and Systems Engineering, in progress
- Adam Fidel, Texas A&M CSE, in progress
- Anurag Garg, Texas A&M CSE, in progress
- Anurag Garg, Texas A&M CSE, in progress (NB distinct from above person)
- Difan Chen, Texas A&M ECE, in progress

AT&T Labs Interns:

- Damon Wischik, Cambridge (now Cambridge) 1998
- Timur Friedman, UMass (now Asst. Prof., Sorbonne), 1999, 2000
- Alexandre Gerber, Eurocom, (now Lion Cave Capital), 2001
- Sumeet Singh, UCSD (now Cisco), 2003
- Changchun Zou, UMass (now Assoc. Prof., U. Florida), 2004
- Vyas Sekar, CMU (now Asst. Prof. CMU) 2005
- Yu Gu, UMass (now Amazon), 2006, 2007, 2008
- Haakon Ringberg, Princeton (now Google), 2007
- Amogh Dhamdhere, GaTech (now CAIDA), 2008
- Yu Jin, U Minnesota (now AT&T) 2008, 2009
- Chi-Yao Hong, UIUC (now Google), 2010
- Yi-Chao Chen, UT Austin (in progress) 2011, 2012
- Wei Dong, UT Austin (now Google), 2011, 2012
- Yingying Chen, U Minnesota (now Microsoft), 2011, 2012.
- Balakrishnan Chandrasekaran, Duke (in progress) 2013

MOST PUBLICATIONS LISTED BELOW ARE DOWNLOADABLE IN PREPRINT FORM AT: <http://nickduffield.net/papers/>

UNDER SUBMISSION

- [S1] A. Hasanzadeh, X. Liu, N. Duffield, K.R. Narayanan, B. Chigoy, A Graph Signal Processing Approach For Real-Time Traffic Prediction In Transportation Networks, 2017, <https://arxiv.org/abs/1711.06954>
- [S2] Nesreen Ahmed, Nick Duffield, Liangzhen Xia, Sample-Based Estimation of Node Similarity in Streaming Bipartite Graphs, 2017, <https://arxiv.org/abs/1712.08685>
- [S3] David S. Johnson, Lee Breslau, Ilias Diakonikolas, Nick Duffield, Yu Gu, MohammadTaghi Hajiaghayi, Howard Karloff, Mauricio G. C. Resende, Subhabrata Sen, Near-Optimal Disjoint-Path Facility Location Through Set Cover by Pairs, 2016, <https://arxiv.org/abs/1611.01210>

ARCHIVAL JOURNALS

- [J1] Nesreen K. Ahmed, Nick Duffield, Theodore Willke, Ryan A. Rossi, On Sampling from Massive Graph Streams, Proc. Very Large Data Bases, 2017
- [J2] Jiawei Chang, Nick Duffield, Hao Ni, Weijun Xu, Signature Inversion for Monotone Paths, Electronic Journal of Probability, 2017,
- [J3] Nesreen K. Ahmed, Jennifer Neville, Ryan A. Rossi, Nick Duffield, Theodore L. Willke, Graphlet Decomposition: Framework, Algorithms, and Applications, Knowledge and Information Systems, Vol. 50, No. 3, pp. 689–722. 2017
- [J4] E. Cohen, G. Cormode, N. Duffield, C. Lund, On the Tradeoff between Stability and Fit, ACM Transactions on Algorithms, Vol. 13 Issue 1, Article No. 7, October 2016.
- [J5] E. Cohen, N. Duffield, H. Kaplan, C. Lund, M. Thorup. Algorithms and estimators for summarization of unaggregated data streams. Journal of Computer and System Sciences, 2014.
- [J6] M. Lee, N. Duffield, R. Kompella. High-fidelity per-flow delay measurements with reference latency interpolation. IEEE/ACM Trans. Netw. 21(5): 1567-1580, 2013.
- [J7] Y. Jin, N. Duffield, J. Erman, P. Haffner, S. Sen, Z.-L. Zhang. A modular machine learning system for flow-level traffic classification in large networks. ACM Transactions on Knowledge Discovery from Data, 6(1): 4, 2012.
- [J8] M. Lee, N. Duffield, R. Kompella. Opportunistic flow-level latency estimation using consistent Net-Flow. IEEE/ACM Trans. Netw. 20(1): 139–152, 2012.
- [J9] E. Cohen, G. Cormode, N. Duffield. Structure-aware sampling: Flexible and accurate summarization. Proceedings of the VLDB Endowment, 4(11): 819–830, 2011.
- [J10] E. Cohen, N. Duffield, H. Kaplan, C. Lund, M. Thorup. Efficient stream sampling for variance-optimal estimation of subset sums. SIAM J. Comput. 40(5): 1402–1431, 2011.
- [J11] J. Sommers, P. Barford, N. Duffield, A. Ron. Multiobjective monitoring for SLA compliance. IEEE/ACM Trans. Netw. 18(2): 652–665, 2010.
- [J12] E. Cohen, N. Duffield, H. Kaplan, C. Lund, M. Thorup. Composable, scalable, and accurate weight summarization of unaggregated data sets. Proceedings of the VLDB Endowment, 2(1): 431-442, 2009.
- [J13] D. Stutzbach, R. Rejaie, N. Duffield, S. Sen, W. Willinger. On unbiased sampling for unstructured peer-to-peer networks. IEEE/ACM Trans. Netw. 17(2): 377–390, 2009.
- [J14] N. Duffield, M. Grossglauser. Trajectory sampling with unreliable reporting. IEEE/ACM Trans. Netw. 16: 37–50, 2008.
- [J15] J. Sommers, P. Barford, N. Duffield, A. Ron. A geometric approach to improving active packet loss measurement. IEEE/ACM Trans. Netw. 16: 307–320, 2008.

- [J16] N. Duffield, C. Lund, M. Thorup. Priority sampling estimating arbitrary subset sums. *Journal of the ACM*, 54(6), 2007.
- [J17] N. Duffield. Network tomography of binary network performance characteristics. *IEEE Transactions on Information Theory*, 52: 5373–5388, 2006.
- [J18] N. Duffield, J. Horowitz, F. Lo Presti, D. Towsley. Explicit loss inference in multicast tomography. *IEEE Transactions on Information Theory*, 52: 3852–3855, 2006.
- [J19] C. Zou, N. Duffield, D. Towsley, W. Gong. Adaptive defense against various network attacks (Extended Version). *IEEE JSAC*, 24(10): 1877–1888, 2006.
- [J20] N. Duffield, F. Lo Presti, V. Paxson, D. Towsley. Network Loss tomography using striped unicast probes. *IEEE/ACM Trans. Netw.* 14: 697–710, 2006.
- [J21] N. Duffield, C. Lund, M. Thorup. Estimating flow distributions from sampled flow statistics. *IEEE/ACM Trans. Netw.*, 13(5): 933–946, 2005.
- [J22] N. Duffield, C. Lund, M. Thorup. Learn more, sample less: Control of volume and variance in network measurement. *IEEE Transactions on Information Theory*, 51(5): 1756–1775, 2005.
- [J23] N. Duffield, F. Lo Presti. Network tomography from measured end-to-end delay covariance. *IEEE/ACM Trans. Netw.* 12(6): 978–992, 2004.
- [J24] N. Duffield. Sampling for passive internet measurement: A review. Invited paper, *Statistical Science*, 19:3: 472–498, 2004.
- [J25] N. Duffield, S. Low. Allocating commodity resources in aggregate traffic networks. *Performance Evaluation*, 57: 235–422, 2004.
- [J26] F. Lo Presti, N. Duffield, J. Horowitz, D. Towsley. Multicast-based inference of network-internal delay distributions. *IEEE/ACM Trans. Netw.* 10: 761–775, 2002.
- [J27] N. Duffield, J. Horowitz, D. Towsley, W. Wei, T. Friedman. Multicast-based loss inference with missing data. *IEEE Journal on Selected Areas in Communications*, 20: 700–713, 2002.
- [J28] N. Duffield, J. Horowitz, F. Lo Presti, D. Towsley. Multicast topology inference from measured end-to-end loss. *IEEE Transactions in Information Theory*, 48: 26–45, 2002.
- [J29] N. Duffield, M. Grossglauser. Trajectory sampling for direct traffic observation. *IEEE/ACM Trans. Netw.* 9(3): 280–292, 2001.
- [J30] N. Duffield, W. Massey, W. Whitt. A nonstationary offered load model for packet networks, *Telecommunications Systems*. 16(3,4): 271–296, 2001.
- [J31] N. Duffield, J. Horowitz, F. Lo Presti, D. Towsley. Multicast topology inference from end-to-end measurements. *Advances in Performance Analysis*, 3: 207–226, 2000.
- [J32] A. Adams, T. Bu, R. Caceres, N. Duffield, T. Friedman, J. Horowitz, F. Lo Presti, S.B. Moon, V. Paxson, D. Towsley. The use of end-to-end multicast measurements for characterizing internal network behavior. *IEEE Communications Magazine*, 38(5): 152–159, 2000.
- [J33] R. Caceres, N. Duffield, A. Feldmann, J. Friedmann, A. Greenberg, R. Greer, T. Johnson, C. Kalmanek, B. Krishnamurthy, D. Lavelle, P.P. Mishra, K.K. Ramakrishnan, J. Rexford, F. True, J.E. van der Merwe. Measurement and analysis of IP network usage and behavior. *IEEE Communications Magazine*, 38(5): 144–151, 2000.
- [J34] N. Duffield. A large deviation analysis of errors in measurement based admission control to buffered and bufferless resources. *Queueing Systems*, 34: 131–168, 2000.
- [J35] N. Duffield, P. Goyal, A.G. Greenberg, P.P. Mishra, K.K. Ramakrishnan, J.E. van der Merwe. Resource management with hoses: Point-to-cloud services for virtual private networks. *IEEE/ACM Trans. Netw.* 10(5): 679–692, 2002.
- [J36] R. Caceres, N. Duffield, J. Horowitz, D. Towsley. Multicast-based inference of network-internal loss characteristics. *IEEE Transactions on Information Theory*, 45: 2462–2480, 1999.
- [J37] N. Duffield, K.K. Ramakrishnan, A.R. Reibman. Issues of quality when smoothing rate adaptive video. *IEEE Transactions on Multimedia*, 1(4): 352–364, 1999.

- [J38] N. Duffield. Queueing at large resources driven by long-tailed $M/G/\infty$ -modulated processes. *Queueing Systems*. 28: 245–266, 1998.
- [J39] N. Duffield, W. Whitt. Large deviations of inversely related processes with nonlinear scalings. *Annals of Applied Probability*, 8: 995–1026, 1998.
- [J40] N. Duffield, K.K. Ramakrishnan, A.R. Reibman. SAVE: An algorithm for smoothed adaptive video over explicit rate networks. *IEEE/ACM Trans. Netw.* 6: 717–728, 1998.
- [J41] N. Duffield, W. Whitt. A source traffic model and its transient analysis for network control. *Stochastic Models*. 14: 51–78, 1998.
- [J42] N. Duffield. Conditioned asymptotics for tail probabilities in large multiplexers. *Performance Evaluation*, 31: 281–300, 1998.
- [J43] N. Duffield. Exponents for the tails of distributions in some polling models. *Queueing Systems*. 26: 105–119, 1997.
- [J44] N. Duffield, W. Whitt. Control and recovery from rare congestion events in a large multi-server system. *Queueing Systems* 26: 69–104, 1997.
- [J45] N. Duffield. Economies of scale for long-range dependent traffic in short buffers. *Telecommunications Systems*. 7: 267–280, 1997.
- [J46] N. Duffield. Economies of scale in queues with sources having power-law large deviation scalings. *J. Appl. Prob.* 33: 840–857, 1996.
- [J47] D.D. Botvich, N. Duffield. Large deviations, economies of scale, and the shape of the loss curve in large multiplexers. *Queueing Systems*. 20: 293–320, 1995.
- [J48] N. Duffield, N. O’Connell. Large deviations and overflow probabilities for the general single server queue, with applications. *Math. Proc. Cam. Phil. Soc.* 118: 363–374, 1995.
- [J49] N. Duffield, J.T. Lewis, N. O’Connell, R. Russell, F. Toomey. Entropy of ATM traffic streams: A tool for estimating quality of service parameters. *IEEE JSAC* 13: 981–990, 1995.
- [J50] N. Duffield. Exponential bounds for queues with Markovian arrivals. *Queueing Systems* 17: 413–430, 1994.
- [J51] E. Buffet, N. Duffield. Exponential upper bounds via martingales for multiplexers with Markovian arrivals. *J. Appl. Prob.* 31: 1049–1061, 1994.
- [J52] N. Duffield. Local mean-field Markov processes: An application to message-switching networks. *Prob. Theory Relat. Fields* 93: 485–505, 1992.
- [J53] N. Duffield, R.F. Werner. Mean-field dynamical semigroups on C^* -algebras. *Rev. Math. Phys.* 4: 383–424, 1992.
- [J54] N. Duffield, R.F. Werner. Local dynamics of mean-field quantum systems. *Helv. Phys. Acta* 65: 1016–1054, 1992.
- [J55] N. Duffield, H. Roos, R.F. Werner. Microscopic and macroscopic limiting dynamics of a class of inhomogeneous mean-field quantum systems. *Ann. Inst. H. Poincaré: Physique Theorique*. 56: 143–186, 1992.
- [J56] N. Duffield. Local correlation functions for mean-field dynamical semigroups on C^* -algebras. *Helv. Phys. Acta*. 64: 610–632, 1991.
- [J57] N. Duffield. Classical and thermodynamic limits of generalized quantum spin systems. *Commun. Math. Phys.* 127: 27–39, 1990.
- [J58] N. Duffield. A large deviation principle for the decomposition of product representations. *Proc. Am. Math. Soc.* 109: 503–515, 1990.
- [J59] N. Duffield, R. Kühn. The thermodynamics of site-random mean-field quantum spin systems. *J. Phys. A.: Math. Gen.* 22: 4643–4658, 1989.
- [J60] N. Duffield, J.V. Pulé. Thermodynamics and phase transitions in the Overhauser model. *J. Stat. Phys.* 54: 449–475, 1989.

- [J61] N. Duffield, J.V. Pulé. A new method for the thermodynamics of the B.C.S. model. *Commun. Math. Phys.* 118: 475–494, 1988.
- [J62] N. Duffield. The continuum limit of dissipative dynamics in H. Fröhlich’s pumped phonon system. *Helv. Phys. Acta*, 61: 363–378, 1988.
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