

Stanford



Balaji Prabhakar

VMware Founders Professor, Professor of Electrical Engineering and, by courtesy, of Operations, Information and Technology at the Graduate School of Business

Bio

BIO

Prabhakar's research focuses on the design, analysis, and implementation of data networks: both wireline and wireless. He has been interested in designing network algorithms, problems in ad hoc wireless networks, and designing incentive mechanisms. He has a long-standing interest in stochastic network theory, information theory, algorithms, and probability theory.

ACADEMIC APPOINTMENTS

- Professor, Electrical Engineering
- Professor, Computer Science
- Professor (By courtesy), Operations, Information & Technology
- Affiliate, Precourt Institute for Energy

PROFESSIONAL EDUCATION

- PhD, UCLA (1994)

Teaching

COURSES

2020-21

- Introductory Research Seminar in Electrical Engineering: EE 301 (Aut)
- Technology for Financial Systems: CS 349F (Aut)

2019-20

- Introduction to Statistical Signal Processing: EE 278 (Aut)
- Introductory Research Seminar in Electrical Engineering: EE 301 (Aut)

2018-19

- Introduction to Statistical Signal Processing: EE 278 (Aut)
- Technology for Financial Systems: CS 349F (Spr)

2017-18

- Introduction to Statistical Signal Processing: EE 278 (Aut)
- Self-Programming Networks: EE 392K (Win)

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

Serhat Arslan, Pan Hu, Ali Sharafat, Tushar Swamy

Doctoral Dissertation Advisor (AC)

Ahmad Ghalayini, Sina Jandaghi Semnani, Shiyu Liu, Vig Sachidananda, Vin Sachidananda

Master's Program Advisor

Aunica Steele

Doctoral (Program)

Karan Chadha, Jinkun Geng, Sina Jandaghi Semnani, Shiyu Liu, Vig Sachidananda, Vin Sachidananda, Srivatsan Sridhar

Publications

PUBLICATIONS

- **Deconstructing Datacenter Packet Transport**
Alizadeh, M., Yang, S., Katti, S., McKeown, N., Prabhakar, B., B., S., Shenker
2013
- **EyeQ: Practical Network Performance Isolation for the Multi-tenant Cloud** *REM*
Jeyakumar, V., Alizadeh, M., Mazieres, D., Prabhakar, B., Kim, C., Greenberg, A.
2013; 1005 (A1): A2
- **INSINC: A Platform for Managing Peak Demand in Public Transit** *Land Transport Authority, Journeys*
Pluntke, C., Prabhakar, B.
2013
- **The Regulation of Ant Colony Foraging Activity without Spatial Information** *PLOS COMPUTATIONAL BIOLOGY*
Prabhakar, B., Dektar, K. N., Gordon, D. M.
2012; 8 (8)
- **Asymptotic independence of queues under randomized load balancing** *QUEUEING SYSTEMS*
Bramson, M., Lu, Y., Prabhakar, B.
2012; 71 (3): 247-292
- **EyeQ: Practical Network Performance Isolation at the Edge**
Jeyakumar, V., Alizadeh, M., Mazieres, D., Prabhakar, B., Kim, C., Azure, W.
2012
- **Less Is More: Trading a Little Bandwidth for Ultra-Low Latency in the Data Center**
Alizadeh, M., Kabbani, A., Edsall, T., Prabhakar, B., Vahdat, A., Yasuda, M.
2012
- **Stability Analysis of QCN: The Averaging Principle**
Alizadeh, M., Kabbani, A., Atikoglu, B., Prabhakar, B.
2011
- **Analysis of DCTCP: Stability, Convergence, and Fairness**
Alizadeh, M., Javanmard, A., Prabhakar, B.
2011
- **Data Center TCP (DCTCP)** *ACM SIGCOMM 2001 Conference 2010*
Alizadeh, M., Greenberg, A., Maltz, D. A., Padhye, J., Patel, P., Prabhakar, B., Sengupta, S., Sridharan, M.
ASSOC COMPUTING MACHINERY.2010: 63-74

- **AF-QCN: Approximate fairness with quantized congestion notification for multi-tenanted data centers**
Kabbani, A., Alizadeh, M., Yasuda, M., Pan, R., Prabhakar, B.
2010
- **Data Center TCP (DCTCP)**
Alizadeh, M., Greenbergh, A., Maltz, D., A., Padhye, J., Patel, P., Prabhakar, B.
2010
- **Incentive mechanisms for decongesting roads**
Merugu, D., Gomes, N., R., Prabhakar, B.
2009
- **Approximate bandwidth partitioning—from academia to industry**
Pan, R., Bonomi, F., Prabhakar, B.
2008
- **ElephantTrap: A low cost device for identifying large flows**
Lu, Y., Wang, M., Prabhakar, B., Bonomi, F.
2007
- **Detailed network measurements using sparse graph counters: The theory**
Lu, Y., Montanari, A., Prabhakar, B.
2007
- **Analysis of randomized load balancing with general services using the cavity method**
Bramson, M., Lu, Y., Prabhakar, B.
2007
- **Optimal throughput-delay scaling in wireless networks - Part II: Constant-size packets** *IEEE International Symposium on Information Theory and Its Applications*
El Gamal, A., Mammen, J., Prabhakar, B., Shah, D.
IEEE-INST ELECTRICAL ELECTRONICS ENGINEERS INC.2006: 5111–16
- **Optimal throughput-delay scaling in wireless networks - Part I: The fluid model** *IEEE TRANSACTIONS ON INFORMATION THEORY*
El Gamal, A., Mammen, J., Prabhakar, B., Shah, D.
2006; 52 (6): 2568-2592
- **Randomized gossip algorithms** *IEEE TRANSACTIONS ON INFORMATION THEORY*
Boyd, S., Ghosh, A., Prabhakar, B., Shah, D.
2006; 52 (6): 2508-2530
- **Congestion control in networks with no congestion drops**
Lu, Y., Pan, R., Prabhakar, B., Bergamasco, D., Alaria, V., Baldini, A.
2006
- **Optimal throughput-delay trade-off in wireless networks – Part II: Constant-size packets** *IEEE Transactions on Information Theory*
Gamal, A., El, Mammen, J., Prabhakar, B., Shah, D.
2006; 11 (52): 5111-5116
- **SHRiNK: A method for enabling scaleable performance prediction and efficient network simulation** *IEEE-ACM TRANSACTIONS ON NETWORKING*
Pan, R., Prabhakar, B., Psounis, K., Wischik, D.
2005; 13 (5): 975-988
- **Systems with multiple servers under heavy-tailed workloads** *International Symposium on Computer Performance Modelling, Measurement and Evaluation*
Psounis, K., Molinero-Fernandez, P., Prabhakar, B., Papadopoulos, F.
ELSEVIER SCIENCE BV.2005: 456–74
- **Belief propagation based multi-user detection**
Montanari, A., Prabhakar, B., Tse, D.
2005

- **Systems with multiple servers under heavy-tailed workloads**
Psounis, K., Fernandez, P., Molinero, Prabhakar, B., Papadopoulos, F.
2005
- **SIFT: A simple algorithm for tracking elephant flows and taking advantage of power laws**
Psounis, K., Ghosh, A., Prabhakar, B., Wang, G.
2005
- **Mixing times for random walks on geometric random graphs**
Boyd, S., Ghosh, A., Prabhakar, B., Shah, D.
2005
- **Network hardware algorithms**
Prabhakar, B.
2005
- **Bloom filters: Design innovations and novel applications**
Lu, Y., Prabhakar, B., Bonomi, F.
2005
- **Near-optimal depth-constrained codes** *IEEE TRANSACTIONS ON INFORMATION THEORY*
Gupta, P., Prabhakar, B., Boyd, S.
2004; 50 (12): 3294-3298
- **Modeling correlations in web traces and implications for designing replacement policies** *COMPUTER NETWORKS*
Psounis, K., Zhu, A., Prabhakar, B., Motwani, R.
2004; 45 (4): 379-398
- **Delay bounds for combined input-output switches with low speedup** *2nd Internet Performance Symposium*
Giaccone, P., Leonardi, E., Prabhakar, B., Shah, D.
ELSEVIER SCIENCE BV.2004: 113-28
- **A new proof of Parisi's conjecture for the finite random assignment problem**
Nair, C., Prabhakar, B., Sharma, M.
2004
- **Analysis and optimization of randomized gossip algorithms**
Boyd, S., Ghosh, A., Prabhakar, B., Shah, D.
2004
- **Delay bounds for combined inputoutput switches with low speedup** *Performance Evaluation*
Giaccone, P., Leonardi, E., Prabhakar, B., Shah, D.
2004; 1-2 (55): 113-128
- **The existence of fixed points for the $M/GI/1$ queue** *ANNALS OF PROBABILITY*
Mairesse, J., Prabhakar, B.
2003; 31 (4): 2216-2236
- **The attractiveness of the fixed points of a $M/GI/1$ queue** *ANNALS OF PROBABILITY*
Prabhakar, B.
2003; 31 (4): 2237-2269
- **Randomized scheduling algorithms for high-aggregate bandwidth switches** *IEEE INFOCOM 2002 Meeting*
Giaccone, P., Prabhakar, B., Shah, D.
IEEE-INST ELECTRICAL ELECTRONICS ENGINEERS INC.2003: 546-59
- **Invariant rate functions for discrete-time queues** *ANNALS OF APPLIED PROBABILITY*
Ganesh, A., O'Connell, N., Prabhakar, B.
2003; 13 (2): 446-474

- **Approximate fairness through differential dropping** *COMPUTER COMMUNICATION REVIEW*
Pan, R., Breslau, L., Prabhakar, B., Shenker, S.
2003; 33 (2): 23-39
- **Incentive mechanisms for smoothing out a focused demand for network resources** *COMPUTER COMMUNICATIONS*
Leyton-Brown, K., Porter, R., Prabhakar, B., Shoham, Y., Venkataraman, S.
2003; 26 (3): 237-250
- **Entropy and the timing capacity of discrete queues** *IEEE International Symposium on Information Theory*
Prabhakar, B., Gallager, R.
IEEE-INST ELECTRICAL ELECTRONICS ENGINEERS INC.2003: 357-70
- **Approximate fair allocation of link bandwidth** *IEEE MICRO*
Pan, R., Prabhakar, B., Breslau, L., Shenker, S.
2003; 23 (1): 36-43
- **Constrained wireless scheduling: throughput, energy and delay**
Giaccone, P., Prabhakar, B., Shah, D.
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- **The attractiveness of the fixed points of a $M/G/1$ queue** *Annals of Probability*
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- **The existence of fixed points for the $M/G/1$ queue** *Annals of Probability*
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2003; 4 (31): 2216-2236
- **Randomized scheduling algorithms for highaggregate bandwidth switches** *IEEE Journal on Selected Areas in Communications*
Giaccone, P., Prabhakar, B., Shah, D.
2003; 4 (21): 546-559
- **The scaling hypothesis: Simplifying the prediction of network performance using scaled-down simulations** *1st HotNets Workshop*
Psounis, K., Pan, R., Prabhakar, B., Wischik, D.
ASSOC COMPUTING MACHINERY.2003: 35-40
- **Energy-efficient packet transmission over a wireless link** *IEEE-ACM TRANSACTIONS ON NETWORKING*
Uysal-Biyikoglu, E., Prabhakar, B., Gamal, A. E.
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- **Efficient randomized web-cache replacement schemes using samples from past eviction times** *IEEE-ACM TRANSACTIONS ON NETWORKING*
Psounis, K., Prabhakar, B.
2002; 10 (4): 441-454
- **An implementable parallel scheduler for input-queued switches** *IEEE MICRO*
Giaccone, P., Shah, D., Prabhakar, B.
2002; 22 (1): 19-25
- **On Parisi's conjecture for the random assignment problem**
Sharma, M., Prabhakar, B.
2002
- **Flow table-based design to approximate fairness**
Pan, R., Breslau, L., Prabhakar, B., Shenker, S.
2002
- **A study of the applicability of a scaling hypothesis**
Pan, R., Psounis, K., Sharma, M.
2002

- **An implementable parallel scheduler for input queued switches** *IEEE Micro*
Giaccone, P., Shah, D., Prabhakar, B.
2002; 1 (22): 19-25
- **Towards simple, high-performance schedulers for high aggregate bandwidth switches**
Giaccone, P., Prabhakar, B., Shah, D.
2002
- **Efficient randomized algorithms for input-queued switch scheduling** *IEEE MICRO*
Shah, D., Giaccone, P., Prabhakar, B.
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- **Maintaining statistics counters in router line cards** *IEEE MICRO*
Shah, D., Iyer, S., Prabhakar, B., McKeown, N.
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- **Approximate fairness through differential dropping - (summary)** *COMPUTER COMMUNICATION REVIEW*
Pan, R., Breslau, L., Prabhakar, B., Shenker, S.
2002; 32 (1): 72-72
- **Approximate fair dropping for variable-length packets** *IEEE MICRO*
Psounis, K., Pan, P., Prabhakar, B.
2001; 21 (1): 48-56
- **Smoothing out focused demand for network resources**
Leyton-Brown, K., Porter, R., Venkataraman, S., Prabhakar, B.
2001
- **Packet dropping schemes, some examples and analysis**
Pan, R., Nair, C., Yang, B., Prabhakar, B.
2001
- **An efficient randomized algorithm for inputqueued switch scheduling**
Shah, D., Giaccone, P., Prabhakar, B.
2001
- **Approximate fair dropping for variable length packets** *by invitation, IEEE Micro*,
Psounis, K., Pan, R., Prabhakar, B.
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- **The randomness in randomized load balancing**
Nair, C., Prabhakar, B., Shah, D.
2001
- **Entropy and the timing capacity of discrete queues**
Prabhakar, B., Gallager, R.
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- **An implementable parallel scheduler for inputqueued switches**
Giaccone, P., Shah, D., Prabhakar, B.
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- **The synchronization of Poisson processes and queuing networks with service and synchronization nodes** *ADVANCES IN APPLIED PROBABILITY*
Prabhakar, B., Bambos, N., Mountford, T. S.
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Psounis, K., Prabhakar, B., Engler, D.
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- **CHOKe — a stateless active queue management scheme for approximating fair bandwidth allocation**
Pan, R., Prabhakar, B., Psounis, K.
2000
- **An approximate fair dropping scheme for variable length packets**
Psounis, K., Pan, R., Prabhakar, B.
2000
- **Near-optimal routing lookups with bounded worst case performance**
Gupta, P., Prabhakar, B., Boyd, S.
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- **The throughput of data switches with and without speedup**
Dai, J., Prabhakar, B.
2000
- **On the speedup required for combined input- and output-queued switching** *AUTOMATICA*
Prabhakar, B., McKeown, N.
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Kaithamana, S., Fan, J. L., Osuga, Y., Liang, S. G., Prabhakar, B. S.
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Gallager, R., Prabhakar, B.
1999
- **Invariant rate functions for discrete time queues**
Ganesh, A., J., O'Connell, N., Prabhakar, B.
1999
- **CHOKe — A stateless mechanism for providing quality of service in the Internet**
Prabhakar, B., Pan, R.
1999
- **On the speedup required for combined input and output queued switching** *invited paper, Automatica*
Prabhakar, B., McKeown, N.
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- **Stochastic analysis of stable marriages in combined input output queued switches**
Goel, A., Prabhakar, B.
1999
- **Entropy and the Shannon capacity of queueing systems**
Gallager, R., Prabhakar, B.
1999
- **A two-bit scheme for routing lookup**
Prabhakar, B., Gupta, P., Boyd, S.
1999
- **On the synchronization of Poisson processes and queueing networks with service and synchronization nodes** *Stanford University Computer Science Department Technical Report, STAN-CS-TR-98-1613*
Prabhakar, B., Bambos, N., Mountford, T., S.
1998

- **A large deviations characterization of the fixed point of a $M/G/1$ queue**
Ganesh, A., J., O'Connell, N., Prabhakar, B.
1998
- **Multicast scheduling for input-queued switches** *IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS*
Prabhakar, B., McKeown, N., Ahuja, R.
1997; 15 (5): 855-866
- **Matching output queueing with combined input and output queueing**
McKeown, N., Prabhakar, B., Zhu, M.
1997
- **The Cesaro limit of departures from certain $M/G/1$ queueing tandems** *Stochastic Networks: Theory and Applications*
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Prabhakar, B., McKeown, N., Mairesse, J.
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- **Convergence of departures in tandem networks of $M/G/1$ queues** *Probability in the Engineering and Informational Sciences*
Prabhakar, B., Mountford, T., S., Bambos, N.
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- **The entropy and delay of processes in ATM networks**
Prabhakar, B., Bambos, N.
1995
- **On the weak convergence of departures from an infinite series of $M/M/1$ queues** *Annals of Applied Probability*
Mountford, T., S.
1995; 1 (5): 121-127
- **IMA Volumes in Mathematics and its Applications**
Prabhakar, B.
edited by Kelly, F., Williams, R.
Springer Verlag, New York.1995
- **Entropy methods for high speed communications**
Prabhakar, B., Bambos, N.
1995
- **Designing a multicast switch scheduler**
Prabhakar, B., McKeown, N.
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- **Convergence of departures from an infinite sequence of queues**
Mountford, T., S., Prabhakar, B.
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- **The asymptotics of traffic processes in large queueing networks**
Prabhakar, B., Mountford, T., S., Bambos, N.
1994
- **On infinite queueing tandems** *Systems & Control Letters*
Bambos, N., Prabhakar, B.
1994; 4 (23): 305-314
- **Estimation of wind profile from laser beam propagation distortion**
Balakrishnan, A., V., Prabhakar, B.

