

MONIA GHOBADI

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RESEARCH INTERESTS

My research interests are in the general area of computer networking, including data center networking, transport protocols, switch and router architecture, resource management, network measurement, and online social networks. I am interested in theoretical analysis of new networking protocols as well as building and experimenting with them. My current research is on designing new transport protocols in data center networks. In the past I have worked on sizing buffers in Internet routers.

EDUCATION

- Sept. 2007 - Present **University of Toronto**, Toronto, ON, Canada
Ph.D. in Computer Science
Advisor: Prof. Yashar Ganjali
Thesis: Congestion Control in Data Centers.
GPA: 4.0/4.0
- Sept. 2005 - Aug. 2007 **University of Victoria**, Victoria, BC, Canada
M.Sc. in Computer Science
Co-Advisors: Professor Ali Shoja, Professor Sudhakar Ganti
Thesis: Resource Optimization Algorithms for VPNs Using the Hose Model
GPA: 4.0/4.0
- Sept. 2001 - Jun. 2005 **Sharif University of Technology**, Tehran, Iran
B.Eng. in Computer Engineering
Thesis: Load Balancing in Hypermesh and k -ary n -cube Interconnection Networks
GPA: 17.2/20.0

RESEARCH EXPERIENCES

- Apr. 2011 - Nov. 2011 **Search Infrastructure Group, Google Inc. Host: Yuchung Cheng**
- TCP-Trickle–YouTube traffic is bursty, and these bursts trigger packet losses and stress router queues, causing TCP’s congestion control algorithm to kick in. In this project, we introduce TCP-Trickle, a server-side mechanism that uses TCP to rate limit YouTube video streaming. TCP-Trickle paces the video stream by placing an upper bound on TCP’s congestion window as a function of the streaming rate and the round-trip time. We evaluated TCP-Trickle on YouTube production data centers in Europe and India and analyzed its impact on losses, bandwidth, RTT, and video buffer under-run events. The results show that TCP-Trickle reduces the average TCP loss rate by up to 43% and the average RTT by up to 28% while maintaining the streaming rate requested by the application.

- March 2010 - Apr. 2011 **Computer Networks Research Group, University of Toronto**
In collaboration with SciNet High Performance Computing Consortium
OpenTCP– In the absence of any explicit feedback mechanism from the network, most congestion control schemes rely on end-to-end measurements to determine the appropriate sending rate. OpenTCP is a dynamic congestion control framework for Software Defined Networks. Using a centralized *Oracle* – which is a controller application – OpenTCP can collect network statistics, aggregate these statistics, and provide *hints* to the end-hosts in the network. The end-hosts can use this extra information to improve the existing congestion control mechanism. Currently, we are in the process of deploying OpenTCP in a 4000 node data center network to evaluate its performance.
- May. 2009 - Feb. 2010 **Platforms Group, Google Inc. Host: Glen Anderson**

TCP Pacing in Data Center Networks–TCP senders inject bursts of packets into the network at the beginning of each round-trip time. These bursts stress the network queues which may cause loss, reduction in throughput and increased latency. Such undesirable effects become more pronounced in data center environments where traffic is bursty in nature and buffer sizes are small. In this work, we study the effectiveness of pacing in data center networks and present a model for the general effectiveness of pacing. We validate our model using a novel and practical implementation of paced TCP in the Linux kernel and perform several experiments in a test-bed.
- Jan. 2009 - May. 2009 **Computer Networks Research Group, University of Toronto**

Precise Traffic Generation–Generating realistic and responsive traffic that reflects different network conditions and topologies is a key challenge associated with performing valid experiments in network testbeds. In this work we design and implement (i) Caliper, a highly-accurate packet injection tool, and (ii) NetThreads, a new platform that dramatically simplifies the development of low-level network applications on the NetFPGA board. NetThreads provides a familiar environment to software developers where multithreaded C programs can be compiled and run on the NetFPGA. On top of NetThreads, we have built Caliper, a precise and responsive traffic generator that takes packets generated on a host computer and transmits them onto a gigabit Ethernet network with precise inter-transmission times. Caliper and NetThreads are both freely available.
- Sept. 2007 - Dec. 2008 **Computer Networks Research Group, University of Toronto**

Router Buffer Sizing project–Internet routers require buffers to hold packets during times of congestion. The buffers need to be fast, and so ideally they should be small enough to use fast memory technologies such as SRAM or all-optical buffering. This project proposes a solution to significantly reduce buffer sizes in the backbone routers of Internet. We set up a testbed for running time-sensitive networking experiments such as router buffer sizing experiments. We deployed Stanford University’s programmable routers (NetFPGA) in the testbed and performed an extensive set of experiments on router buffer sizes at University of Toronto’s Advanced Packet Switch and Networking Laboratory.
- Sept. 2005 - Jun. 2007 **Parallel, Networking and Distributed Applications research group (PANDA), University of Victoria**

QoS guarantee and Resource Provisioning problem—Virtual Private Networks (VPNs) provide a secure and reliable communication between customer sites over a shared network. With increase in number and size of VPNs, providers need efficient provisioning techniques that adapt to customer demands. In this work we proposed a new approach to guarantee delay limits between endpoints while optimizing the bandwidth provisioning cost. Our proposed approach takes into account the user preferences in meeting the delay limits and provisioning cost to find the optimal solution of resource allocation problem.

WORK EXPERIENCES

Apr. 2011 - Nov. 2011 **Google Inc., Mountain View, CA. Host: Yuchung Cheng**

I worked at Google on a seven months research project collaborating between the YouTube team and the TCP team. The work involved making changes to TCP stack in the Linux kernel as well as YouTube video serving application. I built custom Linux kernel deployed on production YouTube servers, performed experiments on live YouTube traffic, and analyzed tera bytes of TCP data. The project significantly reduced retransmission rate and RTT for YouTube videos, and is planned to be deployed globally. We submitted a US patent and a paper describing our work.

May. 2009 - Feb. 2010 **Google Inc., Mountain View, CA. Hosts: Glen Anderson and Aspi Sigantoria**

I worked at Google on two back-to-back internships with Infrastructure and Platforms groups. I was involved with two main projects: (i) diagnosing response time latency changes by mining network configurations, and (ii) TCP pacing in Data Center networks.

Jan. 2007 - Apr. 2007 **Alcatel-Lucent Network Technology (ANT) lab, Victoria, BC, Canada**

The Alcatel-Lucent Network Technology Lab (ANT Lab) consists of several Alcatel-Lucent 7450ESS-1 switches with the latest MPLS-VPN support. The purpose of this internship was to study and research on advanced IP features, with a primary focus on MPLS-VPN services.

Jul. 2006 - Sept. 2006 **Open Source Software Developer, Gnome foundation**

I was selected as one of the six female students over the world who received two months grant from Google to remotely work on an open source software development project in Gnome Women Summer Outreach Program. My project was Integrating GNOME Terminal with GNU Screen, a console based screen manager that multiplexes multiple interactive shells onto a single terminal and has been released successfully. The patch files (about 2000 lines) and the project blog are available online.

Aug. 2004 - Aug. 2005 **Network Assistant/Software developer, Institute for Studies in Theoretical Physics and Mathematics (IPM), Tehran, Iran**

I worked at IRANET, the network department of IPM which is the largest ISP in Iran providing Internet services to Iranian academic institutes. My job included configuring core Cisco switches and routers for providing Internet service to the clients as well as implementing several software tools for our network management needs such as accesslist controllers and network map generators.

PUBLICATIONS

- 2012 M. Ghobadi, Y. Cheng, “TCP-Trickle: Rate Limiting YouTube Video Streaming”, to appear in USENIX ATC, June 2012.
- 2012 M. Ghobadi, G. Anderson, Y. Ganjali, J. Chu, L. Brakmo, N. Dukkipati, “TCP Pacing in Data Center Networks”, Submitted to IEEE Globecom 2012.
- 2011 M. Ghobadi, Y. Cheng, “Bounding Congestion Window to Rate Limit Large Content Transfer”, US patent pending, application number US-61/558,116, Nov. 2011.
- 2011 N. Dukkipati, M. Mathis, Y. Cheng, M. Ghobadi, “Proportional Rate Reduction for TCP”, Proceedings of the 2011 ACM SIGCOMM conference on Internet Measurement (IMC), pages 155–170, Berlin, Germany, Nov. 2011. **(Excellent papers of 2011 by Google research.)**
- 2010 M. Ghobadi, M. Labrecque, G. Salmon, K. Aasaraai, S. H. Yeganeh, Y. Ganjali, J. G. Steffan, “Caliper: a tool to generate precise and closed-loop traffic”, Proceedings of the ACM SIGCOMM 2010 conference on SIGCOMM, pages 445–446, New Delhi, India, Aug. 2010.
- 2010 A. Tootoonchian, M. Ghobadi, Y. Ganjali, “OpenTM: Traffic Matrix Estimator for OpenFlow Networks”, Proceedings of the 11th International Conference on Passive and Active Network Measurement (PAM), pages 201–210, Switzerland, Apr. 2010.
- 2009 H. Rastegarfar, M. Ghobadi, Y. Ganjali. “Emulation of Optical PIFO Buffers”, Proceedings of the IEEE Global Communications Conference (Globecom), pages 1–6, Hawaii, USA, Nov. 2009.
- 2009 G. Salmon, M. Ghobadi, Y. Ganjali, M. Labrecque, J. Steffan. “NetFPGA-based Precise Traffic Generation”, NetFPGA Developers Workshop, Aug. 2009.
- 2009 M. Labrecque, J. Steffan, G. Salmon, M. Ghobadi, Y. Ganjali. “NetThreads: Programming NetFPGA with Threaded Software”, NetFPGA Developers Workshop, Aug. 2009.
- 2008 N. Beheshti, Y. Ganjali, M. Ghobadi, N. McKeown, and G. Salmon. “Experimental study of router buffer sizing”, Proceedings of the 8th ACM SIGCOMM conference on Internet Measurement (IMC), pages 197–210, Vouliagmeni, Greece, Oct. 2008. **(Best Paper Award)**
- 2008 M. Ghobadi, S. Ganti, G. C. Shoja, “Resource Optimization Algorithms for Virtual Private Networks Using the Hose Model”, The International Journal of Computer and Telecommunications Networking, Elsevier, 52(16), pages 3130–3147, Aug. 2008.
- 2008 N. Beheshti, Y. Ganjali, M. Ghobadi, J. Naous, N. McKeown, and G. Salmon. “Performing Time-sensitive network experiments”, Proceedings of the 4th ACM/IEEE Symposium on Architectures for Networking and Communications Systems (ANCS), pages 127–128, San Jose, California, Nov. 2008.

- 2007 M. Ghobadi, S. Ganti, G. C. Shoja, “Hierarchical Provisioning Algorithm for Virtual Private Networks Using the Hose Model”, Proceedings of the IEEE International Conference on Global Communications (Globecom), pages 2467–2471, Nov. 2007.
- 2007 M. Ghobadi, S. Ganti, G. C. Shoja, “Resource Optimization to Provision a Virtual Private Network Using the Hose Model”, Proceedings of the IEEE International Conference on Communications (ICC), pages 512–517, 2007.

HONORS AND AWARDS

- May 2009 NSERC (Natural Sciences and Engineering Research Council of Canada) CGS award (\$70,000)
- Oct. 2008 Best paper award, Internet Measurement Conference (IMC)
- May 2008 Ontario Graduate Scholarship (\$15,000, awarded to only 60 international students in all disciplines in Ontario)
- Sept. 2007 Wolfond fellowship (\$8,000), University of Toronto
- Sept. 2007 Four years guaranteed funding for Ph.D., University of Toronto (\$28,000 per year)
- Sept. 2005 University of Victoria graduate Scholarship (\$13,500)
- Jul. 2006 One of 6 female students selected over the world for GNOME Women Summer Outreach Program
- Jul. 2001 Ranked 22nd in Iran National University Entrance Exam

LANGUAGES AND MUSIC

- Persian Native.
- English Test of English as a Foreign Language (TOEFL), Graduate Record Examinations (GRE).
- French Diplome d’Etudes en Langue Francaise (DELF) certificate.
- Piano Royal Conservatory of Music (RCM).
- Violin Royal Conservatory of Music (RCM).