

Xiaolan Zhang

Department of Computer Science
140 Governors Drive
University of Massachusetts
Amherst, MA 01003

Email: ellenz@cs.umass.edu
Phone: (413) 244-1809
Work: (413) 545-3179
<http://www-net.cs.umass.edu/~ellenz>

RESEARCH INTERESTS

My research interests are in the area of Computer Network and Distributed Systems. I am specifically interested in mobile ad hoc network, disruption tolerant network, multimedia streaming systems, network coding, network (e.g. mobility) trace analysis and modeling, and performance evaluation (through modeling, simulation and experimentation).

EDUCATIONS

- **Ph.D. in Computer Science** Sept 2007 (Expected)
UNIVERSITY OF MASSACHUSETTS, AMHERST
Thesis Title: *Routing in DTN: Performance Modeling, Network Coding Benefit, and Real Mobility Trace Modeling*
Advisors: Prof. Jim Kurose, Prof. Don Towsley
- **Master of Science (M.S.) in Computer Science** May, 2001
UNIVERSITY OF MASSACHUSETTS, AMHERST Amherst, MA
- **Bachelor of Science (B.S.) in Computer Science** July, 1992
BEIJING UNIVERSITY Beijing, China

PUBLICATIONS Conference and Workshop paper

- **Xiaolan Zhang**, Jim Kurose, Brian Levine, Don Towsley, and Honggang Zhang, “Study of a Bus-Based Disruption Tolerant Network: Mobility Modeling and Impact on Routing”, to appear in ACM MobiCom 2007 (acceptance ratio 11%).
- Giovanni Neglia, and **Xiaolan Zhang**, “Optimal Delay-Power Trade-off in Sparse Delay Tolerant Networks: a preliminary study”, *SIGCOMM Challenged Network workshop, 2006*.
- **Xiaolan Zhang**, Giovanni Neglia, Jim Kurose, and Don Towsley, “On the Benefits of Random Linear Coding for Unicast Applications in Disruption Tolerant Networks”, *IEEE Second Workshop on Network Coding, Theory, and Applications, 2006*.
- **Xiaolan Zhang**, Giovanni Neglia, Jim Kurose, and Don Towsley, “Performance Modeling of Epidemic Routing”, *IFIP Networking 2006*, one of the top rank papers and recommended for fast track consideration of Computer Networks journal (acceptance ratio 20.4%).
- **Xiaolan Zhang**, Michael K. Bradshaw, Yang Guo, Bing Wang, Jim Kurose, Prashant Shenoy, and Don Towsley, “AMPS: A Flexible, Scalable Proxy Testbed for Implementing Streaming Services”, *International Workshop on Networking and Operating Systems Support for Digital Audio and Video (NOSSDAV) 2004* (acceptance ratio 25.3%).
- **Xiaolan Zhang**, Don Towsley, and Jack Wileden, “Towards Interoperable Multimedia Streaming Systems”, *International Packet Video workshop, 2002*.

Journal

- **Xiaolan Zhang**, Giovanni Neglia, Jim Kurose, and Don Towsley, “Performance Modeling of Epidemic Routing”, to appear *Elsevier Computer Networks journal, 2007, Volume 51/10, pages 2859-2891*.

Technical Report

- Bing Wang, Michael K. Bradshaw, Yang Guo, Jim Kurose, Subhabrata Sen, Prashant Shenoy, Don Towsley, Wei Wei, **Xiaolan Zhang**, “Empirical Study of Proxy-assisted Video Streaming Over the Best-effort Internet”, *UMass CMPSCI Technical Report 03-33*.

RESEARCH PROJECTS

Projects in Disruption Tolerant Networks (DTNs)

DTNs refer to challenged networks where links have long, variable delays, arbitrarily long periods of disconnections, and/or high error rates. I studied routing in mobile DTNs in my thesis: developing a mathematic model for epidemic style routing, demonstrating the benefits of network coding to improve delay vs resource trade-off for unicast applications, and characterizing and modeling a real DTN mobility trace.

- **Performance Modeling of Epidemic Routing** *Ph.D. thesis work, Sept'04 - July'05*
For very sparse mobile ad hoc networks, where there is often no contemporaneous end-to-end path between nodes in the network (i.e., Disruption Tolerant Networks), we developed a rigorous, unified framework based on Ordinary Differential Equations (ODEs) to study epidemic routing and its variations. Derived as limits of Markovian models under a natural scaling as the number of nodes increases, the ODE models yield closed-form expressions for several performance metrics of interest, and a numerical solution complexity that does not increase with the number of nodes. Using this ODE approach, we quantitatively characterized the performance trade-off achieved by various schemes. I considered the effect of buffer management by complementing the forwarding models with Markovian and fluid buffer models.
- **Benefit of Network Coding for Unicast Application in Mobile DTN** *Ph.D. thesis work, Sept'05 - Dec'05*
I investigated the benefits of using a form of network coding known as Random Linear Coding (RLC) for unicast communications in DTN. I demonstrated that RLC achieves smaller block delivery delay than non-network-coded packet forwarding under bandwidth constraints, and that the relative benefit increases further when buffer space within DTN nodes is limited. I found that when the network is relatively loaded, RLC achieves improvements over non-coding scheme only if the spreading of the information is appropriately controlled.
- **Modeling Studies of Real Mobility Traces** *Ph.D. thesis work, March'06 - current*
I studied traces taken from UMassDieselNet, a sparse mobile wireless network consisting of WiFi nodes attached to buses. As buses travel their routes, they encounter other buses and in some cases are able to establish pair-wise connections between buses. I analyzed these traces to characterize the inter-contact behavior and found that the all-bus-pairs aggregated inter-contact times show no discernible structure. However, when we analyzed the deterministic inter-meeting times for bus pairs on different route pairs, and further considered the random noise of actual bus movements and the probability that two buses fails to set up a connection when in transmission range, we found that the inter-contact times aggregated at a route level can be modeled as mixtures of normal distributions. Based on this analysis, we constructed simple mobility models that capture the behavior described above. I obtained lower bounds on the end-to-end delivery times from these traces and compared the performance of simple epidemic style routing algorithms to these lower bounds.

Measurement for Voice Over IP (VoIP) network

- **Measurement Support for VoIP Network Management** *June'04-August'04*
During my internship at Bell Labs, I worked on a project that studied how to provide measurement support for gateway selection and call routing in VoIP networks. When a VoIP endpoint makes a call to a PSTN (Public Switched Telephone Network) endpoint, the network selects a PSTN gateway (and a route to the gateway, if path selection is supported by the network) to route the call into the PSTN. To support gateway selection and call routing based on the call quality provided by the gateways/paths, we designed and implemented a measurement system for continuously assessing the quality of paths between different client endpoints and gateways. The system is

composed of *Gateway Monitors* that are deployed at the gateways to perform passive and active measurements, and a *Monitor Controller* that configures, controls, collects data from the *Gateway Monitors*, and performs data analysis and aggregation.

Projects in Multimedia Streaming Systems

- **AMPS Streaming Proxy Project** *April'01-March'04*
 AMPS system is a flexible, scalable proxy research platform designed to support a wide, composable, and extensible set of next-generation streaming services, such as content insertion, on-the-fly protocol and format translation, Tivo-like interactive operations, localized broadcasting, and prefix caching, etc. The design of AMPS is highly modular with well-defined communication interfaces among modules so that all modules can be replaced and reordered to create new systems and/or services. AMPS is not tied to any signaling protocol, streaming protocol or stream format. All signaling messages and multimedia streams, on entering the platform, are converted to the internal request protocol and stream format; allowing the support of translation between different protocol signaling protocols and streaming formats.

To evaluate the scalability and quality of service supported by AMPS proxy, we performed experimental studies on the AMPS proxy in a Gigabit LAN testbed. Using a client/workload generator/proxy/server configuration, we designed system testing and component benchmark testing to evaluate the performance of the system as a whole, and that of individual components. Through our study, we identified the CPU to be the bottleneck resource at the proxy, and identified the most CPU-intensive components in the proxy through profiling. I quantified the maximum request rate that can be handled by the control plane and the maximum data throughput that can be supported by the data plane. I also evaluated the end-to-end performance supported by the proxy, measuring the client reception quality in terms of start-up delay and delay jitter. I studied the performance impact of various design decisions and learned several important lessons, e.g., the importance of system tuning and efficient event/packet dispatching.
- **Translation Proxy for Multimedia Streaming Systems** *Sept'00-April'01*
 A translation proxy connects a multimedia client and a streaming server from different vendors, by translating control signaling between client and server, and performing data packets reception (from server), repacketization and streaming (to the client). I determined the differences among the following three platforms via implementation and experimentation: *AMPS* server and client (from our group that supports periodic broadcast and prefix caching transmission scheme), *Quick-Time* player and *Darwin* Streaming Server, and *RealPlayer* and *RealServer*, and implemented a prototype translation proxy that connects these platforms.

TALKS

- Disruption Tolerant Networks: Performance and Mobility Trace Modeling, Motorola, March 2007.
- Characterizing a Bus-Based Disruption Tolerant Network, invited talk at International workshop on Wireless Traffic Measurements and Modeling (WitMeMo), August 2006.
- On the Benefits of Random Linear Coding for Unicast Applications in Disruption Tolerant Networks, at IEEE NETCOD, April 2006
- Performance Modeling of Epidemic Routing, at IFIP Networking conference, May 2006
- AMPS: A Flexible, Scalable Proxy Testbed for Implementing Streaming Services, at NOSSDAV, June 2004

TEACHING TRAINING EXPERIENCE

- Teaching Assistant Jan'01-May'01, Jan'99-May'99
 DEPARTMENT OF COMPUTER SCIENCE
 UNIVERSITY OF MASSACHUSETTS, AMHERST Amherst,MA
 For Distributed Operating System, Undergraduate Computer Literacy courses.
- User Training July'93-May'98
 GEOGRAPHICAL INFORMATION SYSTEM LAB,
 BEIJING UNIVERSITY Beijing, P.R.China
 Taught clients to use softwares that I had been involved in development.

**WORK
EXPERIENCE**

- Senior Software Engineer and Project Leader July'93-May'98
GEOGRAPHICAL INFORMATION SYSTEM LAB,
BEIJING UNIVERSITY Beijing, P.R.China
Worked on a large-scale Geographical Information System. Responsibilities include system analysis, design, implementation, testing and user training.
- Testing Engineer July'93-Jan'94
HEWLETT PACKARD CORP. Cupertino, CA
Accepted training in software development process, testing methodology, test cases development and implementation, test result analysis and reporting etc.
- Software Engineer July'92-July'93
STATE KEY CASE LAB, BEIJING UNIVERSITY Beijing, P.R.China
Worked on a software design tool. Responsibilities include code maintainence, porting to various systems, user training.

SOFTWARE

- DTN Simulator for simulating various routing schemes for DTN network with various mobility models, resource constraints
- Multimedia Streaming Proxy, an extensible, scalable streaming proxy in C++.
- Translation Proxy for protocol translation between different streaming systems.
- Microsoft DirectShow based Multimedia Broadcast Server
- VoIP passive measurement tool for monitoring VoIP call and reporting call quality

SKILLS

Languages: C, C++, PERL, Shell, Java, MySQL
Platforms: Linux, Windows
Tools: Matlab, gdb, OProfile, tcpdump, ethereal, CVS
Protocols: TCP/IP, HTTP, SIP, RTSP & RTP/RTCP
Software: Multimedia streaming system, simulator, network monitoring tool design and implementation

**PROFESSIONAL
ACTIVITIES**

- Reviewer for several network conferences and journals, including MASS (IEEE International Conference on Mobile Ad-hoc and Sensor Systems), JSAC (IEEE Journal on Selected Areas in Communications), and MMSJ (ACM Multimedia Systems Journal), etc.
- Student member of IEEE and ACM.

**HONORS AND
AWARDS**

- IFIP Networking 2006 travel grant
- ACM NOSSDAV 2004 travel grant.
- Recipient of Beijing University Legend scholarship