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Objective: A summer internship in the area of Communication Networks with emphasis on P2P networks and Network Security.

EDUCATION

Ph.D candidate in Electrical and Computer Engineering — Current
University of Illinois, Urbana-Champaign — GPA: 3.87/4.00
Advisors: Prof. R. Srikant and Carolyn Beck

M.S. in General Engineering — May 2003
University of Illinois, Urbana-Champaign — GPA:3.84/4.00
Advisor: Prof. R. Srikant and Prof. Carolyn Beck

B. Tech in Mechanical Engineering — May 2001
Indian Institute of Technology (IIT), Madras, India — GPA : 8.43/10

RESEARCH EXPERIENCE

Robustness of Active Queue Management (AQM) Schemes in Internet Routers (M.S. Thesis): Starting with RED, many AQM schemes have been proposed in the literature to manage congestion in the Internet. The original purpose of RED was to avoid synchronization among flows through randomization. However, the primary purpose of AQM schemes today is to ensure small and stable queue lengths (QoS guarantees), and maintain high link utilization. In my Master's thesis, we considered two major classes of AQM schemes, one which marks packets based on some function of the queue length and the other which marks packets as a function of a counter maintained by the router. The counter, known as the *virtual queue,* is the size of a fictitious queue that is served by a link whose capacity is slightly smaller than the capacity of the real link. The idea here is that the virtual queue length is always larger than the real queue length (since the virtual queue capacity is smaller than the real queue capacity) and hence it provides early warning about congestion.

Our main result was that the additional degree of freedom available in the choice of the capacity of the virtual queue ensures that virtual queue-based schemes are robust. By robustness, we mean that virtual queue-based AQM schemes, when used in conjunction with TCP congestion control, remain stable and ensure small queue lengths even in the presence of bursty traffic, while real queue-based algorithms are not. Thus, for example, RED implemented in a virtual queue is more robust than the usual form of RED.

Stability of Internet Congestion Control algorithms with File Arrivals and Departures (Ongoing Ph.D. work): Congestion control algorithms have been typically studied under the assumption that the number of file transfers in progress is fixed. However, in reality, in any network files arrive and depart and the question we wished to answer in this project is the following: are congestion control schemes stable in the presence of file arrivals and departures? By stability, here we mean that the number of file transfers in the network is bounded in some appropriate stochastic sense. Assuming exponentially distributed file sizes, it has been proved by others that the Internet is stable provided that the load on each link is less than the link capacity. Our goal was to answer this question for general file-size distributions.

At this point, we have been able to obtain partial solutions to this problem. Given some traffic statistics and a network topology, we have developed a numerical test based on a technique called the Sum-of-Squares (SoS) method, which can verify the stability of the network. We have applied this technique successfully for small examples of networks with a star topology or a linear topology.

Priority-based Differentiation of Mice and Elephants in Internet Routers (Ongoing Ph.D. work): It is well-known that file sizes in the Internet have a very large variance. One implication of this is that most of the files are small and contribute to a small amount of the total traffic, while a few large files account for most of the traffic in the Internet. If all the files share the available capacity in a fair manner, then short files may experience long delays. In

this work, we studied the performance of a simple priority scheme at the router which preferentially treats short-flows. Using simple fluid models and **NS-2** simulations, we were able to show that such a priority scheme improves the performance of short-flows significantly while the performance of long-flows does not deteriorate much.

Summer Internship at John.F. Welch Technology Center, Bangalore, India, June 2003-August 2003 - Joint work with Dr. Ram Turaga

Design of Digital Control Algorithms for High Speed Magnetic Bearings
At very high speeds, frictional loss in conventional bearings becomes significantly high and removing the heat generated becomes problematic. A novel solution is to make use of magnetic bearings which are of non-contact type. (A non-contact bearing does not directly come in contact with the rotor and hence the frictional losses are non existent.) As levitation is not possible with a passive magnetic field (i.e. just a simple magnet), control laws are needed to generate an active magnetic field whose strength is determined by the amount of levitation.

In this joint work, we were able to design and implement (using analog circuits) control laws that ensured levitation. Also, we were able to interface the sensors and actuators directly to a computer, so that it could be controlled using the software LABVIEW. This is of significant interest as different control laws can be tested very easily without actually implementing them on a analog circuit.

PUBLICATIONS

C1 A. Lakshmikantha, C. L. Beck and R. Srikant "Robustness of Real and Virtual Queue based AQM schemes ", Proceedings of American Control Conference held in Denver,2003

C2 A. Lakshmikantha, C. L. Beck and R. Srikant "Connection level Stability Analysis of the Internet using Sum of Squares (SoS) Techniques", appeared in Conference on on Information Sciences and Systems held at Princeton University, 2004.

C3 A.Lakshmikantha and M. Babbar "A Modified NSGA-II to solve noisy multi-objective problems ", Proceedings of Genetic and Evolutionary Computation Conference held in Chicago, 2003

C4 A.Lakshmikantha, C.L. Beck and R. Srikant "Performance Analysis of Priority Queueing Schemes in Internet Routers", appeared Conference on on Information Sciences and Systems at John Hopkins University, 2004.

C5 A. Lakshmikantha, C.L. Beck and R. Srikant "Processor Sharing versus Priority Schemes for TCP flows in Internet Routers", Submitted to Conference on Decision and Control 2005.

J1 A. Lakshmikantha, C. L. Beck and R. Srikant "Robustness of Real and Virtual Queue based AQM schemes ", to appear in IEEE-Transactions on Networking, 2005.

PROJECTS

1. Designed and Developed a Data Transfer Protocol optimized for reliability with an option of multiple connections to achieve higher throughput (Implemented in **C**).
2. Simulated the *Distance Vector* and *Link-State* routing algorithms using *POSIX* threads to study the relative merits of popular routing schemes in the Internet (Implemented in **C**).
3. Modified the Non-Dominated Sorting Genetic Algorithm II (*NSGA-II*) to solve multi objective optimization problems with noisy objective functions. (Implemented in **C++**).
4. Developed a Linear predictor to predict the behavior of the stock market using estimation techniques from Digital Signal Processing (Implemented in **MATLAB**).
5. Analyzed the performance of the *CHOKE* queue management algorithm (Implemented in **NS-2**).

GRADUATE COURSE WORK

Communication Networks : Communication Networks, Modeling and Control of High Speed Networks

Communications and Signal Processing: Digital Communications, Random Processes, Advanced Digital Signal Processing, Information Theory

Mathematics : Introduction to Real Analysis, Introduction to Complex Analysis, Real Analysis (To be taken in Spr-2005)

Optimization and Games: Game Theory, Genetic Algorithms, Control of Stochastic Systems

Control Theory: Control Systems Theory and Design, Control of Stochastic Systems, Simulation of Dynamical Systems, Robust Control Theory

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COMPUTER PROFICIENCY

- Programming Languages: C, C++
- Others: Network Simulator (NS-2), MATLAB, Latex, gnuplot, Simulink, LABVIEW
- Protocols: Familiarity with IEEE 802.3, IEEE 802.5, IEEE 802.11 and TCP/IP