AVINASH SRIDHARAN

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EDUCATION:

University of Southern California Los Angeles, CA
Phd in Electrical Engineering (August 2004 – August 2008)
University of Southern California Los Angeles, CA
Masters in Electrical Engineering August 2002 – August 2004.
CGPA: 3.9 on a 4 point scale
Army Institute of Technology. India, Pune
Bachelor of Engineering, Electronics and Telecommunications July1996-July 2000

DOB: 15th Sep 1978

RESEARCH OBJECTIVE:

My primary area of research is analyzing and designing network protocols in Embedded Wireless Networks. The goal of my research is to design and implement network protocols by applying analytical tools from the domain of convex optimization. Of late there has been a lot of interest in looking at convex optimization techniques to find global optimal solutions for networking problems in wireless networks. The top down approach introduced by these techniques seem quiet promising especially due to the impact of the physical layer on higher level network protocols. Basically these techniques provide a clean framework to perform cross layer optimization. The missing piece to the puzzle that we would like to solve is how to build practically implement able protocols from this framework. The current literature in this domain, although propose solutions to a multitude of wireless networking problems, the resultant distributed solutions are not implement able due to idealistic assumptions made in the models used to formulate these problems. We would like to attack these problems from an optimization perspective by leveraging our knowledge of modeling real world embedded wireless networks and use exiting convex optimization techniques to propose distributed solutions that result in running code.

As a secondary I am also interested in developing intrusion detection algorithms for detecting zero day attacks on the IP backbone. In the past few years worm spreads have posed a considerable threat to the security of the internet. The number of machines and the speed of infection of worms such as ‘code red’ and ‘blaster’ have generated an immediate need to detect malicious traffic at the earliest stage of these spreads. A prominent signature of such an imminent attack is port scans. To counter this threat there has been considerable research in developing algorithms that perform intrusion detection at the enterprise networks. My interest in this area is to come up with algorithms that try to solve the problem on the IP backbone. One of the main differences between solving the problem on the enterprise network and on the IP backbone is the lack of bidirectional information in the backbone that makes the problem all the more challenging.

PUBLICATIONS:

Avinash Sridharan and Bhaskar Krishnamachari, "Max-Min Fair Collision-Free Scheduling for Wireless Sensor Networks," Multihop Wireless Networks (MWN'04) held in conjunction with the IEEE International Performance Computing and Communications Conference
IPCCC, April 2004

John Caffrey, Ramesh Govindan, Eric Johnson, Bhaskar Krishnamachari, Sami Masri, Gaurav Sukhatme, Krishna Chintalapudi, Karthik Dantu, Sumit Rangwala, Avinash Sridharan, Ning Xu, Marco Zuniga, "Networked Sensing for Structural Health Monitoring," International Workshop on Structural Control, Columbia University, New York, June, 2004.

Avinash Sridaran, Tao Ye and Supratik Bhattacharyya, “Connectionless PortScan Detection on the Backbone”, Malware 2006 Workshop in conjunction with 25th IEEE International Performance Computing and Communications Conference, IPCCC 2006

PATENTS:

Patent Application: 3298/SPRI.120372 - Connectionless Port Scan Detection on the Backbone (Filed, August 2005):
This patent is related to the work done in collaboration with Sprintlabs on Port Scan Detection algorithms.

RESEARCH PROJECTS:

Advisor: Prof Bhaskar Krishnamachari
Department of Electrical Engineering
University of Southern California
Autonomous Networks Research Group

Max Min Fairness in Wireless Sensor Networks: (A step towards congestion avoidance):
For embedded wireless networks specifically and wireless networks in general there is an inherent unfairness in tree based routing. The unfairness manifests itself in the form of unfair rates achieved by sources that are closer to the sink as compared to sources that are further down the tree. We use the notion of max-min rate allocation to define fairness, and propose distributed algorithms for achieving the dual objective of achieving a max-min fair rate allocation while maximizing network utilization. As a first we had proposed a heuristic based on an additive increase algorithm that would achieve the max-min fair rate allocation while trying to maximize network utilization. Based on this heuristic we had proposed a TDMA MAC. Lately we approached the problem using convex optimization techniques. Using duality we prove that additive increase algorithms for wireless networks would achieve the max-min fair rate allocation but will not be able to maximize network utilization in every instance of a tree. Through our analysis we came up with an algorithm that uses a priority list based on weights allocated to sources. The priority list is used to identify sources that would be allowed to increase their rates. Using duality we could prove the optimality of our algorithm.

One of the primary aims of this research is to realize working systems using the analytical framework that convex optimization techniques provide. In order to do so the current objective is to model various system parameters which are part of our constraint optimization formulation. As a first we are developing models for the CSMA MAC in tinyos-2.x to calculate the achievable saturation throughput in these networks.

Structural Health Monitoring: We are trying to develop protocols for wireless sensor networks targeted at the specific application of structural health monitoring. The application involves deployment of wireless sensor nodes across a structure to detect the response to an actuation such as an earthquake in order to gauge the health of this structure. As a first step one of the key hurdles that needed to be crossed was coming up with an integrated structural-network simulator to ease the development and deployment issues in such a project. We have achieved this goal by integrating the structural simulator provided as a MATLAB control tool box and TOSSIM (the TinyOS Sensor network simulator).

Implementing Wireless link models and Interference Models in EmStar and TOSSIM: At USC I am part of the Autonomous Networks Research Group (ANRG) that has proposed models for Wireless links and Interference observed in Sensor Networks based on extensive empirical measurements. We have implemented the link model in the EmStar simulator and are currently in the process of publishing the code. We also propose to implement the link as well as the interference models in TinyOS-2.x version of TOSSIM.

Port Scan Detection on the IP Backbone: This research is part of the internship that I had undertaken at **Sprint Labs** and is being continued at USC. The objective of this work was to develop intrusion detection algorithms for detecting malicious worm traffic on the IP backbone. As part of this research we developed an intrusion detection algorithm, TAPS. TAPS applies sequential hypothesis tests across multiple time slots to sources using the destination IP to destination port ratio accessed by each source. The use of sequential hypothesis tests allows for a decision to be made on the behavior of a source within a few time slots.

WORK EXPERIENCE:

Sprint Labs, Burlingame, CA, USA May 2006 - August 2006

Intern

Implementing TAPS on CMON2:

We had designed an intrusion detection algorithm called TAPS in collaboration with Sprint Labs, Burlingame in May 2004. The objective of this internship was to implement the algorithm on their continuous monitoring box CMON2. One of the main challenges in the implementation of the algorithm was the choice of the data structure to store the access information of each source IP that was observed in the link. Since a scanner could generate

hundreds and thousands of accesses in a matter of seconds maintaining a unique count of these distinct IP accesses becomes prohibitively expensive. We chose to use probabilistic sketches to maintain this information. In our implementation we used the Flajolet Martin Distinct counters to maintain these probabilistic sketches. One of the main findings of our implementation was that even with a fixed hash array of 256 for each source IP encountered we can get an accuracy of close 1% error on the distinct IP accesses by the source IP. With the probabilistic sketches we have been able to run our algorithm on the CMON box continuously for nine days on an OC-48 link without any flow drops.

Cisco System, India, Banglore Jan 2005 – August 2005

My responsibility as a Software engineer in the Cisco Systems ISBU group was the maintenance and development of the Forwarding Information Base (FIB) drivers for the Catalyst 6500 series routers. The work involved bug fixes and enhancements in the Forwarding Information Base device drivers for Earl5, Earl6 and Earl7 supervisors on the Catalyst 6500 router.

Sprint Labs, Burlingame, CA, USA May 2004 - August 2004

Intern

Port Scan Detection Algorithms: The objective of this internship was to develop online port scan detection algorithms that could run on the IP back bone. We are looking at sequential hypothesis testing techniques to perform this functionality on the backbone. The underlying philosophy of our algorithm is the fact that a scanner goes to a many more IP's as compared to ports or vies a versa. Using this as the basis of our hypothesis we have formulated a new algorithm to perform port scan detection on the backbone.

Infosys Technologies Ltd, (ITLInfosys) July 2000 - July 2002

Software Engineer

Cisco Transport Manager: CTM is the network management suite provided by the Optical Transport Business Unit of Cisco for managing their, optical networking devices. The CTM client is a JAVA based GUI that is capable of talking to the optical routers over CORBA.
Responsibilities: Enhanced the performance management features of CTM client, for their SONET (ONS15454, ONS15327) and SDH devices (ONS15454SDH).
Network Management System for Jetstream Communications (Jetvision): Jetvision is a Network Management Suite provided by Jetstream communications for managing their VoDSL gateways (CPX 1000). The Jetvision suite consisted of the Jetvision client and server , and the Jetcraft client. All three components were written in JAVA and were capable of speaking to the CPX box using CORBA as the middleware. Jetvision client and server were targeted towards managing a large number of CPX boxes whereas Jetcraft was targeted towards managing a single CPX.
Responsibilities: Developed JetCraft a Java based graphical user interface. Wrote the install shield for Jetvision Suite and tested the clients and servers.