

Amit Kumar Saha

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- Education** **PhD**, Department of Computer Science, February 2007
Rice University, Houston, Texas, USA.
Advisor: Dr. David B. Johnson
Dissertation: *Throughput and Coverage Improvement in Wireless Mesh Networks.*
- Master of Science**, Department of Computer Science, May 2003
Rice University, Houston, Texas, USA.
Advisor: Dr. David B. Johnson
Dissertation: *Energy Saving and Partition Bridging using Directional Antennas in Mobile Ad Hoc Networks.*
- Bachelor of Technology (Honours)** in Computer Science and Engineering, June 1999
Indian Institute of Technology, Kharagpur, West Bengal, India.
Advisor: Dr. A. K. Majumdar
Dissertation: *Content Based Image Retrieval from Image Databases.*
Awards: Recipient of the *Dr. B.C.Roy Gold Medal* in 1999, awarded to the single graduating student (from a batch of ≈ 500) with the best mix of academics and extra curricular activities.
- Career History** *Undergraduate Student*, IIT Kharagpur \rightarrow *Graduate Student*, Rice University \rightarrow *Software Engineer*, Tropos Networks \rightarrow *Software Engineer*, Juniper Networks \rightarrow *Senior Staff Engineer*, Juniper Networks \rightarrow *Senior Technical Leader*, Cisco Systems \rightarrow *Principal Engineer*, Cisco Systems.
- Professional Summary** I have extensive research and development background and industry experience in distributed systems and networks. I focus on overall system design with special emphasis on automated system-wide verification and visualization.
- Leadership Projects** In **Cisco Systems**, I am a *Principal Engineer* in the Cloud CTO's team, analysing large scale OpenStack based cloud installations. I developed a completely automated service for verifying and diagnosing the networking functionality provided by OpenvSwitch, a popular networking plugin used in OpenStack networking. Here is a talk presented at the OpenStack Summit, Vancouver, BC in May 2016.
- I am leading a project on Optimizing Data Processing Workloads using Non Volatile Memory (NVM) exploring the programming implications of NVM in enhancing software data workload processing capabilities.
- I am deeply involved in collaborating with academia and am currently a visiting faculty in the Department of Computer Science, Indian Institute of Technology, Gandhinagar, India. Additionally, I am a Cisco Research Grant sponsor for a project with the same department.
- Prior to Cisco Systmes, in **Juniper Networks**, I was one of the earliest member of the engineering team that conceptualized, designed, and developed the QFabric product and all the following QFX series products from Juniper. The following are projects that I did over and above my regular responsibilities:
- *QFabrics Analytics Platform.* The QFabric system is a massively distributed data center switch with more than 100 top-of-rack (TOR) devices, multiple fabric elements, and additional switches constituting the control plane ethernet. I co-lead the design and development of a Python based, scalable platform for system-wide visibility and diagnostics of the network fabric of the QFabric system. The application automatically discovers the

exact physical connectivity of the distributed switch, validates the system states, detects faults and anomalies along all possible data and control paths, and finally generates interactive graphical and textual reports. This platform was a huge hit with customers and other engineers - it got integrated into Juniper's Junos Space Network Director management software. Here is a video of it (relevant part starts around 6 mins).

- *QFabric Log Collector and Analyzer*. I built on the QFabric Analytics Platform to collect feature specific run-time state from a live QFabric system. The collected output is displayed in an intuitive HTML format thus displaying a system-wide view on a single pane of glass. I developed feature specific verification logic to test the correctness (or to diagnose the problem). This application was extensively used by the test engineers and off shoots of this idea are still being developed.
- *Virtual Chassis Fabric Visualizer*. I conceptualized, designed, and developed a completely open source based application that allows visualizing the fabric of a virtual chassis. Further details of this project can be found on the public blog on Juniper's website.
- *Customer Mindshare*. I am actively involved in gaining customer mindshare via writing public blogs on Juniper's website. These blogs are regularly used by the marketing team to help customers better understand Juniper's products and engineering vision. Here are couple blogs that I wrote recently:
 - Visualizing a Virtual Chassis Fabric. A video on this.
 - The QFX5100 - Not Just a Switch.
- *Scaling Virtual LANs*. I led a team of around 6 engineers in redesigning the QFabric switch software to support 64K VLANs. I architected and designed the entire distributed system including the packet forwarding layer, the control plane layer, the configuration layer, and automated testing of the feature.
- *Educational Collaborations*. I am designing a short course on computer networking to be taught at IIT Gandhinagar, Gujrat, India. Also, as a regular member of the intern recruiting panel at Juniper Networks, I travel to different colleges to interview and recruit interns, some of whom are later retained as permanent employees.

Regular Projects

Juniper Networks Jan 2009 – Present
Sunnyvale, CA, USA and Bangalore, KA, India

Additionally, here are brief writeups about the regular projects that I have been working on:

- *Unicast L3 features*. I am a lead engineer in designing and implementing layer 3 unicast features in Juniper's upcoming product based on a home grown, custom ASIC.
- *Next Generation Virtual Chassis*. I was a lead engineer working on Juniper's next generation virtual chassis technology that given any source-destination pair, allows for distributing traffic via hashing along multiple existing paths, each with its own capacity.
- *Access Control*. I designed and implemented the software part of the access control mechanisms for the QFabric and QFX series products. Packet header fields of incoming packets are matched against access control rules to decide on actions, such as drop and rate-limit, that need to be taken on matching packets.
- *Packet Walkthrough*. I was part of a team verifying the passage of each and every type of packet through Juniper's custom ASIC. This requires knowledge of hardware specification of the ASIC and then verifying that the hardware behavior matches the expectation of the overlying software.

Tropos Networks Inc. Mar 2007 – Dec 2008
Sunnyvale, CA, USA

I was a member of the Routing, Roaming, and Radio Management team at Tropos Networks. I have worked on several projects including the following substantial ones:

- *Licensing.* Designed and developed a licensing and protection solution which would allow Tropos to prevent counterfeit appliances and increase revenue through licensing. The solution used Maxim TPM chip and a symmetric-key based software validation module that authenticates the chip using HMAC-SHA1.
- *Performance Evaluation.* Designed and developed a fully automated test suite that performs throughput tests on all possible links on an outdoor wireless mesh network and generates graphical representation of the results.
- *Mobile Node.* Redesigned and developed routing and mobility protocol for the Tropos Mobile Mesh Router, which allows the users to connect to a mesh network at vehicular speeds. The roaming performance was improved from 1-2 seconds to fewer than 100 msec.
- *Network Analysis.* Designed and developed a new product Tropos Drone that is used to simulate the clients in the mesh networks to measure/improve performance and reliability of the mesh networks (Two patent applications pending).
- *Outage Management.* Designed and developed an outage management solution for Tropos MetroMesh products. The outages would be logged at the individual units and logs would then be downloaded for off line analyses, thus allowing for identification of outages, their durations, and their root causes. This software was running on live Tropos Networks deployments within a month of my joining the company.

**Research Assistant, Monarch Group, Rice University
Houston, TX, USA**

Fall 2000 – Fall 2006

As a member of the Mobile Networking Architecture (Monarch) group (<http://monarch.cs.rice.edu>). I have worked on several projects:

- **Throughput and Coverage Improvement in Wireless Mesh Networks** Fall 2004 – Fall 2006
A wireless mesh network includes a number of static, wireless base stations that are strategically deployed and controlled by the system. These base stations wirelessly forward user traffic over multiple hops to “gateway” base stations, each of which additionally has a connection to the internet. My research is part of the Transit Access Points (TAPs) project at Rice University (<http://www.taps.rice.edu/>) and is also relevant to the emerging IEEE 802.16 standard being promoted by the WiMAX Forum. Both the IEEE 802.16 Working Group and the TAPs project envision providing wireless broadband access to residential and public areas, with end clients possibly being mobile. As part of my PhD dissertation, I have addressed the problem of routing among base stations for best-effort traffic in the presence of simultaneous traffic, a condition that earlier routing protocols have neglected. In my work, I have also taken into account the effects of channel loss and channel modulation rates.

In collaboration with Byoung-Jo (“J”) Kim and N.K. Shankar from AT&T Labs, Middletown, NJ, USA, I have also developed a scheme to increase the coverage of base stations thus covering a given geographical area more economically than with existing schemes. This new scheme also improves the capacity of the covered area by allowing for spatial radio resource reuse. We have proposed this work in the IEEE 802.16 Task Group meetings.

- **Physical Realization of Ad hoc Networks (PRAN)** Fall 2003 – Summer 2004
I, together with Khoa To, Santashil PalChaudhuri, and Shu Du, fellow graduate students at Rice University, developed a novel, portable system for physical implementation of ad hoc network routing protocols. This system, called PRAN, allows the use of existing simulation models of protocols, without modification, to create a physical implementation of the same protocol. This helps in easier debugging, validation, reuse, and maintenance, as a single code base can now be used for both simulation and physical implementation. Our system works in FreeBSD and Linux and currently has physical implementations of DSR and AODV, two common routing protocols for mobile ad hoc networks, created from the unmodified *ns-2* simulation models of these two protocols. We presented a live demonstration of our work at the Tenth Annual International Conference on Mobile Computing and Networking (MobiCom 2004).

- Modeling Mobility in Vehicular Ad Hoc Networks Fall 2003 – Summer 2004
I developed a tool to generate movement scenario files compatible to the *ns-2* network simulator, from real road mapping data, making these scenarios more realistic than synthetic scenarios. This work used the publicly accessible U.S. Census Bureau TIGER/Line database and is also adaptable to other sources of real mapping data.
- Directional Antennas in Mobile Ad Hoc Networks Fall 2001 – Spring 2003
In my M.S. thesis, I explored two novel uses of the capability of directional antennas to transmit packets over longer distances, using the same power as an omni directional antenna. First, I used directional antennas to bridge permanent network partitions by adaptively transmitting selected packets over a longer distance. Second, I used directional antennas to repair routes in use; when an intermediate node along the route moves out of wireless transmission range, I bridge the route breakage by using the capability of a directional antenna to transmit packets over a longer distance.

Research Intern, AT&T Labs, Middletown, NJ, USA Summer 2005
Worked with Dr. Byoung-Jo (“J”) Kim and Dr. N.K.Shankar in the Mobile Wireless Network Research Group on the following:

- Analyzed the feasibility and advantages of packet forwarding using wireless backhaul in a conventional IEEE 802.16 environment.
- Developed a scheme to increase the coverage of base stations thus covering a given geographical area more economically than with existing schemes.
- Proved that the new scheme also improves the capacity of the covered area by allowing for spatial radio resource reuse.
- Proposed our work in the IEEE 802.16 Task Group meetings.

Research Intern, Microsoft Research, Redmond, WA, USA Summer 2003
Worked with Dr. Alec Wolman in the Systems and Networking Group on the following:

- Designed and implemented an SNMP-based IEEE 802.11a/b wireless access point monitoring client.
- Analyzed collected data to gather statistics about the usage of a wireless network in a real corporate setting.

Teaching Assistant, Rice University Fall 2000 – Fall 2002
Department of Computer Science, Houston, TX, USA

My responsibilities as a teaching assistant primarily involved helping students in projects and laboratory assignments through tutorial sessions and one-on-one meetings with students, clarifying material taught by the instructor, and helping the instructor in grading examinations and assignments. I served as a teaching assistant for the following four courses:

- Intermediate Programming — *Dr. John Greiner*, Fall 2000
- Operating Systems — *Dr. David B. Johnson*, Spring 2001
- Computer Systems Architecture — *Dr. Scott Rixner*, Fall 2001, Fall 2002
- Advanced Microprocessor Architecture — *Dr. Scott Rixner*, Spring 2003

Software Engineer, Hughes Software Systems May 1999 – June 2000
Gurgaon, Haryana, India

This company was an end-to-end communication solutions provider in the field of telecommunication infrastructure, service provision, and more recently, business process outsourcing sectors. This company was bought over by Flextronics Software Systems (FSS) and then by Aricent. During my stay there, I worked on the following telecommunication related projects:

- Designed and implemented a web-based network management tool to extract information from call detail records (CDRs) that are obtained from telephone switches.

- Designed and implemented a fraud management tool for GSM traffic. This tool tapped the information from SS7 links, used in GSM networks, and used this information to detect and notify, in real time, fraudulent behavior in the network.
- Designed and implemented a CORBA-based security server for an optical network management tool. This server implemented fine grained access control up to the level of individual procedures of objects in the network management tool.

- Publications**
- Safari: A Self-Organizing, Hierarchical Architecture for Scalable Ad Hoc Networking. *Shu Du, Ahamed Khan, Santashil PalChaudhuri, Ansley Post, Amit Kumar Saha, Peter Druschel, David B. Johnson, Rudolf Riedi*. Ad Hoc Networks, 485–507, Vol. 6, No.4, June 2008.
- Identifying High Throughput Paths in 802.11 Mesh Networks: a Model-based Approach. *Theodoros Salonidis, Michele Garetto, Amit Saha, Edward Knightly*. The 15th IEEE International Conference on Network Protocols (ICNP 2007), Oct, 2007.
- RMAC: A Routing-Enhanced Duty-Cycle MAC Protocol for Wireless Sensor Networks. *Shu Du, Amit Kumar Saha, David B. Johnson*. The 26th Annual IEEE Conference on Computer Communications (INFOCOM 2007), May, 2007.
- Design and Performance of PRAN: A System for Physical Implementation of Ad Hoc Network Routing Protocols. *Amit Kumar Saha, Khoa To, Santashil PalChaudhuri, Shu Du, David B. Johnson*. IEEE Transactions on Mobile Computing, pages 463–479, Vol. 6, No. 4, April 2007. A preliminary version of this paper was published in ACM SIGCOMM Asia Workshop April, 2005.
- Physical Implementation and Evaluation of Ad Hoc Network Routing Protocols using Unmodified Simulation Models. - *Amit Kumar Saha, Khoa To, Santashil PalChaudhuri, Shu Du, David B. Johnson*. ACM SIGCOMM Asia Workshop 2005, Beijing, China, April, 2005.
- Routing Improvements Using Directional Antennas in Mobile Ad Hoc Networks. *Amit Kumar Saha, David B. Johnson*. Proceedings of IEEE Globecom 2004, November-December 2004.
- Modeling Mobility for Vehicular Ad Hoc Networks. *Amit Kumar Saha, David B. Johnson*. Poster in the First ACM International Workshop on Vehicular Ad Hoc Networks (VANET 2004), pages 91–92 , October 2004.
- Adaptive Clock Synchronization in Sensor Networks. *Santashil PalChaudhuri, Amit Kumar Saha, David B. Johnson*. Proceedings of the Third Symposium on Information Processing in Sensor Networks (IPSN 2004), pages 340–348, April 2004.
- Treecast: A Stateless Addressing and Routing Architecture for Sensor Networks. *Santashil PalChaudhuri, Shu Du, Amit Kumar Saha, David B. Johnson*. Proceedings of the Fourth International Workshop on Algorithms for Wireless, Mobile, Ad Hoc and Sensor Networks (WMAN 2004), April 2004.
- Design and Evaluation of a Metropolitan Area Multitier Wireless Ad Hoc Network Architecture. *Jorjeta Jetcheva, Yih Chun Hu, Santashil PalChaudhuri, Amit Kumar Saha, David B. Johnson*. Proceedings of the Fifth IEEE Workshop on Mobile Computing Systems and Applications (WMCSA 2003), pages 32–43, October 2003.
- An Object Oriented Fuzzy Data Model for Similarity Detection in Image Databases. *Indrajit Bhattacharya, Amit Kumar Saha, and Dr. A.K.Majumdar*. IEEE Transaction on Knowledge and Data Engineering, pages 1186–1189, Vol. 14, No. 5, 2002.
- Patents**
- US patent US8537761 B1, (Aug, 2012) “Incorporation of Mesh Base Stations in a Wireless System”, *Byoung-Jo Kim, N. K, Shankaranarayanan, Amit Saha — AT&T Corporation*.
- US patent US8248948 B2, (Sep, 2013) “Monitoring Network Conditions of a Wireless Network”, *Kevin Weil, Mukesh Gupta, Amit Saha, Cyrus Behroozi — Tropos Networks Inc., Sunnyvale, CA*.

US patent US9391843 B1, (Jul, 2016) “Pre-computing effects of modifying components in a data center switch”, *Amit Saha and Rajeev Batni — Juniper Networks, Sunnyvale, CA.*

US patent US9491090 B1, (Nov, 2016) “Methods and apparatus for using virtual local area networks in a switch fabric”, *Amit Saha, Ravi Shekhar, Pavan Kumar, Easwar Swaminathan, Abhay Kumar — Juniper Networks, Sunnyvale, CA.*

Awards and Honors

Recipient of the *Dr. B.C.Roy Gold Medal* in 1999, awarded by IIT Kharagpur, Kharagpur, West Bengal, India to the single graduating student with the best mix of academics and extra curricular activities.

Awarded the Rice Graduate Fellowship for the academic year 2000-2001.

I was the president of *Friends of Young Minds*, a student organization at Rice University that used to collect computers from donors in and around Houston, test and fix the computers, and send them to organizations working for underprivileged children in India.

Invited panelist at the Ninth International Conference on COMmunication Systems & NETworkS (COMSNETS 2017).

Professional Activities

Member of Technical Program Committee (TPC):

- The ACM International Workshop on Cognitive Radio Networks (CoRoNet 2009); colocated with MobiCom 2009.
- The Fourth ACM International Workshop on Wireless Network Testbeds, Experimental evaluation and CHaracterization (WiNTECH 2009); colocated with MobiCom 2009.
- The Fifth ACM International Workshop on Wireless Network Testbeds, Experimental evaluation and CHaracterization (WiNTECH 2010); colocated with MobiCom 2010.
- The Ninth International Conference on COMMunication Systems & NETworkS (COMSNETS 2017)

Technical reviewer for peer reviewed journals such as, ACM Transactions on Modeling and Computer Simulations, ACM Transactions on Mobile Computing, ACM Transactions on Sensor Networks, IEEE Transactions on Computers, IEEE Transactions on Vehicular Technology, IEEE Transactions on Wireless Communications, and Elsevier Ad Hoc Networks, peer reviewed conferences such as, IEEE INFOCOM, IEEE GLOBECOM, IEEE SECON, IEEE WCNC 2009 IEEE CCNC 2010 ACM MobiHoc, ICDCS, and DCOSS, and peer reviewed workshops such as, ACM CoRoNet 2009, ACM WiNTECH 2009

References

Available on request.
