

SUMATHI GOPAL

Wireless Information Network Laboratory (WINLAB)
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Career Objective

Conduct research in wireless networking, network protocols, vehicular networks and novel network architectures. Contribute to innovative products using these technologies.

Expertise Summary

Experimental validation of network systems, protocol development, transport protocols, cross-layer optimization, detailed understanding of 802.11 wireless systems, interaction of transport and link layer protocols in 802.11 wireless networks, network test-bed experience and protocol simulation in NS2.

Education

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| 09/2002 - Present | PhD (Graduating in May 2007),
WINLAB, Electrical and Computer Engineering Department, Rutgers University
Thesis: Cross-layer aware transport protocols for wireless networks |
| 01/1999 - 08/2000 | M.S. in Electrical and Computer Engineering, CAIP, Rutgers University
Thesis: Aristotle and The Knowledge Web |
| 09/1994 - 10/1998 | Bachelor of Engineering in Electronics and Communication,
B.M.S. College of Engineering, Bangalore University, Bangalore, India |

Research Experience

PhD Candidate and Research Assistant, WINLAB, Rutgers University (09/2002 - Present)
Advisors: Prof. Dipankar Raychaudhuri and Dr. Sanjoy Paul

- **CLAP: A Cross Layer Aware transport Protocol**
Developed novel cross layer framework and implemented new CLAP transport protocol for reliable file transfer in time-varying single hop and multi-hop wireless networks. To supplement CLAP with cross-layer status information, designed and implemented a *Register-and-Pull* architecture for *intra*-node information, and evaluated multiple assimilation protocols for *inter*-node updates in multi-hop wireless networks.
- **CLAP for hop-by-hop transport in the CNF architecture for the Future Internet**
Leveraged rate information from the MAC layer to simulate CLAP as a reliable link-layer protocol in the novel Cache and Forward (CNF) Architecture for the future Internet.
- **TCP Dynamics and self-interference in 802.11 wireless local area networks**
With simulations and ORBIT test-bed validation, evaluated TCP performance due to MAC collisions between TCP data and ack packets in 802.11 single-hop wireless networks (a phenomenon known as *self-interference*). Conducted in-depth experimental analysis of TCP dynamics in 802.11 wireless local area networks and exposed the complex interaction of *self-interference* and TCP's popular *fast-recovery* algorithm that often leads to timeouts.

Masters Candidate and Research Assistant, CAIP, ECE Dept, Rutgers University (06/99 - 07/00)

- Implemented key software modules to automate webpage generation and synchronize multimedia display components, for a novel online classroom called *Aristotle*. Implemented "Knowledge Web" - a graphical tool to organize and present multimedia-rich teaching material.

Industry Experience

Thomson Student Fellow, Corporate Research, Thomson Inc., Princeton, NJ (09/2002 - Present)

- **Feasibility of 802.11 wireless LANs to video multicast**
With extensive wireless LAN experimentation in the Thomson office premises, exposed the sensitivity of 802.11 MAC to packet sizes. In the context of VBR streams, proposed cross-layer techniques to improve the quality of video multicast over wireless LANs.

- *Application-layer FEC for video multicast over wireless LANs*
Implemented multicast receiver capability in Thomson's MMAF player (MultiMedia Application Framework) and set up demos in the multi-storey office environment to demonstrate gains with packet-level FEC in video streams.

Intern, Corporate Research, Thomson Inc, Princeton NJ (02/2002 - 07/2002)

- *NPM: Network Performance Monitoring software for unicast and multicast traffic*
Developed NPM as a generic pattern-based traffic generator for use in various projects including lip-sync error modeling, 3G video performance, WLAN video multicast feasibility, time-varying bandwidth characterization in the ORBIT test-bed and emulate error traces in a DVB-H network.
- *Lip-sync error patterns over the public Internet*
Modeled time-varying lip-sync error during video conferencing, with 15-18 hop Internet experiments.
- *Modeling of H.263/H.26L video traffic*
Modeled frame-size traces of standard H.26L videos for traffic generation in OPNET simulations.

Intern and Research Associate, C&C Research Labs (CCRL), NEC USA, Princeton NJ (05/2000 - 01/2002)

- *SOAP and XML in a Helper Environment for Mobile Wireless Devices*
Developed a unique low-power software architecture for short-range wireless transfer, to view real-time mobile content on nearby "kiosk displays". Used the Simple Object Access Protocol (SOAP) and XML for messaging, with implementation on a Compaq iPAQ PDA using embedded-VC++.
- *GENMON - a GENeric network MONitoring and visualization tool for active networks*
Implemented GENMON with a centralized probe-based approach using SNMP MIBs, to assimilate *load status* from network nodes and provide a real-time, interactive display of network topology.

Industrial Trainee, National Aerospace Laboratories (NAL), Bangalore, India (01/1998 - 04/1998)

- Developed automatic testing procedures of an aircraft fatigue-measuring instrument (called *Fatigue-meter*) and implemented a simple signalling protocol for automatic messaging within the testing system.

Professional Activities

- Reviewer for several conferences since 2004: ICC 04, WCNC 2004-06, E-WIND 2005, PIMRC 05, Globecom 05, VTC 05, MASS 06, and CCNC 06-07. Assisted Prof. Raychaudhuri in reviewing some journal papers.
- Contributed to the preparation of several grant proposals in WINLAB 2004-present. Contributed the section titled "Experimental Validation" in the recently successful (09/06) NSF NETS-FIND proposal - "Post Cards from The Edge: A Cache and Forward Architecture for the Future Internet".
- Mentor and professional guide to two first year graduate students in WINLAB 06-07.
- Graduate Student Representative, Electrical and Computer Engineering Dept, Rutgers Univ. 09/04 - Present. Liaison between graduate students and the Department Chairman. Organized the first ECE *Graduate Student Research Day* 03/2005

Hobbies and Volunteer Activities

- Volunteer - "Asha for Education" (10/2000-Present) and Chapter coordinator 07/01 - 07/02.
- Volunteer, 'Recording for the Blind and Dyslexic' 2000-2002. Sponsored by NEC USA Inc.
- Singer, student and ardent listener of Karnatic music (classical music from southern India)
- Scrabble Player

Awards

- Recipient of the Thomson Student Research Fellowship Award. 09/2002 - Present
- Top 0.5% in All-India Karnataka-state Common Entrance Test (CET) for Engineering in 1994
- Certificate of Merit by Karnataka state government as among the top 0.01% in S.S.L.C (standardized state-wide 10th grade examination) in 1992
- Ranked second in Karnataka state in "National Gandhi Examination", Year 1991.

EEOC Information

Sex : Female
 Ethnicity : Asian
 Visa Status : U.S. Permanent Resident

Publications

Refereed:

1. Sumathi Gopal, Sanjoy Paul, "TCP Dynamics in 802.11 Wireless Local Area Networks", *To appear in IEEE Computer and Communications Conference (ICC) 2007*, to be held in Glasgow, Scotland, UK, June 25-28th 2007.
2. Sumathi Gopal, Sanjoy Paul, Dipankar Raychaudhuri "Leveraging MAC-layer information for single-hop wireless transport in the Cache and Forward Architecture of the Future Internet", The Second International Workshop on Wireless Personal and Local Area Networks (WILLOPAN) held in conjunction with COMSWARE 2007, Bangalore, INDIA, January 12th, 2007
3. Sumathi Gopal, Dipankar Raychaudhuri, "Experimental Evaluation of the TCP Simultaneous-Send problem in 802.11 Wireless Local Area Networks", ACM SIGCOMM Workshop on Experimental Approaches to Wireless Network Design and Analysis (E-WIND), Conference held in Philadelphia, USA in August 2005.
4. Sumathi Gopal, Sanjoy Paul, Dipankar Raychaudhuri, "Investigation of the TCP Simultaneous-Send problem in 802.11 Wireless Local Area Networks", Proceedings of the IEEE Computer and Communications Conference (ICC) 2005, Volume 5, page(s):3594 - 3598. Conference held in Seoul, South Korea. 16-20th May 2005.
5. Sumathi Gopal, Kumar Ramaswamy, Charles Wang. "On Video Multicast Over Wireless LANs", Proceedings of the IEEE Conference on Multimedia and Expo (ICME), Volume 2, Page(s): 1063-1066. Conference held in Taipei, Taiwan, June 2004.
6. Faulkner G., Gopal S., Ittycheriah A., Mammone R., Medl A. & Novak M., "The Aristotle Project", Proceedings of the World Conference on Educational Multimedia, Hypermedia and Telecommunications, pages 327-332, Conference held in Montreal, Canada, June 2000.

Non-Refereed:

1. Sumathi Gopal, Sanjoy Paul, Dipankar Raychaudhuri, "CLAP: A Cross Layer Aware transport Protocol for time-varying wireless links", Technical Report, TR-293, 01/2007, WINLAB, Rutgers University
2. Sumathi Gopal, Dipankar Raychaudhuri, "Survey of adaptive transport protocols for media delivery over wireless networks", Technical Report, TR-279, 10/2005, Wireless Information Network Lab (WINLAB), Rutgers University
3. Sumathi Gopal, Charles Wang, "Statistical Modelling of H.263 and H.26L encoders", Technical Report, TR-06-27-2002, 06/2002, Thomson Inc., Princeton, NJ.
4. Sumathi Gopal, Charles Wang, "Lip-Sync Error for Video-conferencing over the Public Internet", Technical Report, TR-07-20-2002. 07/2002, Thomson Inc., Princeton, NJ.
5. J. Zhang, X.Ji, Y.Ni, S.Gopal, "SOAP and XML in a Helper Environment for Mobile Wireless Devices", Technical Report, May 2001, C&C Research Labs (CCRL), NEC USA Inc. 2001-C068-4-5463-3, 11/08/2001
6. Sumathi Gopal, "The Knowledge Web", Technical Report, C&C Research Labs (CCRL), NEC USA Inc. 2001-C032-4-5463-2, 05/14/2001
7. J. Zhang, S. Gopal, "A generic monitoring tool for active networks", Technical Report, C&C Research Labs (CCRL), NEC USA Inc. 2001-C012-4-5463-1, 03/29/2001
8. Sumathi Gopal, "Aristotle and the Knowledge Web", Technical Report, TR-246, Center for Advanced Information Processing (CAIP), Rutgers University, 08/29/2000
9. Sumathi Gopal, "Aristotle and the Knowledge Web", *Masters Thesis*, Electrical and Computer Engineering Dept., Rutgers University, August 2000

Patents

Junbiao Zhang, Sumathi Gopal, "A Generic Network Monitoring Tool", *Patent Pending*.
Patent Application # 20030041142

Talks

1. "Approaches to Cross-Layer Transport in Wireless Networks", 21st Annual IEEE Workshop on Computer Communications (CCW), (Expected), Pittsburgh, PA, 02/06/2007
2. "On Video Multicast over Wireless LANs", Corporate Research Monthly talk, Thomson Inc. Princeton, NJ. 06/2004
3. "Media delivery 101: A case study of Real Networks Inc.", Student Seminar series, WINLAB, Piscataway, NJ 01/2003
4. Poster on "Distributed Learning Systems", AT&T Student Research Day, Florham Park, NJ, 10/1999.
5. "Aristotle: A Distributed Learning System", The Sun Road Show, Princeton University, Princeton, NJ 09/1999.