Bhaskaran Raman

Curriculum Vitae

212 CSE,	3071, Type III,
Department of CSE,	IIT Kanpur Campus,
IIT Kanpur, INDIA 208016.	Kanpur, INDIA 208016.
Phone: +91-512-259-7588	Phone: +91-512-259-8801
Fax: +91-512-259-0725	Fax: +91-512-259-4008
braman@cse.iitk.ac.in	
http://www.cse.iitk.ac.in/users/braman/	

Current Employment

Assistant Professor in the Department of Computer Science and Engineering, at the Indian Institute of Technology - Kanpur, INDIA.

Research Interests

Computer networks, Wireless and mobile networks, Protocol design & evaluation, Wireless measurement studies, Computing and communication system design for the developing world, System building and protocol design for wireless sensor networks.

Teaching Interests

Graduate as well as undergraduate teaching; wireless networks, computer networks and protocols, Internet-based distributed systems, operating systems.

Education

- Aug 1997-Dec 2002: Doctor of Philosophy (PhD) in Computer Science University of California at Berkeley, CA Research advisor: Prof. Randy H. Katz Thesis topic: An Architecture for Performance and Availability Constrained Composition of Services in the Wide-Area Internet
- Aug 1997-May 1999: Master of Science (M.S.) in Computer Science University of California at Berkeley, CA Research advisor: Prof. Randy H. Katz Thesis topic: Personal Mobility in the ICEBERG Integrated Communication Network
- Aug 1993-May 1997: Bachelor of Technology (B. Tech) in Computer Science & Engineering

Indian Institute of Technology - Madras, India Advisor: Prof. C. R. Muthukrishnan

Research Experience

- Assistant Professor, Department of CSE, Indian Institute of Technology Kanpur, INDIA, Jun 2003 to present.
 - I have worked on the RuralNet (Digital Gangetic Plains) project, exploring the use of IEEE 802.11 for low-cost, long-distance rural networking.
 - I am currently working on the FRACTEL project, which extends RuralNet further, by considering a mesh network consisting of long-distance as well as short-distance links. The goal of FRACTEL is to provide scalable and predictable mesh network performance.
 - I am also working on BriMon, a sensor-network based system for structural monitoring of (rail) bridges.
- Visiting Researcher, CalIT2, University of California at San Diego, Jul-Dec 2004. I worked on exploring the use of the "claims allocation" literature in the domain of economics, to network scheduling.
- Graduate Student Researcher, SAHARA Project, University of California at Berkeley, EECS Department, Summer 2001 to Fall 2002.

As a senior graduate student, I played an active part in the development of the SAHARA architecture. My PhD thesis explored a specific form of *service composition* – the central theme of the SAHARA project.

• Summer Intern, IBM T.J.Watson Research Center, New York, 1999.

I worked on issues related to service discovery and network layering in Bluetooth scatternets. (See paper titled "Arguments for Cross-layer optimizations in Bluetooth Scatternets" below).

- Graduate Student Researcher, ICEBERG Project, University of California at Berkeley, EECS Department, Summer 1998 to Summer 2001.
 - I have been part of the team involved with the design of ICEBERG an Internetbased architecture for integration of services across heterogeneous access networks and devices.
 - I have played a lead role in the two code releases of different versions of ICEBERG software.
 - In Summer 1998, I worked on building a gateway to interface cell-phones on a GSM wireless network to the Internet. This was done as part of testbed development for the ICEBERG project.
 - I worked on the design and implementation of the "Universal Inbox" for my Master's thesis.
- Graduate Operating Systems Course, University of California at Berkeley, Fall 1997. I worked on a project that looked at techniques for reordering data on the fly in data processing applications. The idea was to reorder the data based on continuous user feedback so that the user has control over which data items are processed first. (See under "publications" below).

Refereed Publications

- "FRACTEL: A Fresh Perspective on (Rural) Mesh Networks", Kameswari Chebrolu and Bhaskaran Raman, *Accepted for publication*, ACM NSDR'07, A Workshop in SIGCOMM 2007.
- "Long Distance Wireless Mesh Network Planning: Problem Formulation and Solution", Sayandeep Sen and Bhaskaran Raman, The 16th Annual Interntional World Wide Web Conference (WWW 2007), May 2007, Banff, Canada. [Acceptance rate: 14.7%]
- "Experiences in using WiFi for Rural Internet in India", Bhaskaran Raman and Kameswari Chebrolu, IEEE Communications Magazine, Jan 2007, Special Issue on New Directions In Networking Technologies In Emerging Economies.
- "Implications of Link Range and (In)Stability on Sensor Network Architecture", Bhaskaran Raman, Kameswari Chebrolu, Naveen Madabhushi, Dattatraya Y Gokhale, Phani K Valiveti, and Dheeraj Jain, The First ACM International Workshop on Wireless Network Testbeds, Experimental evaluation and CHaracterization (WiNTECH 2006), A MOBICOM 2006 Workshop, Sep 2006, Los Angeles, USA. [Acceptance rate: 35.5%]
- "Long-Distance 802.11b Links: Performance Measurements and Experience", Kameswari Chebrolu, Bhaskaran Raman, and Sayandeep Sen, 12th Annual International Conference on Mobile Computing and Networking (MOBICOM), Sep 2006, Los Angeles, USA. [Acceptance rate: 11.7%]
- "Rural Telephony: A Socio-Economic Case Study", Sayandeep Sen, Sukant Kole, and Bhaskaran Raman, International Conference on Information and Communication Technologies and Development (ICTD-2006), May 2006, U.C.Berkeley.
- "Wake-on-WLAN", Nilesh Mishra, Kameswari Chebrolu, Bhaskaran Raman, and Abhinav Pathak, The 15th Annual Interntional World Wide Web Conference (WWW 2006), May 2006, Edinburgh, Scotland. [Acceptance rate: 11%]
- "Channel Allocation in 802.11-based Mesh Networks", Bhaskaran Raman, The 25th Annual Conference on Computer Communications (IEEE INFOCOM), Barcelona, Spain, April 2006. [Acceptance rate: 18%]
- "Feasibility Study of Spatial Reuse in an 802.11 Access Network", A. R. Harish, Sreekanth Garigala, Bhaskaran Raman, and Phalguni Gupta, XXVIII URSI General Assembly, New Delhi, India, Oct 2005.
- "Design and Evaluation of a new MAC Protocol for Long-Distance 802.11 Mesh Networks", Bhaskaran Raman and Kameswari Chebrolu, 11th Annual International Conference on Mobile Computing and Networking (MOBICOM), Aug/Sep 2005, Cologne, Germany. [Acceptance rate: 10.3%]
- "A Network Layer Approach to Enable TCP over Multiple Interfaces", Kameswari Chebrolu, Bhaskaran Raman, Ramesh Rao, Wireless Networks (WINET), Springer Science + Business Media, Volume 11, Issue 5, Sep 2005, Pages 637-650.
- "Revisiting MAC Design for an 802.11-based Mesh Network", Bhaskaran Raman and Kameswari Chebrolu, Third Workshop on Hot Topics in Networks (HotNets-III), 15-16 Nov 2004, San Diego, CA, USA. [Acceptance rate: 19.7%]

- "Turning 802.11 Inside-Out", Pravin Bhagwat, Bhaskaran Raman, and Dheeraj Sanghi, ACM SIGCOMM Computer Communication Review, Vol. 34, No: 1, pp. 33-38, Jan 2004. (Also appears in HotNets-II proceedings).
- "Turning 802.11 Inside-Out", Pravin Bhagwat, Bhaskaran Raman, and Dheeraj Sanghi, Second Workshop on Hot Topics in Networks (HotNets-II), 20-21 Nov 2003, Cambridge, MA, USA. [Acceptance rate: 19.3%] (Also appears in CCR).
- "An Architecture for Highly Available Wide-Area Service Composition", Bhaskaran Raman and Randy H. Katz, Computer Communications Journal, Vol. 26, No: 15, pp. 1727-1740, Special issue on "Recent Advances in Communication Networking", Sep 2003.
- "Load Balancing and Stability Issues in Algorithms for Service Composition", Bhaskaran Raman and Randy H. Katz, The 22nd Annual Joint Conference of the IEEE Computer and Communications Societies, IEEE INFOCOM, Apr 2003. [Acceptance rate: 21%].
- "Emulation-based Evaluation of an Architecture for Wide-Area Service Composition", Bhaskaran Raman and Randy H. Katz, International Symposium on Performance Evaluation of Computer and Telecommunication Systems (SPECTS 2002), July 2002. [Acceptance rate: 60%].
- "The SAHARA Model for Service Composition Across Multiple Providers", Bhaskaran Raman, Sharad Agarwal, Yan Chen, Matthew Caesar, Weidong Cui, Per Johansson, Kevin Lai, Tal Lavian, Sridhar Machiraju, Z. Morley Mao, George Porter, Timothy Roscoe, Mukund Seshadri, Jimmy Shih, Keith Sklower, Lakshminarayanan Subramanian, Takashi Suzuki, Shelley Zhuang, Anthony D. Joseph, Randy H. Katz, Ion Stoica, *Invited Paper*, International Conference on Pervasive Computing (Pervasive 2002), pp. 1-14, Aug 2002.
- "Arguments for Cross-Layer Optimizations in Bluetooth Scatternets", Bhaskaran Raman, Pravin Bhagwat, and Srinivasan Seshan, Symposium on Applications and the Internet (SAINT'01), pp. 176-184, Jan 2001. [Acceptance rate: 18.5%].
- "Universal Inbox: Providing Extensible Personal Mobility and Service Mobility in an Integrated Communication Network", Bhaskaran Raman, Randy H. Katz, and Anthony D. Joseph, Workshop on Mobile Computing Systems and Applications (WMSCA'00), pp. 95-106, Dec 2000. [Acceptance rate: 37.7%].
- "Online Dynamic Reordering", Vijayshankar Raman, Bhaskaran Raman, and Joseph M. Hellerstein, The VLDB Journal The International Journal on Very Large Data Bases, Vol. 9, No: 3, pp. 247-260, Dec 2000.
- "ICEBERG: An Internet-core Network Architecture for Integrated Communications", Helen J. Wang, Bhaskaran Raman, Chen-nee Chuah, Rahul Biswas, Ramakrishna Gummadi, Barbara Hohlt, Xia Hong, Emre Kiciman, Zhuoqing Mao, Jimmy S. Shih, Lakshminarayanan Subramanian, Ben Y. Zhao, Anthony D. Joseph, and Randy H. Katz, IEEE Personal Communications, Vol. 7, No: 4, pp. 10-19, Aug 2000: Special Issue on IP-based Mobile Telecommunication Networks.
- "The ICEBERG Project: Defining the IP and Telecom Intersection", Bhaskaran Raman, Helen J. Wang, Jimmy S. Shih, Anthony D. Joseph, and Randy H. Katz, IT Professional, Vol. 1, No: 6, pp. 38-45, Nov/Dec 1999.

• "Online Dynamic Reordering for Interactive Data Processing", Vijayshankar Raman, Bhaskaran Raman, and Joseph M. Hellerstein, Proc. of the 25th International Conference on Very Large Databases (VLDB), pp. 709-720, Sep 1999. Selected one of the best papers. [Acceptance rate: 16%].

Theses

- "An Architecture for Performance and Availability Constrained Service Composition in the Wide-Area Internet", Bhaskaran Raman, PhD Thesis, EECS Department, U.C.Berkeley, Dec 2002.
- "Personal Mobility in the ICEBERG Integrated Communication Network", Bhaskaran Raman, Master's Thesis, EECS Department, U.C.Berkeley, May 1999.
- "A Portable User-Level Thread Package", Bhaskaran Raman, B. Tech Project Report, Indian Institute of Technology, Madras, May 1997.

Selected Presentations

- "Experience with WiFi for Rural Internet in India", Bhaskaran Raman, Invited presentation at Australia-India Broadband and IT Workshop, Melbourne, Australia, 10-11 July 2006.
- "RuralNet (Digital Gangetic Plains): WiFi-Based Low-Cost Rural Networking", Bhaskaran Raman, Keynote Presentation, Symposium on Wireless Networking Systems, University of Philippines, 19 Nov 2005.
- "Digital Gangetic Plains (DGP): 802.11-based Low-Cost Networking for Rural India", Bhaskaran Raman, Invited presentation at Wireless4Development, Djursland, Denmark, Sep 2004.

Sponsored Projects and Consultancy Projects

- Project type: Sponsored research Title: WiFiNetMon Funding agency: Lucent Bell Labs Research, Bangalore Objectives: To identify and address issues related to network monitoring and management in long-distance WiFi networks, and WiFi mesh networks in general. Duration: 3 months: Feb 2007 to April 2007 Approved budget: Rs. 1.5 lakhs
- Project type: Sponsored research Title: RuralNet (Digital Gangetic Plains II) Funding agency: Media Lab Asia Objectives: To explore mechanisms for robust, cost-effective, and high-performance operation of large (100-300 nodes) long-distance 802.11 mesh networks as well as point-topoint networks, to explore 802.11g performance, to characterize application performance on such networks. Duration: 15 months: May 2005 to July 2006 Approved budget: Rs. 33.78 lakhs

- Project type: Consultancy Title: Bharani: An Implementation of Sectorized WiFi MAC Objectives: Implementation and testing of a sectorized WiFi-based MAC protocol, designed to operate in a point-to-multipoint (P2MP) setting. Duration: 5 months: Sep 2005 to Jan 2006 Approved budget: Rs. 5.90 lakhs
- Project type: Sponsored research Title: Turning 802.11 Inside Out: Wireless Networking for Rural India Funding agency: Ministry of Human Resource Development (MHRD) Objectives: To build research infrastructure, explore specific research issues geared towards making 802.11 a commercially viable option for rural networking, to improve the technological base in 802.11 wireless networking in India. Duration: Two years: May 2004 to April 2006 Approved budget: Rs. 20.00 lakhs

Master's Theses Guided

- Nilesh Mishra, Design Issues and Experiences with BRIMON Railway BRIdge MONitoring Project, IIT Kanpur, Aug 2006
- Narasimha Puli Reddy, The SRAWAN MAC Protocol to support Real-Time Services in Long Distance 802.11 Networks, IIT Kanpur, Aug 2006
- VMD Jagannath, WiBeaM: Design and Implementation of Wireless Bearing Monitoring System, IIT Kanpur, Jun 2006
- Abhishek Maheshwari, Implementation and Evaluation of a MAC scheduling algorithm for IEEE 802.16 WirelessMAN, IIT Kanpur, May 2006
- Sayandeep Sen, Topology Planning for Long Distance Wireless Mesh Networks, IIT Kanpur, May 2006
- Manikantah Kodali, Improving Fault Tolerance in 802.11 Wireless Long Distance Rural Networks, IIT Kanpur, May 2006 [jointly advised by A. R. Harish]
- Hemanth Haridas, BriMon: Design and Implementation of Railway Bridge Monitoring Application, IIT Kanpur, May 2006 [jointly advised by Kameswari Chebrolu]
- Pavan Kumar, Design, Implementation, and Evaluation of new MAC Protocols for Long Distance 802.11 Networks, IIT Kanpur, May 2006, **Cadence Silver Medal 2006**, *Best M.Tech. Thesis in the Departments of Computer Science & Engineering and Electrical Engineering for Good Academic Performance, Innovation in Thesis, Development of New Technology and/or Substantial Betterment of Existing Technology*
- Prashant Sharma, Radio Placement Algorithm and Dynamic Channel Allocation for Large Area Community Networks, IIT Kanpur, Aug 2005
- Venkata Rao Chimata, Implementation and Performance Issues of VoIP in Long Distance 802.11b Networks, IIT Kanpur, June 2005

- Sridhar Kumar Kotturu, ScaleNet: A Platform for Scalable Network Emulation, IIT Kanpur, June 2005
- Mohit Choudhury, Three Beacon Sensor Network Localization through Self Propogation, IIT Kanpur, May 2005, Cadence Silver Medal - 2005, Best M.Tech. Thesis in the Departments of Computer Science & Engineering and Electrical Engineering for Good Academic Performance, Innovation in Thesis, Development of New Technology and/or Substantial Betterment of Existing Technology
- Sreekanth Garigala, Experimental Validation of Simultaneous Operation in an 802.11 Multihop Mesh Network, IIT Kanpur, July 2004 [jointly advised by Phalguni Gupta]

BTech Projects Guided

- Abhinav Pathak, IPv4 Support for HIP, May 2006
- Ayush Ghai and Nihit Purwar, Evaluation of IEEE 802.16 Broadband Wireless Access MAC, May 2006
- Abhimanyu Singh Shekhawat, Measurement And Analysis Of Packet Delivery Performance For The Tmote Sky Mote In Wireless Sensor Networks, May 2006 [jointly advised by Kameswari Chebrolu]
- Deepak Jorwal and Gaurav Singh, Analysis of Throughput Gain using Directional Antennae in Community Networks, May 2006 [jointly advised by Dheeraj Sanghi]
- Sabyasachi Roy and Ashwini Kumar, Realistic Support For IEEE802.11b MAC in NS, IIT Kanpur, May 2004
- Paul Ipe, Power Allocation Issues in a Wireless Mesh Network, IIT Kanpur, May 2004
- Santosh Kumar and Abhay Gupta, Modeling of Web User Behaviour and User Perceived Website Availability, IIT Kanpur, May 2004

Teaching Experience

- Fall 2003 to present: Assistant Professor in the Department of Computer Science and Engineering, at Indian Institute of Technology Kanpur, INDIA.
 - Jan-Apr 2007: "CS698t: Wireless Networks, Principles and Practice", Student evaluation: not yet known.
 - Aug-Nov 2006: "CS425: Computer Networks", Student evaluation: not yet known.
 - Jan-Apr 2006: "CS725: Topics in Networking", Student evaluation: 3.71/4.00 [Institute average: 3.01/4.00], Recognized in the Academic Senate meeting.
 - Aug-Nov 2005: "CS698t: Wireless Networks, Principles and Practice", Student evaluation: 3.41/4.00 [Institute average: 3.12/4.00].
 - Jan-Apr 2005: "Esc101N: Fundamentals of Computing", Student evaluation: 3.28/4.00 [Institute average: 2.76/4.00].
 - Jan-Apr 2004: "CS422: Computer Architecture", Student evaluation: 3.41/4.00 [Institute average: 3.07/4.00].

- Aug-Nov 2003: "CS625: Advanced Computer Networks", Student evaluation: 3.60/4.00 [Institute average: 3.11/4.00], Recognized in the Academic Senate meeting.
- Fall 1997, Spring 1998: Teaching Assistant for CS61a "Structure and Interpretation of Computer Programs", U.C.Berkeley.
 Fall 1996, Spring 1997: Teaching Assistant for CS110 - "Introduction to Computing", Indian Institute of Technology, Madras.

Professional Activities

- Technical Program Committee Chair:
 - WiNTECH 2007: The Second ACM International Workshop on Wireless Network Testbeds, Experimental evaluation and CHaracterization, A workshop in MobiCom 2007, 10 Sep 2007, Montreal, QC, Canada.
 - WISARD 2007: WIreless Systems: Advanced Research and Development, A workshop in COMSWARE 2007, 07-08 Jan 2007, Bangalore, INDIA.
- Technical Program Committee Member: 2008: INFOCOM 2007: SIGCOMM, NSDR, NCC, WiNTECH, WWW mobility track 2006: IWDC, COMSWARE, WMCSA, ICDCS, WWW mobility track, WWW developing regions track 2005: MSWiM
- Member of ACM.

Honors

- Ranked 12th (100,000 total candidates) in the Joint Entrance Examination for admission to the Indian Institute of Technology 1993
- Recipient of National Talent Scholarship (1991-1997)
- Placed among top 0.1% of students in Mathematics in All India Senior School Certificate Examination 1991

Other Activities

I'm a volunteer for "Asha for Education" (http://www.ashanet.org/), an organization which works to promote basic education in India.