Prof. Lakshminarayanan Subramanian

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Computer Science Department
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Areas of Interest

Networking, Computing for Development

Education

PhD in Computer Science, Dec 2005
University of California at Berkeley
Thesis: Decentralized security mechanisms for Internet Routing
Advisors: Prof. Randy H. Katz, Prof. Scott Shenker, Prof. Ion Stoica

MS in Computer Science, May 2002
University of California at Berkeley
Thesis: Inferring the Geographic Properties of the Internet

B.Tech in Computer Science, May 1999
Indian Institute of Technology, Madras

The Nurture program, a graduate program in Mathematics, 1995-1998
The Institute of Mathematical Sciences (IMSc), India

Professional Experience

Assistant Professor, New York University, 2006-Present
Consultant, Microsoft Research Search Labs (June 2011)
Researcher, Intel Research Berkeley, 2005-2006
Research Assistant, UC Berkeley, 1999-2005

Awards and Honors

- NSF CAREER Award, 2009-2014
- IBM Faculty Award, 2010
- IBM Faculty Award, 2009
- Microsoft Research Challenge Grant Award, 2008

- Best Demo Award, ACM SIGCOMM 2011
  - Aditya Dhananjay, Matt Tierney, Jinyang Li, Lakshminarayanan Subramanian. "WiRE: A New Rural Connectivity Paradigm"
- Honorable Mention Award, Information and Communication Technologies for Development (ICTD) 2009
  - Michael Paik, Lakshminarayanan Subramanian. "ATMosphere: A System for ATM Services in Rural Contexts"
- ACM Doctoral Dissertation Nomination, 2005
- C.V. Ramamoorthy Award (2005) for outstanding contributions in a new research area in computer science.
- Best Student paper award, ACM/USENIX Networked Systems Design and Implementation (NSDI) 2004
  - Lakshminarayanan Subramanian, Volker Roth, Ion Stoica, Randy H.Katz and Scott Shenker. "Listen and Whisper: Security Mechanisms for BGP"
- Silver Medalist, 36th International Mathematics Olympiad, Toronto, Canada, 1995
- All India First Rank, Roorkee University Entrance examination for which roughly 100,000 students appeared

Research Projects

I co-lead three (partially overlapping) research groups at NYU:
- **Networks and Wide-area Systems (NeWS)** group (http://news.cs.nyu.edu) jointly with Prof. Jinyang Li
- **CATER Lab** (http://cater.cs.nyu.edu) a multidisciplinary research group focused on computing for development (joint with Economics, School of Medicine, College of Nursing, NYU-Poly Technology Management)
- **Center for Technology and Economic Development** (http://cted.nyu.edu) at NYU Abu Dhabi (led by Prof. Yaw Nyarko in NYU Economics)

I have worked on the following research projects categorized based on research themes:

Rural Wireless Networks
- **WiRE:** Wireless Rural Extensions is a comprehensive low-cost, solar-powered, high-performance, low-power, highly reliable rural network architecture (replacement for rural cellular telcos)
- **ROMA:** High performance multi-radio mesh networks
- **WiLDNet:** Wifi-based Long Distance Networks is a low-cost, high performance, point-to-point wireless connectivity solution
- **Simbalink:** A remote monitoring platform for solar home systems, solar-powered wireless devices

Re-architecting the Web for Emerging Regions
- **Low-bandwidth Transport:** A middle-box layer to enhance TCP performance in sub-packet regimes
- **RuralCafe:** Asynchronous, yet interactive web browsing and web search
- **Contextual Information Portals:** Vertical slicing of the web for any given topic
- **Event Logger for Firefox:** End-host Web optimization engine for low bandwidth networks

Mobile Information Services for Emerging Regions
- **Hermes:** A Data-over-GSM voice codec for data transmission over unknown acoustic channels
- **UjU:** A lightweight, efficient, cost-aware platform for SMS-based mobile applications
- **SMSFind**: An SMS-based web search engine which answers a search query in 140 bytes
- **ATMosphere**: Enabling Rural ATMs to work under intermittent connectivity with offline authentication

Low-cost Information Verification:
- **PaperSpeckle**: A low-cost paper fingerprinting mechanism that can uniquely fingerprint any piece of paper
- **Signet**: Auditable transactions using Subscriber Identity Module (SIM) cards
- **Epothecary:** Pedigree verification of pharmaceutical products using mobile devices

Internet Architecture and Social Networks
- **SumUp/Gatekeeper**: Sybil-resilient online content rating system and Sybil-resilient admission control
- **One More Bit is Enough:** Congestion control for high bandwidth-delay product networks
- **Listen and Whisper**: Security mechanisms for Internet routing (PhD thesis work)
- **OverQoS:** Overlay-based QoS architecture for the Internet (Berkeley)
- **HLP:** Next-generation Inter-domain routing protocol (Berkeley)

PhD Students and Postdocs

I am currently advising the following PhD students at NYU:
- Jay Chen (graduated July 2011, joining NYU Abu Dhabi as Visiting Assistant Professor in Sept 2011)
    - o Thesis: Re-architecting Web and Mobile Information Access for Emerging Regions
- Nguyen Tran (co-advised with Prof. Jinyang Li) (expected May 2012)
    - o Proposed Thesis: Sybil-resilient mechanisms for Distributed Systems
    - o Winner of *Google PhD Fellowship*, 2010 (distributed systems)
- Ashlesh Sharma (expected May 2012)
    - o Proposed Thesis: Low-cost Information Verification Mechanisms for Emerging Regions
    - o *Co-Founder, Entrupy Inc* (commercializing PaperSpeckle project)
- Nektarios Paisios (expected May 2012) (co-advised with Prof. Ken Perlin and Prof. Dennis Shasha)
    - o Proposed Thesis: Mobile Accessibility Tools for Visually Impaired Users
    - o Winner of *Google Limewire Fellowship*
- Aditya Dhananjay (co-advised with Prof. Jinyang Li) (expected 2013)
    - o Proposed Thesis: WiRE: Rethinking the Rural Connectivity Paradigm
    - o Winner of *Harold Grad Memorial Prize* (outstanding performance for a graduate student)
- Michael Paik (expected 2013)
    - o Proposed Thesis: Enabling Applications via Usable Security in Emerging Regions
- Matthew Tierney (co-advised with Prof. Jinyang Li) (expected 2014)
    - o *NSF IGERT Fellowship* (wireless networks, mobile services, privacy in cloud services)
- Sunandan Chakraborty (expected 2015) (data mining tools for development)

I have also worked with the following postdoctoral researchers at NYU:
- Esther Ezra, PhD (reputation based routing), now joining the NYU Computer Science department as a visiting faculty member
- Vincent Toubiana, PhD (postdoc with Prof. Helen Nissenbaum), now at Alcatel Lucent, France.

I have also worked closely with the following PhD students at UC Berkeley and RPI:
- Rabin Patra (advised by Prof. Eric Brewer; *Co-Founder of Tarana Wireless Inc*)
- Sergiu Nedevschi (advised by Prof. Eric Brewer; *Co-Founder of Tarana Wireless Inc*)
- Sonesh Surana (advised by Prof. Eric Brewer; Co-founded startup acquired by Solar Semiconductor)
- Matthew Caesar (advised by Prof. Randy Katz; assistant professor at UIUC)
- Jayanthkumar Kannan (advised by Prof. Ion Stoica; Intel Research, now at Google)
- Yong Xia (advised by Prof. Shivkumar Kalyanaraman (RPI); Microsoft, now at NEC Labs China)

I have also served on the thesis committee of the following PhD students:
- Michael Freedman (advisor: David Mazieres; now an assistant professor at Princeton)
- Jinyuan Li (advisor: David Mazieres; now at VMWare)
- Siddartha Annapurna Reddy (advisor: David Mazieres; now at Dyyno Inc)
- Sze Ming Chow (advisors: Yevgeniy Dodis and Victor Shoup; now a postdoc at Waterloo)
- Daniel Wichs (advisors: Yevgeniy Dodis and Victor Shoup; joining IBM Research)
- Joel Alwen (advisors: Yevgeniy Dodis and Victor Shoup)
- Yair Sovran (advisor: Jinyang Li)

MS Students

I have worked with several MS students on specific research projects:
- Wei-Chih Lu (NYU-Poly)
    - Thesis: SMSAppStore: A Platform for SMS-based Applications (appeared in ACM DEV 2010) and managed all UjU deployments in India, Ghana and Mexico
    - ***Co-Founder, Toodhu Mobile LLC***
- Saurabh Kumar (Microsoft)
    - Automatic Generation of Embedded Signatures for Duplicate Detection on a Public Network. (Joint work with AT&T Research, Patent awarded)
- Nathan Silberman (now a PhD student at NYU with Prof. Rob Fergus)
    - Worked on following papers: "On the Rise and Fall of ISPs" (NetEcon 2009), "Automated Detection of Diabetic Retinopathy" (AAAI 2010)
- Trishank Karthik (Rich Bonneau Lab, now at Biodigital Solutions)
    - Worked on following papers:"Contextual Information Portals", "Document Classification for Focused Topics" (AAAI 2010)
- Brendan Linn (Lionside, now at NGMoco)
    - Worked on an early version of SMSFind (Mobiheld 2009)
    - Winner of ***Matthew Smosna Prize*** (highest level of academic achievement for MS student)
- Arvind Kumar (now at VMWare) (Worked on ELMR, SIGMOD 2009 Demo paper)
- Amey Purandare (now at Bloomberg) (Worked on ELMR, SIGMOD 2009 Demo paper)
- Faiz Kazi (now at a startup in Japan) (Worked on UjU for ACM DEV 2010)
- Rachid Ennaji (Cost-aware mobile web browsing, now at Amazon)
- Sindhura Chava (Cost-aware mobile web browsing, now at Barclays Capital)
- Nahanaeli Schelling, Meredith Hasson, Ariel Nevarez (all from NYU ITP)
    - Worked on Simbalink, the solar monitoring platform (ICTD 2010)
    - ***Co-Founders of Simbalink LLC***
- Margaret Mckenna (NYU ITP) (data mining tools for development)
- Sajan Ravindran (NYU ITP) (road traffic networks)
- Vipin Jain (NYU-Poly) (road traffic networks, DNS reputation service)
- Anubhav Singh (characterizing health awareness of communities)
- Mohan Pandiyan (mobile health applications)
- Vrutti Vyas (mobile accessibility)

Courses

Systems Projects, Fall 2011
Distributed Systems, Fall 2011
Networks and Mobile Systems, Spring 2011

Undergraduate Operating Systems, Fall 2010
Networks and Distributed Systems, Spring 2010
Networks and Distributed Systems, Spring 2009
Honors Operating Systems, Fall 2008
Information and Communication Technologies for Developing Regions, Fall 2007
What if a Computer Lies?, Spring 2007
Networks and Distributed Systems, (co-taught with Jinyang Li), Fall 2006

Professional Activities

- Co-Founder, Entrupy Inc
  - Startup focused on commercializing PaperSpeckle, a paper fingerprinting mechanism developed and patented at NYU
- Co-Founder, Toodhu Mobile LLC
  - Startup focused on mobile applications and services in emerging regions
- Leading the effort to establish ACM SIGDEV, a new ACM Special Interest Group on Computing for Development
- PC Chair and Co-Founder, First ACM Symposium on Computing for Development (DEV) 2010
- Track Chair, WWW 2011 Track on "Web for Emerging Regions"
- Co-Editor, IEEE Pervasive Computing, Special issue on ICTD (September 2012)
- Editorial Board: "Information Technologies and International Development (ITID)" journal
- PC Chair, ACM SOSP 2011 Mobiheld workshop
- General Chair, ACM Hotnets 2009
- Organizing Committee, CCC Workshop on "Computer Science and Global Development"
- Steering Committee: ACM Workshop on Networked Systems for Developing Regions (NSDR) 2010-12
- Track Chair: WWW 2008 Track on "Technologies for Developing Regions"
- PC Chair: ACM SIGCOMM Workshop on Networked Systems for Developing Regions, 2008
- Track Chair: VTC 2009 Fall Series, "Green Radio" Track
- Organizer, NY Systems/Networking Summit 2006 and 2009
- Program Committee Member:
  - ACM DEV 2012, ACM SIGCOMM 2012, ICTD 2012, Mobisys 2012, Mobihoc 2012, INFOCOM 2012, NSDI 2011, Mobihoc 2011, NSDR 2011, ACM DEV 2010, ICTD 2010, NSDR 2010, SIGCOMM MobiHeld 2010, IwQoS 2010, ASPLOS 2010 (ERC), WiMesh 2010, ICTD 2009, NSDR 2009, IwQoS 2009, ACM SIGCOMM 2008, SIGCOMM NSDR 2008, CoNext 2008, WWW 2008, ICDCN 2008, IwQoS 2008, IwQoS 2007, USENIX SRUTI 2007, EC 2007, NPSec 2007, NPSec 2006

NYU Service

- Co-lead the NYU Abu Dhabi Center for Technology and Economic Development (http://cted.nyu.edu)
- PhD Fellowship Committee (2010-2011)
- MS Graduate Curriculum Committee (2010-2011)
- NYU-Abu Dhabi Faculty Search Committee (2010-2011)
- NYU-Poly Faculty Search Committee (2010-2011)

Grants

1. Center for Technology and Economic Development (CTED) at NYU Abu Dhabi, (with Prof. Yaw Nyarko), $7,290,000. 2010-2015.
2. "A Low Cost Efficient Wireless Architecture for Rural Network Connectivity", NSF Career Award, Amount: $410,000, 2009-2014.
3. Senior Personnel, "NSF IGERT: INSPIRE: Information Security and Privacy: An Interdisciplinary, Research and Education Program", $2,850,000, 2010-13. (PIs: Nasir Memon, Helen Nissenbaum, Ramesh Karri, Anindya Ghose, Rae Zimmerman) (played an important role in the writing of the proposal after the pre-proposal stage).
4. "Real-time DNS Reputation Service", IBM Faculty Award, $40,000, Sept 2010.
5. "Reputation of IP addresses and User Identities", IBM Faculty Award, $50,000 (including $10K matching funds from NYU-Poly CATT center), Sept 2009.
6. "Sustainable Mobile Systems for Developing Regions". Amount: $79,500, NYU-Poly Joint Research Grant. Joint with Prof. Bharat Rao, Sept 2009.
7. "Secure Mobile Banking and Inter-personal Payments", Amount:$10,000. Nokia Grant, Sept 2009
8. "SMS-based Web Search", Amount: $12,500. Nokia Grant, Sept 2009.
9. "Design of Intermittency Aware Networked Systems", NSF NeTS NECO Project 0832153-0831934, Award amount: $570,000. Joint with Prof. Eric Brewer, UC Berkeley. Sept 2008. (NYU share: $285,000)
10. "SmartTrack: Design of Smartphone based Distributed Information Store", Microsoft Grant. Cellphones for Healthcare. Award amount: $98,630. Jan 2008
11. "Cellphone based Distributed Information Systems", NYU University Challenge Research Fund. Award Amount: $10,000, June 2008.

Journal Publications

Michael Paik and Lakshminarayanan Subramanian. "SigNet: Low Cost Auditable Transactions using SIM cards and Mobile Phones." *ACM SIGOPS Operating Systems Review, 2009 (Best papers from ACM SOSP NSDR 2009 workshop).*

Yong Xia, Lakshminarayanan Subramanian, Ion Stoica and Shivkumar Kalyananaraman. One More Bit is Enough. *IEEE/ACM Transactions on Networking*, Dec 2008.

Chen Nee Chuah, Lakshminarayanan Subramanian and Randy H. Katz. DCAP: Detecting Misbehaving flows via Collaborative Aggregate Policing, *ACM SIGCOMM Computer Communications Review*, October, 2003.

Lakshminarayanan Subramanian, Muralidhar Talupur, Kamala Krithivasan and C.Pandu Rangan. On the Generative Power of Simple H-Systems, *Journal of Automata, Languages and Combinatorics*, Volume 5 (2000), Number 4.

H. J. Wang, B. Raman, C-N. Chuah, R. Biswas, R. Gummadi, B. Hohlt, X. Hong, E. Kiciman, Z. Mao, J. S. Shih, L. Subramanian, B. Y. Zhao, A. D. Joseph, and R. H. Katz, ICEBERG: An Internet-core Network Architecture for Integrated Communications, *IEEE Personal Communications Special Issue on IP-based Mobile Telecommunications Networks*, August 2000.

Conference Proceedings

Ashlesh Sharma, Lakshminarayanan Subramanian and Eric Brewer. "PaperSpeckle: Microscopic Fingerprinting of Paper." *ACM Computer and Communications Security (CCS)*, 2011.

Aditya Dhananjay, Matt Tierney, Jinyang Li and Lakshminarayanan Subramanian. "WiRE: A New Rural Connectivity Paradigm." *ACM SIGCOMM*, 2011, (demo paper) (*Winner of Best Demo Award*).

Jay Chen, Janardhan Iyengar, Lakshminarayanan Subramanian and Bryan Ford. "TCP Behavior in Sub-Packet Regimes." *ACM SIGMETRICS*, 2011, (extended abstract).

Jay Chen, Russell Power, Lakshminarayanan Subramanian and Jonathan Ledlie. "Design and Implementation of Contextual Information Portals." *World Wide Web (WWW) Conference*, Hyderabad, India, 2011.

Jay Chen, David Hutchful, Bill Thies and Lakshminarayanan Subramanian. "Analyzing and Acceleration Web Access in a school in Peri-urban India." *World Wide Web (WWW) Conference*, Hyderabad, India, 2011.

Nektarios Paisios, Alex Rubensteyn, Vrutti Vyas and Lakshminarayanan Subramanian."Recognizing Currency Bills using a Mobile Phone: An Aid for the Visually Impaired." *ACM User Interface Software and Technology (UIST)*, 2011, (demo paper).

Nektarios Paisios, Alex Rubensteyn, Matt Tierney, Vrutti Vyas and Lakshminarayanan Subramanian. "Tracking Indoor Location and Motion for Navigational Assistance". *ACM User Interface Software and Technology (UIST)*, 2011, (poster paper).

Sunandan Chakraborty, Lakshminarayanan Subramanian. "Location Specific Summarization of Climatic and Agricultural Trends." *World Wide Web (WWW) Conference*, Hyderabad, India, 2011.

Nguyen Tran, Jinyang Li, Lakshminarayanan Subramanian and Sherman Chow. "Optimal Social-network based Sybil-resilient Node Admission Control." *INFOCOM*, 2011.

Jay Chen, Aditya Dhananjay, Saleema Amhershi, Lakshminarayanan Subramanian. "Comparing Web Interaction Models in Developing Regions", *First ACM Symposium on Computing for Development (DEV)* 2010.

Wei Chih Lu, Jay Chen, Matt Tierney, Bharat Rao, Lakshminarayanan Subramanian. "SMSAppStore: SMS based Applications Made Easy", *First ACM Symposium on Computing for Development (DEV)*, 2010.

Jay Chen, Lakshminarayanan Subramanian, Eric Brewer. "SMS-based Web Search on Low-end Mobile Devices." *ACM MOBICOM*, 2010.

Aditya Dhananjay, Ashlesh Sharma, Michael Paik, Jay Chen, Jinyang Li and Lakshminarayanan Subramanian. "Data Transmission over Unknown Acoustic Channels", *ACM MOBICOM*, 2010.

Nahanalei Schilling, Meredith Hasson, Ariel Navarez, Sara Lee, Wei Chih Lu, Matt Tierney and Lakshminarayanan Subramanian. "Towards a Feasible and Decentralized Solar-based Rural Electrification System." *International Conference on Information and Communication Technologies for Development (ICTD)*, 2010.

Nguyen Tran, Jinyang Li, Lakshminarayanan Subramanian, Sherman Chow. "Collusion Resilient Credit-based Reputations for Peer-to-peer Content Distribution."*Workshop on Economics of Networks, Systems and Computation (NetEcon)*, 2010.

Nguyen Tran, Jinyang Li, Lakshminarayanan Subramanian and Sherman Chow. "Improving Social-Network-based Sybil-resilient Node Admission Control", *ACM Principles of Distributed Computing (PODC) 2010,* (brief announcement).

Jay Chen, Trishank Karthik and Lakshminarayanan Subramanian. "Contextual Information Portals" *AAAI Spring Symposium*, 2010.

Russell Power, Jay Chen, Trishank Karthik and Lakshminarayanan Subramanian. "Document Classification for Focused Topics" *AAAI Spring Symposium*, 2010.

Nathan Silberman, Kristy Ahlrich, Rob Fergus and Lakshminarayanan Subramanian. "The Case for Automated Detection of Diabetic Retinopathy", *AAAI Spring Symposium*, 2010.

Prabal Dutta and Lakshminarayanan Subramanian. "Human-Enabled Microscopic Environmental Sensing and Feedback." *AAAI Spring Symposium*, 2010.

Aditya Dhananjay, Hui Zhang, Jinyang Li, and Lakshminarayanan Subramanian. "Practical, Distributed Channel Assignment and Routing in Dual Radio Mesh Networks", *ACM SIGCOMM*, 2009.

Michael Paik and Lakshminarayanan Subramanian. "SigNet: Low Cost Auditable Transactions using SIM cards and Mobile Phones." *ACM SOSP Workshop on Networked Systems for Developing Regions (NSDR)*, 2009.

Ashlesh Sharma, Lakshminarayanan Subramanian and Dennis Shasha. "Secure Branchless Banking." *ACM SOSP Workshop on Networked Systems for Developing Regions (NSDR)*, 2009.

Ashlesh Sharma, Nathan Silberman, Lakshminarayanan Subramanian and Nicholas Economides. "On the Rise and Fall of ISPs." *Workshop on Economics of Networks, Systems and Computation (NetEcon)*, 2009.

Lakshminarayanan Subramanian. "Defining Hard Technical Challenges in the ICTD Space." *CCC Workshop on Computer Science and Global Development*, 2009.

Michael Paik, Jay Chen, and Lakshminarayanan Subramanian. "Epothecary: Cost-Effective Drug Pedigree Tracking Using Mobile Phones." *ACM SIGCOMM MobiHeld Workshop*, 2009.

Jay Chen, Brendan Linn and Lakshminarayanan Subramanian. "SMS-based Contextual Web Search." *ACM SIGCOMM MobiHeld Workshop*, 2009.

Arvind Kumar, Jay Chen, Arthur Meacham, Amey Purandare and Lakshminarayanan Subramanian. "ELMR:Efficient Lightweight Mobile Records." *ACM SIGMOD*, 2009 (demo paper).

Jay Chen, Lakshminarayanan Subramanian and Jinyang Li. "RuralCafe: Web Search in the Rural Developing World". *World Wide Web Conference (WWW)* 2009.

Michael Paik and Lakshminarayanan Subramanian. "ATMosphere: A System for ATM Microdeposit Services in Rural Contexts". *IEEE/ACM Conference on Information and Communication Technologies and Development (ICTD),* 2009, (*Honorable Mention*).

Arthur Meacham, Ashlesh Sharma, Michael Paik, Giulio Quarta, Phil Smith, John Trahanas, Brian Levine, Mary Ann Hopkins, Barbara Rapchak and Lakshminarayanan Subramanian. "The Case for SmartTrack". *IEEE/ACM Conference on Information and Communication Technologies and Development (ICTD),* 2009.

Jay Chen, Lakshminarayanan Subramanian and Kentaro Toyama. "Web Browsing Behavior under Poor Connectivity." *ACM Conference on Human Factors in Computing Systems (CHI)*, 2009. (extended abstract).

Trandinh Nguyen, Bonan Min, Jinyang Li and Lakshminarayanan Subramanian. "Sybil Resilient Online Content Voting". *ACM/USENIX Networked Systems Design and Implementation (NSDI)* 2009.

Sherman Chow, Jie Han Lee and Lakshminarayanan Subramanian. "A Two-Party Computation Model for Privacy Preserving Queries over Distributed Databases." *Networks and Distributed Systems Security (NDSS)*, 2009.

Sergiu Nedevschi, Rabin Patra, Sonesh Surana, Sylvia Ratnasamy, Lakshminarayanan Subramanian and Eric Brewer. "An Adaptive High-Performance MAC for Long-Distance Multihop Wireless Networks." *ACM MOBICOM*, 2008.

Ashlesh Sharma, Lakshminarayanan Subramanian and Eric Brewer. "Secure Rural Supply Chain Management using Low Cost paper Watermarking." *ACM SIGCOMM Workshop on Networked Systems for Developing Regions (NSDR)*, 2008.

Sonesh Surana, Rabin Patra, Sergiu Nedevschi, Manuel Ramos, Lakshminarayanan Subramanian and Eric Brewer**. "**Beyond Pilots: Keeping Rural Wireless Networks Alive." *ACM/USENIX Networked Systems Design and Implementation (NSDI)*, 2008.

Rabin Patra, Sergiu Nedevschi, Sonesh Surana, Anmol Sheth, Lakshminarayanan Subramanian and Eric Brewer. "WiLDNet: Design and Implementation of High-Performance Wifi-based Long Distance Wireless Networks." *ACM/USENIX Symposium on Networked Systems Design and Implementation (NSDI),* 2007.

Anmol Sheth, Sergiu Nedevschi, Rabin Patra, Sonesh Surana, Lakshminarayanan Subramanian and Eric Brewer. "Packet Loss Characterization in Wifi-based Long-Distance Networks," *IEEE INFOCOM 2007*.

Lakshminarayanan Subramanian, Sonesh Surana, Anmol Sheth, Sergiu Nedevschi, Rabin Patra, Melissa Ho and Eric Brewer. "Rethinking Wireless for the Developing World." *ACM Hotnets 2006*.

Shridhar Mubaraq Mishra, John Hwang, Dick Filippini, Tom Du, Reza Moazzami, and Lakshminarayanan Subramanian. "Economic Analysis of Networking Technologies for Rural Developing Regions." *First Workshop on Internet and Network Economics*, Dec 2005.

Lakshminarayanan Subramanian, Randy H. Katz, Volker Roth, Scott Shenker and Ion Stoica. "Reliable Broadcast in Unknown Fixed-Identity Networks." *ACM Principles of Distributed Computing (PODC), July 2005.*

Lakshminarayanan Subramanian, Matthew Caesar, Cheng Tien Ee, Mark Handley, Morley Mao, Scott Shenker and Ion Stoica. "HLP: A Next Generation Interdomain Routing Protocol." *ACM SIGCOMM 2005 Conference on Applications, Technologies, Architectures, and Protocols for Computer Communication*, Philadelphia, PA, August 2005.

Yong Xia, Lakshminarayanan Subramanian, Ion Stoica and Shivkumar Kalyanaraman**. "**One More Bit is Enough." *ACM SIGCOMM 2005 Conference on Applications, Technologies, Architectures, and Protocols for Computer Communication*, Philadelphia, PA, August 2005.

Jayanthkumar Kannan, Lakshminaryanan Subramanian, Ion Stoica and Randy H. Katz. "Analyzing Cooperative Containment of Fast-scanning Worms." *USENIX Workshop on Steps to Reduce Unwanted Traffic in the Internet (SRUTI)*, Cambridge, MA, July 2005.

Emre Kiciman and Lakshminarayanan Subramanian. "A Root-cause Localization Model for Large-scale Systems." *First Workshop on Hot Topics in Systems Dependability (HotDep),* June 2005.

Matthew Caesar, Lakshminarayanan Subramanian and Randy H. Katz. "A Case for an Internet Health Monitoring System." *First Workshop on Hot Topics in Systems Dependability (HotDep),* June 2005.

Lakshminarayanan Subramanian, Matthew Caesar, Cheng Tien Ee, Mark Handley, Morley Mao, Scott Shenker and Ion Stoica. "Towards a Next Generation Interdomain Routing Protocol." *Third Workshop on Hop Topics in Networks (HotNets-III)*, Nov, 2004.

Lakshminarayanan Subramanian, Volker Roth, Ion Stoica, Scott Shenker and Randy H. Katz. "Listen and Whisper: Security Mechanisms for BGP." *First Symposium on Networked Systems Design and Implementation (NSDI'04)*, March, 2004.*(Awarded best student paper)*

Lakshminarayanan Subramanian, Ion Stoica, Hari Balakrishnan and Randy H. Katz. "OverQoS: An Overlay based Architecture for Enhancing Internet QoS." *First Symposium on Networked Systems Design and Implementation (NSDI'04)*, March, 2004.

Lakshminarayanan Subramanian, Ion Stoica, Hari Balakrishnan and Randy H. Katz. "OverQoS: Offering QoS using Overlays." *First Workshop on Hop Topics in Networks (HotNets-I)*, October 28-29, 2002.

B. Raman, S. Agarwal, Y. Chen, M. Caesar, W. Cui, P. Johansson, K. Lai, T. Lavian, S. Machiraju, Z. M. Mao, G. Porter, T. Roscoe, M. Seshadri, J. Shih, K. Sklower, L. Subramanian, T. Suzuki, S. Zhuang, A. D. Joseph, R. H. Katz, I. Stoica. "The SAHARA Model for Service Composition Across Multiple Providers," *Proceedings of the International Conference on Pervasive Computing*, August 26-28, 2002.

Lakshminarayanan Subramanian, Venkata N. Padmanabhan and Randy H.Katz. "Geographic Properties of Internet Routing." *USENIX Annual Technical Conference*, Monterey, CA, June 2002.

Lakshminarayanan Subramanian, Sharad Agarwal, Jennifer Rexford and Randy H.Katz. "Characterizing the Internet Hierarchy from Multiple Vantage Points." *IEEE INFOCOM 2002* , New York, June 2002.

Venkata N. Padmanabhan and Lakshminarayanan Subramanian. "An Investigation of Geographic Mapping Techniques for Internet Hosts." *Proceedings of the ACM SIGCOMM 2001 Conference on Applications, Technologies, Architectures, and Protocols for Computer Communication*, San Diego, CA, August 2001. Also appeared as an extended abstract in *ACM SIGMETRICS 2001.*

Shivnath Babu, Lakshminarayanan Subramanian and Jennifer Widom. "A Data Stream Management System for Network Traffic Management." *ACM SIGMOD Workshop on Network Related Data Management (NRDM 2001)*, Santa Barbara, CA, May 2001.

Lakshminarayanan Subramanian and Randy H.Katz. "An Architecture for Building Self-Configurable Systems." *IEEE/ACM Mobile Ad Hoc Networking and Computing (MobiHoc 2000)*, Boston, August 2000.

Chen Nee Chuah, Lakshminarayanan Subramanian, Randy H.Katz and Anthony D.Joseph. "QoS Provisioning using a Clearing House Architecture." *Eighth International Workshop on Quality of Service (IwQoS 2000)*, Feb 2000.

Karthikeyan Mahesh, Lakshminarayanan Subramanian and S.V.Raghavan. "An Efficient Rerouting Mechanism for Dynamic Network Resource Management." *International Conference on Multimedia Computing and Systems (ICMCS 1999)*, Florence, June, 1999.

Lakshminarayanan Subramanian, S.S. Ghosh and N. Balakrishnan. "An Implementation of MPI over HTTP." *High Performance Computing and Networking, Europe (HPCN-Europe 1999)*, Amsterdam, April 1999. Appeared in *Lecture Notes in Computer Science*, Vol. 1593, Springer, pp 1299-1302.

Patents

Venkata N. Padmanabhan and Lakshminarayanan Subramanian. *"System and Method for Determining the Geographic Location of Internet Hosts."* US Patent 7711846, Awarded May 4, 2010.

Balachander Krishnamurthy, Saurabh Kumar and Lakshminarayanan Subramanian. "*Automatic Generation of Embedded Signatures for Duplicate Detection on a Public Network."*, Issued US Patent 7979413, Aug 2011.

Balachander Krishnamurthy, Saurabh Kumar and Lakshminarayanan Subramanian. *"Unique Packet Identifiers for Preventing Sensitive Data Leakage."* Application No.: 12/156,371; Filed: May 30, 2008

Ashlesh Sharma, Lakshminarayanan Subramanian and Eric Brewer. *"Method, System and Computer Accessible Medium for Authentication of Paper using a Speckle Pattern"* Provisional Patent Filed June 5, 2008. PCT Filed Jun 5, 2009. US Patent Application No: 12/996,610.

Ashlesh Sharma, Lakshminarayanan Subramanian and Eric Brewer, *"Microscopic Fingerprinting of a Random Physical Surface"*. US Provisional Patent Filed, Mar 2011.

Recent Invited Talks

1. Circumventing Communication Blackouts, Advancing the New Machine Conference, UC Berkeley, Apr 2011
2. Rethinking Rural Connectivity Models, CTED Conference, NYU Abu Dhabi, March 2011
3. Information Access under Poor Connectivity, Liberation Technology Seminar Series, Stanford, Feb 2011
4. Computing for Development: A High Impact Research Area, CMU seminar series, Nov 2010
5. Computing for Development: A New High Impact Research Area, CRA Snowbird Summit, Invited Session, July 2010.
6. Connectivity for the Next Billion Summit organized by Microsoft Research India, Aug 2010
7. Networked Systems for Developing Regions, Tutorial at Eurosys, Apr 2010
8. Connectivity for the Next Billion – talk at 2020 Future of Networking, Spain, 2010
9. Human-enabled Mobile Sensing, AAAI Spring Symposium, 2010
10. Secure Information Flow in Trust Networks, IBM Research, April 2010
11. Mobile Services for Development, NYU Law School, April 2010
12. Secure Information Flow in Trust Networks, UC Berkeley TRUST seminar series, March 2010
13. On the Rise and Fall of ISPs, Economics of Networks and Systems (NetEcon), 2009
14. Technology and Development, NYU Wagner, Oct 2009
15. Sustainable Networks and Systems for the Developing World, UC Berkeley, March 2009

16. Sustainable Networks and Systems for the Developing World, MIT, April 2009
17. Sustainable Networks and Systems for the Developing World, Univ of Washington, Feb 2009
18. Sustainable Networks and Systems for the Developing World, Princeton, April 2009
19. Technologies for Development, CATER Workshop, April 2009
20. Can technology Aid Poverty Alleviation?, NYU Africa House, March 2009
21. The CATER initiative, Google NYC, April 2009
22. The CATER initiative, Microsoft Research, March 2009
23. The CATER initiative, Cisco Research, Jan 2009
24. Invited Panelist, "How can Technology Impact Development", World Wide Web 2008