

# Curriculum Vitae

Ram Ramanathan

<http://www.ir.bbn.com/people/~ramanath/index.html>

## Education

- PhD            Computer and Information Sciences, University of Delaware, 1993  
*Dissertation:* Scheduling Algorithms for Multi-hop Radio Networks  
*Advisor:* Prof. Errol Lloyd  
*Awarded the Alan Colburn prize for best dissertation in Engineering and Sciences*
- M.S            Computer and Information Sciences, University of Delaware, 1989
- B.Tech        Electrical Engineering, Indian Institute of Technology, Madras, India, 1985

## Professional Experience

BBN Technologies, Cambridge, Massachusetts (Since 1993)

Principal Scientist	2005-
Division Scientist	2000-2004
Senior Scientist	1996-1999
Scientist	1993-1995

**Responsibilities:** Lead advanced research for the DoD (esp. DARPA); architect, design and help build advanced systems; develop and evangelize visions for next generation systems; invent new technologies; acquire significant new business; publish and participate in conference/journal organization.

## Honors/Awards

- IEEE Fellow, citation “for contributions to mobile ad hoc networks using topology control and directional antennas”
- Promoted to BBN Principal Scientist (equivalent to a Full Professor) “for leadership and ground-breaking contributions to mobile ad hoc networking”
- Best paper award, “Utilizing Directional Antennas for Ad Hoc Networking” IEEE Milcom conference, 2002
- Best paper award, “Multicast Tree Generation in Networks with Asymmetric Links” IEEE Infocom conference, San Francisco, 1996
- BBN Science Development Program Outstanding Publication Award, 1997
- BBN Science Development Program Outstanding Publication Award, 1993
- BBN Young Author Publication Award, 1994
- Alan Colburn Prize, Best Dissertation in Engineering and Sciences, University of Delaware, June 1993.
- Best student paper award, “Scheduling Algorithms for Multi-hop Radio Networks” ACM SIGCOMM conference, Baltimore, 1992.

### **Teaching/Tutorial**

- Adjunct Faculty, Boston University, 1995-1996. Taught undergraduate course “Computer Communication and Networks” (SC 546)
- Presented Tutorial on “Directional Antenna Systems in Ad Hoc Networks”, at the ACM MobiHoc 2003 conference (with M. Takai and N. Vaidya)

### **Publications/Patents**

- 10 journal, 30 conference publications, 4 book chapters. Three best paper awards. Six publications as sole author. (Details at end of CV)
- 8 patents (4 as sole or primary inventor). Several more pending. (Details at end of CV)

### **Professional Activities**

- Associate Editor-in-chief, IEEE Transactions on Mobile Computing (Jan 2011 - )
- Associate Editor, IEEE Transactions on Mobile Computing (Jan 2008 – Jan 2010)
- Program Committee Co-Chair, ACM Mobicom, 2007
- PhD Dissertation committee member for Samuel Nelson, University of Illinois at Urbana-Champaign (advisor Robin Kravets), 2011
- PhD Dissertation committee member for Robert McTasney, University of Colorado (advisor Dirk Grunwald), April 2008
- Editorial Board, Ad Hoc Networks Journal (Elsevier), 2003 - 2006
- Program committee member for ACM Mobicom (1999, 2000, 2002, 2003, 2006, 2008, 2009)
- Program committee member for ACM MobiHoc (2000, 2001, 2002)
- Program committee member for IEEE Infocom (2005)
- NSF Proposal Review panel (2003, 2008)
- Tutorial on “Directional Antenna Systems in Ad Hoc Networking”, Mobihoc 2003
- Member, Steering Committee, MobiHoc, 2001
- Co-Guest editor for ACM/Baltzer MONET special issue on Routing in Mobile Networks
- Active in IETF standardization efforts for IDPR and NIMROD between 1994 and 1997

### **Keynote Speaker**

- Keynote, “Making Multihop Wireless Networks Scale”, University of Alberta CS Workshop, November 2009
- Keynote, “Mobile Ad Hoc Networks: A Story and its Morals”, University of Delaware, Computer Science Day, December 2008

### **Selected Invited Talks/Panels**

- Invited Talk, “Challenges in Enabling and Exploiting Opportunistic Spectrum Access: An Industry Perspective,” Beyond Cognitive Radio workshop, University of Illinois, Urbana Champaign, June 2011
- Invited Talk, “Architecting the Next Generation Mesh/Ad Hoc Network”, Harvard University, Cambridge, MA, March 2008
- Invited Speaker, “From INPUT to PARAMETER: The Topology Dichotomy in the Future Wireless Internet”, NSF FIND Mobility Workshop, Cambridge, MA, Sep. 2007

- Panel presentation, “Wireless Research: Challenges and Future Directions”, NSF NETS PI Meeting, Chicago, July 2007
- Invited Talk, “Routing in Disruption Tolerant Networks”, Motorola Labs, Chicago, May 2007
- Invited Talk, “Mesh Cognizant Waveform Control”, University of Illinois at Urbana Champaign, June 2007
- ACM WICON panel presentation, “Wireless Internet Evolution: Trends and Implications”, August 2006
- Invited Talk, “Directional Antennas for Ad Hoc Networks”, Northeastern University, July 2004

### **Selected Research Grants**

- Principal Investigator: Network Science Collaborative Technology Alliance (Army Research Lab), Communications Center team, \$610,000 (currently active)
- Principal Investigator: Scalability Study and Communications Plan Assist Toolkit (JTRS Joint Program Office), \$710,000 (currently active)
- Principal Investigator for numerous SBIR projects as subcontractor, totalling over \$1M in all over past 7 years. Currently active on two of them.
- Key Person<sup>1</sup>, “Wireless Network after Next”, DARPA, \$33,000,000 approx. over 3 years (2007-2010)
- Principal Investigator: XG Architectures and Protocols, DARPA, \$1,800,000, Aug 2002- Feb 2004
- Senior co-Principal Investigator: “Utilizing Directional Antennas for Ad Hoc Networking”, DARPA, \$1,880,000, Feb 2001- Dec 2003
- Principal Investigator: “Density- and Asymmetry Adaptive Wireless Network”, DARPA, \$1,400,000, Oct 1997- April 2001

### **Publications – Journal**

- J1. J.B.D. Cabrera, R. Ramanathan, C. Gutierrez, R. Mehra, “Stable Topology Control for Mobile Ad Hoc Networks,” *IEEE Communications Letters*, Vol. 11, No. 7, July 2007, pp. 574-576.
- J2. R.R. Choudhury, X. Yang, R. Ramanathan, N.H.Vaidya, “On Designing MAC Protocols for Wireless Networks using Directional Antennas,” *IEEE Transactions on Mobile Computing*, Vol. 5, No.5, May 2006, pp. 477-491.
- J3. R. Ramanathan, J. Redi, C. Santivanez, D. Wiggins, S. Polit, “Ad Hoc Networking with Directional Antennas: A Complete System Solution,” *IEEE Journal on Selected Areas in Communications*, Vol. 23, No. 3, Mar. 2005, pp. 496-506.
- J4. E.L. Lloyd, R. Liu, M. Marathe, R. Ramanathan, S.S. Ravi, “Algorithmic Aspects of Topology Control Problems for Ad Hoc Networks,” *Mobile Networks and Applications (MONET)*, Volume 10, Nos. 1-2, pp. 19-34.
- J5. S. Ramanathan, “A Unified Framework and Algorithm for Channel Assignment in Wireless Networks,” *Wireless Networks* 5, (1999), pp. 81-94.

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<sup>1</sup> At BBN, a key person for a large grant/project is one of typically 1-3 people that works with the PI in leading parts of the proposal and plays a key role in the project.

- J6. S. Ramanathan and M. Steenstrup, "Hierarchically-organized, multihop mobile wireless networks for multimedia support, *ACM/Baltzer MONET*, Vol. 3, No. 1, pp. 101-119.
- J7. S. Ramanathan, "Multicast tree generation in networks with asymmetric links," *IEEE/ACM Transactions on Networking*, Vol. 4, No. 4, Aug 1996, pp. 558-567
- J8. S. Ramanathan and M. Steenstrup, "A Survey of Routing Techniques for Mobile Networks", *ACM Baltzer Mobile Networks and Applications* (special Issue on Routing in Mobile Networks), Vol. 1, No. 2, pp. 89-103.
- J9. S. Ramanathan and E.L. Lloyd, "Scheduling Algorithms for Multihop Radio Networks", *IEEE/ACM Transactions on Networking*, Vol. 1, No. 2, April 1993.
- J10. E.L. Lloyd and S. Ramanathan, "Efficient Distributed Algorithms for Channel Assignment in Multihop Radio Networks", *Journal of High Speed Networks*, Vol. 2, No. 4, 1993.

### **Publications – Conferences**

- C1. J. Redi, R. Ramanathan, "The WNaN Network Architecture," *Proc. IEEE Milcom*, Baltimore, November 2011
- C2. B. Khanna, R. Ramanathan, "Interference-aware Multipath Routing in MANETs", *Proc. IEEE Milcom*, Baltimore, November 2011
- C3. W. Ren, Q. Zhao, R. Ramanathan, J. Gao, A. Swami, A. Bar-Noy, M. Johnson, P. Basu, "Broadcasting in Multi-Radio Multi-Channel Wireless Networks using Simplicial Complexes," *Proc. IEEE MASS*, Valencia, Spain, October 2011.
- C4. A. Bar-Noy, P. Basu, M. Johnson, and R. Ramanathan, "Minimum-cost Broadcast through Varying-size Neighborcast", in *ALGOSENSORS 2011*, Saarbrücken, Germany, September 2011.
- C5. R. Ramanathan, A. Bar-Noy, P. Basu, M. Johnson, W. Ren, A. Swami, Q. Zhao, "Beyond Graphs: Capturing Groups in Networks," *Proc. IEEE NetSciComm*, Shanghai, April 2011
- C6. R. Ramanathan, G. Jakllari, "A Sync-less Time Divided MAC protocol for Mobile Ad Hoc Networks", *Proc. Of IEEE Military Communications Conference (MILCOM)*, Boston, MA, October 2009.
- C7. R. Ramanathan, F. Tchakountiou, "Channel Access over Path Segments for Ultra-low-latency MANETs," *Proc. of IEEE Military Communications Conference (MILCOM)*, Orlando, FL, October 2007.
- C8. R. Ramanathan, P. Basu, R. Krishnan, "Towards a Formalism for Routing in Challenged Networks," *Proceedings of CHANTS 2007*, Montreal, 2007.
- C9. R. Ramanathan, R. Hansen, P. Basu, R. Hain, R. Krishnan, "Prioritized Epidemic for Routing in Opportunistic Networks," *Proceedings of MobiOpp 2007*, Puerto Rico, June 2007.
- C10. C. Santivanez, R. Ramanathan, C. Partridge, R. Krishnan, M. Condell, and S. Polit, "Opportunistic Spectrum Access: Challenges, Architecture, Protocols," *Proceedings of ACM WICON 2006*, Boston, MA, 2006.
- C11. J. Redi, W. Watson, R. Ramanathan, P. Basu, F. Tchakountio, M. Girone, and M. Steenstrup, "Design and Implementation of a MIMO MAC Protocol for Ad

- Hoc Networking,” *Proceedings of The SPIE Defense and Security Symposium*, Orlando, FL, April 2006.
- C12. R. Ramanathan, “Challenges: A Radically New Architecture for Next Generation Mobile Ad Hoc Networks”, *Proc. ACM MOBICOM 2005*, Cologne, Germany, August 2005.
- C13. M. Ozdemir, A. Bruce McDonald, R. Ramanathan, “Asynchronous Reservation Oriented Multiple Access for Wireless Networks (AROMA),” *Proceedings of the IEEE International Conference on Wireless Networks, Communications, and Mobile Computing (WirelessCom 2005)*, Maui, Hawaii, June 2005 (also patented – see item #2 in patent list)
- C14. F. Tchakountiou, R. Ramanathan, “Anticipatory Routing for Highly Mobile Endpoints,” *Proc. Sixth IEEE Workshop on Mobile Computing Systems and Applications (WMCSA) 2004*, English Lake District, UK, Dec. 2004,
- C15. R. Ramanathan, J. Redi, C. Santivanez, D. Wiggins, S. Polit, “Ad Hoc Networking with Directional Antennas: A Complete System Solution,” *Proc. of IEEE WCNC 2004*, Atlanta, GA, March 2004.
- C16. J. Redi, R. Ramanathan, “Utilizing Directional Antennas for Ad Hoc Networking”, *Proc. IEEE Military Communications Conference (MILCOM)*, Anaheim, CA, October 2002 (**Received Best Classified Paper award**).
- C17. E.L. Lloyd, R. Liu, M.V. Marathe, R. Ramanathan, S.S. Ravi, “Algorithmic Aspects of Topology Control Problems for Ad Hoc Networks,” *Proc. of ACM MOBIHOC 2002, Lausanne, Switzerland, 2002*.
- C18. C. Santivanez, B. McDonald, I. Stavrakakis, R. Ramanathan, “On the Scalability of Ad Hoc Routing Protocols,” *Proc. IEEE INFOCOM 2002*, New York, NY, June 2002.
- C19. J. Sterbenz, R. Krishnan, R. Rosales-Hain, A. Jackson, D. Levin, R. Ramanathan, J. Zao, “Survivable mobile wireless networks: issues, challenges and research directions,” *Proc. 3<sup>rd</sup> ACM workshop on Wireless Security (WiSE)*, Atlanta, GA, Sep. 2002.
- C20. R. Ramanathan, “On the performance of ad hoc networks using beamforming antennas,” *Proc. ACM MOBIHOC 2001*, Long Beach, 2001.
- C21. R. Ramanathan, “Making Ad Hoc Networks Density Adaptive,” *Proc. IEEE Military Communications Conference (MILCOM)*, Tysons Corner, VA, October 2001.
- C22. F. Tchakountio, R. Ramanathan, “Tracking Highly Mobile Endpoints,” *Proceedings of ACM Workshop on Wireless Mobile Multimedia (WoWMoM)*, July 2001, Rome, Italy.
- C23. R. Ramanathan, R. Hain, “An ad hoc wireless testbed for scalable, adaptive, QoS support”, *Proc. Wireless Communications and Networking Conference (WCNC)*, Chicago, September 2000.
- C24. S. Ramanathan, R. Hain, “Topology Control in Multihop Wireless Networks using Transmit Power Adjustment”, *Proc. IEEE INFOCOM '00, Tel Aviv, Israel, 2000*.
- C25. R. Krishnan, R. Ramanathan, M. Steenstrup, “Optimization Algorithms for Large Self-Structuring Networks”, *Proc. IEEE INFOCOM '99, New York, 1999*.
- C26. S. Ramanathan, “A Unified Algorithm for (T/F/C)DMA Channel Assignment in Wireless Networks”, *Proc. IEEE INFOCOM '97, Kobe, Japan, 1997*.

- C27. K. Kasera, S. Ramanathan, "A Location Management Protocol for Hierarchically Organized Multihop Wireless Networks", *Proc. of the International Conference on Universal Personal Communications (ICUPC) (now WCNC), San Diego, 1997.*
- C28. S. Ramanathan, "An Algorithm for Multicast Tree Generation in Networks with Asymmetric Links", *Proc. IEEE INFOCOM '96, San Fransisco, March 1996, 337-344. (Received Best Paper award).*
- C29. S. Ramanathan and E.L. Lloyd, "Scheduling Algorithms for Multihop Radio Networks", *Proc. ACM SIGCOMM 1992, Baltimore, August 1992, pp. 211-222. (Received Best Student Paper award).*
- C30. E. L. Lloyd and S. Ramanathan, "On the Complexity of Distance-2 Coloring with Applications to Radio Networks", in *Proc. 4<sup>th</sup> Internat-ional Conference on Computing and Information, Toronto, May 1992.*
- C31. E. L. Lloyd and S. Ramanathan, "On the Complexity of Link Scheduling in Multi-hop Radio Networks", in *Proc. 26<sup>th</sup> Conference on Information Sciences and Systems, Princeton University, Mar. 1992, 491-495.*
- C32. S. Ramanathan and M. Paterakis, "A Cellular Approach to Packet Radio Network Design", *Proc. 25<sup>th</sup> Conference on Information Sciences and System, Johns Hopkins University, May 1991, 755-759.*
- C33. S. Ramanathan and A. S. Sethi, "Load Balancing over Multiple Trunk Lines", *Proc. 10<sup>th</sup> International Conference on Computer Communications, New Delhi, Nov. 1990, 456-564.*

### **Book Chapters**

- B1. R. Ramanathan, "Antenna Beamforming and Power Control for Ad Hoc Networks," in *Mobile Ad Hoc Networking*, S. Basagni et al. (eds.), IEEE Press/Wiley, pp. 139-173, 2004.
- B2. C. Santivanez and R. Ramanathan, "Scalability of Routing in Ad Hoc Networks: Principles and Practice," in *Ad Hoc Wireless Networking*, X. Cheng, X. Huang, and D. Du (Eds.), Kluwer Academic Publishers, pp. 561-621, 2004.
- B3. S. O. Krumke, R. Liu, E.L. Lloyd, M. Marathe, R. Ramanathan, S.S. Ravi, "Topology Control Problems under Symmetric and Asymmetric Power Thresholds," in *Ad Hoc, Mobile, and Wireless Networks*, LNCS, Vol. 2865/2003, pp. 187-198
- B4. S. Ramanathan and G. Sivakumar, "Rewrite Systems for Protocol Specification and Verification", *Formal Description Techniques III*, J.Quemada et al (eds), North-Holland, Amsterdam, 1991, 79-94.

### **Magazine Articles**

- R. Ramanathan, J. Redi, "A Brief Overview of Ad Hoc Networks: Challenges and Directions," *IEEE Communications Magazine*, 50<sup>th</sup> Anniversary Commemorative Issue, May 2002.

### **Selected Patents**

1. Self-organizing Mobile Wireless Station Network, *Patent number 5,850,592*, awarded December 15, 1998. Co-inventors: None.
2. Method and Apparatus for Asynchronous Reservation-Oriented Multiple Access (AROMA), *Patent number 6,577,613*, awarded June 2003. Co-inventors: None.
3. A node belonging to multiple clusters in an ad hoc wireless network, *Patent number 6,711,409*, awarded March 2004. Co-inventors: J. Zavgren, J. Weinstein, I. Castineyra, C. Elliott, B. Passman
4. Optimizing solutions using local virtual forces. *US 20070022061*, awarded January 2007. Co-inventors: M. Brinn, A. Helsing
5. Directional Carrier Sense Medium Access for Wireless Nodes, *U.S. Patent No. 7,321,580*, awarded January 22, 2008. Co-inventors: Cesar Santivanez
6. Systems and methods for adaptive routing in mobile ad-hoc networks and disruption tolerant networks. BBN Technologies May 2009: *US 20090129316*, co-inventors: P. Basu, R. Hansen, C. Jones, R. Krishnan, R. Hain
7. No-sight routing for ad-hoc networks, *US 20100322240*, December 2010, co-inventors: G. Troxel, S. Polit
8. Ultra-low latency packet transport in ad hoc networks. Raytheon BBN Technologies, *US 8027289*, awarded September 2011, co-inventors: B. Elliott, M. Bergamo