

Ramesh R. Rao

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Ramesh Rao has been a faculty member at UC San Diego since 1984. Prior to becoming the Calit2 UCSD division director in 2001, Professor Rao was the director of the Center for Wireless Communications (CWC) at UCSD. Dr. Rao is involved on a day-to-day basis with a wide variety of research initiatives at Calit2. He leads several major interdisciplinary and collaborative projects and has been a PI on dozens of federal-, state-, foundation- and industry-funded grants.

1. Professional Roles, Activities, and Awards (as of: June 29, 2012)

- Fellow of the Institute of Electrical and Electronics Engineers (IEEE) for leadership in wireless communications
- Senior Fellow of the California Council on Science and Technology (CCST)
- Qualcomm Endowed Chair in Telecommunications and Information Technology
- Professional Gordon Engineering Leadership Award 2010, Gordon Engineering Leadership Center, UCSD
- Member, UC San Diego Health System Advisory Board
- Member of the Board of Advisors, CommNexus San Diego: A Network of Communications Companies
- Member, Rady Children's Hospital and Health Center Board of Trustees' Information Technology Task Force
- Member, Weqaya Advisory Task Force, Health Authority – Abu Dhabi (HAAD), United Arab Emirates
- Member of the Board of Governors IEEE Information Theory Society, 1997-1999 and 2000-2002
- Secretary, Technical Activities Council and Technical Committees Board, IEEE Communications Society, 1990-1991
- Publications Editor, IEEE Transactions on Information Theory, 1999-2001
- Editor for Packet Multiple Access, IEEE Transactions on Communications, 1997-2000
- Guest Editor, Special Issue on Multimedia Network Radios, IEEE Journal of Selected Areas in Communications, 1998
- Member, Editorial Board, IEEE Networks, 1997-1999
- Chair, the National Research Council's Committee on Using Information Technology to Enhance Disaster Management, the findings were published by the NRC in 2007: "Improving Disaster Management: The Role of IT in Mitigation, Preparedness, Response and Recovery."

- Organized "The New Role of Science and Engineering in Risk Reduction," NSF Workshop, La Jolla, CA, February, 2003
- Testified before House Armed Services Committee on Calit2 research related to Homeland Security, February 2002
- Member, Education Task Force of The San Diego Foundation Regional Vision Council
- *Best Paper Award*
P. Zhou, B.S. Manoj and R. Rao, "On Optimizing Non-Asymptotic Throughput of Wireless Mesh Networks," Proceedings of the 5th IEEE Consumer Communications and Networking Conference (CCNC 2008), Las Vegas, NV, January 10-12, 2008, pp. 343-347.
- *Best Demonstration Award*
Douglas Palmer, Rajesh Gupta, and Ramesh Rao, "Calit2 Sensor Nodes and their use for data integration in WIISARD," Fourth International Symposium on Information Processing in Sensor Networks (ISPN) 2005
- Distinguished Alumnus Award 2008, National Institute of Technology (NITT), Tiruchirappalli
- National Merit Scholarship, Govt. of India, 1967

2. Recent Research Grants (as of: November 17, 2011)

Title	Role, Granting Agency, Total award, Time period
Creation of a Research Program of the California Institute for Telecommunications and Information Technology (Calit2) at the UC San Diego in collaboration with Saudi Arabia's King Abdulaziz City for Science and Technology (KACST)	PI, King Abdulaziz City for Science & Technology (KACST) \$3,469,803; March 2010-March 2013
Cognitive Protocol Stack Design	PI, Army Research Office (ARO) \$360,000; October 2011 – September 2014
WIISARD SAGE: Self-Scaling Systems for Mass Casualty Management	Co-PI, National Institute of Health (NIH) \$1,565,855; September 2009 – September 2012
DURIP: CogMeshNet: A Cognitive Mesh Networking Testbed	PI, Army Research Office (ARO) \$149,945; August 2011 – August 2012
Opportunistic Communications and Cognitive Cross-layer Protocol Stack Design	PI, Army Research Office (ARO) \$307,414; September 2009 - August 2011

SBIR Phase II: 60 GHZ Wide Band, Local Radio (WBLR)	PI, MaXentric Technologies – Navy \$120,000; April 2010 – April 2011
Communication, Command and Control, and Sensor Concepts for Network Centric Operations	PI, SPAWAR \$15,000,000; October 2003-January 2011 <i>This SPAWAR grant has led to 51 UCSD professor-led contracts.</i>
Collaborative Research: Responding to the Unexpected (RESCUE)	PI, National Science Foundation (NSF) \$3,541,999 (UCSD), \$12.5M total; October 2003-Sept 2008/2009
ResponSphere: An IT Infrastructure for Responding to the Unexpected	Co-PI, NSF \$900,795 (UCSD); \$1,801,590 total; September 2004-August 2009
Therapeutic Window for Acute Stroke Therapy	Co-PI, National Institute of Health (NIH)/NINDS \$ 6,131,542; July 2003-June 2008
Wireless Internet Information System for Medical Response in Disasters	Co-PI, NIH \$4,065,027; October 2003-September 2006
Proximity Driven Mobile Malware	PI, University of Bath \$8,339.35; July 2007-June 2008
SGER: The CogNet (Cognitive Complete Knowledge Network) System	PI, NSF \$100,000; October 2006-September 2007
NRT: Scalable Testbed for Next Generation Mobile Wireless Networking Technologies	Co-PI, NSF \$390,000 (UCSD); \$5,558,716 total; October 2003-Sept. 2007
Adaptive Systems	PI, UC Discovery/ Ericsson \$2,520,197; July 2002-June 2006
Region-Based Image Compression Subject to Energy and Bandwidth Constraints	Co-PI, Office of Naval Research (ONR) \$ 592,147; January 2003-December 2005
BioNet System Design and Development Support	PI, SPAWAR \$1,166,220; September 2004-September 2005

“Smart” Sensor Networks for Visual Context Capture and Interactivity

Co-PI, UC Discovery/ Ericsson/Hewlett-Packard \$441,126; August 2003-August 2005

Application and Network-Aware Multi-Layer Adaptation of Wireless Protocols and Architectures

Co-PI, UC Discovery/ Nokia/ Ericsson/ Intersil Corporation/ST Microelectronics \$301,647; August 2003-August 2005

3. Publications (as of: April 6, 2012)

Journals, Books, and Book Chapters

66. C.K. Verma, B.R. Tamma, B. S. Manoj, and R. Rao, "A Realistic Small-World Model for Wireless Mesh Networks," *IEEE Communications Letters*, Vol. 15, No. 4, April 2011, pp. 455-457. DOI: 10.1109/LCOMM.2011.020111.100266
65. B. R. Tamma, A. Badamb, C. Siva Ram Murthy, and R. R. Rao, "K-Tree: A multiple tree video multicast protocol for Ad hoc wireless networks," *Computer Networks*, Vol. 54, Issue 11 (2 August 2010), pp. 1864-1884. DOI: 10.1016/j.comnet.2010.02.013
64. P. Zhou, X. Wang, B. S. Manoj, and R. Rao, "On Optimizing Gateway Placement for Throughput in Wireless Mesh Networks," *EURASIP Journal on Wireless Communications and Networking*, Vol. 2010 (2010), 12 pp. DOI: 10.1155/2010/368423
63. T. DeFanti, G. Dawe, D. Sandin, J. Schulze, P. Otto, J. Girado, F. Kuester, L. Smarr, and R. Rao, "The StarCAVE, a third-generation CAVE and virtual reality OptIPortal," *Future Generation Computer Systems*, Vol. 25, Issue 2 (February 2009), pp. 169-178. DOI: 10.1016/j.future.2008.07.015
62. B.S. Manoj, R.R. Rao, and M. Zorzi, "CogNet: a cognitive complete knowledge network system," *IEEE Wireless Communications*, Vol. 15, Issue 6 (January 19, 2009), pp. 81-88. DOI: 10.1109/MWC.2008.4749751
61. B.C. Meyer, R. Raman, T. Hemmen, R. Obler, J.A. Zivin, R. Rao, R.G. Thomas, P.D. Lyden, "Efficacy of site-independent telemedicine in the STRoKE DOC trial: a randomised, blinded prospective study," *Lancet Neurology*, Vol. 7, Issue 9 (September 2008), pp. 787-795. DOI: 10.1016/S1474-4422(08)70171-6
60. P. Zhou, X. Wang, and R. Rao, "Asymptotic Capacity of Infrastructure Wireless Mesh Networks," *IEEE Transactions on Mobile Computing*, Vol. 7, Issue 8 (August 2008), pp.1011-1024. DOI: 10.1109/TMC.2007.70778
59. B.S. Manoj, P. Zhou, and R.R. Rao, "Dynamic adaptation of CSMA/CA MAC protocol for wide area wireless mesh networks," *Elsevier Computer Communications*, Vol. 31, Issue 8 (May 25, 2008), pp. 1627-1637. DOI: 10.1016/j.comcom.2008.01.048

58. M. Rossi, M. Zorzi, and R.R. Rao, "Statistically assisted routing algorithms (SARA) for hop count based forwarding in wireless sensor," *Wireless Networks*, Vol. 14, Number 1 (February 2008), pp. 55-70. DOI: 10.1007/s11276-006-7791-8
57. R.B. Dilmaghani and R.R. Rao, "Hybrid Wireless Mesh Network with Application to Emergency Scenarios," *Journal of Software*, 2008, Vol. 3, No. 2 (February 2008), pp. 52-60. DOI: 10.4304/jsw.3.2.52-60
56. B.C. Meyer, R. Raman, R. Rao, R.D. Fellman, J. Beer, J. Werner, J.A. Zivin, and P.D. Lyden, "The STRoKE DOC trial technique: 'video clip, drip, and/or ship'," *International Journal of Stroke*, Vol. 2 (November 2007), pp. 281-287. DOI: 10.1111/j.1747-4949.2007.00153.x
55. B.S. Manoj, R.R. Rao, and M. Zorzi, "Architectures, Protocols, and Analytical Approaches for Next Generation Cognitive Networking," in *Cognitive Wireless Networks: Concepts, Methodologies and Visions Inspiring the Age of Enlightenment of Wireless Communications*. F.H.P. Fitzek and M. Katz, Eds. Dordrecht, The Netherlands: Springer, 2007, pp. 271-284.
54. R.R. Rao, J. Eisenberg, and T. Schmitt (Eds.), *Improving Disaster Management: The Role of IT in Mitigation, Preparedness, Response, and Recovery*, Committee on Using Information Technology to Enhance Disaster Management, National Research Council, Washington, DC: National Academies Press, 2007, 177 pp.
53. M. Zorzi and R.R. Rao, Reply to "Comments on 'Capture and Retransmission Control in Mobile Radio'," *IEEE Journal on Selected Areas in Communications*, Vol. 24, No. 12 (2006), pp. 2341-2342. DOI: 10.1109/JSAC.2006.887340
52. P. Nuggehalli, V. Srinivasan, C. Chiasserini, and R.R. Rao, "Efficient cache placement in multi-hop wireless networks," *IEEE / ACM Transactions on Networking*, Vol. 14, No. 5 (October 2006), pp. 1045-1055. DOI: 10.1109/TNET.2006.882863
51. K. Wang, C.F. Chiasserini, J.G. Proakis, and R.R. Rao, "Joint Scheduling And Power Control Supporting Multicasting In Wireless Ad Hoc Networks," *Ad Hoc Networks*, Volume 4, Issue 4 (July 2006), pp. 532-546. DOI: 10.1016/j.adhoc.2005.06.001
50. P.B. Gibbons, T.F. Abdelzaher, J. Aspnes, R. Rao (Eds.), *Distributed Computing in Sensor Systems*, Proceedings of the Second IEEE International Conference (DCOSS 2006), San Francisco, CA, USA, June 18-20, 2006, (Lecture Notes in Computer Science 4026 Springer 2006), 563 pp.
49. K. Chebrolu and R. Rao, "Bandwidth Aggregation for Real-Time Applications in Heterogeneous Wireless Networks," *IEEE Transactions On Mobile Computing*, Vol. 5, No. 4 (April 2006), pp. 388-403. DOI: 10.1109/TMC.2006.1599407
48. P. Nuggehalli, V. Srinivasan, and R.R. Rao, "Energy efficient transmission scheduling for delay constrained wireless networks," *IEEE Transactions On Wireless Communications*,

Vol. 5, No. 3 (2006), pp. 531-539. DOI: 10.1109/TWC.2006.1611083

47. B.S. Manoj and R.R. Rao, "Load Balancing in Wireless Mesh Networks," in *Wireless Mesh Networks: Architectures, Protocols, and Standards*. Y.S. Zhang, et al., Eds., Florida: CRC Press, 2006, pp. 263-296.
46. B.S. Manoj and R.R. Rao, "Wireless Mesh Networks: Issues and Solutions," in *Wireless Mesh Networks: Architectures, Protocols, and Standards*. Y.S. Zhang, et al., Eds., Florida: CRC Press, 2006, pp. 3-48.
45. K. Chebrolu, B. Raman, and R.R. Rao, "A Network Layer Approach to Enable TCP over Multiple Interfaces," *ACM / Kluwer Journal of Wireless Networks*, Vol. 11 (2005), pp. 637-650. DOI: 10.1007/s11276-005-3518-5
44. B.C. Meyer, P.D. Lyden, L. Al-Khoury, Y. Cheng, R. Raman, R. Fellman, J. Beer, R. Rao, and J.A. Zivin, "Prospective Reliability of the STRoKE DOC Wireless / Site Independent Telemedicine System," *Neurology* 2005, no. 64 (March 2005), pp. 1058-1060.
43. V. Srinivasan, P. Nuggehalli, C.F. Chiasserini, and R. R. Rao, "An Analytical Approach to the Study of Cooperation in Wireless Ad Hoc Networks," *IEEE Transactions on Wireless Communications*, Vol. 4, No. 2 (March 2005), pp.722. DOI: 10.1109/TWC.2004.842950
42. K. Wang, C.F. Chiasserini, J. Proakis, and R. R. Rao, "A Joint Solution to Scheduling and Power Control for Multicasting in Wireless Ad Hoc Networks," *EURASIP Journal on Applied Signal Processing, Special Issue on Cross Layer Design for Communications and Signal Processing Systems* (February 2005), pp. 144-152. DOI: 10.1155/ASP.2005.144
41. C.F. Chiasserini, P. Nuggehalli, V. Srinivasan, and R. R. Rao, "Optimal Rate Allocation for Energy Efficient Multipath Routing in Ad Hoc Wireless Networks," *IEEE Transactions on Wireless Communications*, Vol. 3. No. 3 (May 2004), pp. 891-899. DOI: 10.1109/TWC.2004.826343
40. M. Zorzi and R.R. Rao, "Geographic Random Forwarding (GeRaF) for Ad Hoc and Sensor Networks: Multihop Performance," *IEEE Transactions on Mobile Computing*, Vol. 2, No. 4 (October-December 2003), pp. 337-348. DOI: 10.1109/TMC.2003.1255648
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36. K. Wang, J. Proakis, and R. R. Rao, "Energy-Efficient Routing Algorithms Using Directional Antennas for Mobile Ad Hoc Networks," *International Journal of Wireless Information Networks, Special Series on Mobile Ad Hoc Networks (MANETs): Standards, Research, Applications*, Vol. 9, No. 2 (April 2002), pp. 105-118. DOI: 10.1023/A:1015303800432
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30. C. F. Chiasserini and R. R. Rao, "Stochastic Battery Discharge in Portable Communication Devices," *IEEE Aerospace and Electronic Systems Magazine*, Vol. 15, No. 8 (August 2000), pp. 41-45. DOI: 10.1109/BCAA.2000.838358
29. M. Zorzi, A. Chockalingam, and R. R. Rao, "Throughput Analysis of TCP on Channels with Memory," *IEEE Journal on Selected Areas of Communication*, Vol. 18 (July 2000), pp. 1289-1300. DOI: 10.1109/49.857929
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27. M. Zorzi and R. R. Rao, "Latency probability of a retransmission scheme for error control on a two-state Markov channel," *IEEE Transactions on Communications*, Vol. 47, No. 10 (October 1999), pp. 1537-1548. DOI: 10.1109/26.795822
26. M. Zorzi and R. R. Rao, "On the impact of burst errors on wireless ATM," *IEEE Personal Communications*, Vol.6, No.4 (August 1999), pp.65-76. DOI: 10.1109/98.788217
25. E. Ayanoglu, V. Bahl, R. S. Cheng, R. R. Rao, and M. Zorzi, "Multimedia Network Radios (guest editorial)," *IEEE Journal on Selected Areas in Communications*, Vol. SAC-17 (May 1999), pp. 753-755.
24. A. M. Chen and R. R. Rao, "Wireless Channel Models- Coping with Complexity," *Wireless*

- Multimedia Network Technologies, Kluwer Academic Publishers, pp. 271-288, 1999. DOI: 10.1007/0-306-47330-5_15
23. M. Zorzi, R. R. Rao, and L. B. Milstein, "Error statistics in data transmission over fading channels," IEEE Transactions on Communications, Vol.46, No.11 (November 1998), pp.1468-1477. DOI: 10.1109/26.729391
 22. A. Chockalingam, P. Dietrich, L. B. Milstein, and R. R. Rao, "Performance of Closed-Loop Power Control in DS-CDMA Cellular Systems," IEEE Transactions on Vehicular Technology, Vol. 47, No. 3 (August 1998) pp.774-789. DOI: 10.1109/25.704833
 21. B. Slutsky, R. R. Rao, P. C. Sun, Y. Tancevski, and S. Fainman, "Defense frontier analysis of quantum cryptographic systems," Applied Optics, Vol. 37, No. 14, Optical Society of America (May 1998), pp. 2869-2878. DOI: 10.1364/AO.37.002869
 20. B. Slutsky, R. R. Rao, Pang Chen Sun, and Shaya Fainman, "Security of quantum cryptography against individual attacks," Physical Review A, Physical Review A (Atomic, Molecular, and Optical Physics), Vol. 57, No. 4, APS through AIP (April 1998) pp. 2383-2398. DOI: 10.1117/12.300902
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 17. M. Zorzi and R. R. Rao, "The effect of correlated errors on the performance of TCP," IEEE Communications Letters, Vol. 1, No. 5 (September 1997), pp. 127-129. DOI: 10.1109/4234.625033
 16. M. Zorzi and R. R. Rao, "On the statistics of block errors in bursty channels," IEEE Transactions on Communications, Vol. 45, No. 6 (June 1997), pp.660-667. DOI: 10.1109/26.592604
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11. M. Zorzi and R. R. Rao, "On the use of renewal theory in the analysis of ARQ protocols," *IEEE Transactions on Communications*, Vol. 44, No. 9 (September 1996), pp.1077-1081 DOI: 10.1109/26.536913
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8. F. Xu, R. R. Rao, and Yeshayahu Fainman, "An Intelligent Photonic Switch Using Polarization Sensitive Birefringent Computer Generated Holograms," *Optics Letters*, Vol. 20, No. 3 (February 1995), pp. 336-338
7. M. Zorzi and R. R. Rao, "Capture and Retransmission Control in Mobile Radio," *Journal of Selected Areas in Communications*, Vol. 12, No. 8 (October 1994) pp. 1189-1198. DOI: 10.1109/49.329345
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5. R. R. Rao, "Computer Communications - A First Course -- J. Walrand," Book Review *IEEE Transactions on Information Theory* Vol. 38, No. 5 (January 1992), pp. 214-216.
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Conference Proceedings

171. J. Daftari, G. Quer, and R. Rao, "Wavelet Coherence Reveals Entrainment of Heart Rate Variability Among People Involved in Group Activities," accepted for publication in the Proc. of the IEEE International Conference on Communications (ICC 2012), Ottawa, Canada, Jun. 10-15, 2012.
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165. Y. Liu, B. R. Tamma, B. S. Manoj, and R. Rao, "Traffic Prediction for Cognitive Networking in Multi-Channel Wireless Networks," Proc. of IEEE INFOCOM 2010 Workshop on Cognitive Wireless Communications and Networking 2010, March 2010, San Diego, CA.
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161. B. Nicola, B.R. Tamma, B.S. Manoj, R.R. Rao, and M. Zorzi, "A Neural Network based

- Cognitive Controller for Dynamic Channel Selection," Proc. of the IEEE International Conference on Communications, 2009 (ICC '09), Dresden, Germany, June 14-18, 2009, pp. 1-5. DOI: 10.1109/ICC.2009.5198636
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158. A.A. Bhorkar, B.S. Manoj, B.D. Rao, and R. Rao, "Antenna Selection Diversity Based MAC Protocol for MIMO Ad Hoc Wireless Networks," Proc. of the IEEE Global Telecommunications Conference, 2008 (Globecom 2008), New Orleans, LA, November 30-December 4, 2008, pp. 1-6. DOI: 10.1109/GLOCOM.2008.ECP.135
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