

Cory C. Beard

PERSONAL DATA

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AREAS OF SPECIALIZATION

Disaster communication networks, integrated communication networks, wireless networking, differentiated quality of service provisioning, network traffic engineering, queueing theory, and intelligent agents.

Current activities:

- MAC-layer quality of service and emergency traffic prioritization in ad hoc networks using queueing theory models and game theory.
- Quality of service provisioning in EV-DO Revision A and Revision B.
- Scheduling in 3G and 4G wireless cellular systems.
- Preemptive and queueing policies for providing preference to emergency traffic in wireless cellular networks.
- Quality of service in IEEE 802.11 and 802.16 networks.
- Active queue management to support multi-class dropping preferences for emergency applications.
- Overlay networks for emergency applications.
- Deflection-based packet rerouting in congested networks.

EDUCATION

Undergraduate University of Missouri-Columbia
Bachelor of Science in Electrical Engineering, Summa Cum Laude
May 1990
University of Missouri Curators Scholar, 1986-1990.

Master's University of Missouri-Columbia
Master of Science in Electrical Engineering
Advisor: Dr. Charles Slivinsky
May 1992
Fully supported through a National Science Foundation Graduate Fellowship

Ph.D. University of Kansas
Doctor of Philosophy in Electrical Engineering
Dissertation: "Dynamic Agent-Based Prioritized Resource Allocation for Stressed Networks"
Defended August 9, 1999
Advisor: Dr. Victor S. Frost
Fully supported through a Madison and Lila Self Graduate Fellowship

FUNDED RESEARCH WORK

- Advanced Network Simulation Tools Principal Investigator.
Summary: Development of simulation modules in OPNET for study of traffic mixes and QoS requirements within EV-DO Revision A and Revision B.
Hiring capability for two faculty (½ summer month) and two ½ time student appointments.
Funding Status: Funded project through the Sprint Corporation – Advanced Network Design.
Total Budget: \$61,000
Co-Investigator Budget Credit: \$30,500
May 2007 to December 2007.
- CAREER: Priority Users and Applications on the Internet Role: Principal and Sole Investigator
Summary: Development and investigation of mechanisms for supporting emergency and high revenue users in today's Internet, Diffserv-capable networks and networks which use connection-oriented mechanisms.
Hiring capability for 4 ¼ time appointments.
Funding Status: NSF CAREER Award ANI-0133605.
Total Budget: \$376,893
March 2002 to February 2007
- Constraint-based Routing for Traffic Engineering in MPLS/GMPLS: Year II Role: Co-Investigator with Deep Medhi (P.I.) and Appie van de Liefvoort, both of UMKC.
Summary: Development of models for assessing the complexity of future network architectures that involve MPLS and the migration of legacy services to MPLS.
Funding Status: Funded project through the Sprint Corporation - Technology Planning and Integration.
Hired 3 graduate research assistants.
Total Budget: \$100,225.
Co-Investigator Budget Credit: \$25,000.
November 2001 - October 2002.
- Architectures for Infinite Capacity Networks Role: Principal and Sole Investigator.
Summary: Develop a framework, architecture, and protocols for networks of infinite capacity. In addition, these protocols will be adapted to apply to finite capacity networks.
Funding Status: Funded project through the Society of Self Fellows, University of Kansas.
Hired 2 graduate research assistants.
Total Budget: \$20,000.
January 2001 - December 2002

- Constraint-Based Routing for Traffic Engineering in MPLS/MPLambdaS
 Role: Co-Investigator with Deep Medhi (P.I.) and Appie van de Liefvoort.
 Summary: Study of tradeoffs in control paths and forwarding paths for implementing IP traffic engineering using MPLS.
 Funding Status: Funded project through the Sprint Corporation - Technology Planning and Integration.
 Hired 2 graduate research assistants.
 Total Budget: \$69,000.
 Co-Investigator Budget Credit: \$17,250.
 Completed (October 2000 - September 2001)
- Prioritized Preemption In Stressed Networks
 Role: Principal and Sole Investigator.
 Summary: Creation of mechanisms for preempting lower priority users when higher priority users need access to network resources. Also involved is a comparison of the benefits of this approach compared to non-preemptive approaches (i.e., holding back capacity unused in case priority users need resources).
 Research Assistants: Xianghong Zeng, Aashish Chandra, Hongchuan Xiao
 Funding Status: Funded project from the University of Missouri Research Board.
 Hired 3 graduate research assistants.
 Total Budget: \$24,582
 Completed (January 2000 - June 2001)

Total Awards: \$651,700

Total Awards (as Principal Investigator and as Co-Investigator credit): \$494,225

EMPLOYMENT EXPERIENCE

- University of Missouri-Kansas City
 Positions: Assistant Professor, 1999-2005
 Associate Professor, 2005-present
 School of Computing and Engineering
 Department of Computer Science and Electrical Engineering
 Began this appointment (1999-2001) as an Assistant Professor of Electrical and Computer Engineering in the Kansas City Coordinated Engineering Program of the University of Missouri-Columbia. Became part of UMKC in 2001.
- Black & Veatch
 Position: Project Electrical Engineer - 1992 to 1995
 Responsibilities: Designed, studied, and assisted in procurement of distribution information management systems, distribution automation systems, database applications, and communication systems for electric utilities.
 8400 Ward Parkway, Kansas City, MO 64114
 (913) 458-2000

- Sprint Corporation Position: Engineering Intern - Technology Planning and Integration, Summer 1997
 Responsibilities: Evaluated and developed distributed object computing standards (CORBA, TINA, etc.) for telecommunications.
 Technology Planning and Integration, Mailstop KSOPKB0802
 9300 Metcalf Avenue, Overland Park, KS 66212
 (913) 854-0903
- Missouri Public Service Company Position: Engineering Intern - Summer 1991 and Summer 1989
 Responsibilities: Performed distribution system studies, formulated construction recommendations, and revised construction standards.
 Address: 10700 E. 350 Highway, P. O. Box 11739,
 Kansas City, MO 64138
 (816) 737-7600

PUBLICATIONS

Journal Publications

1. Cory C. Beard and Victor S. Frost, "Prioritized Resource Allocation for Stressed Networks," *IEEE/ACM Transactions on Networking*, Vol. 6, no. 5, October 2001, pp. 618-633.
2. Cory C. Beard and Victor S. Frost, "Ticket Servers for Network Traffic Prioritization," *Journal of Network and Systems Management*, June 2003, pp. 151-170.
3. Cory C. Beard and Victor S. Frost, "Prioritization of Emergency Network Traffic using Ticket Servers: A Performance Analysis," *Simulation: Transactions of the Society for Modeling and Simulation International*, Vol. 80, No. 6, pp. 289-299, June 2004.
4. S. Srivastava, B. Krithikaivasan, C. Beard, D. Medhi, A. Van de Liefvoort, W. Alanqar, A. Nagarajan, "Benefits of Traffic Engineering using QoS Routing Schemes and Network Controls," *Computer Communications Journal*, vol. 27/5, pp. 387-399, March 20, 2004.
5. Manali Joshi, Ajay Mansata, Salil Talauliker, and Cory Beard, "Design and Analysis of Multi-Level Active Queue Management Mechanisms for Emergency Traffic," *Computer Communications Journal*, Volume 28, Issue 2, 10 February 2005, Pages 162-173.
6. Cory Beard, "Preemptive and Delay-Based Mechanisms to Provide Preference to Emergency Traffic," *Computer Networks Journal*, Vol. 47:6, pp. 801-824, 22 April 2005.
7. Ken Carlberg, Ian Brown, Cory Beard, "Framework for Supporting Emergency Telecommunications Service (ETS) in IP Telephony", *Internet Engineering Task Force, Request for Comments 4190*, November 2005.
8. Jiazhen Zhou and Cory Beard, "A Controlled Preemption Scheme for Emergency Applications in Cellular Networks," *IEEE Transactions on Vehicular Technology*, vol. 58, no. 7, pp. 3753-3765, September 2009.
9. Zhefu Shi, Cory Beard, and Ken Mitchell, "Analytical Models for Understanding Misbehavior and MAC Friendliness in CSMA Networks," *Performance Evaluation*, vol. 66, pp. 469-487, September 2009.

Conference Papers and Presentations

1. Jung Hwan Kim, Baek-Young Choi, and Cory Beard, "QoS and Channel Aware Packet Bundling for VoIP Traffic in Cellular Networks" *International Teletraffic Conference 21*, Paris, France, September 15-17, 2009.
2. Zhefu Shi, Cory Beard, Ken Mitchell, "Tunable Traffic Control for Multihop CSMA Networks," *2008 IEEE Military Communications Conference (MILCOM '08)*, San Diego, November 2008.

3. Jiazhen Zhou and Cory Beard, "Adaptive Probabilistic Scheduling for a Cellular Emergency Network." *First International Workshop on Next Generation Networks for First Responders and Critical Infrastructures (NetCri07)*, April 2007.
4. Zhefu Shi, Cory Beard, and Ken Mitchell, "Misbehavior and MAC Friendliness in CSMA Networks," *IEEE Wireless Communications and Networking Conference (WCNC) 2007*, Hong Kong, March 11-15, 2007.
5. Jiazhen Zhou and Cory Beard, "Tunable Preemption Controls for a Cellular Emergency Network," *IEEE Wireless Communications and Networking Conference (WCNC) 2007*, Hong Kong, March 11-15, 2007.
6. Daniel Fokum and Cory Beard, "A Scheme For Improved Delay and Frame Drop Probabilities in 802.11e Networks," *IASTED International Conference on Wireless Networks and Emerging Technologies 2006 (WNET '06)*, Banff, Alberta, Canada, July 3-6, 2006.
7. Jiazhen Zhou and Cory Beard, "Combined Preemption and Queuing Schemes for Admission Control of a Wireless Emergency Network," *IEEE Wireless Communications and Networking Conference (WCNC) 2006*, Las Vegas, NV, April 3-5, 2006. (117/301 accepted – 38.9%)
8. Jiazhen Zhou and Cory Beard, "Weighted Earliest Deadline Scheduling and Its Analytical Solution for Admission Control in a Wireless Emergency Network." *International Teletraffic Congress 19*, Beijing, August 29-September 2, 2005.
9. Brijraj Vaghani and Cory Beard, "A Scheme to Measure Error Rates in the Presence of Adjacent Channel Interference using Frequency Domain Analysis," *IASTED International Conference on Communications, Internet, and Information Technology (CIIT 2004)*, St. Thomas, US Virgin Islands, November 22-24, 2004 (40% acceptance rate).
10. Manali Joshi and Cory Beard, "Reducing Queue-Fill Variability for Emergency Traffic in a Differentiated Services Network," *ICCCN '04*, October 2004, Chicago.
11. Ala I. Al-Fuqaha, Ghulam M. Chaudhry, Cory Beard, Mohsen Guizani, Miguel Labrador, and Ibrahim Habib, "Link-State Update Policies for All-Optical DWDM Transport Networks," *Proceedings of the 2004 IEEE International Conference on Communications*, Paris, June 2004.
12. Dijiang Huang, Deep Medhi, Cory Beard, Lein Harn, "Trust Analysis of Link State Network Routing," *Proceedings of the Second International Trusted Internet Workshop (TIW 2003)*, December, 2003, Hyderabad, India.
13. Balaji Krithikaivasan, Shekhar Srivastava, Cory Beard, Appie van de Liefvoort, Deep Medhi, "Controlling Performance in the Congested Parts of an Asymmetric Network using Controls and Routing," *2003 IEEE Symposium on Computers and Communications*, Kemer - Antalya, Turkey, June 2003.
14. Cory Beard, "Network Requirements for Internet Emergency Preparedness Services," *IEEE Workshop on Disaster Recovery Networks*, in conjunction with *IEEE INFOCOM 2002*, New York City, June 24, 2002.
15. Shekhar S., Balaji K., Venkatesh V., Cory Beard, Deep Medhi, Appie Van de Liefvoort, Wesam Alanqar, Ananth Nagarajan, "A Case Study on Evaluating the Benefits of MPLS Traffic Engineering through Constraint-Based Routing and Network Controls," *Proceedings of the 2002 IEEE International Conference on Communications*, New York, New York, May 2002.
16. Cory C. Beard and Victor S. Frost, "Ticket Server Performance Evaluation Using a Hybrid Simulation Approach," *Proceedings of the SCS 2001 Advanced Simulation Technologies Conference*, Seattle, Washington, April 2001.
17. Xianghong Zeng and Cory Beard, "Prioritized Resource Allocation at Diffserv Ingress Routers", *Proceedings of the 2000 IASTED International Conference on Parallel and Distributed Computing and Systems (PDCS 2000)*, Las Vegas, Nevada, November 2000.

18. O. Elkeelany, G. Chaudhry, and C. Beard, "Deadlock Characterization in Irregular Computer Networks," *Proceedings of the 2000 ISCA International Conference on Parallel and Distributed Computing Systems*, Las Vegas, Nevada, August 2000.
19. Cory C. Beard and Victor S. Frost, "Connection Admission Control for Differentiating Priority Traffic on Public Networks," *Proceedings of the 1999 IEEE Military Communications International Symposium*, Atlantic City, New Jersey, November 1999.
20. Cory C. Beard and Victor S. Frost, "Dynamic Agent-Based Prioritized Connection Admission for Stressed Networks," *Proceedings of the 1999 IEEE International Conference on Communications*, Vancouver, Canada, June 1999. (375 out of 850 were accepted, 44% acceptance rate).

Technical Reports

1. Brijraj Vaghani and Cory Beard, "Improving Spectral Efficiency and Reducing Adjacent Channel Interference of a Wireless Emergency Communication System".
2. Jian Gao and Cory Beard, "Removal of Unnecessary Queue Variance with Active Queue Management".
3. Jian Gao and Cory Beard, "Overlay Networks to Support Internet Emergency Preparedness Services".
4. Hongchuan Xiao and Cory Beard, "Support for High Priority Traffic Using Preemption."
5. Dijiang Huang, Amit Sinha, Deep Medhi, Cory Beard, "Strategies for Addressing Link State Routing Protocol Vulnerabilities: A Panoramic View," 2003.
6. Ajay Mansata, Salil Talauliker, Manali Joshi, and Cory Beard, "Removal of the Noise Source Inherent to AQM," 2003.
7. Cory Beard, "Mechanisms for Providing Internet Emergency Services," February 2003.
8. Shekhar S., Balaji K., Venkatesh V., Cory Beard, Deep Medhi, Appie Van de Liefvoort, "Constraint Based Routing and Control in MPLS, Technical Report: 2000-2001," submitted to the Sprint Corporation, November 2001.

Dissertation

- Cory C. Beard, *Dynamic Agent-Based Prioritized Resource Allocation for Stressed Networks*, Ph.D. Dissertation, Defended August 9, 1999.

TEACHING EXPERIENCE

Courses Taught

ECE 5590WC Wireless Communications
 ECE 301ES Introduction to Electrical and Computer Engineering
 CS 520/ECE 5590NA Network Architecture I
 ECE 401WN Introduction to Wireless Networking
 ECE 380 Signals and Systems
 ECE 401RB Robotic Systems
 ECE 474 Introduction to Communication Systems
 ECE 476 Introduction to Wireless Communications (also co-listed as ECE 501C, and CS 513)
 ECE 401B Performance Analysis of Computer Networks
 ECE 301E Introduction to Computer Networks
 ECE 401C Advanced Computer Networks

STUDENT SUPERVISION AND MENTORING

Master's Degree Thesis Committee Chairperson

1. Xianghong Zeng, "Schedulable Regions for Guaranteed Network Quality of Service," November 2000.

2. Dan Jiao, "Analysis of a New Connection Preemption Protocol for ATM", July 2001.
3. Hongchuan Xiao, "Application Of Preemption Admission Policy In Multi-Class Overloaded Loss Networks," May 2002.
4. Padmanabhan Krishnan, "Multi Layer Quality Of Service Support In Wireless Ad Hoc Networks", June 2003.
5. Chintan Shah, "Evaluation of Connection Admission Control Using Statistical Service Assurances and Its Interaction with Constraint-Based Routing," July 2003.
6. Amol Mehta, "Reliable Emergency Services," December 2003.
7. Ajay Mansata, "Alternate Routing For Quality Of Service Support In A Differentiated Services Network," December 2003.
8. Manali Joshi, "Reducing Queue-Fill Variability for Quality of Service in a Differentiated Services Network," February 2004.
9. Kavita Patel, "Alternate Optical Network Architectures - SONET Or Mesh," April 2004.
10. Brijraj Vaghani, "Improvement in Spectral Efficiency for Wireless Emergency Communications," December 2004.
11. Usha Damodaran, "Packet Loss Effects on MPEG4," September 2005.
12. Daniel Fokum, "The Effects of MAC Layer Parameters on Quality of Service provided by 802.11e," December 2005.
13. Sagar Hatkar, "Cross Layered Routing Implementation for Ultrawideband Communication," May 2006.
14. Anubhav Visen, "An MPLS DiffServ based Traffic Engineering and QoS Architecture," June 2006.
15. Ramalingam Palanivel Rathinam, "Using Forwarding Host To Improve End To End Network Performance," July 2006.
16. Shamanth Kengeri Padmaraj, "Investigating the Multi User Diversity Technique for Optimizing System Performance and Efficient Channel Allocation in Wireless Networks," May 2007.
17. Kartik Shah, "Throughput Enhancement Using Wireless Mesh Networks," March 2008.
18. Vidyadhari Dharmaraju, "Throughput Optimization In Wireless Local Area Networks," April 2008.
19. Srujana Thodupunoori, "Reverse Link Performance of EV-DO Revision A," September 2008.
20. Chaitanya Cherakupally, "Enhancement of Distributed Scheduling in 802.16 Mesh Networks," November 2008.
21. Bhanu Tadinada, "Improving the Range of WiMax Cell Using a Mesh Topology," December 2008.
22. Jimish Thakkar, "Amplify and Forward Relay Performance in Wimax 802.16j," February 2009.

SERVICE

- Chair, SCE Recruiting and Retention Committee, 2009 to present.
- UMKC Faculty Senator, 2006 to present.
- Co-director, CSEE Seminar, 2007-2008.
- Co-chair of CSEE Master's Committee, 2007 to present.
- Member of CSEE Master's Committee, 2006 to 2007.
- Member of Faculty Development and Post Tenure Review Committee, Department of Computer Science and Electrical Engineering, 2007 to present.
- Chair, Ad Hoc Committee on Wireless Communications Curriculum, 2006.
- Secretary of the Faculty, School of Computing and Engineering, 2004 to 2008.
- Faculty Advisor, IEEE Student Robotics Team, 2004 to present.
- Tau Beta Pi co-advisor, 2002 to present.
- University of Missouri-Kansas City IEEE Branch Counselor, 1999 to present.

- Faculty Advisor, International Students Incorporated, 2004 to present.
- Member of UMKC Amnesty Committee, 2000 to present.
- NSF Panelist, NeTS program, 2009.
- Presentation to high school students at the Pre-engineering/Technology Acceleration Academy at Kansas City Kansas Community College, July 7, 2009.
- Reviewer, Internet Workshop on Quality of Service (IWQoS), 2009.
- Reviewer, ICCCN '08 Conference, 2008.
- Reviewer, Computer Networks Journal, January 2008.
- Reviewer, IEEE Region 5 Technical Conference, 2008.
- Reviewer, University of Missouri Research Board, April 2008.
- Technical Program Committee, Mission Critical Networks Workshop, in conjunction with INFOCOM 2008.
- Invited Presentation: "Offering Help During a Disaster: Emergency Communications," Science Pioneers Saturday Science Seminar, November 17, 2007, approximately 300 Kansas City area high school students in attendance.
- Member of University of Missouri Doctoral Faculty, Computer and Telecommunications Networking Discipline, co-discipline in Electrical and Computer Engineering.
- Member of UMKC Graduate Faculty.
- Member of Electrical and Computer Engineering Degree Program Committee, 2002 to present.
- Chair, SCE Recruiting, Retention, and Outreach Committee, 2004.
- Member of Computer Science/Electrical Engineering Master's Committee, 2001 to 2004
- Member of Computer Science/Electrical Engineering Faculty Search Committee, 2002-2003.
- Member of School of Interdisciplinary Computing and Engineering Enrollment/Advancement Strategic Planning Committee, 2002.
- Member of UMKC Chancellor's Task Force on the Proposal for a School of Interdisciplinary Computing and Engineering at UMKC, 2000.
- Member of Kansas City CEP Computer Committee, 1999-2001.
- 2000 UMKC CEP Good Teaching Award Review Committee
- Student member of Department Chairperson Search Committee, University of Kansas, Department of Electrical Engineering and Computer Science, 1997-1998.
- Member of Advisory Board, University of Kansas Department of Electrical Engineering and Computer Science, 2003 to 2007.
- Treasurer and Technical Program Committee Member, IEEE Internet Protocol Operations and Management Symposium, October 2003, Kansas City, MO.
- Invited speaker, Mathematics and Physics Institute, "Computer Networks for Disaster Management: Problems and Proposed Solutions", Independence, MO, September 28, 2001.
- Seminar speaker, School of Interdisciplinary Computing and Engineering, "Computer Networks for Disaster Management: Problems and Proposed Solutions", September 21, 2001.
- Invited speaker, University of Iowa Electrical Engineering Graduate Seminar, "Prioritized Connection Admission Control in Computer Networks", September 13, 2001.
- Invited Panelist, University of Kansas Graduate School Fall Workshop: Preparing Future Faculty, October 2000.
- Session Chair and Reviewer, 2000 IASTED International Conference on Parallel and Distributed Computing and Systems.
- Session Chair and Program Committee Member, 2000 ISCA International Conference on Parallel and Distributed Computing Systems.
- President, University of Kansas Society of Self Fellows, an alumni organization, 1999-2000.

- Reviewer, Computer Networks Journal, 2005.
- Reviewer, IEEE/ACM Transactions on Networking.
- Reviewer, Journal of Network and Systems Management.
- Reviewer, IEEE INFOCOM.
- Reviewer, IEEE International Conference on Communications.
- Reviewer, IEEE GLOBECOM.

EVENTS

- Judge, FIRST Lego League Robotics Regional Competition, UMKC, February 24, 2008.
- Judge, FIRST Robotics High School Kansas City Region, March 2007.

HONORS AND ACCOMPLISHMENTS

- 2008 LEAP (Leadership Excellence Achievement Program) faculty award of the Western Chapter of the Missouri Society of Professional Engineers.
- School of Computing and Engineering Good Teaching Award, 2005.
- UMKC IEEE Chapter, IEEE Region 5 Regional Activities Student Branch Membership Growth Award 2003-2004. Region 5 consists of universities in the states of Colorado, Kansas, Missouri, Oklahoma, Arkansas, Texas, Louisiana.
- 2004 UMKC Activity and Program Council Faculty Appreciation Award.
- National Science Foundation Faculty Early Career Development (CAREER) award, 2002.
- University of Missouri New Faculty Teaching Scholar, 2001-2002.
- Meriwether Lewis Fellow, Community of Learners: Transformation in Higher Education Conference, University of Missouri-Kansas City, May 14-15, 2001.
- Graduate Teaching Assistant Award, University of Kansas, 1999.
- Madison and Lila Self Graduate Fellowship, University of Kansas, 1995-1999.
- National Science Foundation Graduate Fellowship, University of Missouri-Columbia, 1990-1992.
- University of Missouri Curators Scholar, University of Missouri-Columbia, 1986-1990.
- Membership in Eta Kappa Nu, Tau Beta Pi, Phi Kappa Phi, Pi Mu Epsilon

COMMUNITY ACTIVITIES

- Active in Life Spring Church, Spring Hill, Kansas.
- Olathe Bible Church Co-Teacher of the Year - 2000.
- Eagle Scout