

Douglas Craig Schmidt

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Educational Background

- **Ph.D. Computer Science**, summer 1994, University of California, Irvine
Dissertation: “An Object-Oriented Framework for Experimenting with Alternative Process Architectures for Parallelizing Communication Subsystems.”
Co-advisors: Dr. Tatsuya Suda and Dr. Richard W. Selby
- **M.S. Computer Science**, summer 1990, University of California, Irvine, specializing in software engineering
- **M.A. Sociology**, summer 1986, College of William and Mary, Williamsburg, Virginia
Thesis: “A Statistical Analysis of University Resource Allocation Policies.”
Advisor: Dr. Michael A. Faia
- **B.A. Sociology**, summer 1984, College of William and Mary, Williamsburg, Virginia

Professional Experience

- **3/02 – present: Program Manager**
Currently leading the national effort on middleware as a Program Manager for over \$60 million dollars of funding at the DARPA Information Exploitation Office (IXO). Programs include Program Composition for Embedded Systems (PCES).
- **9/01 – 3/02: Deputy Director**
Served as the Deputy Director for the DARPA Information Technology Office (ITO), helping to set the national IT research and development agenda and manage programs on autonomous systems, network-centric command and control systems, distributed real-time and embedded systems, and augmented cognition for the U.S. Department of Defense.
- **6/00 – 3/02: Program Manager**
Currently leading the national effort on middleware as a Program Manager for over \$60 million dollars of funding at the DARPA Information Technology Office (ITO). Programs included the Program Composition for Embedded Systems (PCES).
- **6/01 – 6/02: Co-chair for the Software Design and Productivity (SDP) Coordinating Group**
The SDP Coordinating Group formulates the multi-agency research agenda in fundamental software design for the Federal government’s Information Technology Research and Development (IT R&D) Program, which is the collaborative IT research effort of the major Federal science and technology agencies.
- **8/99 – present: Associate Professor with tenure**
Conducting research on design patterns, implementation, and experimental analysis of object-oriented techniques that facilitate the development of high-performance, real-time distributed object computing systems on parallel processing platforms running over high-speed networks and embedded system interconnects in the Department of Computer Engineering at the University of California, Irvine.

- **6/99 – 8/99: Associate Professor with tenure**
Conducted research on design patterns, implementation, and experimental analysis of object-oriented techniques that facilitate the development of high-performance, real-time distributed object computing systems on parallel processing platforms running over high-speed networks and embedded system interconnects in the Department of Computer Science and the Department of Radiology at Washington University in St. Louis.
- **6/98 – 6/99: Associate Professor without tenure (early promotion)**
Conducted research on design patterns, implementation, and experimental analysis of object-oriented techniques that facilitate the development of high-performance, real-time distributed object computing systems on parallel processing platforms running over high-speed networks and embedded system interconnects in the Department of Computer Science and the Department of Radiology at Washington University in St. Louis.
- **8/94 – 6/98: Assistant Professor**
Conducted research on object-oriented patterns and techniques for developing highly extensible, high-performance communication frameworks in the Department of Computer Science and the Department of Radiology at Washington University in St. Louis.
- **3/91 – 8/94: Computer System Design Research Assistant**
Developed an object-oriented framework for multi-processor-based communication subsystems with Professor Tatsuya Suda at the University of California, Irvine.
- **8/88 – 3/91: Software Engineering Research Assistant**
Devised measurement-guided software development techniques for large-scale software systems with Professor Richard Selby at the University of California, Irvine.
- **6/88 – 8/88: Research Assistant**
Studied the impact of computing on end-users in forty U.S. city governments with Dr. John King and the URBIS project at the Public Policy Research Organization, University of California, Irvine.
- **1/85 – 8/86: Sociology Research Assistant**
Examined university resource allocation policies via statistical analysis with Dr. Michael Faia at the College of William and Mary, Williamsburg, Virginia.

Awards and Honors

1. Co-chair of the Software Design and Productivity (SDP) Coordinating Group of the Federal government's multi-agency Information Technology Research and Development (IT R&D) Program, the collaborative IT research effort of the major Federal science and technology agencies. The SDP Coordinating Group formulates the multi-agency research agenda in fundamental software design.
2. Invited speaker at the dedication of the Henry Samueli School of Engineering, along with UC Irvine Chancellor, Ralph Cicerone; Dean of the School of Engineering, Nicolaos Alexopoulos; Chairperson of the Regents of the University of California, S. Sue Johnson; President of the University of California, Dick Atkinson; and CTO and co-founder of Broadcom Henry Samueli.
3. One of the three founding members of the Scientific Advisory Board for the *International Symposium of Distributed Objects and Applications* conference series.
4. Member of the advisory board for Entera, which provides Internet content delivery systems based on ACE.
5. Received early promotion to tenure as an Associated Professor at Washington University, St. Louis, five years after joining the faculty as an Assistant Professor in 1994.
6. Director of the "Center for Distributed Object Computing" at Washington University, St. Louis since spring of 1999.

7. Invited to participate in the OO Working Group of the “Strategic Directions in Computing Research” workshop sponsored by ACM at MIT in June 1996.
8. Received joint appointment to the Mallinckrodt Institute Department of Radiology, Washington University School of Medicine, February 1996.
9. Invited to serve as editor-in-chief of the C++ Report magazine, published by SIGS.
10. Invited by Dr. Martina Zitterbart to participate in a 4-week international exchange program at the Universität Karlsruhe Institut für Telematik in Karlsruhe, Germany, April 1993.
11. Served as elected representative to the Associated Graduate Student organization at the University of California, Irvine from May 1991 to June 1992.
12. Served as elected graduate student representative to the Computer Science Computing Resource Committee at the University of California, Irvine from August 1988 to August 1990.
13. Invited to work with Dr. Peter G. W. Keen at the International Center for Information Technology, Washington D.C. on a project assessing techniques for improving software productivity in the summer of 1987.

Professional Activities

Editorial Activities

1. Wrote the foreword to the book *Fundamentals of Distributed Object Systems: The CORBA Perspective*, by Zahir Tari and Omran Bukhres, Wiley and Sons, 2001.
2. Wrote the foreword to the book *Design Patterns in Communication Software*, edited by Linda Rising and published by Cambridge University Press, 2000.
3. Guest editor of the Special Issue on Components and Patterns for *The Journal of Theory and Practice of Object Systems*, Wiley & Sons, to appear 2002.
4. Invited editorial on “Trends in Distributed Object Computing” for the special issue on Distributed Object-Oriented Systems appearing in the Parallel and Distributed Computing Practices journal, edited by Maria Cobb and Kevine Shaw, Vol. 3, No. 1, March 2000.
5. Co-editor of “Building Application Frameworks: Object-Oriented Foundations of Framework Design,” John Wiley & Sons, 1999 (co-editors are Mohamed Fayad and Ralph Johnson), ISBN 0-471-24875-4.
6. Co-editor of “Implementing Application Frameworks: Object-Oriented Frameworks at Work,” John Wiley & Sons, 1999 (co-editors are Mohamed Fayad and Ralph Johnson), ISBN 0-471-25201-8.
7. Guest editor of the Special Issue on OO Application Frameworks for the Communications of the ACM, (co-editor Mohamed Fayad), ACM, October, 1997.
8. Guest editor of the special issue on Distributed Object Computing for USENIX Computing Systems Journal, November/December, 1996.
9. Guest editor of a feature topic on Distributed Object Computing for IEEE Communications Magazine, February, 1997.
10. Guest editor of the Special Issue on Patterns and Pattern Languages for Communications of the ACM, (co-editors Ralph Johnson and Mohamed Fayad), ACM, October, 1996.
11. Co-editor of a book entitled “Pattern Languages of Program Design,” Addison-Wesley, 1995 (co-editor is Jim Coplien, Bell Labs).
12. Editor of the Patterns++ section of the C++ Report Magazine, April 1997 - March 1998.
13. Editor-in-chief of the C++ Report Magazine, January 1996 - February 1997.
14. Editorial board member of the IEEE Computer Society - Computer Science & Engineering Practice Board.

Program Chairmanships

1. Program co-chair for Middleware 2003, 4th IFIP/ACM/USENIX International Conference on Distributed Systems Platforms, Rio de Janeiro, Brazil, June 2003.
2. Area vice-chair and session chair for Middleware at the 23rd IEEE International Conference on Distributed Computing Systems (ICDCS), May 2003, Providence, RI.
3. Program co-chair for the 4th International Symposium on Distributed Objects and Applications, October 28–November 1, 2002, Irvine, CA.
4. Co-organizer of the cross-agency Software Design and Productivity Coordinating Group Workshop on New Visions for Software Design and Productivity: Research and Applications, December 13-14, Nashville, TN.
5. Program co-chair for the 3rd International Symposium on Distributed Objects and Applications, September 18-20, 2001, Rome, Italy.
6. Co-organizer of the cross-agency Workshop on New Visions for Software Design and Productivity, April 18-19, 2000, Ballston, VA.
7. Area vice-chair and session chair for Middleware at the IEEE International Conference on Distributed Computing Systems, April 16-19, Phoenix, AZ, 2001.
8. Tutorial chair for the 6th USENIX Conference on Object-Oriented Technologies and Systems, January 27 - February 3, 2001, San Antonio, TX.
9. Co-chair of the OMG Workshop on Real-time and Embedded CORBA, in Reston, VA, July 24-27, 2000.
10. General chair of the IFIP/ACM International Conference Middleware 2000 in New York, Spring, 2000.
11. Tutorial chair for the 5th USENIX Conference on Object-Oriented Technologies and Systems, May 3-7, 1999, San Diego, CA.
12. Treasurer for the Fourth International Workshop on Object-oriented Real-time Dependable Systems (WORDS'99) January 27-29, 1999, Radisson Hotel, Santa Barbara, California, USA.
13. Tutorial chair for the 4th USENIX Conference on Object-Oriented Technologies and Systems, April 27-30, 1998, Santa Fe, New Mexico.
14. Co-chair of the mini-track on Engineering Client-Server Systems for the HICSS-31 conference, the Big Island of Hawaii - January 6-9, 1998.
15. Tutorial chair for the 3rd USENIX Conference on Object-Oriented Technologies and Systems, Portland, OR, June 1997.
16. Publicity chair for the 5th IEEE International Workshop on Object-Orientation in Operating Systems, IEEE TCOS and USENIX, Seattle, Washington, October 27-28, 1996.
17. Program chair for 3rd conference on Programming Languages of Programming, Allerton, IL, USA, September, 1996.
18. Program chair for the 2nd USENIX Conference on Object-Oriented Technologies, June 1996.

Program Committees

1. Technical program committee member of the SPIE/ACM Conference on Multimedia Computing and Networking, Santa Clara, California, January 29-31, 2003.
2. Technical program committee member of SC 2002, Baltimore, MD, November 16-22, 2002.
3. Technical program committee member of DS-RT 2002, Fort Worth TX October 11-13 2002.
4. Member of the steering committee for EMSOFT 2002: Second Workshop on Embedded Software, Grenoble, France, October, 7–9th, 2002.
5. Technical program committee member of the 8th IEEE Real-Time and Embedded Technology and Application Symposium (RTAS), San Jose, CA, September 24-27, 2002.

6. Technical program committee member of the Workshop on Dependable Middleware-Based Systems, held as a part of DSN 2002, Washington, D.C., June 23-36, 2002.
7. Technical program committee member of the OMG Real-time/Embedded CORBA workshop, Washington, DC, July 15–18, 2002.
8. Technical program committee member of the 16th European Conference on Object-Oriented Programming, University of Malaga, Spain June 10-14, 2002.
9. Technical program committee member of the Tenth International Workshop on Quality of Service (IWQoS), May 15-17, 2002, Miami Beach, Florida.
10. Technical program committee member of International Symposium on Object-Oriented Real-time Distributed Computing (ISORC), Washington DC, April 29 – May 1, 2002.
11. Technical program committee member for the Seventh IEEE International Workshop on Object-oriented Real-time Dependable Systems (WORDS 2002), January 7-9, 2002, San Diego, CA.
12. Member of the steering committee for EMSOFT 2001: First Workshop on Embedded Software, Lake Tahoe, California, October, 8th–10th, 2001.
13. Technical program committee member for the International Workshop on Multimedia Middleware October 5th, 2001, Ottawa, Canada.
14. Technical program committee member for the OMG Workshop on Real-time and Embedded CORBA, in Reston, VA, June 4-6, 2001.
15. Technical program committee member for the USENIX 2001 conference, Boston, MA, June 25-30, 2001.
16. Technical program committee member for the International Symposium on Object-oriented Real-time Distributed Computing (ISORC), May 2-4, Magdenburg, Germany, 2001.
17. Technical program committee member for the 6th USENIX Conference on Object-Oriented Technologies and Systems, January 27 - February 3, 2001, San Antonio, TX.
18. External reviewer for OOPSLA 2000, Minneapolis, MN, October 2000.
19. Technical program committee member for the 3rd IFIP International Conference on Trends towards a Universal Service Market (USM'2000), September 12-14, 2000.
20. Technical program committee member for the International Symposium on Distributed Objects and Applications (DOA '00), OMG, Antwerp, Belgium, September 2000.
21. Technical program committee member for the ACM SIGCOMM 2000, Stockholm, Sweden, August 30 to September 1st, 2000.
22. Technical program committee for the Pattern Languages of Programming (PLoP) conference, Monticello, Illinois, August, 2000.
23. Technical program committee member for the 9th IEEE International Conference on High-Performance Distributed Computing, August, 2000.
24. Technical program committee member for the “International Workshop on Software Engineering for Parallel and Distributed Systems” (PDSE 2000), at the 22nd International Conference on Software Engineering (ICSE-2000), in Limerick, Ireland in June, 2000.
25. Technical program committee member for the 6th IEEE Real-Time Technology and Application Symposium (RTAS), May 17-19, 2000, Washington DC, USA.
26. Technical program committee member for the 1999 ACM OOPSLA conference, Denver, Colorado, November 1-5, 1999.
27. Technical program committee member for the IFIP Sixth International Workshop on Protocols For High-Speed Networks (PfHSN '99), Wednesday August 25 – Friday August 27, 1999 Salem, MA.
28. Technical program committee member for the 1999 IEEE Real-Time Technology and Applications Symposium (RTAS99), Vancouver, British Columbia, Canada, June 2-4, 1999.
Technical program committee member for the 5th USENIX Conference on Object-Oriented Technologies and Systems, May 3-7, 1999, San Diego, CA.

29. Technical workshop committee for the International Software Architecture workshop, ACM SIGSOFT's FSE9 conference in Orlando FL, November 1-5, 1998.
30. Technical program committee for the workshop on Software and Performance (WOSP98), Santa Fe, New Mexico, Oct 12-16 1998.
31. Technical program committee for the IFIP International Conference on Distributed Systems Platforms and Open Distributed Processing: Middleware '98. September 15-18 1998, The Lake District, England.
32. Technical program committee for the TOOLS USA'98 conference. Santa Barbara, California, August 3 - 7, 1998.
33. Technical program committee for the IEEE High Performance Distributed Computing conference, Chicago, IL, July 28-31, 1998.
34. Technical program committee for 12th European Conference on Object-Oriented Programming, Brussels, Belgium, July 20 - 24, 1998.
35. Technical program committee for the 3rd EuroPLoP conference, Kloster Irsee, Germany, July 9-11, 1998.
36. Technical program committee of IEEE International Conference on Configurable Distributed Systems (ICCDs '98), Annapolis, MD, May 4-6, 1998.
37. Technical program committee of IEEE IWQoS '98 in Napa Valley, CA, May 18-20, 1998.
38. Technical program committee member for the 4th USENIX Conference on Object-Oriented Technologies and Systems, April 26-29, 1998, Santa Fe, New Mexico.
39. Technical program committee member for the 3rd International Workshop on Software Engineering for Parallel and Distributed Systems, at the 20th International Conference on Software Engineering (ICSE-20), in April 20-21, Kyoto, Japan.
40. Technical program committee for the IEEE Conference on Open Architectures and Network Programming, April 3-4, 1998, San Francisco, CA.
41. Technical program committee for the Workshop on Middleware for Real-Time Systems and Services, held in conjunction with IEEE Real-time Systems Symposium, December 2nd, San Francisco, California.
42. Technical program committee for the Open Signaling for ATM, Internet and Mobile Networks. October 6th and 7th, 1997, Columbia University, New York, NY.
43. Technical program committee member for the 24th International Conference on Technology of Object-Oriented Languages and Systems (TOOLS Asia '97). Beijing, China, September 22 - 25, 1997.
44. Technical program committee for the 4th Pattern Languages of Programming conference, Allerton Park, Illinois, September 3-5, 1997.
45. Technical program committee member for the 3rd USENIX Conference on Object-Oriented Technologies and Systems, Portland, June 16-19th 1997.
46. Session chair of the Patterns technical paper session at ECOOP '97, June 13th, 1997.
47. Technical program committee member for the 1997 European Conference on Object-Oriented Programming (ECOOP), June 9-13, 1997, Jyväskylä, Finland.
48. Chair of the technical session on "Distributed Object Computing" for the IFIP/IEEE Fifth International Workshop on Quality of Service (IWQoS '97).
49. Technical program committee member for the 2nd International Workshop on Software Engineering for Parallel and Distributed Systems, at the 19th International Conference on Software Engineering (ICSE-19) Sheraton Boston Hotel and Towers, Boston, Massachusetts, USA, May 19 and 20, 1997.
50. Technical program committee member for the 3rd USENIX Conference on Object-Oriented Technologies and Systems, Portland, 1997.

51. Technical program committee member for the 5th IEEE International Workshop on Object-Orientation in Operating Systems, IEEE TCOS and USENIX, Seattle, Washington, October 27-28, 1996.
52. Technical program committee for the 1997 ACM SIGCOMM conference.
53. Technical program committee for the 1995, 1996, and 1997 IEEE INFOCOM conferences.
54. Technical program committee for the 3rd IEEE workshop on Architecture and Implementation of High Speed Communication Subsystems (HPCS '95), held in Mystic, Connecticut, August 1995.
55. Technical program committee for the 8th *IFIP International Working Conference on Upper Layer Protocols, Architectures, and Applications*, held in Barcelona, Spain, June 1 to 3, 1994.

Workshops Organized

1. Co-organizer of the OOPSLA '01 workshop "Towards Patterns and Pattern Languages for OO Distributed Real-time and Embedded Systems" Tampa Bay, FL, October 14, 2001.
2. Organizer and chair of a panel on real-time extensions to OO middleware, OPENSIG Fall '97 workshop on Open Signaling for ATM, Internet and Mobile Networks Columbia University, October 6-7 1997, New York, NY.
3. Co-organizer of a workshop for the 1997 European Conference on Object-Oriented Programming entitled CORBA: Implementation, Use, and Evaluation, Jyvaskyla, Finland, June 10th, 1997.
4. Organizer and chair of a panel on "QoS and Distributed Systems Platforms" for the IFIP Fifth International Workshop on Quality of Service (IWQoS '97), May 22-24th, 1997, Columbia University, New York.
5. Co-organizer of the OOPSLA '95 workshop on "Patterns for Concurrent, Parallel, and Distributed OO Systems" together with Greg Lavender of the ISODE Consortium and Dennis Kafura of Virginia Tech.
6. Co-facilitator of the ECOOP '95 workshop on Pattern Languages of Object-Oriented Programs together with Frank Buschmann of SIEMENS AG Corporate Research and Development, held in Aarhus, Denmark, August 1995.

Reviewer for Professional Submittals

Refereed papers for the following journals, conferences, and grant review processes:

1. Elsevier Journal of Systems and Software Special Issue on Software Architecture: Engineering Quality Attributes, 2002.
2. IEEE Communications Magazine, Evolving Communications Software: Techniques and Technologies, 2001.
3. DARPA Network Embedded Software Technology (NEST) program, 2001.
4. DARPA Software Enabled Control (SEC) program, 2000.
5. IEEE Concurrency magazine, Object-Oriented Systems Track, 1999
6. IEEE Journal on Selected Areas in Communications special issue on "Service Enabling Platforms for Networked Multimedia Systems," 1999.
7. IEEE Journal of Communications and Networks, 1999.
8. Reviewer for the 4th Pattern Languages of Programming Design book published by Addison Wesley.
9. The International Journal of Time-Critical Computing Systems, special issue on Real-time Middleware, edited by Wei Zhao.
10. Next Generation Internet (NGI) networking research review panel, October 1998.
11. IEE Transactions on Software Engineering, special issue on Configurable Distributed Systems.

12. Theme issue on Symbolic Modeling in Practice for the Communications of the ACM.
13. "Multimedia DBMS and the WWW" Minitrack at the 32nd Hawaii International Conference on System Sciences, 1999.
14. "Dependable Distributed Systems" Minitrack at the 32nd Hawaii International Conference on System Sciences, 1999.
15. IEEE Computer special issue on "Design Challenges for High-Performance Network Interfaces," 1998.
16. 1998 NSF Experimental Software Systems review panel.
17. ACM SIGMetrics Conference, 1998.
18. ACM Transactions on Software Engineering Methods.
19. Special Issue on Patterns and Pattern Languages for the journal of Theory and Practice of Object Systems, (Stephen P. Berczuk, Editor), John Wiley and Sons, 1995.
20. Special Issue of Computer Communications on Building Quality of Service into Distributed Systems.
21. IEEE Communications Magazine.
22. IEEE/ACM Journal of Transactions on Networking.
23. Communications of the ACM.
24. IEE/BCS Distributed Systems Engineering Journal.
25. Software Practice and Experience, John Wiley and Sons.
26. 1998, 1997, and 1996 NSF networking program.
27. 1996 NSF software engineering and programming languages CAREER panel.
28. 1994 California MICRO (Microelectronics Innovation Computer Research Opportunity) engineering computer network grant review process.
29. IEEE Conference on Parallel and Distributed Computing Systems, 1994.
30. IEEE International Conference on Computer Communications and Networks, 1994.
31. IEEE INFOCOM conference, 1994.
32. 1993 NASA Applied Information Systems Research grant review process.
33. 1992 California MICRO (Microelectronics Innovation Computer Research Opportunity) engineering computer network grant review process.
34. 7th *IFIP International Conference on Upper Layer Protocols, Architectures, and Applications*, 1992.
35. The 1992 Special Issue on Measurement for IEEE Journal Transactions on Software Engineering.

Memberships: IEEE, ACM, and USENIX

Courses Taught

Courses at University of California, Irvine

1. ECE 011 Computational Methods in ECE, Winter 2000
2. ECE 255 Distributed Software Architecture Design, Spring 2000

Courses at Washington University, St. Louis

1. CS 562 Advanced Object-Oriented Software Development with Patterns and Frameworks, Spring 1999
2. CS 242 Introduction to Software Design, Spring 1998
3. CS 673 Distributed Systems research seminar, Fall 1997

4. CS 422 Operating Systems Organization, Fall 1997
5. CS 242 Introduction to Software Design, Spring 1997
6. CS 544 Distributed System Design, Fall 1996
7. Ada tasking course for McDonnell Douglas, Fall 1996
8. OO design course for McDonnell Douglas, Spring 1996
9. CS 523 Distributed Operating Systems Organization, Spring 1995
10. CS 242 Introduction to Software Design, Fall 1995
11. CS 673 Distributed Systems research seminar, Spring 1995
12. CS 422 Operating Systems Organization, Fall 1994

Theses Supervised

- *Doctoral and masters Committees*

1. Served on final doctoral thesis committee for Irfan Pyarali, December, 2001.
2. Served on final doctoral thesis committee for Chris Gill, December, 2001.
3. Chaired thesis topic defense committee for Carlos O’Ryan, September, 2001.
4. Served as external examiner for Daniel Heggander’s Ph.D. thesis in the Department of Software Engineering and Computer Science at Blekinge Institute of Technology, Sweden, September, 2001.
5. Served as external examiner for Mohammad Radaideh’s masters thesis in the Electrical Engineering department at McMaster’s University, Canada, Winter 2000.
6. Served as external examiner for David Holmes’ Ph.D. thesis in the information and computer sciences department at Macquarie University, Sydney, Fall 1999.
7. Served on final doctoral thesis committee for Priya Narasimhan, August, 1999.
8. Chaired masters committee for Nagarajan Surendran, August, 1999.
9. Served on Doctoral final thesis defense for Christo Papadopoulos, August, 1999.
10. Chaired masters committee for Alexander Babu Arulanthu, July, 1999.
11. Chaired oral exam committee for Chris Gill, June, 1999.
12. Served on thesis topic defense for Michael Plezbert, February, 1999.
13. Served on masters committee for Craig Nauman, February, 1999.
14. Served on doctoral exam committee for Chuck Cranor, July, 1998.
15. Chair of doctoral exam committee for Andy Gokhale, May, 1998.
16. Chair of masters exam committee for Sumedh Mungee, May, 1998.
17. Chair of masters exam committee for Sergio Flores, May, 1998.
18. Served on masters exam committee for Mihai Tutunaru, April, 1998.
19. Served on doctoral exam committee for Michael Plezbert, June, 1997.
20. Served on masters committee for Todd Rogers, June 1997.
21. Chair of masters committee for Prashant Jain, June 1997.
22. Chair of doctoral topic defense for James Hu, February 1997.
23. Chair of masters committee for Tim Harrison, February 1997.
24. Served on masters committee for Robert Engel, January 1997.
25. Served on committee for final doctoral thesis defense of R. Gopalakrishnan, November, 1996.
26. Chair of doctoral topic defense committee for Andy Gokhale, October, 1996.
27. Served on committee for final doctoral thesis defense of Lorrie Cranor, September, 1996.
28. Served on doctoral thesis topic proposal committee for Christos Papadopoulos July, 1995.
29. Served on doctoral thesis topic proposal committee for Charles Cranor December, 1994.
30. Served on oral exam committee for Andy Gokhale December, 1994.
31. Served on doctoral thesis proposal committee for Lorrie Cranor, December, 1994.
32. Served on doctoral final thesis defense committee for Donald Wilcox, November, 1994.
33. Served on masters committee for Madhavapeddi. Shreedhar, September, 1994

34. Served on doctoral thesis topic proposal committee for R. Gopalakrishnan, September, 1994.

- *Full-time Staff*

1. Dr. Raymond Klefstad

- *Doctoral Student Advisees*

1. Angelo Corsaro (UCI)
2. Ossama Othman (UCI)
3. Mayur Deshpande (UCI)
4. Nanbor Wang (WU)

- *Masters Student Advisees*

1. Arvind Krishna (UCI)
2. Sumita Rao (UCI)
3. Jaiganesh Balasubramanian (UCI)

- *Graduated students and staff*

1. Alexander Babu Arulanthu, MS 1999, working for Sylanro in Campbell, CA.
2. Everett Anderson, BS 1998, working for Sun, Mountain View, CA.
3. Shawn Atkins, BS 1998, working at Lucent, in Columbus, OH.
4. Darrell Brunsch, BS 1999, working at Microsoft, Redmond, WA.
5. Matt Braun, BS 1998, living in New Zealand with his mother, Carol Mosley-Braun, who is US ambassador to New Zealand.
6. Chris Cleeland, working for OCI in St. Louis, MO.
7. Sergio Flores-Gaitan, MS 1998, working at Microsoft, Redmond, WA.
8. Chris Gill, PhD 2001, Assistant Professor, Washington University, St. Louis, MO.
9. Andy Gokhale, PhD 1998, Research Scientist at Vanderbilt University, Nashville, TN.
10. Priyanka Gontla, MS 2000, working for OCI, Irvine, CA.
11. Pradeep Gore, MS 2000, working for OOMWorks, St. Louis, MO.
12. Tim Harrison, MS 1997, working for Mayasoft, Palo Alto, CA.
13. Prashant Jain, MS 1997, working at Siemens ZT in Munich, Germany.
14. Vishal Kachroo, MS 1999, working at Stentorsoft, CA.
15. Michael Kircher, BS 1998, working at Siemens ZT in Munich, Germany.
16. Yamuna Krishnamurthy, MS 2000, working at OOMWorks, St. Louis, MO.
17. Fred Kuhns, Research Associated, Washington University, St. Louis, MO.
18. David Levine, Director of Engineering, CombineNet, Inc, Pittsburg, PA.
19. Sumedh Mungee, MS 1998, working at Fujitsu in Santa Clara, CA.
20. Bala Natarajan, MS 2000, Research Associate, Washington University, St. Louis, MO.
21. Carlos O’Ryan, MS 2000, working at AT Desk, Charleston, SC.
22. Kirthika Parameswaran, MS 2000, working at Telcordia, Morristown, NJ.
23. Irfan Pyarali, PhD 2001, working for OOMWorks, St. Louis, MO.
24. Marina Spivak, MS 2000, working at AT Desk, Charleston, SC.
25. Nagarajan Surendran, MS 1999, working for Sylanro in Campbell, CA.
26. Seth Widoff, BS 1998, working as an independent consultant, San Francisco, CA.

Department/School/Community Service

Service at Washington University, St. Louis

1. Faculty recruiting committee
2. CS committee on recruiting industrial graduate students (RIGS)
3. CEITR: CS Experimental Infrastructure for Teaching and Research
4. Introductory course committee
5. Graduate admission committee
6. CS representative to the CEC advisory board
7. CS departmental chair search committee

Consulting Work

1. ARINC, Fountain Valley, CA
2. ACM, NY, NY
3. Anderson Consulting, Chicago, IL
4. BellSouth, Atlanta, GA
5. Boeing, St. Louis, MO
6. Credit Suisse, Zurich, Switzerland
7. AG Communication Systems, Phoenix, AZ
8. AT&T Research, Murray Hill, NJ
9. Bellcore, Morristown, NJ
10. Edward D. Jones, St. Louis, MO
11. Envision Inc. St. Louis, MO
12. Ericsson, Cypress, CA
13. Jet Propulsion Lab, Pasadena, CA
14. Kodak Imaging, Rochester, NY
15. Lockheed Martin Tactical Systems, Minneapolis, MN
16. Lucent Bell Labs, Naperville, IL
17. Lucent Bell Labs, Murray Hill, NJ
18. Lucent, Whippany, NJ
19. McDonnell Douglas, St. Louis, MO
20. Microsoft, Redmond, WA
21. Morgan Stanley, New York, NY
22. Motorola Iridium, Chandler, AZ
23. Motorola LAN Mobile Products, Chicago, IL
24. National Security Agency, Ft. Meade, MD
25. Naval Air Weapons Stations, China Lake, CA
26. Nortel, Ottawa, Canada
27. Object Computing Institute, St. Louis, MO
28. Object Technologies International, Ottawa, CA
29. Odetics Broadcasting, Anaheim, CA
30. Raytheon, San Diego, CA
31. SAIC, Washington D.C.
32. Siemens Medical Engineering, Erlangen, Germany
33. Siemens Corporate Research, Princeton, NJ
34. SIGS, New York, NY
35. Teradyne, Chicago, IL
36. UC Berkeley Extension, Palo Alto, CA
37. USENIX, Lake Forest, CA

Publications

In Print

- **Refereed Journal Publications**

- J37 Douglas C. Schmidt and Carlos O’Ryan, “Patterns and Performance of Distributed Real-time and Embedded Publisher/Subscriber Architectures,” Submitted to the Journal of Systems and Software, Special Issue on Software Architecture – Engineering Quality Attributes, edited by Jan Bosch and Lars Lundberg, 2002.

- J36 Carlos O’Ryan, Douglas C. Schmidt, and J. Russell Noseworthy, “Patterns and Performance of a CORBA Event Service for Large-scale Distributed Interactive Simulations,” *International Journal of Computer Systems Science and Engineering*, CRL Publishing, Volume 17, Number 2, March, 2002.
- J35 Douglas C. Schmidt, Bala Natarajan, Aniruddha Gokhale, Nanbor Wang, and Chris Gill, “TAO: A Pattern-Oriented Object Request Broker for Distributed Real-time and Embedded Systems,” *IEEE Distributed Systems Online*, Volume 3, Number 2, February, 2002.
- J34 Douglas C. Schmidt, Rick Schantz, Mike Masters, Joseph Cross, David Sharp, and Lou DiPalma, “Towards Adaptive and Reflective Middleware for Network-Centric Combat Systems,” *CrossTalk*, November, 2001.
- J33 Nanbor Wang, Douglas C. Schmidt, Ossama Othman, and Kirthika Parameswaran, “Evaluating Meta-Programming Mechanisms for ORB Middleware,” *IEEE Communications Magazine* special issue on “Evolving Communications Software: Techniques and Technologies,” co-edited by Bill Opdyke and Algirdas Pakstas, Volume 39, Number 10, October, 2001.
- J32 Nanbor Wang, Douglas C. Schmidt, Kirthika Parameswaran, and Michael Kircher, “Towards a Reflective Middleware Framework for QoS-enabled CORBA Component Model Applications,” *IEEE Distributed Systems Online* special issue on Reflective Middleware, July, 2001.
- J31 Chris Gill, David Levine, and Douglas C. Schmidt, “The Design and Performance of a Real-Time CORBA Scheduling Service,” *The Real-time Systems, The International Journal of Time-Critical Computing Systems*, special issue on Real-Time Middleware, Kluwer Academic Publishers, guest editor Wei Zhao, Volume 20, Number 2, March 2001.
- J30 Douglas C. Schmidt, Sumedh Mungee, Sergio Flores-Gaitan, and Aniruddha Gokhale, “Software Architectures for Reducing Priority Inversion and Non-determinism in Real-time Object Request Brokers,” *Journal of Real-time Systems*, Kluwer, Vol. 21, No. 2, 2001.
- J29 Ossama Othman, Carlos O’Ryan, and Douglas C. Schmidt, “An Efficient Adaptive Load Balancing Service for CORBA,” *IEEE Distributed Systems Online*, March, 2001.
- J28 Ossama Othman, Carlos O’Ryan, and Douglas C. Schmidt “The Design of an Adaptive CORBA Load Balancing Service,” *IEEE Distributed Systems Online*, April, 2001.
- J27 Carlos O’Ryan, Douglas C. Schmidt, Fred Kuhns, Marina Spivak, Jeff Parsons Irfan Pyarali, and David L. Levine, “Evaluating Policies and Mechanisms to Support Distributed Real-Time Applications with CORBA,” *Concurrency and Computing: Practice and Experience* (Special Issue on Distributed Objects and Applications), Wiley and Sons, Vol. 13, No. 2, February, 2001.
- J26 Douglas C. Schmidt, Vishal Kachroo, Yamuna Krisnamurthy, and Fred Kuhns, “Developing Next-generation Distributed Applications with QoS-enabled DPE Middleware,” *IEEE Communications magazine*, edited by Abdi Modarressi and Sheshadri Mohan, Vol 17, No. 10, October, 2000.
- J25 Douglas C. Schmidt and Fred Kuhns, “An Overview of the Real-time CORBA Specification,” *IEEE Computer*, Special Issue on Object-Oriented Real-time Distributed Computing, edited by Eltefaat Shokri and Philip Sheu, June 2000.
- J24 James Hu and Douglas C. Schmidt, Developing Flexible and High-performance Web Servers with Frameworks and Patterns, Symposium on Frameworks, *ACM Computing Surveys*, (Fayad and Wegner, eds.) Vol. 32(1es), March 2000.
- J23 Fred Kuhns, Douglas C. Schmidt, Carlos O’Ryan, and David L. Levine, “Supporting High-performance I/O in QoS-enabled ORB Middleware,” *Cluster Computing: the Journal on Networks, Software, and Applications*, Volume 3, Number 3, 2000.
- J22 Irfan Pyarali, Carlos O’Ryan, Douglas C. Schmidt, Nanbor Wang, Vishal Kachroo, and Aniruddha Gokhale, “Using Principle Patterns to Optimize Real-time ORBs,” *IEEE*

- Concurrency*, Object-Oriented Systems track, edited by Murthy Devarakonda, Volume 8, Number 1, January-March 2000.
- J21 James Hu, Irfan Pyarali, and Douglas C. Schmidt, "The Object-Oriented Design and Performance of JAWS: A High-performance Web Server Optimized for High-speed Networks," *The Parallel and Distributed Computing Practices* journal, special issue on Distributed Object-Oriented Systems, edited by Maria Cobb, Vol. 3, No. 1, March 2000.
- J20 Andy Gokhale and Douglas C. Schmidt, "Optimizing a CORBA IIOP Protocol Engine for Minimal Footprint Multimedia Systems," *IEEE Journal on Selected Areas in Communications* special issue on Service Enabling Platforms for Networked Multimedia Systems, September, 1999.
- J19 Douglas C. Schmidt and Chris Cleeland, "Applying Patterns to Develop Extensible and Maintainable ORB Middleware," *IEEE Communications Magazine*, April, 1999.
- J18 Irfan Pyarali and Douglas C. Schmidt, "An Overview of the CORBA Portable Object Adapter," Special Issue on CORBA in the *ACM StandardView* magazine, March, 1999.
- J17 Prashant Jain, Seth Widoff, and Douglas C. Schmidt, "The Design and Performance of MedJava, A Distributed Electronic Medical Imaging System Developed with Java Applets and Web Tools," *IEEE/BCS Distributed Systems Engineering Journal*, Volume 5, No. 4, December 1998.
- J16 Douglas C. Schmidt, "Evaluating Architectures for Multi-threaded CORBA Object Request Brokers," *Communications of the ACM*, Special Issue on CORBA, ACM, edited by Krishnan Seetharaman, Volume 41, No. 10, October 1998.
- J15 Andy Gokhale and Douglas C. Schmidt, "Measuring and Optimizing CORBA Latency and Scalability Over High-speed Networks," *IEEE Transactions on Computing*, April, 1998.
- J14 Douglas C. Schmidt and James Hu, "Developing Flexible and High-performance Web Servers with Frameworks and Patterns," *Computing Surveys*, ACM, Vol. 29, March 1998.
- J13 Douglas C. Schmidt, David Levine, and Sumedh Mungee, "The Design of the TAO Real-Time Object Request Broker," *Computer Communications*, Special Issue on Building Quality of Service into Distributed System, Elsevier Science, April, 1998.
- J12 Guru Parulkar, Douglas C. Schmidt, Eileen Kraemer, Jon Turner, Anshul Kantawala, "An Architecture for Monitoring, Visualization, and Control and Gigabit Networks," *IEEE Network*, September/October, 1997.
- J11 Douglas C. Schmidt, "Lessons Learned Building Reusable OO Frameworks for Distributed Software," *Communications of the ACM* Special Issue on OO Application Frameworks, ACM, Vol. 40, No. 10, October, 1997.
- J10 Douglas C. Schmidt, "Applying Patterns to Meet the Challenges of Concurrent Software," *IEEE Concurrency*, Special Edition on Software Engineering for Parallel and Distributed Systems, Vol. 5, No. 3, August, 1997.
- J9 Douglas C. Schmidt, Andy Gokhale, Tim Harrison, and Guru Parulkar, "A High-performance Endsystem Architecture for Real-time CORBA," *IEEE Communications Magazine*, Vol. 14, No. 2, February, 1997.
- J8 Silvano Maffei and Douglas C. Schmidt, "Constructing Reliable Distributed Communication Systems with CORBA," *IEEE Communications Magazine*, Vol. 14, No. 2, February, 1997.
- J7 Douglas C. Schmidt, "Using Design Patterns to Develop Reusable Object-Oriented Software," *ACM Computing Surveys*, Vol. 28, No. 4es, December 1996.
- J6 Irfan Pyarali, Douglas C. Schmidt, and Tim Harrison, "Design and Performance of an Object-Oriented Framework for High-Speed Electronic Medical Imaging," *USENIX Computing Systems*, November/December, Vol. 9, No. 4, 1996.
- J5 Douglas C. Schmidt, "A Family of Design Patterns for Application-level Gateways," *The Journal of Theory and Practice of Object Systems* (Special Issue on Patterns and

- Pattern Languages), Wiley and Sons, Vol. 2, No. 1, 1996.
- J4 Douglas C. Schmidt, "Experience Using Design Patterns to Develop Reuseable Object-Oriented Communication Software," *Communications of the ACM Special Issue on Object-Oriented Experiences*, ACM, Vol. 38, No. 10, October, 1995, pp 65–74.
- J3 Douglas C. Schmidt and Tatsuya Suda, "An Object-Oriented Framework for Dynamically Configuring Extensible Distributed Systems," *Distributed Systems Engineering Journal* (Special issue on Configurable Distributed Systems), IEE, Vol. 2, December, 1994, pp. 280–293.
- J2 Douglas C. Schmidt, Donald F. Box, and Tatsuya Suda, "ADAPTIVE: A Dynamically Assembled Protocol Transformation, Integration, and eValuation Environment," *Journal of Concurrency: Practice and Experience*, Wiley and Sons, Ltd., Vol. 5, No. 4, June, 1993, pp. 269–286.
- J1 Douglas C. Schmidt and Tatsuya Suda, "Transport System Architecture Services for High-Performance Communication Systems," *Journal of Selected Areas of Communications special-issue on Protocols for Gigabit Networks*, IEEE, Vol. 11, No. 4, May, 1993, pp. 489–506.

- **Book Publications and Book Chapters**

- **Books Authored**

- BA2 Douglas C. Schmidt and Steve Huston, *C++ Network Programming: Mastering Complexity with ACE and Patterns*, Addison-Wesley Longman, 2001.
- BA1 Douglas C. Schmidt, Michael Stal, Hans Rohert, and Frank Buschmann, *Pattern-Oriented Software Architecture: Patterns for Concurrent and Networked Objects*, John Wiley and Sons, 2000.

- **Books Edited**

- BE3 Co-editor of *Building Application Frameworks: Object-Oriented Foundations of Framework Design*, John Wiley & Sons, 1999 (co-editors are Mohamed Fayad and Ralph Johnson), ISBN 0-471-24875-4
- BE2 Co-editor of *Implementing Application Frameworks: Object-Oriented Frameworks at Work*, John Wiley & Sons, 1999 (co-editors are Mohamed Fayad and Ralph Johnson), ISBN 0-471-25201-8
- BE1 Co-editor of *Pattern Languages of Program Design*, Addison-Wesley, 1995 (co-editor is Jim Coplien, Bell Labs).

- **Book Chapters**

- BC30 Richard E. Schantz and Douglas C. Schmidt, "Middleware for Distributed Systems: Evolving the Common Structure for Network-centric Applications," *Encyclopedia of Software Engineering*, edited by John Marciniak and George Telecki, Wiley and Sons, 2001.
- BC29 Sumedh Mungee, Nagarajan Surendran, Yamuna Krishnamurthy, and Douglas C. Schmidt "The Design and Performance of a CORBA Audio/Video Streaming Service," *Multimedia Networking: Technology, Management, and Applications*, edited by Mahbubur Syed, Idea Group Publishing, Hershey, USA, 2001.
- BC28 Nanbor Wang, Douglas C. Schmidt, and Carlos O'Ryan "An Overview of the CORBA Component Model," *Component-Based Software Engineering*, (George Heineman and Bill Councill, eds.), Addison-Wesley, Reading, MA, 2001.
- BC27 Douglas C. Schmidt, "Applying a Pattern Language to Develop Application-Level Gateways," *Design Patterns in Communications*, (Linda Rising, ed.), Cambridge University Press, 2000.
- BC26 Douglas C. Schmidt and Chris Cleeland, "Applying a Pattern Language to Develop Extensible ORB Middleware," *Design Patterns in Communications*, (Linda Rising, ed.), Cambridge University Press, 2000.

- BC25 Carlos O’Ryan, Fred Kuhns, Douglas C. Schmidt, and Jeff Parsons, “Applying Patterns to Develop a Pluggable Protocols Framework for Object Request Broker Middleware,” *Design Patterns in Communications*, (Linda Rising, ed.), Cambridge University Press, 2000.
- BC24 David L. Levine, Christopher D. Gill, and Douglas C. Schmidt, “Object Lifecycle Manager – A Complementary Pattern for Controlling Object Creation and Destruction,” *Design Patterns in Communications*, (Linda Rising, ed.), Cambridge University Press, 2000.
- BC23 Douglas C. Schmidt, “A Family of Design Patterns For Flexibly Configuring Network Services in Distributed Systems,” *Design Patterns in Communications*, (Linda Rising, ed.), Cambridge University Press, 2000.
- BC22 James Hu and Douglas C. Schmidt, “JAWS: A Framework for High-performance Web Servers,” *Object-Oriented Application Frameworks* book, John Wiley & Sons, October, 1999.
- BC21 Chris Cleeland and Douglas C. Schmidt, “External Polymorphism, An Object Structural Pattern for Transparently Extending C++ Concrete Data Types” in *C++ Gems II*, (Robert Martin, ed.), SIGS, NY, 1999.
- BC20 Douglas C. Schmidt, “GPERF: A Perfect Hash Function Generator” in *C++ Gems II*, (Robert Martin, ed.), SIGS, NY, 1999.
- BC19 Douglas C. Schmidt, Tim H. Harrison, and Nat Pryce, “Thread-specific Storage: an Object Behavioral Pattern for Efficiently Accessing per-Thread State” in *C++ Gems II*, (Robert Martin, ed.), SIGS, NY, 1999.
- BC18 Irfan Pyarali, Tim Harrison, Douglas C. Schmidt, and Thomas Jordan, “Proactor: an Object Behavioral Pattern for Demultiplexing and Dispatching Handlers for Asynchronous Events,” *Pattern Languages of Program Design*, (Harrison, Foote, and Rohnert, eds.), Addison-Wesley, Reading, MA, 1999.
- BC17 Douglas C. Schmidt and Paul Stephenson, “Using Design Patterns to Evolve System Software from UNIX to Windows NT,” In *The Patterns Handbook*, (Linda Rising, ed.), Cambridge University Press, 1998.
- BC16 Douglas C. Schmidt, David L. Levine, and Chris Cleeland, “Architectures and Patterns for High-performance, Real-time CORBA Object Request Brokers,” *Advances in Computers*, Academic Press, Ed., Marvin Zelkowitz, Volume 48, July 1999.
- BC15 Douglas C. Schmidt and Tatsuya Suda, “A Framework for Measuring the Performance of Alternative Process Architectures for Parallel Communication Subsystems,” in *Network Performance Modeling and Simulation*, Walrand, Bagchi, and Zobrist, Ed., Gordon and Breach Publishers, 1998.
- BC14 Douglas C. Schmidt, “Applying Design Patterns and Frameworks to Develop Object-Oriented Communication Software,” to appear in the *Handbook of Programming Languages*, Volume I, edited by Peter Salus, MacMillan Computer Publishing, 1997.
- BC13 Chris Cleeland, Douglas C. Schmidt, and Tim H. Harrison, “External Polymorphism – An Object Structural Pattern for Transparently Extending Concrete Data Types,” *Pattern Languages of Program Design*, (Martin, Buschmann, and Riehl, eds.), Addison-Wesley, Reading, MA, 1997.
- BC12 Timothy H. Harrison, Douglas C. Schmidt, and Irfan Pyarali, “Asynchronous Completion Token – An Object Behavioral Pattern for Efficient Asynchronous Event Handling,” *Pattern Languages of Program Design*, (Martin, Buschmann, and Riehl, eds.), Addison-Wesley, Reading, MA, 1997.
- BC11 Douglas C. Schmidt and Timothy H. Harrison, “Double-Checked Locking – A Optimization Pattern for Efficiently Initializing and Accessing Thread-safe Objects,” *Pattern Languages of Program Design*, (Martin, Buschmann, and Riehl, eds.), Addison-Wesley, Reading, MA, 1997.
- BC10 Douglas C. Schmidt, “Acceptor and Connector – A Family of Object Creational

- Patterns for Initializing Communication Services,” *Pattern Languages of Program Design*, (Martin, Buschmann, and Riehl, eds.), Addison-Wesley, Reading, MA, 1997.
- BC9 Douglas C. Schmidt and Paul Stephenson, “Using Design Patterns to Evolve System Software from UNIX to Windows NT,” In *Wisdom of the Gurus*, (Charles Bowman, ed.), Cambridge University Press, 1996.
- BC8 Douglas C. Schmidt and Steve Vinoski, “Comparing Alternative Distributed Programming Techniques” in *Wisdom of the Gurus*, (Charles Bowman, ed.), Cambridge University Press, 1996.
- BC7 Douglas C. Schmidt, “A Case Study in C++ Design Evolution” in *C++ Gems*, (Stanley Lippman, ed.), SIGS, NY, 1996, pp. 99–120.
- BC6 Douglas C. Schmidt and Steve Vinoski, “Distributed Object Computing in C++” in *C++ Gems*, (Stanley Lippman, ed.), SIGS, NY, 1996, pp. 303–316.
- BC5 Douglas C. Schmidt and Steve Vinoski, “Comparing Alternative Distributed Programming Techniques” in *C++ Gems*, (Stanley Lippman, ed.), SIGS, NY, 1996, pp. 316–336.
- BC4 Douglas C. Schmidt and Steve Vinoski, “Comparing Alternative Server Programming Techniques” in *C++ Gems*, (Stanley Lippman, ed.), SIGS, NY, 1996, pp. 337–362.
- BC3 Douglas C. Schmidt and Charles D. Cranor, “Half-Sync/Half-Async: A Architectural Pattern for Efficient and Well-structured Concurrent I/O” in *Pattern Languages of Program Design*, (Coplien, Vlissides, and Kerth, eds.), Addison-Wesley, Reading, MA, 1996.
- BC2 R. Greg Lavender and Douglas C. Schmidt, “Active Object: An Object Behavioral Pattern for Concurrent Programming,” in *Pattern Languages of Program Design*, (Coplien, Vlissides, and Kerth, eds.), Addison-Wesley, Reading, MA, 1996.
- BC1 Douglas C. Schmidt, “Reactor: An Object Behavioral Pattern for Concurrent Event Demultiplexing and Event Handler Dispatching,” *Pattern Languages of Program Design*, (Addison-Wesley, 1995), edited by James O. Coplien and Douglas C. Schmidt.

- **Refereed Conference Publications**

- C62 Richard Schantz and Douglas C. Schmidt, “Research Advances in Middleware for Distributed, Real-time, and Embedded Systems,” Computer Communications stream of the 17th IFIP World Computer Congress, Montreal, Canada, August 25-30, 2002.
- C61 Raymond Klefstad, Douglas C. Schmidt, and Carlos O’Ryan, “Towards Highly Configurable Real-time Object Request Brokers,” the IEEE International Symposium on Object-Oriented Real-time Distributed Computing (ISORC), Washington DC, April 29 – May 1, 2002.
- C60 Angelo Corsaro, Douglas C. Schmidt, Chris Gill, and Ron Cytron, “Formalizing Meta-Programming Techniques to Reconcile Heterogeneous Scheduling Policies in Open Distributed Real-Time Systems,” Proceedings of the 3rd International Symposium on Distributed Objects and Applications, September 8-10, 2001, Rome, Italy.
- C59 David A. Karr, Craig Rodrigues, Yamuna Krishnamurthy, Irfan Pyarali, and Douglas C. Schmidt “Application of the QuO Quality-of-Service Framework to a Distributed Video Application,” Proceedings of the 3rd International Symposium on Distributed Objects and Applications, September 8-10, 2001, Rome, Italy.
- C58 Nanbor Wang, Kirthika Parameswaran, and Douglas C. Schmidt, “The Design and Performance of Meta-Programming Mechanisms for Object Request Broker Middleware,” Proceedings of the 6th USENIX Conference on Object-Oriented Technologies and Systems (COOTS), San Antonio, TX, Jan/Feb, 2001.
- C57 Andy Gokhale, Bala Natarajan, Douglas C. Schmidt and Shalini Yajnik, “Applying Patterns to Improve the Performance of Fault-Tolerant CORBA,” of the 7th International

- Conference on High Performance Computing (HiPC 2000), ACM/IEEE, Bangalore, India, December 2000.
- C56 Andy Gokhale, Bala Natarajan, Douglas C. Schmidt and Shalini Yajnik, "DOORS: Towards High-performance Fault-Tolerant CORBA," Proceedings of the 2nd International Symposium on Distributed Objects and Applications (DOA '00), OMG, Antwerp, Belgium, September 2000.
- C55 Nanbor Wang, Michael Kircher, and Douglas C. Schmidt, "Applying Reflective Techniques to Optimize a QoS-enabled CORBA Component Model Implementation, the 24th Annual International Computer Software and Applications Conference (COMP-SAC 2000), Taipei, Taiwan, October 25-27 2000.
- C54 Irfan Pyarali, Carlos O'Ryan, Douglas C. Schmidt, "A Pattern Language for Efficient, Predictable, Scalable, and Flexible Dispatching Components," Proceedings of the 7th Pattern Language of Programming Conference, Monticello, Illinois, August, 2000.
- C53 Douglas C. Schmidt, Carlos O'Ryan, Irfan Pyarali, Michael Kircher and, Frank Buschmann, "Leader/Followers: A Design Pattern for Efficient Multi-threaded Event Demultiplexing and Dispatching," Proceedings of the 7th Pattern Languages of Programming Conference, Monticello, Illinois, August 2000.
- C52 Carlos O'Ryan, Douglas C. Schmidt, Fred Kuhns, Marina Spivak, Jeff Parsons Irfan Pyarali, and David L. Levine, "Evaluating Policies and Mechanisms for Supporting Embedded, Real-Time Applications with CORBA 3.0," Proceedings of the Sixth IEEE Real-Time Technology and Applications Symposium (RTAS'00), Washington D.C., USA, May 31-June 2, 2000.
- C51 Nanbor Wang, Douglas C. Schmidt, and David Levine, "Optimizing the CORBA Component Model for High-performance and Real-time Applications," Work-in-progress session of the IFIP/ACM Middleware 2000 Conference, Pallisades, New York, April 3-7, 2000.
- C50 Alexander B. Arulanthu, Carlos O'Ryan, Douglas C. Schmidt, Michael Kircher, and Jeff Parsons, "The Design and Performance of a Scalable ORB Architecture for CORBA Asynchronous Messaging," Proceedings of the IFIP/ACM Middleware 2000 Conference, Pallisades, New York, April 3-7, 2000.
- C49 Carlos O'Ryan, Fred Kuhns, Douglas C. Schmidt, Ossama Othman, and Jeff Parsons, The Design and Performance of a Pluggable Protocols Framework for Real-time Distributed Object Computing Middleware, Proceedings of the IFIP/ACM Middleware 2000 Conference, Pallisades, New York, April 3-7, 2000.
- C48 Irfan Pyarali, Carlos O'Ryan, and Douglas C. Schmidt, "A Pattern Language for Efficient, Predictable, Scalable, and Flexible Dispatching Mechanisms for Distributed Object Computing Middleware," Proceedings of the IEEE/IFIP International Symposium on Object-Oriented Real-time Distributed Computing, March 15-17, 2000, Newport Beach, California.
- C47 David Levine, Douglas C. Schmidt, and Sergio Flores-Gaitan, "An Empirical Evaluation of OS Support for Real-time CORBA Object Request Brokers," Proceedings of the Multimedia Computing and Networking 2000 (MMCN00) conference, ACM, San Jose, CA, January 25-27 2000.
- C46 Douglas C. Schmidt, "Middleware Techniques and Optimizations for Real-time, Embedded Systems," Proceedings of the 12th International Symposium On System Synthesis, IEEE, San Jose, CA, USA November, 11, 1999
- C45 Bryan S. Doerr, Thomas Venturella, Rakesh Jha, Christopher D. Gill, and Douglas C. Schmidt, "Adaptive Scheduling for Real-time, Embedded Information Systems," Proceedings of the 18th IEEE/AIAA Digital Avionics Systems Conference (DASC), St. Louis, Missouri, October 24-29, 1999.
- C44 Christopher D. Gill, David L. Levine, Carlos O'Ryan, and Douglas C. Schmidt, "Distributed Object Visualization for Sensor-Driven Systems," Proceedings of the 18th IEEE/AIAA

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- C43 Fred Kuhns, Douglas C. Schmidt, and David L. Levine, "The Performance of a Real-time I/O Subsystem for QoS-enabled ORB Middleware," Proceedings of the International Symposium on Distributed Objects and Applications (DOA '99), Edinburgh, Scotland, September 1999.
- C42 David L. Levine, Christopher D. Gill, and Douglas C. Schmidt, "Object Lifecycle Manager – A Complementary Pattern for Controlling Object Creation and Destruction." Proceedings of the 5th Pattern Languages of Programming Conference, Allerton Park, Illinois, USA, 15 – 18 August 1999.
- C41 Fred Kuhns, Douglas C. Schmidt, David Levine, and Rajeev Bector, "The Design and Performance of a Real-time I/O Subsystem," Proceedings of the 5th IEEE Real-Time Technology and Applications Symposium (RTAS99), Vancouver, British Columbia, Canada, June 2-4, 1999.
- C40 Irfan Pyarali, Carlos O’Ryan, Douglas C. Schmidt, Nanbor Wang, Vishal Kachroo, and Aniruddha Gokhale, "Applying Optimization Patterns to Design Real-time ORBs," Proceedings of the 5th USENIX Conference on Object-Oriented Technologies and Systems, May 3-7, 1999, San Diego, CA.
- C39 Andy Gokhale and Douglas C. Schmidt, "Techniques for Optimizing CORBA Middleware for Distributed Embedded Systems" Proceedings of INFOCOM '99, March 21-25th, New York, New York.
- C38 Sumedh Mungee, Nagarajan Surendran, and Douglas C. Schmidt, "The Design and Performance of a CORBA Audio/Video Streaming Service," Proceedings of the 31st Hawaii International Conference on System Systems (HICSS), Hawaii, January, 1999, minitrack on Multimedia DBMS and the WWW, Hawaii, January 1999.
- C37 Chris D. Gill, David L. Levine, and Douglas C. Schmidt, "Dynamic Scheduling for Avionics Applications," Proceedings of the 17th IEEE/AIAA Digital Avionics System Conference, 31 October - 6 November 1998.
- C36 James Hu, Irfan Pyarali, and Douglas C. Schmidt, "Applying the Proactor Pattern to High-Performance Web Servers," Proceedings of the 10th International Conference on Parallel and Distributed Computing and Systems, IASTED, Las Vegas, Nevada, October 28-31, 1998.
- C35 Douglas C. Schmidt, Sumedh Mungee, and Andy Gokhale, "Alleviating Priority Inversion and Non-determinism in Real-time CORBA ORB Core Architectures," Proceedings of the Fourth IEEE Real-Time Technology and Applications Symposium (RTAS), Denver, Colorado, June 3-5, 1998.
- C34 Prashant Jain, Seth Widoff, and Douglas C. Schmidt, "The Design and Performance of MedJava, A Distributed Electronic Medical Imaging System Developed with Java Applets and Web Tools" Proceedings of the 4th USENIX Conference on Object-Oriented Technologies and Systems, Sante Fe, New Mexico, April 1998. This was selected as the best student paper in the conference.
- C33 James Hu, Sumedh Mungee, and Douglas C. Schmidt, "Techniques for Developing and Measuring High-performance Web Servers over ATM Networks," Proceedings of INFOCOM '98, San Francisco, March/April, 1998.
- C32 Aniruddha Gokhale and Douglas C. Schmidt, "Optimizing the Performance of the CORBA Internet Inter-ORB Protocol Over ATM," Proceedings of the 31st Hawaii International Conference on System Systems (HICSS), Hawaii, January, 1998. This was selected as the best paper in the Software Technology Track (188 submitted, 77 accepted).
- C31 Aniruddha Gokhale and Douglas C. Schmidt, "Evaluating the Performance of Demultiplexing Strategies for Real-time CORBA," Proceedings of GLOBECOM '97 conference, IEEE, Phoenix, AZ, November, 1997.
- C30 James Hu, Irfan Pyarali, and Douglas C. Schmidt, "Measuring the Impact of Event Dispatching and Concurrency Models on Web Server Performance Over High-speed

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- C29 Tim Harrison and David Levine and Douglas C. Schmidt, “The Design and Performance of a Real-time CORBA Event Service,” Proceedings of OOPSLA '97, ACM, Atlanta, GA, October 1997.
- C28 Aniruddha Gokhale and Douglas C. Schmidt and Stan Moyer, “Tools for Automating the Migration from DCE to CORBA,” Proceedings of ISS 97: World Telecommunications Congress, IEEE Toronto, Canada, September, 1997.
- C27 Douglas C. Schmidt, Tim H. Harrison, and Nat Pryce, “Thread-specific Storage: an Object Behavioral Pattern for Efficiently Accessing per-Thread State,” The 4th annual Pattern Languages of Programming conference in Allerton Park, Illinois, September 1997.
- C26 Irfan Pyarali, Tim Harrison, Douglas C. Schmidt, and Thomas Jordan, “Proactor: an Object Behavioral Pattern for Demultiplexing and Dispatching Handlers for Asynchronous Events,” the 4th annual Pattern Languages of Programming conference in Allerton Park, Illinois, September 1997.
- C25 Prashant Jain and Douglas C. Schmidt, “Service Configurator – A Pattern for Dynamic Configuration of Services,” Proceedings of the 3rd Conference on Object-Oriented Technologies and Systems, USENIX, Portland, OR, June 16-19, 1997.
- C24 Aniruddha Gokhale and Douglas C. Schmidt, “Evaluating Latency and Scalability of CORBA Over High-Speed ATM Networks,” Proceedings of the International Conference on Distributed Computing Systems '97, IEEE, Baltimore, Maryland, May 27–30, 1997.
- C23 Aniruddha Gokhale and Douglas C. Schmidt, “Performance of the CORBA Dynamic Invocation Interface and Internet Inter-ORB Protocol over High-Speed ATM Networks,” Proceedings of GLOBECOM '96, IEEE, London England, November, 1996.
- C22 Aniruddha Gokhale and Douglas C. Schmidt, “Measuring the Performance of Communication Middleware on High-Speed Networks,” Proceedings of SIGCOMM '96, ACM, San Francisco, August 28-30th, 1996.
- C21 Irfan Pyarali, Tim Harrison, and Douglas C. Schmidt, “Design and Performance of an Object-Oriented Framework for High-Speed Electronic Medical Imaging,” Proceedings of the 2nd Conference on Object-Oriented Technologies and Systems (COOTS), USENIX, Toronto, June 18-22, 1996.
- C20 Douglas C. Schmidt, “A Family of Design Patterns For Flexibly Configuring Network Services in Distributed Systems,” Proceedings of the International Conference on Configurable Distributed Systems, IEEE, Annapolis, Maryland, May 6-8, 1996.
- C19 Douglas C. Schmidt “Using Design Patterns to Develop High-Performance Object-Oriented Communication Software Frameworks,” Proceedings of the 8th Annual Software Technology Conference, Salt Lake City, Utah, April 21-26, 1996.
- C18 Douglas C. Schmidt, Timothy H. Harrison, and Irfan Pyarali, “An Object-Oriented Framework for High-Performance Electronic Medical Imaging,” Proceedings of the *Very High Resolution and Quality Imaging* mini-conference at the Symposium on Electronic Imaging in the International Symposia Photonics West 1996, SPIE, San Jose, California USA, January 27 - February 2, 1996.
- C17 Douglas C. Schmidt and Charles D. Cranor, “Half-Sync/Half-Async: A Pattern for Efficient and Well-structured Concurrent I/O,” *The 2nd Pattern Languages of Programs Conference* Monticello, Illinois, September 6-8, 1995.
- C16 R. Greg Lavender and Douglas C. Schmidt, “Active Object: An Object Behavioral Pattern for Concurrent Programming,” *The 2nd Pattern Languages of Programs Conference*, Monticello, Illinois, September 6-8, 1995.
- C15 Guru Parulkar, Douglas C. Schmidt, and Jonathan S. Turner, “ aI_tP_m : a Strategy for Integrating IP with ATM,” the Symposium on Communications Architectures and Protocols (SIGCOMM), ACM, Cambridge, MA, August 30 to September 1, 1995.

- C14 Douglas C. Schmidt, Tim Harrison, and Ehab Al-Shaer, "Object-Oriented Components for High-speed Network Programming," *Proceedings of the Conference on Object-Oriented Technologies (COOTS)*, USENIX, June 26-29, 1995 Monterey, California, USA, pp. 21–38.
- C13 Douglas C. Schmidt and Paul Stephenson, "Experience Using Design Patterns to Evolve Communication Software Across Diverse OS Platforms," *Proceedings of the 9th European Conference on Object-Oriented Programming (ECOOP)*, ACM, Aarhus, Denmark, August, 1995,.
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- C11 Douglas C. Schmidt, "Reactor: An Object Behavioral Pattern for Concurrent Event Demultiplexing and Dispatching," *The 1st Annual Conference on the Pattern Languages of Programs*, Monticello, Illinois, August, 1994, pp. 1–10.
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- W35 Aniruddha S. Gokhale and Douglas C. Schmidt and Joseph K. Cross and Christopher Andrews and Sylvester J. Fernandez and Bala Natarajan and Nanbor Wang and Chris D. Gill, "Towards Real-time Support in Fault-tolerant CORBA," IEEE Workshop on Dependable Middleware-Based Systems, Washington, D.C., June 23-26, 2002.
- W34 Chris Gill, Joe Loyall, Rick Schantz, and Douglas C. Schmidt, "Lessons Learned From Using Adaptive DOC Middleware in Real Application Contexts," IEEE Workshop on Dependable Middleware-Based Systems, Washington, D.C., June 23-26, 2002.
- W33 Joseph K. Cross and Douglas C. Schmidt, "Meta-Programming Techniques for Distributed Real-time and Embedded Systems," Proceedings of the 7th IEEE Workshop on Object-oriented Real-time Dependable Systems, San Diego, CA, January, 2002.
- W32 Douglas C. Schmidt and Mayur Deshpande and Carlos O’Ryan, "Operating System Performance in Support of Real-time Middleware," Proceedings of the 7th IEEE Workshop on Object-oriented Real-time Dependable Systems, San Diego, CA, January, 2002.
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- M54 Douglas C. Schmidt and Steve Huston, "Why Standards Alone Won't Get You Portable Software And How to Make Open Source Development Work for You," *InformIT: Focus on C++*, Addison-Wesley.
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- M51 Douglas C. Schmidt and Steve Vinoski, "Real-time CORBA, Part 1: Motivation and Overview," *C/C++ Users Journal*, October, 2001.
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- Chris Gill, Fred Kuhns, Douglas C. Schmidt, and Ron Cytron, “Empirical Differences Between COTS Middleware Scheduling Paradigms,” Submitted to the 8th IEEE Real-Time Technology and Applications Symposium, San Jose, CA, September 2002.
- Angelo Corsaro and Douglas C. Schmidt, “Evaluating Real-Time Java Features and Performance for Real-time Embedded Systems,” Submitted to the 8th IEEE Real-Time Technology and Applications Symposium, San Jose, CA, September 2002.
- Irfan Pyarali, Douglas C. Schmidt, and Ron Cytron, “Achieving End-to-End Predictability of the TAO Real-time CORBA ORB,” Submitted to the 8th IEEE Real-Time Technology and Applications Symposium, San Jose, CA, September 2002.
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- Christopher D. Gill, Douglas C. Schmidt, and Ron Cytron, “Multi-Paradigm Scheduling for Distributed Real-Time Embedded Computing,” IEEE Proceedings Special Issue on Modeling and Design of Embedded Systems, October, 2002.

Presentations

Conference Presentations

1. “Operating System Performance in Support of Real-time Middleware,” Proceedings of the 7th IEEE Workshop on Object-oriented Real-time Dependable Systems, San Diego, CA, January, 2002.
2. “Designing an Efficient and Scalable Server-side Asynchrony Model for CORBA,” Proceedings of the ACM SIGPLAN Workshop on Optimization of Middleware and Distributed Systems (OM 2001), Snowbird, Utah, June 18, 2001.
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14. "Half-Sync/Half-Async: A Pattern for Efficient and Well-structured Concurrent I/O," *Proceedings of the 2nd Pattern Languages of Programs Conference* Monticello, Illinois, September 6-8, 1995.
15. "Acceptor and Connector: Design Patterns for Actively and Passively Initializing Network Services." Workshop on Pattern Languages of Object-Oriented Programs at ECOOP '95, August 7 - 1, 1995, Aarhus, Denmark.
16. "Object-Oriented Components for High-speed Network Programming," *Proceedings of the Conference on Object-Oriented Technologies (COOTS)*, USENIX, June 26-29, 1995 Monterey, California, USA, pp. 21-38.
17. "Experience Using Design Patterns to Evolve Communication Software Across Diverse OS Platforms," *Proceedings of the 9th European Conference on Object-Oriented Programming (ECOOP)*, ACM, Aarhus, Denmark, August, 1995,.
18. "Measuring the Performance of Parallel Message-based Process Architectures," *Proceedings of the INFOCOM Conference on Computer Communications*, IEEE, Boston, MA, April, 1995, pp. 624-633.
19. "High-Performance Event Filtering for Dynamic Multi-point Applications," Proceedings of the 1st Workshop on High Performance Protocol Architectures (HIPPARCH), INRIA, Sophia Antipolis, France, December, 1994, p 1-8.
20. "Flexible Configuration of High-Performance Object-Oriented Distributed Communication Systems," 9th OOPSLA Conference, invited paper to the Workshop on Flexibility in Systems Software, ACM, Portland, Oregon, October, 1994, pp. 1-4.
21. "Performance Experiments on Alternative Methods for Structuring Active Objects in High-Performance Parallel Communication Systems," 9th OOPSLA Conference, poster session, ACM, Portland, Oregon, October, 1994, pp. 1-12.
22. "Measuring the Impact of Alternative Parallel Process Architectures on Communication Subsystem Performance," *Proceedings of the Proceedings of the 4th International Workshop on Protocols for High-Speed Networks*, IFIP, Vancouver, British Columbia, August, 1994, pp. 103-118.
23. "Reactor: An Object Behavioral Pattern for Concurrent Event Demultiplexing and Dispatching," *Proceedings of the 1st Annual Conference on the Pattern Languages of Programs*, Monticello, Illinois, August, 1994, pp. 1-10.
24. "Experiences with an Object-Oriented Architecture for Developing Dynamically Extensible Network Management Software," *Proceedings of the Globecom Conference*, IEEE, San Francisco, California, November, 1994, pp. 1-7.
25. "Configuring Function-based Communication Protocols for Distributed Applications," *Proceedings of the 8th International Working Conference on Upper Layer Protocols, Architectures, and Applications*, IFIP, Barcelona, Spain, June 1-3, 1994, pp. 361-376.

26. "The ADAPTIVE Service Executive: An Object-Oriented Architecture for Configuring Concurrent Distributed Communication Systems," *Proceedings of the 8th International Working Conference on Upper Layer Protocols, Architectures, and Applications*, IFIP, Barcelona, Spain, June 1-3, 1994, pp. 163–178.
27. "ASX: An Object-Oriented Framework for Developing Distributed Applications," *Proceedings of the 6th C++ Conference*, USENIX, Cambridge, Massachusetts, April, 1994, pp. 200–220.
28. "The Service Configurator Framework: An Extensible Architecture for Dynamically Configuring Concurrent, Multi-service Network Daemons," *Proceedings of the 2nd International Workshop on Configurable Distributed Systems*, IEEE, Pittsburgh, PA, March 21-23, 1994, pp. 190–201.
29. "Tools for Generating Application-Tailored Multimedia Protocols on Heterogeneous Multi-Processor Platforms," *Proceedings of the 2nd Workshop on High-Performance Communications Subsystems*, IEEE, Williamsburg, Virginia, September 1-3, 1993, pp. 1–7.
30. "A Framework for Developing and Experimenting with Parallel Process Architectures to Support High-Performance Transport Systems," *Proceedings of the 2nd Workshop on High-Performance Communications Subsystems*, IEEE, Williamsburg, Virginia, September 1-3, 1993, pp. 1–8.
31. "ADAPTIVE: a Framework for Experimenting with High-Performance Transport System Process Architectures," *Proceedings of the 2nd International Conference on Computer Communications and Networks*, ISCA, San Diego, California, June 28-30, 1993, pp. 1–8.
32. "ADAPTIVE: A Flexible and Adaptive Transport System Architecture to Support Lightweight Protocols for Multimedia Applications on High-Speed Networks," *Proceedings of the 1st Symposium on High Performance Distributed Computing*, IEEE, Syracuse, New York, September 9-11, 1992, pp. 174–186.
33. "GPERF: A Perfect Hash Function Generator," *Proceedings of the 2nd C++ Conference*, USENIX, San Francisco, California, April 9-11, 1990, pp. 87–102.

Invited Lectures

1. Invited panelist on "Objects and Real-time Systems" OOPSLA '02, Seattle, WA, November 4-8, 2000.
2. "Research Advances in Middleware for Distributed, Real-time, and Embedded Systems," Computer Communications stream of the 17th IFIP World Computer Congress, Montreal, Canada, August 25-30, 2002.
3. "One Step Closer to World Domination," panelist in the "Standards Movements in Object-oriented Real-time Computing" panel at the ISORC 2002 Conference, Washington, DC, April 30, 2002.
4. "How to Maintain Superiority in the Face of the Commoditization of IT," tutorial at the UCI CEO Roundtable, Maui, Hawaii, April 12, 2002.
5. "Transformation or Transmogrification? Surviving the Commoditization of IT," panelist at the UCI CEO Roundtable, Maui, Hawaii, April 11, 2002.
6. "Patterns and Principles of Mission-critical Middleware," Henry Samueli School of Engineering Research Review, University of California, Irvine, March 14th, 2002.
7. "DARPA: an Agency Overview," CRA Academic Careers Workshop, Arlington, Virginia, February 10 - 12, 2002.
8. "Towards Adaptive and Reflective Middleware for Distributed, Real-time, and Embedded Systems," Electrical Engineering and Computer Science Department, Vanderbilt University, January 28th, 2002.

9. "Protecting Critical Cyber Infrastructure from Asymmetric Threats," panelist at the 7th IEEE Workshop on Object-oriented Real-time Dependable Systems, San Diego, CA, January 10, 2002.
10. "The Researcher's Dilemma: When Technology Success Causes Great Communities to Fail (at Mission-oriented R&D Agencies)," Software Design and Productivity Coordinating Group Workshop on New Visions for Software Design and Productivity: Research and Applications, Nashville, TN, December 13-14, 2001.
11. "Towards Adaptive and Reflective Middleware for Mission-Critical Systems," Computer Science Department, College of William and Mary, September 7th, 2001.
12. "Adaptive and Reflective Middleware Systems," Lockheed Martin, Moorestown, NJ, August 21st, 2001.
13. "Adaptive and Reflective Middleware Systems," United Technology Research Center, Hartford, Connecticut, June 28th, 2001.
14. "Adaptive and Reflective Middleware Systems," Raytheon Annual Processing Systems Technology Network (PSTN) Symposium, Lexington, MA, June 20th, 2001.
15. Invited presenter for the Vendors' Panel at the OMG 2nd Workshop on Real-time and Embedded Distributed Object Computing, June 4-7, 2001.
16. "Towards Pattern Languages and QoS-enabled Middleware for Distributed Real-time and Embedded Systems," DARPA ITO workshop on Embedded Software, Lake Tahoe, NV, October 8-10, 2001.
17. "TAO, CORBA, and the HLA/RTI", Invited keynote talk at the Fifth IEEE International Workshop on Distributed Simulation and Real Time Applications Cincinnati, Ohio, USA August 13-15, 2001.
18. "Patterns and Principles of Middleware for Distributed Real-time and Embedded Systems," Raytheon, Sudbury, March 29th, 2001.
19. "Adaptive and Reflective Middleware Systems," Distinguished Lecture at Florida Atlantic University, Boca Raton, FL, March 1st, 2001.
20. "Adaptive and Reflective Middleware for Mission-Critical Distributed and Embedded Systems," University of Alabama, Birmingham, AL, January 31st, 2001.
21. "Adaptive and Reflective Middleware for Mission-Critical Distributed and Embedded Systems," Telcordia, Morristown, NJ, November 20th, 2000.
22. "Adaptive and Reflective Middleware for Mission-Critical Distributed and Embedded Systems," George Mason University, Fairfax, VA, November 20th, 2000.
23. "Adaptive and Reflective Middleware for Mission-Critical Distributed and Embedded Systems," Lucent CORBA Forum, Naperville, IL, November 17th, 2000.
24. "Putting an ORB on a Diet," Invited talk at the session on *Performance and QoS of Embedded CORBA ORBs* at the OMG's Workshop on Embedded Object-Based Systems, January 17-19, 2001.
25. "Adaptive and Reflective Middleware Systems," invited panelist in a session on "Highly Distributed Systems," at the IEEE Symposium on Applications and the Internet, San Diego, CA, January 10, 2001.
26. "Adaptive and Reflective Middleware Systems," invited panelist at the NSF Networking PI meeting, Irvine California, November 1st, 2000.
27. "Surviving the Tornado: The Best Kept Secrets of R&D Success in the Internet Age," Keck Observatory, Hawaii, October 9th, 2000.
28. "Adaptive and Reflective Middleware Systems," BBN Technologies, Boston, MA, September 27th, 2000.
29. "Distributed Application Integration: Myth or Reality?" Keynote talk at 2nd International Symposium on Distributed Objects and Applications (DOA '00), OMG, Antwerp, Belgium, September 21st, 2000.

30. "Surviving the Tornado: The Best Kept Secrets of R&D Success in the Internet Age," Keynote talk at 2nd International Symposium on Distributed Objects and Applications (DOA '00), OMG, Antwerp, Belgium, September 21st, 2000.
31. "High Confidence Adaptive and Reflective Middleware: Fact or Fiction?" Keynote talk for the IFIP Fourth International Conference on Formal Methods for Open Object-Based Distributed Systems, (FMOODS 2000), Stanford University, Stanford, CA, September 7th, 2000.
32. "Adaptive and Reflective Middleware Systems," Lockheed Martin, Ft. Worth, TX, September 6th, 2000.
33. Pattern-oriented Software Architecture: Concurrent and Networked Objects, Raytheon, San Diego, August 25, 2000.
34. "Adaptive and Reflective Middleware Systems," Rockwell/Collins, Cedar Rapids, Iowa, August 22, 2000.
35. "Adaptive and Reflective Middleware Systems," Lockheed Martin, Eagan, MN, August 21, 2000.
36. "Adaptive and Reflective Middleware Systems," Honeywell Technology Center, Minneapolis, MN, August 18, 2000.
37. "Adaptive and Reflective Middleware Systems," Raytheon, Falls Church, VA, July 12, 2000.
38. "Applying Patterns to Develop High-performance and Real-time Object Request Brokers," Lockheed Martin, Eagan, Minnesota, May 19, 2000.
39. "Patterns and Principles of Real-time Object Request Brokers," Cisco, San Jose, April 12, 2000.
40. "Patterns and Principles of Real-time Object Request Brokers," BellSouth, Atlanta, Georgia, March 3, 2000.
41. "Patterns and Principles of Real-time Object Request Brokers," Distinguished Lecturer Series, Michigan State University, East Lansing, Michigan, October 21, 1999.
42. "Towards Minimum ORBs for Wireless Devices and Networks," OPENSIG '99 Workshop, Carnegie Mellon University, Pittsburgh, October, 14-15, 1999.
43. "Applying CORBA Fault Tolerant Mechanisms to Network Management," Lucent CORBA Forum, Naperville, IL, September 28th, 1999.
44. "CORBA for Real-time and Embedded Telecom Systems," Lucent CORBA Forum, Naperville, IL, September 28th, 1999.
45. "Patterns and Principles of Real-time Object Request Brokers," BEA, Munich, Germany, September 16th, 1999.
46. "Real-time CORBA – Fact or Fiction," Siemens CORBA Day, Munich, Germany, September 15th, 1999.
47. "Patterns and Principles of Real-time Object Request Brokers," Siemens MED, Erlangen, Germany, September 13th, 1999.
48. "Patterns and Principles of Real-time Object Request Brokers," RT DII COE TWG, Boeing, Seattle, WA August 25th, 1999.
49. "Patterns for Real-time Middleware," Microsoft, Redmond, WA, August 24th, 1999.
50. "Patterns and Principles of Real-time Object Request Brokers," Lockheed Martin, Eagan, Minnesota, June 22nd, 1999.
51. "Using the ACE Framework and Patterns to Develop OO Communication Software," Dreamworks SGK, Glendale, CA, May 5th, 1999.
52. "Why Telecom Reuse has Failed and how to Make it Work for You," Keynote talk at Nortel Design Forum, Ottawa, CA, April 22nd, 1999.
53. "QoS-enabled Middleware for Monitoring and Controlling High-Speed Networks and Endsystems," Lucent Bell Labs, Murray Hill, NJ, April 15th, 1999.

54. "Optimization Patterns for High-performance, Real-time Object Request Broker Middleware," University of California, Irvine, April, 2nd, 1999.
55. "Principles and Patterns of High-performance Real-time CORBA," University of Southern California, Los Angeles, CA, December 10th, 1998.
56. "Real-time CORBA for Telecom – Fact or Fiction?," Bellcore, Morristown, NJ, December 1st, 1998.
57. "Design Patterns for Real-time Object Request Brokers," Silicon Valley Patterns Group, San Francisco, November 15, 1998.
58. "Why Reuse has Failed and how to Make it Work for You," Keynote talk at Lucent Software Symposium, October 27th, Murray Hill, NJ, 1998.
59. "Real-time CORBA – Fact or Fiction," Lucent CORBA Forum, Holmdel, NJ, September 29, 1998.
60. "Applying Software Design Patterns and Framework to Telecommunication Applications," Nortel Advanced Software Computing and Technology, Monday, April 6, 1998, Ottawa, Canada.
61. "Patterns and Performance of Real-time Object Request Brokers," University of California, Santa Barbara, February 20, 1988.
62. "Principles and Patterns of High-performance, Real-time Object Request Brokers," University of Frankfurt, Germany, February 12th, 1998.
63. "Principles and Patterns of High-performance, Real-time Object Request Brokers," University of Illinois, Urbana-Champaign November 12th, 1997.
64. "Principles and Patterns of High-performance, Real-time Object Request Brokers," University of Missouri, Kansas City, October 31st, 1997.
65. "Principles and Patterns of High-performance, Real-time Object Request Brokers," IBM T.J. Watson Research, September 15, 1997.
66. "Principles and Patterns of High-performance, Real-time Object Request Brokers," University of California, Santa Barbara, August 21st, 1997.
67. "Principles and Patterns of High-performance, Real-time Object Request Brokers," Lucent Technologies, Naperville, IL August 19th, 1997.
68. "Mastering Software Complexity with Reusable Object-Oriented Frameworks, Components, and Design Patterns," 3rd NSA Software Reuse Symposium, August 20th, 1997.
69. "Principles and Patterns of High-performance, Real-time Object Request Brokers," University of Utah, Salt Lake City, Utah, August 11th, 1997.
70. "Using the ACE Framework and Design Patterns to Develop Object-Oriented Communication Software," CERN, Switzerland, July 18th, 1997.
71. "Principles and Patterns of High-performance, Real-time Object Request Brokers," CHOOSE symposium, Zurich, Switzerland, July 17th, 1997.
72. "Principles and Patterns of High-performance, Real-time Object Request Brokers," Lucent Bell Laboratories, Murray Hill, New Jersey, July 9th, 1997.
73. "Using the ACE Framework and Design Patterns to Develop Object-Oriented Communication Software," Lockheed Martin Tactical Systems, Minneapolis, Minnesota, June 26th, 1997.
74. "Design Patterns and Frameworks for Developing Object-oriented WWW Clients and Servers," Carleton University, April 11th, 1997.
75. "Principles and Patterns of High-performance, Real-time Object Request Brokers," University of Maryland, College Park, Maryland, April 2nd, 1997.
76. "A High-Performance End system Architecture for Real Time COBRA," SPARTAN Symposium sponsored by US Sprint, Lawrence Kansas, March 18th, 1997.

77. "Experience with CORBA for Communication Systems," Motorola, Chicago, January 24th, 1997.
78. "High-performance CORBA," Bay Area Object Interest Group, Stanford Linear Accelerator Center, California, December 5th, 1996.
79. "Gigabit CORBA – An Architecture for High-performance Distributed Object Computing," Numerical Aerodynamic Simulation group, NASA, Moffett Field, California, December 3rd, 1996.
80. "Towards High-performance, Real-time CORBA," Distinguished Lecturer at Kansas State University, Manhattan, Kansas, November 7th, 1996.
81. "Gigabit CORBA – An Architecture for High-performance Distributed Object Computing," University of California, Los Angeles, October 3rd, 1996.
82. "Design Patterns and Frameworks for Object-Oriented Communication Software," NSA Software Reuse Symposium, August 28th, 1996.
83. "CORBA – the Good, the Bad, and the Ugly," Lucent Bell-Labs, Naperville, IL, August 22nd, 1996.
84. "Components: the Good, the Bad, and the Ugly," keynote talk for the 1st Components Users Conference, SIEMENS, Munich, Germany, July 15th, 1996.
85. "Design Patterns for Object-Oriented Communication Software," IONA Technologies, Ltd, Dublin, Ireland, July 12th, 1996.
86. "OO Design Patterns and Frameworks for Communication Software," Siemens Corporate Research, Princeton, New Jersey, June 27, 1996.
87. "OO Design Patterns for Concurrent, Parallel, and Distributed Systems," IBM Centre for Advanced Studies, North York, Ontario, Canada, June 17, 1996.
88. "Distributed Object Computing with CORBA", Bell Laboratories, Murray Hill, New Jersey, June 11-12th, 1996.
89. "Design Patterns for Object-Oriented Communication Software," Carleton University, Ottawa, Canada, May 21st, 1996.
90. "Integrating LAN-WAN-Celestial Networks with Design Patterns," Featured technical session at the Object World East conference, Boston, MA, May 9th, 1996.
91. "Using Design Patterns to Develop Object-Oriented Communication Software Frameworks and Applications," McMaster's University, Hamilton, Canada, May 2nd, 1996.
92. "Towards Gigabit CORBA – A High-Performance Architecture for Distributed Object Computing," University of Nevada, Reno, April 25th, 1996.
93. "Domain Analysis: From Tar Pit Extraction to Object Mania?" invited panelist at the 4th International Conference on Software Reuse, Orlando, Florida, April 25th, 1996. (other panelists include Spencer Peterson, SEI CMU, Mark Simos, Organon Motives Inc., Will Tracz, Loral, and Nathan Zalman, BNR Inc).
94. "Concurrent Object-Oriented Network Programming with C++," Kodak Imaging Technology Center, April 19th, 1996.
95. "Using OO Design Patterns and Frameworks to Develop Object-Oriented Communication Systems," INRS/NorTel Workshop on Telecommunication Software, Montreal, CA, March 14th, 1996.
96. "Concurrent Object-Oriented Network Programming with ACE and C++," for Siemens Medical Engineering, Erlangen Germany, February 15th, 1996.
97. "OO Componentware" invited panelist at the *OOP '96 Conference*, SIGS, Munich, Germany, February 13st, 1996. (other panelists included Michael Stal (Siemens AG) and Frank Buschmann (Siemens AG).
98. "Using Design Patterns to Develop High-performance Object-Oriented Communication Software Frameworks," for the Department of Information Systems, Institute of Computer Science, Johannes Kepler University of Linz, Austria, February 12th, 1996.

99. "The Performance of Object-Oriented Components for High-speed Network Programming," for the Digital Libraries research group at Stanford University, Palo Alto California, February 2nd, 1996.
100. "Distributed Object Computing with CORBA, ACE, and C++," for South Western Bell Telephone advanced distributed systems group, St. Louis, MO., January 26th, 1996.
101. "OO Design Patterns for Large-Scale Object-Oriented Communication Software Systems," AG Communication Systems, Phoenix, Arizona, December 11 – 13th, 1995.
102. "Experience Using OO Design Patterns to Develop Large-Scale Object-Oriented Communication Software Systems," Bell Northern Research, 7th Annual Design Forum, Ottawa, Canada, December 6th, 1995.
103. "Using OO Design Patterns to Develop Large-Scale Distributed Systems," Object Technology International, Ottawa, Canada, November 22nd, 1995.
104. "Design Patterns for Concurrent, Parallel, and Distributed Systems," North Dallas Society for Object Technology, September 13th, 1995.
105. "Using Design Patterns for Iridium Communication Services," at Motorola Iridium, Chandler, AZ, June 30th, 1995.
106. "Object Technology and the World-Wide Information Infrastructure," invited panelist at ECOOP '95, Aarhus, Denmark, August 9th, 1995.
107. "Measuring the Performance of CORBA over ATM Networks," HP Labs, Palo Alto, CA, June 28th, 1995.
108. "Measuring the Performance of Object-Oriented Components for High-speed Network Programming," The C++ and C SIG user group, New York, New York, June 5th, 1995.
109. "An Overview of Design Patterns for Object-Oriented Network Programming," St. Louis Chapter of the ACM, St. Louis, MO, March 13th 1995.
110. "Design Patterns for Concurrent Object-Oriented Network Programming," Distributed Systems group at Siemens Corporate Research Center, Munich, Germany, March 3rd, 1995.
111. "Patterns: 'Eureka,' 'Deja-Vu,' or 'Just Say No'?" invited panelist at the *OOP '95 Conference*, SIGS, Munich, Germany January 31st, 1995. (other panelists included Richard Helm, (DMR), Frank Buschmann (Siemens AG), and Dave Thomas (OTI).
112. "Developing Distributed Applications with the ADAPTIVE Communication Environment," *The 12th Annual Sun Users Group Conference*, SUG, San Francisco, California, June 17th, 1994.
113. "Flexible Configuration of High-performance Distributed Communication Systems," presented at the ETH-Zentrum in the Swiss Federal Institute of Technology, Zurich, Switzerland, May 31st, 1994.
114. "Object Oriented Techniques for Developing Distributed Applications," *Computer Science Department Colloquia*, California State University Northridge, December 7th, 1993.
115. "Hosting the ADAPTIVE System in the *x*-Kernel and System V STREAMS," *The x-Kernel Workshop*, IEEE, Tucson, Arizona, November 10th, 1992.
116. "An Environment for Controlled Experimentation on the Performance Effects of Alternative Transport System Designs and Implementations," IBM T. J. Watson Research Center, Hawthorne, New York, September 10th, 1992.

Colloquia, Seminars, and Tutorials

1. Using Design Patterns, Frameworks, and CORBA to Develop Object-Oriented Communication Systems, University of California, Los Angeles Extension, July 22nd-24th, 2002.
2. "Policies and Patterns for High-performance, Real-time Object Request Brokers," Mercury Computers, Tysons Corner, VA, November Feb 7, 2002.

3. Using Design Patterns, Frameworks, and CORBA to Develop Object-Oriented Communication Systems, University of California, Los Angeles Extension, January 23rd-25th, 2002.
4. "Policies and Patterns for High-performance, Real-time Object Request Brokers," Raytheon, Rosslyn, VA, November 12th, 2001.
5. "Pattern-Oriented Software Architecture: Patterns for Concurrent and Networked Objects," OOPSLA 2001, October 15th, 2000, Minneapolis, Minnesota.
6. "Policies and Patterns for High-performance, Real-time Object Request Brokers," International Symposium on Distributed Object Applications (DOA), Rome, September 17-20, 2001.
7. "Policies and Patterns for QoS-enabled Middleware," The JAOO 2001 conference, September 10-14, Aarhus, Denmark.
8. "Using Design Patterns, Frameworks, and CORBA to Develop Object-Oriented Communication Systems," University of California, Los Angeles Extension, July 23rd-25th, 2001.
9. "Policies and Patterns for High-performance, Real-time Object Request Brokers," OMG Second Workshop on Real-time and Embedded Distributed Object Computing on June 4-7, 2001 in Herndon, VA, USA.
10. "Design Patterns for Understanding Middleware and Component Infrastructures," 6th USENIX Conference on Object-Oriented Technologies and Systems, January 29, 2001, San Antonio, TX.
11. "Principles and Patterns of High-performance, Real-time Object Request Brokers," OOP conference, Munich, Germany, January 23, 2001.
12. "Using Design Patterns, Frameworks, and CORBA to Develop Object-Oriented Communication Systems," University of California, Los Angeles Extension, January 3-5, 2001.
13. "Patterns for Concurrent and Distributed Objects," OOPSLA 2000, October 16th, 2000, Minneapolis, Minnesota.
14. "Using Design Patterns, Frameworks, and CORBA to Develop Object-Oriented Communication Systems," University of California, Berkeley Extension, May 24-26, 2000.
15. "Using Design Patterns, Frameworks, and CORBA to Develop Object-Oriented Communication Systems," Jet Propulsion Laboratory, Pasadena, CA, April, 2000.
16. "Using Design Patterns, Frameworks, and CORBA to Develop Object-Oriented Communication Systems," University of California, Los Angeles Extension, March 27-31, 2000.
17. "Optimizing Middleware to Support High-Performance Real-time Distributed and Embedded Systems," OOP conference, Munich, Germany, January 27, 2000.
18. "Effective Architectures for DOC," OOP conference, Munich, Germany, January 24, 2000.
19. "Using Design Patterns, Frameworks, and CORBA to Develop Object-Oriented Communication Systems," University of California, Berkeley Extension, December 13-15, 1999.
20. "Middleware Techniques and Optimizations for Real-time Embedded Systems," 12th International Symposium On System Synthesis, IEEE, San Jose, CA, USA November, 11, 1999
21. "Patterns and Principles of Real-time Object Request Brokers," OOPSLA conference, ACM, Denver, Colorado, November 1-5, 1999.
22. "Using Design Patterns, Frameworks and CORBA to Reduce the Complexity of Developing Reusable Large-Scale Object-Oriented Concurrent Communication Components and Systems," Fifth IEEE International Conference on Engineering of Complex Computer Systems, Las Vegas, Nevada, October 18-21, 1999
23. "Distributed Technologies," Motorola, Schaumburg, IL, August 10-12, 1999.
24. "Patterns and Principles of Real-time Object Request Brokers," the 3rd Components Users Conference, SIEMENS, Munich, Germany, July 12th, 1999.
25. "Using Design Patterns, Frameworks, and CORBA to Develop Object-Oriented Communication Systems," Lucent, Naperville, IL, June 23-24 and June 30 - July 1st, 1999.

26. "Using Design Patterns, Frameworks, and CORBA to Develop Object-Oriented Communication Systems," Motorola Software Symposium, Ft. Lauderdale, Florida, June 21st, 1999.
27. "Using Design Patterns, Frameworks, and CORBA to Develop Object-Oriented Communication Systems," University of California Los Angeles Extension, June 2-4, 1999.
28. "Concurrent Object-Oriented Network Programming and Distributed Object Computing," University of California Berkeley Extension, May 19-21, 1999.
29. "Patterns and Principles of Real-time Object Request Brokers," 5th USENIX Conference on Object-Oriented Technologies and Systems, May 4, 1999, San Diego, CA.
30. "Real-time CORBA for Telecom – Fact or Fiction?" Nortel Design Forum, Ottawa, CA, April 22, 1999.
31. "Using Design Patterns, Frameworks, and CORBA to Develop Object-Oriented Communication Systems," Lucent, Columbus, OH, March 18-19 and 25-26, 1999.
32. "Using Design Patterns, Frameworks, and CORBA to Develop Object-Oriented Communication Systems," Lucent, Holmdel, NJ, March 1-4, 1999.
33. "Using Design Patterns, Frameworks, and CORBA to Develop Object-Oriented Communication Systems," Lucent/Octel, Milpitas, CA, December 14-16, 1998.
34. "Using Design Patterns, Frameworks, and CORBA to Develop Object-Oriented Communication Systems," University of California Los Angeles Extension, December 8-10, 1998.
35. "Using Design Patterns, Frameworks, and CORBA to Develop Object-Oriented Communication Systems," Motorola, Schaumburg, IL, December 2-4, 1998.
36. "Concurrent Object-Oriented Network Programming and Distributed Object Computing," University of California Berkeley Extension, November 16-18, 1998.
37. "Using Design Patterns and Frameworks to Develop Object-Oriented Communication Software," OOPSLA '98, October 19th, 1998, Vancouver, British Columbia.
38. "High-Performance CORBA," Lucent CORBA Forum, Holmdel, NJ, September 29, 1998.
39. "Writing Efficient Multi-Thread CORBA Applications," the 3rd Components Users Conference, SIEMENS, Munich, Germany, July 10, 1998.
40. "Using Design Patterns and Frameworks to Develop Object-Oriented Communication Software," UCLA extension course, Milan, Italy, June 29 - July 1, 1998.
41. "Using Design Patterns, Frameworks, and CORBA to Develop Object-Oriented Communication Systems," Lucent, Naperville, IL, June 8-11, 1998.
42. "Patterns and Performance of Real-time Object Request Brokers," Fourth IEEE Real-Time Technology and Applications Symposium (RTAS), Denver, Colorado, June 5, 1998.
43. "Using Design Patterns, Frameworks, and CORBA to Develop Object-Oriented Communication Systems," University of California Los Angeles Extension, June 1-3, 1998.
44. "Patterns and Principles of Real-time Object Request Brokers," NSA, Ft. Meade, MD, March 22, 1998.
45. Using Design Patterns, Frameworks, and CORBA to Develop Object-Oriented Communication Systems, Crosskeys, Ottawa Canada, March 19-21, 1998.
46. "Concurrent Object-Oriented Network Programming and Distributed Object Computing," University of California Berkeley Extension, March 4-6, 1998.
47. "Building Distributed Communication Software with CORBA," the Motorola Systems Symposium, February, 1998, Austin, Texas, USA.
48. "Introduction to Distributed Objects with CORBA," SIGS OOP '98, February 9-13, 1998, Munich, Germany.
49. "Design Patterns for Developing and Using CORBA Object Request Brokers," SIGS OOP '98, February 9-13, 1998, Munich, Germany.
50. Using Design Patterns, Frameworks, and CORBA to Develop Object-Oriented Communication Systems, Lucent Technologies, Whippany, NJ, January 5-6, 1998.

51. "Using Design Patterns, Frameworks, and CORBA to Develop Object-Oriented Communication Systems," University of California Los Angeles Extension, December 10-12, 1997.
52. "Concurrent Object-Oriented Network Programming and Distributed Object Computing," University of California Berkeley Extension, December 10-12, 1997.
53. "Using Design Patterns and Frameworks to Develop Object-Oriented Communication Systems," Motorola Cellular Infrastructure Group, Arlington Heights, Illinois, December 1 - 3, 1997.
54. "Using Design Patterns and Frameworks to Develop Object-Oriented Communication Systems," TOOLS Pacific '97, Melbourne, Australia November 24 - 27, 1997.
55. "Using Design Patterns and Frameworks to Develop Object-Oriented Communication Systems" for the IEEE GLOBECOM '97 conference, Phoenix, AZ, November 4-8, 1997.
56. "High-performance Distributed Object Computing with CORBA," IEEE International Conference on Network Protocols, Atlanta, GA, October 28th, 1997.
57. "Using Design Patterns and Frameworks to Develop Object-Oriented Communication Systems," OOPSLA '97, ACM, Atlanta, GA, October 6-7th, 1997.
58. "Using Design Patterns and Frameworks to Develop Object-oriented Communication Systems," 24th International Conference on Technology of Object-Oriented Languages and Systems (TOOLS Asia '97). Beijing, China, September 22, 1997.
59. "Principles and Patterns of Distributed Object Computing Systems," for the ACM Principles of Distributed Computing Conference (PODC), Santa Barbara, CA, August 21st, 1997.
60. "OO Design Patterns for Concurrent, Parallel, and Distributed Systems," the 3rd *Conference on Object-Oriented Technology*, USENIX, Portland, Oregon, June 16th, 1996.
61. "Distributed Object Computing with CORBA and ACE," Alta Software, Jacksonville, FL, June 4-5th, 1997.
62. "Distributed Object Computing with CORBA", Object Expo, NY, NY, June 2nd, 1997.
63. "Concurrent Object-Oriented Network Programming and Distributed Object Computing," University of California Berkeley Extension, May 28-30, 1997.
64. "Patterns and Principles of Real-time Object Request Brokers," National Security Agency, Ft. Meade, MD, May 13th, 1997.
65. "Building Distributed Communication Software with CORBA," the Motorola Systems Symposium, March, 1997, Chandler, AZ, USA.
66. "Evaluating Concurrency Models for CORBA Servers," the 2nd Components Users Conference, SIEMENS, Munich, Germany, July 14th, 1997.
67. "Design Patterns for Evolving System Software Components from UNIX to Windows NT," the 2st Components Users Conference, SIEMENS, Munich, Germany, July 14th, 1997.
68. "Techniques and Patterns for Distributed Object Computing with CORBA and C++," University of California Berkeley Extension, December 4-6, 1996.
69. "Design Patterns for Concurrent Object-Oriented Programming with ACE and C++," C++ World, Dallas, TX, November 11th, 1996.
70. "Implementing Concurrent CORBA Applications with Multi-Threaded Orbix and ACE," C++ World, Dallas, TX, November 12th, 1996.
71. "Why Reuse has Failed, and How You Can Make it Work for You," Berne Technology Forum 1996, Berne, Switzerland, October 18, 1996.
72. "Introduction to Distributed Object Programming with CORBA," the Local Computer Networks '96 conference, IEEE, Minneapolis, Minnesota, October 13, 1996.
73. "Object-Oriented Design Patterns for Concurrent, Parallel, and Distributed Systems," the OOPSLA '96 conference, ACM, San Jose, California, October, 1996.
74. "OO Design Patterns Network Programming in C++," Object Expo Europe, London, England, September 23rd, 1996.

75. "Effective Multithreaded CORBA Programming," Object Expo Europe, London, England, September 24th, 1996.
76. "Evaluating Concurrency Models for CORBA Servers," the 1st Components Users Conference, SIEMENS, Munich, Germany, July 15th, 1996.
77. "Design Patterns for Evolving System Software Components from UNIX to Windows NT," the 1st Components Users Conference, SIEMENS, Munich, Germany, July 15th, 1996.
78. "OO Design Patterns for Concurrent, Parallel, and Distributed Systems," the 2nd *Conference on Object-Oriented Technology*, USENIX, Toronto, Canada, June 17, 1996.
79. "OO Design Patterns for Network Programming in C++," the *Object Expo '96 Conference*, SIGS, Sydney, Australia, June 3rd, 1996.
80. "Effective Multi-threaded CORBA Programming Programming," the *Object Expo '96 Conference*, SIGS, Sydney, Australia, June 5th, 1996.
81. "Concurrent Object-oriented Network Programming with C++," University Of California Berkeley Extension, Berkeley, California, May 22nd – 24th, 1996.
82. "Experience Developing Reusable Software Using Object-Oriented Design Patterns and Frameworks," the 4th *International Conference on Software Reuse*, Orlando, Florida, USA April 23-26, 1996.
83. "Using Object-Oriented Design Patterns to Develop Large-Scale Distributed Systems," the *OOP Conference*, SIGS, Munich, Germany, Feb 13th, 1996.
84. "Techniques for Object-Oriented Network Programming," the *OOP Conference*, SIGS, Munich, Germany, Feb 14th, 1996.
85. "Concurrent Object-oriented Network Programming with C++," University Of California Berkeley Extension, Berkeley, California, November 30th-December 1st, 1995.
86. "Using Object-Oriented Design Patterns to Develop Large-Scale Distributed Systems," the 4th *C++ World Conference*, SIGS, Chicago, Illinois, October 31st, 1995.
87. "Techniques for Object-Oriented Network Programming," the 4th *C++ World Conference*, SIGS, Chicago, Illinois, October 31st, 1995.
88. "Experience using OO Design Patterns to Develop Large-scale Distributed Communication Systems," *OOPSLA '95 Conference* in Austin, Texas, October 1995.
89. "Concurrent Object-oriented Network Programming with C++," the 9th *European Conference on Object-Oriented Programming (ECOOP)*, Aarhus, Denmark, August, 1995.
90. "Concurrent Object-Oriented Network Programming with C++," the 1st *Conference on Object-Oriented Technology*, USENIX, Monterey, California, June 23, 1995.
91. "Design Patterns for Concurrent and Distributed Systems," the *Object Expo '95 Conference*, SIGS, New York, NY, June 5th 1995.
92. "Object Oriented Network Programming," the *Object Expo '95 Conference*, SIGS, New York, NY, June 5th, 1995.
93. "Software Construction with Active Objects in C++," the *OOP '95 Conference*, SIGS, Munich, Germany January 31, 1995.
94. "Object-Oriented Concurrent Programming with C++," the *OOP '95 Conference*, SIGS, Munich, Germany January 31, 1995.
95. "Concurrent Object-Oriented Programming," the *Winter USENIX Conference*, USENIX, New Orleans, Louisiana, January, 1995.
96. "Object-Oriented Network Programming with C++," the 3rd *C++ World Conference*, SIGS, Austin, Texas, November 14, 1994.
97. "Object-Oriented Techniques for Dynamically Configuring Concurrent Distributed Applications," the 9th *OOPSLA Conference*, ACM, Portland, Oregon, October 23, 1994.
98. "Object-Oriented Network Programming," the 6th *C++ Conference*, USENIX, Cambridge, Massachusetts, April 11, 1994.

99. "Object-Oriented Techniques for Developing Extensible Network Servers," the 2nd C++ *World Conference*, SIGS, Dallas, Texas, October 19, 1993.

Patents

1. Patent pending: INDIGO – "an Interpretive Network Daemon Implemented by Generic Main Object," 09/215,732. In conjunction with Karlheinz Dorn, Dieter Quehl, Detlef Becker, and Christian Scharf of SIEMENS Medical Engineering, Erlangen, Germany.

Research Support

Total research funding since June 1995: \$9,452,617

- Sole PI: \$5,511,995
- Co-PI: \$3,939,622

Grants and Contracts Received

Title	Funding Agency	Duration	Amount	co-PIs
"Intergovernmental Personnel Act"	DARPA	6/1/00 to 5/31/02	\$198,934	
"Optimizing Component Models"	DARPA	4/1/01 to 6/31/02	\$210,000	
"HLA RTI Next-generation"	SAIC	6/1/01 to 12/31/01	\$70,895	
"ACE Enhancements for Windows NT and Windows CE"	Siemens Medical Engineering	2/1/00 to 9/19/01	\$112,000	
"Scalable and Fault Tolerant Middleware"	MURI	12/1/99 to 3/31/02	\$253,701	
"Protocol Engineering Research Center"	MURI	6/15/00 to 6/14/03	\$264,720	Tatsuya Suda
"Optimizing ORBs for Network Management"	Cisco Systems	1/1/00 to 12/31/00	\$100,000	
"TAO Optimizations"	Raytheon Computing Systems	10/1/99 to 6/01/01	\$50,000	
"ACE+TAO on pSoS"	Motorola Trunking	8/15/99 to 12/31/99	\$30,000	
"Real-time Distributed Object Computing"	Sprint	8/15/99 to 8/14/00	\$133,068	
"TAO Enhancements"	Krones	8/1/99 to 9/1/99	\$5,000	
"ACE Enhancements"	ICOMVERSE	unrestricted gift	\$20,000	
"Weapon Systems Open Architecture"	Boeing	7/15/99 to 1/31/00	\$51,491	
"Fault Tolerant CORBA"	Motorola Labs	7/15/99 to 7/14/00	\$139,000	
"TAO Enhancements"	Global MAINTECH	7/1/99 to 8/1/99	\$5,000	
"ACE QoS Extensions"	Motorola Trunking	6/1/99 to 8/1/99	\$5,000	
"CORBA Interceptors"	Experian	5/15/99 to 7/14/99	\$10,000	
"DCOM performance evaluation"	Microsoft	unrestricted gift	\$30,000	
"TAO Improvements"	OCI	4/1/99 to 9/31/00	\$27,000	
"Middleware Optimizations"	Telcordia/Bellcore	2/1/99 to 1/31/00	\$52,700	
"Minimum CORBA"	Hughes Data Networking	4/1/99 to 3/31/00	\$50,000	David Levine
"Framework Usage Patterns"	Siemens Corporate Research	4/1/99 to 3/31/00	\$35,000	

Grants and Contracts Received (cont'd)

Title	Funding Agency	Duration	Amount	co-PIs
"Dynamic Scheduling and Real-time ORB Optimizations"	Boeing	10/1/98 9/30/99	\$184,860	
"Distributed Object Computing Middleware"	Nortel	11/1/98 10/31/99	\$75,000	
"ACE subsetting,"	Nokia	10/8/98 4/8/99	\$30,000	
"Boeing Research Fellowship"	Boeing	9/1/98 8/31/00	\$81,486	
"Patterns and Frameworks Reuse Curriculum"	Lucent Bell Labs	9/1/98 12/31/98	\$31,200	
"Patterns, Frameworks, and Components"	Siemens ZT	12/1/98 5/31/00	\$175,000	
"High availability frameworks"	Lucent	9/1/98 8/31/99	\$39,400	
"Real-time Distributed Object Computing"	Sprint	8/1/98 7/31/99	\$288,194	
"Distributed Object Integration for the Quorum Project"	DARPA S30602-98-C-0187	9/1/98 8/31/01	\$448,643	BBN
"Evaluating a Flexible Framework for Dynamic Distributed Real-Time Scheduling,"	USENIX	unrestricted gift	\$18,000	
"Distributed Object Computing"	Microsoft	unrestricted gift	\$20,000	
"Distributed Object Visualization Environment"	Lockheed	5/1/98 to 11/31/99	\$54,000	
"Distributed Object Computing with Adaptive End-to-end QoS Guarantees"	DARPA	8/1/97 to 9701561 7/31/00	\$873,625	
"Real-time CORBA for Telecommunications"	Lucent	12/1/97 to 11/31/98	\$100,000	
"Developing an HLA-compliant RTI with ACE"	SAIC	12/15/97 to 1/31/00	\$228,075	
"Real-time CORBA for Wireless"	Motorola LMPS	10/15/97 to 10/14/98	\$200,000	
"Real-time CORBA for Avionics"	Computing Devices International	10/15/97 to 10/14/98	\$39,050	
"Dynamic Scheduling of Real-time OFPs"	Boeing	9/1/97 to 8/31/98	\$224,604	
"Distributed Object Visualization"	Siemens MED	10/1/97 to 9/1/98	\$40,000	
"The ADAPTIVE Communication Environment"	Siemens MED	10/1/97 to 9/1/98	\$70,000	
"The Architect's Assistant"	Siemens Corporate Research	9/1/97 to 8/1/98	\$35,000	
"Monitoring, Visualization, and Control of High Speed Networks"	NSF NCR-97-14698	9/1/97 to 8/31/01	\$1,200,000	G. Parulkar, E. Kraemer, J. Turner, and R. Cytron
"Adaptive Software Technology Demonstration (ASTD)"	Wright Laboratories	9/1/98 to 8/31/02	\$1,200,000	Boeing CDI and Honeywell
"Patterns, Frameworks, and Components for Multimedia Systems"	Siemens Research	1/97 to 6/98	\$150,000	
"Adaptive Servers for High-Performance Imaging"	Kodak Networked Imaging Tech. Center	11/96 to 11/97	\$40,000	
"Real-time CORBA"	Sprint	9/96 to 12/97	\$345,000	Dr. Parulkar (co-PI)

Grants and Contracts Received (cont'd)

Title	Funding Agency	Duration	Amount	co-PIs
“OpenMAP – Object-Oriented Components for Real-time Avionics”	McDonnell Douglas	9/96 to 9/97	\$241,591	
“Compilation and Automatic Optimization of Network Protocol Implementations”	NSF NCR-9628218	8/96 to 8/99	\$411,025	Dr. Varghese and Dr. Cytron (PI)
“Medical Imaging with Java and the WWW”	SIEMENS Medical Engineering	8/96 to 7/97	\$125,000	
“The ADAPTIVE Communication Environment”	SIEMENS Medical Engineering	8/96 to 7/97	\$90,000	
“High-performance Distributed Medical Imaging”	Kodak Imaging	12/94 to 8/96	\$55,152	Dr. Jim Blaine (PI)
“Design Patterns for Concurrent Object-Oriented Networking”	Object Technologies International	4/96 to 4/97	\$25,000	
“Distributed Object Computing with CORBA and DCE”	Bellcore	5/96 to 12/96	\$32,978	
“The ADAPTIVE Communication Environment”	SIEMENS Medical Engineering	6/95 to 6/96	\$170,000	

Summary of Research Contributions

Over the past decade, I have led influential R&D efforts at the University of California, Irvine; Washington University, St. Louis; and the Defense Advanced Projects Research Agency (DARPA). These efforts have yielded significant improvements in the quality of service (QoS) of distributed object computing (DOC) middleware for mission-critical distributed real-time and embedded (DRE) systems. DOC middleware is reusable systems software that manages resources needed by DRE systems and bridges the gap between application-level requirements and the lower-level underlying localized viewpoints of operating system and networking mechanisms. The research agenda throughout my career has involved:

- Conducting innovative research that created and refined core DOC middleware technologies, such as design formalisms, QoS specification and enforcement techniques, and end-to-end middleware optimizations, and
- Working in conjunction with colleagues in academia and industry to demonstrate and mature middleware technologies in the context of real-world mission- and life-critical DRE systems, such as real-time avionics, ballistic missile defense, electronic medical imaging, high-speed network management, distributed interactive simulations, and teleconferencing.

I currently direct the UCI Distributed Object Computing (DOC) Laboratory, which is internationally recognized as one of the leading research groups on DOC middleware for DRE systems. The research contributions of my work have involved:

- Developing innovative optimization techniques and DOC middleware frameworks and components that can achieve high-performance, low latency, and real-time predictability end-to-end across high-speed networks and embedded interconnects.
- Discovering and formalizing patterns and pattern languages to enhance the development and evolution of DOC middleware to meet the stringent QoS requirements of DRE applications.
- Identifying and alleviating key performance bottlenecks and sources of priority inversion and non-determinism in DOC middleware over local-area and wide-area networks.

The R&D efforts I have led have had a significant impact on academic research and commercial practice. Scores of universities throughout the world use the DOC middleware my research group has developed as the basis for their research and teaching efforts. Moreover, our middleware is used in commercial products on thousands of innovative industrial projects at companies throughout the world, including BBN, Boeing, Cisco, Ericsson, Kodak, Hughes, Lockheed Martin, Lucent, Motorola, NASA/JPL, Nokia, Nortel, Raytheon, SAIC, Siemens, Sprint, and Telcordia.

The remainder of this section describe my research goals and key contributions in more depth, and cites representative examples of my publications. I also summarize my research accomplishments during the past decade.

Description of Research Goals and Contributions

My research on DOC middleware has produced distributed services and protocols that enable DRE applications to invoke operations on target objects without concern for their location, language, operating system, or hardware. Middleware for these types of applications must be *flexible*, *efficient*, and *predictable*. Flexibility is necessary to respond rapidly to application requirements that span an increasingly wide range of media types and traffic patterns. Efficiency and predictability are necessary to support the QoS demands of performance-sensitive and time-sensitive DRE applications.

Despite dramatic increases in the performance of networks and computers, designing and implementing flexible, efficient, and predictable DRE applications remains hard, and substantial time and effort is required to develop and deploy these applications today. My research has therefore focused on innovative techniques, patterns, and tools that have improved DRE application development by:

- Rigorously identifying middleware bottlenecks and key sources of priority inversion and non-determinism
- Optimizing end-to-end middleware performance and
- Simplifying middleware software development and evolution.

My specific research goals and contributions are described below.

Rigorously identifying performance bottlenecks and sources of priority inversion and non-determinism in DOC middleware over high-speed networks and embedded systems interconnects. The DOC Lab has developed and employed a middleware testbed environment to conduct extensive experiments that systematically identify the performance bottlenecks and sources of priority inversion and non-determinism in communication middleware software on high-speed networks. The experiments in our testbed have studied *lower-level network programming mechanisms*, such as socket-based C interfaces and the C++ wrappers for sockets, and *higher-level middleware*, such as Real-time CORBA, which is an open international standard for distributed object computing that has been highly influenced by the DOC Lab's R&D on patterns and middleware.

Our experiments on middleware performance have received widespread recognition in academia and industry. As a direct result of the analysis in our work, for instance, many CORBA suppliers have tuned their ORB implementations to improve performance considerably. Thus, the current generation of Real-time CORBA ORBs are now competitive with hand-coded C/C++ TCP/IP implementations. This improvement is important for performance-sensitive, mission/life-critical DRE application domains, such as real-time avionics and high-speed digital imaging, where the use of higher-level middleware greatly decreases development effort and increases system reliability and flexibility.

Two papers published in top conferences related to our empirical studies of middleware include:

1. Aniruddha Gokhale and Douglas C. Schmidt, "Evaluating Latency and Scalability of CORBA Over High-Speed ATM Networks," Proceedings of the International Conference on Distributed Computing Systems '97, IEEE, Baltimore, Maryland, May 27–30, 1997.
2. Aniruddha Gokhale and Douglas C. Schmidt, "Measuring the Performance of Communication Middleware on High-Speed Networks," Proceedings of SIGCOMM '96, ACM, San Francisco, August 28-30th, 1996.

Additional publications related to our middleware performance experiments are available at <http://www.ece.uci.edu/~schmidt/>.

Developing innovative optimization techniques and DOC middleware software that can achieve high-performance, low latency, and real-time predictability end-to-end. Based on the result of our empirical performance studies described above, we have developed middleware optimization techniques that can yield highly efficient and predictable Object Request Broker (ORB) implementations, without sacrificing flexibility, reuse, or standards-conformance. We have applied and demonstrated these optimization techniques in the context of the *ADAPTIVE Communication Environment (ACE)* and *The ACE ORB (TAO)*:

- ACE is an object-oriented toolkit containing frameworks and components that implement key patterns for DRE applications. ACE automates common network programming tasks, such as connection establishment, event demultiplexing, event handler dispatching, message routing, dynamic configuration of services, and flexible management of parallel protocol and service processing.
- TAO is a high-performance, real-time ORB targeted for DRE applications with hard and soft QoS requirements. The TAO ORB leverages the heavily optimized and reusable frameworks in ACE. TAO provides a unique contribution to research on DRE middleware since it is the first standards-based ORB that provided QoS for high-performance, real-time environments, such as high-speed network management, avionics flight control systems, mobile cellular systems, and distributed interactive simulations.

ACE and TAO are open-source software that have been used in thousands of DRE systems around the world. As a testament to the DOC Lab's prowess in technology transfer, two successful companies—Riverace and OCI—now provide commercial support for ACE and TAO using an open-source business model.

The following is a synopsis of the key research contributions and publications stemming from the ACE and TAO projects:

- A **real-time ORB Core** that supports deterministic scheduling and dispatching strategies. TAO's ORB Core concurrency models are designed to minimize context switching, synchronization, dynamic memory allocation, and data movement. TAO was the first standards-based ORB with these capabilities. Papers published on this topic include:
 1. Douglas C. Schmidt, Sumedh Mungee, Sergio Flores-Gaitan, and Aniruddha Gokhale, "Software Architectures for Reducing Priority Inversion and Non-determinism in Real-time Object Request Brokers," *Journal of Real-time Systems*, Kluwer, Vol. 21, No. 2, 2001.
 2. Douglas C. Schmidt, "Evaluating Architectures for Multi-threaded CORBA Object Request Brokers," *Communications of the ACM*, Special Issue on CORBA, ACM, edited by Krishnan Seetharaman, Volume 41, No. 10, October 1998.
- An **optimal active demultiplexing strategy** that associates client requests with target objects in constant time, regardless of the number of objects and operations. TAO was also the first ORB with these capabilities. Papers published on this topic include:
 1. Irfan Pyarali, Carlos O'Ryan, Douglas C. Schmidt, Nanbor Wang, Vishal Kachroo, and Aniruddha Gokhale, "Using Principle Patterns to Optimize Real-time ORBs," *IEEE Concurrency*, Volume 8, Number 1, January-March 2000.
 2. Andy Gokhale and Douglas C. Schmidt, "Measuring and Optimizing CORBA Latency and Scalability Over High-speed Networks," *IEEE Transactions on Computing*, April, 1998.
- A **highly optimized CORBA IIOP protocol engine** and a **highly optimizing IDL compiler** that generates compiled and/or interpreted stubs and skeletons, which enables applications to make fine-grained time/space tradeoffs. Papers published on this topic include:
 1. Andy Gokhale and Douglas C. Schmidt, "Optimizing a CORBA IIOP Protocol Engine for Minimal Footprint Multimedia Systems," *IEEE Journal on Selected Areas in Communications* special issue on Service Enabling Platforms for Networked Multimedia Systems, September, 1999.
 2. Andy Gokhale and Douglas C. Schmidt, "Techniques for Optimizing CORBA Middleware for Distributed Embedded Systems" Proceedings of INFOCOM '99, March 21-25th, New York, New York.
- A **real-time I/O subsystem** that minimizes priority inversion interrupt overhead over high-speed ATM networks and real-time interconnects, such as VME. Papers published on this topic include:
 1. Fred Kuhns, Douglas C. Schmidt, Carlos O'Ryan, and David L. Levine, "Supporting High-performance I/O in QoS-enabled ORB Middleware," *Cluster Computing: the Journal on Networks, Software, and Applications*, Volume 3, Number 3, 2000.
 2. Fred Kuhns, Douglas C. Schmidt, David Levine, and Rajeev Bector, "The Design and Performance of a Real-time I/O Subsystem," Proceedings of the 5th IEEE Real-Time Technology and Applications Symposium (RTAS99), Vancouver, British Columbia, Canada, June 2-4, 1999.

- **Real-time event and scheduling services** that integrate the capabilities of TAO described above to form the basis for next-generation DRE applications for many research and commercial projects, including Boeing, Cisco, Lockheed Martin, Raytheon, Siemens, and SAIC. Papers published on this topic:
 1. Chris Gill, David Levine, and Douglas C. Schmidt, “The Design and Performance of a Real-Time CORBA Scheduling Service,” *The International Journal of Time-Critical Computing Systems*, special issue on Real-Time Middleware, guest editor Wei Zhao, Volume 20, Number 2, March 2001.
 2. Douglas C. Schmidt, David Levine, and Sumedh Mungee, “The Design of the TAO Real-Time Object Request Broker,” *Computer Communications*, Special Issue on Building Quality of Service into Distributed System, Elsevier Science, April, 1998.
 3. Tim Harrison and David Levine and Douglas C. Schmidt, “The Design and Performance of a Real-time CORBA Event Service,” Proceedings of OOPSLA '97, ACM, Atlanta, GA, October 1997.

Additional publications related to the ACE and TAO projects are available at <http://www.ece.uci.edu/~schmidt/>.

Discovering and documenting patterns to simplify the development and evolution of DRE middleware and applications. Achieving widespread reuse of middleware requires a concerted focus on the core *patterns* that underlie DRE middleware and applications. Patterns formalize design expertise and articulate time-proven solutions to forces and problems that arise when developing software. Patterns also aid the development of DRE middleware and applications by expressing the structure and collaboration of components at a level higher than source code or software design models that focus on individual functions, objects, and classes.

During the development of ACE and TAO, my research group identified and captured a *pattern language* of essential middleware patterns for concurrency and networked collaboration. These patterns include the *Acceptor-Connector*, *Active Object*, *Asynchronous Completion Token*, *Component Configurator*, *Double-Checked Locking Optimization*, *Extension Interface*, *Half-Sync/Half-Async*, *Interceptor*, *Leader/Followers*, *Monitor Object*, *Proactor*, *Reactor*, *Scoped Locking*, *Strategized Locking*, *Thread-Safe Interface*, *Thread-Specific Storage*, and *Wrapper Facade*. Our experience applying these patterns throughout ACE and TAO illustrates their importance in generating flexible, efficient, and predictable software architectures for DRE middleware and applications.

Discovering, articulating, and implementing the key patterns via ACE and TAO enabled us to develop DRE middleware that can support applications with statistical, *e.g.*, multimedia applications, and deterministic, *e.g.*, avionics flight and mission control systems, QoS requirements. When these patterns are reified into reusable software frameworks and components, they yield DRE middleware that is considerably more efficient and predictable than is possible using existing middleware technologies. In particular, patterns facilitate reuse of middleware when other forms of reuse are infeasible, *e.g.*, due to fundamental differences in operating system mechanisms or programming language features.

Publications related to this topic as part of the TAO and ACE projects include:

1. Douglas C. Schmidt, Michael Stal, Hans Rohert, and Frank Buschmann, *Pattern-Oriented Software Architecture: Patterns for Concurrent and Networked Objects*, John Wiley and Sons, 2000.
2. Douglas C. Schmidt, David L. Levine, and Chris Cleeland, “Architectures and Patterns for High-performance, Real-time CORBA Object Request Brokers,” *Advances in Computers*, Academic Press, Ed., Marvin Zelkowitz, Volume 48, July 1999.
3. Douglas C. Schmidt and Chris Cleeland, “Applying Patterns to Develop Extensible and Maintainable ORB Middleware,” *IEEE Communications*, April, 1999.

4. Douglas C. Schmidt, "Experience Using Design Patterns to Develop Reuseable Object-Oriented Communication Software," *Communications of the ACM* Special Issue on Object-Oriented Experiences, ACM, Vol. 38, No. 10, October, 1995, pp 65–74.

Additional publications related to patterns documented from the ACE and TAO projects are available at <http://www.ece.uci.edu/~schmidt/>.

Summary of Accomplishments

The following summarizes my accomplishments after graduating with my Ph.D. from the Information and Computer Science Department at the University of California, Irvine in the summer of 1994:

Publications: I have published over 150 works (34 journal papers, 61 conference papers, 2 books, 3 edited book collections, 30 book chapters, and 34 workshop papers). Many of my papers have appeared in the most selective conferences (ACM SIGCOMM, ACM OOPSLA, IEEE INFOCOM, IEEE ICDCS, and the ACM/IEEE ICSE) and journals (IEEE Transactions on Computing and IEEE Journal of Selected Areas of Communications) in my field. I have also given over 100 invited lectures and 100 tutorials world-wide during the past decade.

Funding: Since June 1995 I have been a PI or co-PI for grants, contracts, and gifts totaling more than \$9 million dollars. I have been the sole PI for over \$5 million dollars of this amount.

Graduate advising and training: During my career at Washington University and UC Irvine, I have graduated 9 masters students and 3 doctoral students.

Professional service: I have engaged in the following professional service capacities:

- Served as guest editor of 5 ACM, IEEE, and USENIX journals, and served as associate editor and editor-in-chief of the C++ Report magazine.
- Served as general chair or program chair for 9 conferences, tutorial chair for 4 conferences, and served on the program committees for over 40 IEEE, ACM, IFIP, USENIX, and OMG conferences.
- Served as the Deputy Director for the DARPA Information Technology Office (ITO), helping to set the national agenda on IT research and development for the U.S. Department of Defense.
- Served as a Program Manager at DARPA ITO leading national effort on middleware for over \$60 million dollars of Federal IT R&D funding.
- Served as Co-chair for the Software Design and Productivity (SDP) Coordinating Group, which formulates the multi-agency research agenda in fundamental software design for the Federal government's Information Technology Research and Development (IT R&D) Program, which is the collaborative IT research effort of the major Federal science and technology agencies.