

PAUL A.S. WARD  
CURRICULUM VITAE

## 1 PERSONAL DATA

### 1.1 ADDRESS

Assistant Professor  
Department of Electrical and Computer Engineering  
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### 1.2 EDUCATION

2002: Ph.D. (Computer Science), University of Waterloo  
*Thesis:* A Scalable Partial-Order Data Structure for Distributed-System Observation  
Supervisor: David Taylor  
*Grades:* Cumulative Average: 93% (A+)

1993: MSc (Computer Engineering), University of Waterloo  
*Thesis:* A Propositional Meta-Constraint System: Specification, Application and Implementation  
*Grades:* Cumulative Average: 88% (A)

1988: BScE (Electrical Engineering, Computer Engineering Option), University of New Brunswick  
*Thesis:* A Bit-Serial Digital Filter Section in CMOS VLSI  
*Grades:* Cumulative Grade Point Average: 4.3/4.3 (A+)  
*Rank:* First out of graduating class of about one thousand  
Governor General's Medal for top graduating student  
Lieutenant Governor's Medal for top engineering student  
Brydone Jack Prize for top electrical engineering student

### 1.3 EMPLOYMENT

December 2001 to Present: **Assistant Professor**, Department of Electrical and Computer Engineering, University of Waterloo.

- ~> Instructor of several undergraduate and graduate courses.
- ~> Supervisor of undergraduate and graduate research assistants, and several teaching assistants.
- ~> Research: Problems in dependable distributed computing, especially distributed systems management and autonomic distributed systems ; Wireless Mesh Networks ; Peer-to-peer systems ; Service-based pervasive systems.

January 2004 to Present: **CAS Faculty Fellow**, IBM Toronto Laboratory, Toronto, Ontario

- ~> Working on research problems with Log-and-Trace utility of the Hyades test framework for the Eclipse system.

2000 to Present: **Legal Consulting**

- ~> Provided expert testimony for Green & Chercover pertaining to a dispute between a teacher and the French Catholic School Board in Cambridge.
- ~> Provided expert testimony for Green & Chercover pertaining to a dispute between a teacher and the Thames Valley District School Board.
- ~> Provided expert testimony for McCarthy Tétrault in the icravetv.com dispute.

1998 to 2002: **System Administrator** for the Shoshin Distributed Systems Group

- ~> Maintain heterogeneous network of workstations consisting of a dozen RS/6000 machines running AIX 4.3+, two Solaris machines, a DEC Ultrix machine, several laptops and a dozen PCs running a combination of Redhat Linux and WindowsNT. The machines are connected via a combination of 10/100/1000 Mbit/s Ethernet, 100 Mbit/s FDDI, and a wireless 802.11b network.
- ~> Maintained <http://www.shoshin.uwaterloo.ca/> and <http://www.ccng.uwaterloo.ca/> web sites.

May 1997 to December 2001: **Visiting Student Researcher**, IBM Toronto Laboratory, Toronto, Ontario

- ~> Assist with the development of Object-Level Trace (OLT) for the IBM Component Broker Series (CBS) and IBM WebSphere products. OLT is created from a research prototype developed by Professor David Taylor at the University of Waterloo. I have integrated various changes in the research prototype into the product.
- ~> Study problems of scaling OLT to very large numbers of concurrently executing objects. These problems form the core of my Ph.D. research.
- ~> Analyzed the dimension of distributed computations. This work led to the development of more-efficient means of monitoring and debugging distributed systems.
- ~> Developed algorithms for scalable vector timestamps for use in OLT.

1996 (January to September): **Research Associate**, Simon Fraser University, Burnaby, British Columbia

- ~> Liaison between the Intelligent Software Group and MPR Teltech.
- ~> Developed methods for improving the Toll Information Analyzer product.

1994 to 1996: **Software Developer**, IBM Toronto Laboratory, Toronto, Ontario

- ~> Designed, implemented and tested fast parallel load utility for DB2/Parallel Edition. The utility partitions the data, transmits it to the relevant database nodes, formats and loads the data.
- ~> Developed method of allowing extension of database engine at the physical file level. This method was used for the implementation of the fast parallel load utility.
- ~> Test-case development for automated testing. Moved test-case development work from C to Perl allowing for more portable tests and faster test-case development.
- ~> Supported FVWM and L<sup>A</sup>T<sub>E</sub>X in the Database Group.

1993: **Visiting Researcher**, Weizmann Institute of Science

- ~> Invited by Professor Ehud Shapiro to do groupware research and development.
- ~> Designed and implemented software for audio conferencing over the Internet.
- ~> Integrated audio-conferencing software into groupware prototype.
- ~> This prototype led to the development of “Virtual Places” groupware over the Internet.

1988 to 1990: **Design Engineer**, Applied Microelectronics, Halifax, Nova Scotia

- ~> Designed hardware and software for data translator that receives two input data streams, a DR11/W stream from a PDP 11/44 and a serial 124.8 kbit/s NRZ stream. The serial stream is filtered based on operator inputs, merged with the DR11/W stream and a single 115.2 kbit/s stream of HDLC frames is produced. This work was done as part of the Weather Star 4000 project for The Weather Channel.
- ~> Various other hardware and firmware design and implementation for real-time embedded systems.
- ~> Studied methods to implement two gigabyte, 60 ns per port, 16-port memory architecture. This work was core preliminary work and led Applied Microelectronics to receiving the contract for the development of the memory subsystem for the Next Generation Signal Processor (NGSP) for Defense Research Establishment Atlantic (DREA).
- ~> Project management, including cost and schedule estimation and partial management of two technicians and a secretary.

## 2 RESEARCH

### 2.1 AREAS

- ~> Problems in dependable distributed computing, especially distributed systems management and autonomic distributed systems.
- ~> Wireless networks, including *ad hoc*, mesh, and delay-tolerant wireless networks.
- ~> Peer-to-peer systems.
- ~> Service-based pervasive systems

### 2.2 PUBLICATIONS: 26

#### 2.2.1 BOOKS, BOOK CHAPTERS, AND JOURNALS: 2

1. Jakubczak, S, Lau, A., Li, L, and Ward, P. A simple rate-limiting fairness algorithm for wireless mesh networks. Submitted to Ad Hoc Networks.
2. Deyi Li, X. Shi, Paul Ward and M.M. Gupta. A soft inference mechanism based on cloud models. In T. Martin and F.A. Fontana, editors, Logic Programming and Soft Computing, pp. 163-188, Wiley, 1998.

#### 2.2.2 REFEREED CONFERENCES AND WORKSHOPS: 17

1. Ward, P. and Bedasse, D. Fast convex closure for efficient predicate detection. To appear in EuroPar 2005. 10 pages.
2. Munawar, M. and Ward, P. Better Performance or better manageability? In ICSE Workshop on the Design and Evolution of Autonomic Application Software, 2005. 4 pages.
3. Munawar, M. and Ward, P. Memory-usage prediction in systems using automatic memory management. 3rd Proactive Problem Prediction, Avoidance and Diagnosis Conference, 2005.
4. Jones, E., Karsten, M., and Ward, P. Multipath load balancing in multi-hop wireless networks. To appear in the IEEE International Conference on Wireless and Mobile Computing, Networking and Communications 2005. 9 pages.
5. Jones, E., Li, L., and Ward, P. Practical Routing in Delay-Tolerant Networks. To appear in the ACM SIGCOMM Workshop on Delay-Tolerant Networks, 2005. 8 pages.
6. Munawar, M. and Ward, P. Are two interfaces better than one?. To appear in the IEEE International Conference on Wireless and Mobile Computing, Networking and Communications 2005. 8 pages.
7. Reidemeister, T., Boehm, K., Buchmann, E., and Ward, P. Malicious behaviour in content-addressable peer-to-peer networks. To appear in the Third Annual Communication Networks and Services Research Conference, 2005. 8 pages.
8. Bansal, D. and Ward, P. Third-party flow control. To appear in the Third Annual Communication Networks and Services Research Conference, 2005. 7 pages.
9. Shukla, A., Li, L., Subramanian, A., Ward, P., and Brecht, T. Evaluating the Performance of User-Space and Kernel-Space Web Servers, In CASCON 2004. pages 189-201, October 2004.
10. Ward, P., Huang, T., and Taylor, D. Clustering Strategies for Cluster Timestamps. In International Conference on Parallel Processing, pages 73-81. IEEE Computer Society Press, August 2004.

11. Lee, A. and Ward, P. A Study of Routing Algorithms in Wireless Mesh Networks. Australian Telecommunication Networks and Applications Conference. 4 pages. December, 2004.
12. Dheap, V., Munawar, M., Naik, S., and . Ward, P. Parameterized Neighbourhood-Based Flooding for Ad Hoc Networks. In Milcom 2003, 6 pages, IEEE Communications Society, 2003.
13. Ward, P. and Taylor, D. Self-organizing hierarchical cluster timestamps. In Europar 1 Parallel Processing, Lecture Notes in Computer Science 2150, pages 46-56. Springer-Verlag, August 2001.
14. Ward, P. and Taylor, D.. A Hierarchical Cluster Algorithm for Dynamic, Centralized Timestamps. In Proceedings of the 21st Conference on Distributed Computing Systems, pages 585-593, IEEE Computer Society Press, April 2001.
15. Ward, P. A Framework for Dynamic, Centralized Dimension-Bounded Timestamps. In Proceedings of the 2000 CAS Conference, pages 78-87, Toronto, November 2000.
16. Ward, P. An offline algorithm for dimension-bound analysis. In Dhabaleswar Panda and Norio Shiratori, editors, Proceedings of the 1999 International Conference on parallel Processing, pages 128-136. IEEE Computer Society, 1999.
17. Ward, P. An online algorithm for dimension-bound analysis. In P. Amestoy, et al, editors, EuroPar 9 Parallel Processing, Lecture Notes in Computer Science, No. 1685, pages 144-153. Springer-Verlag, 1999.

### 2.2.3 UNREFEREED WORKSHOPS: 3

1. Ward, P. and Munawar, M. Continuous Monitoring for Problem Determination. CASCON Workshop on self-managed systems, Toronto, October, 2004.
2. Ward, P. and Dheap, D. Automatic Subscription and Notification for Event-Driven Web Services. CASCON Workshop on publish/subscribe middleware, Toronto, October 2003.
3. Ward, P. Networking Issues in Pervasive Computing, CASCON Workshop on Pervasive Computing: Present and Future, October 2002.

### 2.2.4 TECHNICAL REPORTS: 4

1. Bansal, D. and Ward, P. Improving bandwidth utilization in file-sharing peer-to-peer networks. Technical Report 2002-18. Department of Electrical and Computer Engineering, The University of Waterloo, Waterloo, Ontario, Canada N2L 3G1, December 2002.
2. Ward, P. Issues in Scalable Distributed-System Management. Technical Report CS-2001-01, Shoshin Distributed Systems Group, Department of Computer Science, The University of Waterloo, Waterloo, Ontario, Canada N2L 3G1, January 2001.
3. Ward, P. and Taylor, D. Centralized Cluster Timestamps, Technical Report CS-2000-16, Shoshin Distributed Systems Group, Department of Computer Science, The University of Waterloo, Waterloo, Ontario, Canada N2L 3G1, October 2000.
4. Ward, P. On the scalability of distributed debugging: Vector clock size. Technical Report CS98-29, Shoshin Distributed Systems Group, Department of Computer Science, The University of Waterloo, Waterloo, Ontario, December 1998.

### 2.3 GRANTS, CONTRACTS, FELLOWSHIPS AND AWARDS

Paul A.S. Ward	STG Funding (6 of 12 accepted)	\$20,300 pa	May 2004 – May 2006
Paul A.S. Ward	IBM CAS Funding (10 of 40 accepted)	\$60,000 (approx)	2004 – 2007
Paul A.S. Ward	Microsoft Research (17 or 90 accepted)	\$22,500 (US)	2004
Paul A.S. Ward and Dushyant Bansal	Sandvine/NSERC IPS	\$21,000 pa	May 2003 – May 2005
Paul A.S. Ward	NSERC Discovery Grant	\$18,000 pa	May 2003 – May 2007
Aagard, Czarnecki, Ho, and Ward	CFI New Opportunities/OIT Matching	\$719,923.00	2003 – 2007
Paul A.S. Ward	Bell Lab Upgrade	\$50,000	2002–2003
Paul A.S. Ward	E&CE Startup Grant	\$40,000	2002 – present
Paul A.S. Ward	IBM CAS Fellowship	\$25,000	2000
Paul A.S. Ward	OGSST	\$15,000	1999
Paul A.S. Ward	UW Graduate Scholarship	\$2,666	1999
Paul A.S. Ward	Meloche Monnex Scholarship	\$7,500	1998
Paul A.S. Ward	IBM CAS Fellowship	\$25,000 pa	1997–2000
Paul A.S. Ward	ICR Scholarship	\$4,000 pa	1996–1999
Paul A.S. Ward	NSERC '67 Scholarship	\$21,300 pa	1990-1992
Paul A.S. Ward	ICR Scholarship	\$3,000	1990
Paul A.S. Ward	Governor General's Medal	-	1998
Paul A.S. Ward	Lieutenant Governor's Medal	-	1988
Paul A.S. Ward	Brydone Jack Prize	\$450	1988
Paul A.S. Ward	K.R. Chestnut Memorial Prize	\$1,750 pa	1986–1987
Paul A.S. Ward	Leonard Foundation Scholarship	\$1,300 pa	1984–1987
Paul A.S. Ward	APENB Engineering Prize I	\$200	1985
Paul A.S. Ward	Lord Beaverbrook Scholarship	\$2,500 pa	1984–1988
Paul A.S. Ward	Governor General's Medal	-	1984

### 2.4 INVITED TALKS AND SEMINARS

“Fairness in Wireless Mesh Networks.” IBM Toronto Lab, August 31st, 2004.

“Automatic Subscription and Notification for Event-Driven Web Services.” CASCON Workshop on publish/subscribe middleware. Toronto, October, 2003.

“Networking Issues in Pervasive Computing.” CASCON Workshop on Pervasive Computing: Present and Future. Toronto. October 2002.

“Controlled Dissemination of Digital Information.” Vrije Universiteit, Amsterdam. June 2001.

“Scalable Distributed-System Observation.” CASCON, November, 2000.

“Adaptive Mobile Applications.” Bell Research Fair. Toronto, November 2000.

“What is a Computer Scientist?” ACM Regional Finals. Waterloo, November 1999.

## 2.5 OTHER

~> Together with Prof. David Taylor of Computer Science, I continuously upgrade the POET program, a partial-order event tracer for distributed-systems observation and management. This program is freely distributed for research purposes to several institutions throughout the world. The program has been licensed to IBM, and is the basis for the IBM Object-Level Trace product.

### 3 TEACHING

#### 3.1 COURSES TAUGHT

Course	Title	Term	Enrollment	Q1-9	Q10
E&CE 428	Computer Networks and Security	Spring 2005	96	na	na
E&CE 454	Distributed Computing	Spring 2005	84	na	na
E&CE 750-6	Pervasive Computing	Winter 2005	7	na	na
E&CE 750-5	Distributed Computing (ConGESE)	Fall 2004	17	83	83
E&CE 750-6	Pervasive Computing	Spring 2004	4	na	na
E&CE 454	Distributed Computing	Spring 2004	107	83	80
E&CE 750-5	Distributed Systems	Spring 2003	4	na	na
E&CE 454	Distributed Computing	Spring 2003	156	73	67
E&CE 750-6	Pervasive Computing	Winter 2003	15	na	na
E&CE 720-4	Networks	Winter 2003	2	na	na
E&CE 428	Computer Networks and Security	Winter 2003	159	82	80
E&CE 750-5	Distributed Systems	Spring 2002	7	na	na
E&CE 454	Distributed Computing	Spring 2002	97	79	74
E&CE 428	Computer Networks and Security	Winter 2002	126	68	56
CS 654	Distributed Systems	Spring 1999	12	na	na
CS 454	Distributed Systems	Spring 1999	71	na	na
CS 654	Distributed Systems	Spring 1998	4	na	na
CS 454	Distributed Systems	Spring 1998	54	na	na
CMPT-275 (SFU)	Introduction to Software Engineering	Spring 1996	47	na	na

#### 3.2 GRADUATE STUDENT SUPERVISION

Name	Degree	Completed	Comments
Ahmad Munawar	M.A.Sc.	June 2004	Thesis: Multi-Interface Multi-Channel Wireless Mesh Networks. Ahmad was funded by a Commonwealth Scholarship. He is starting a Ph.D. in September under my supervision. He is a funded CAS Fellowship student.
Vijay Dheap	M.A.Sc.	June 2004	Thesis: Event-Driven Response Architecture. Vijay has a job offer with Trilogy, as well as receiving one of only four NSERC Doctoral Awards in E&CE in 2004.
Dushyant Bansal	M.A.Sc.	In progress	Thesis: Reducing bandwidth utilization in peer-to-peer networks. Dushyant has an NSERC IPS working with Sandvine on his thesis.
Dwight Bedassé	M.A.Sc.	In progress	Thesis: Fast Convex Closure. Dwight has a Commonwealth Scholarship.
Szymon Jakubczak	M.A.Sc.	In progress	Thesis: Fairness in Wireless Mesh Networks. Szymon is an exchange student for Poland, doing his degree in the Warsaw University of Technology. While I officially jointly supervise Szymon with Prof. Slawomir Kuklinski, I am in practice the main supervisor, to the point that I fund Szymon.



Name	Degree	Completed	Comments
Evan Jones	M.A.Sc.	In progress	Evan is funded by an NSERC Masters.
Jiajun Wu	M.A.Sc.	In progress	Thesis: Collecting Transaction Data in Event-Monitoring Tools
Adeolu Adeoye	M.A.Sc.	In progress	n/a
Tao Huang	M.A.Sc.	In progress	Thesis: Clustering Strategies for Cluster Timestamps
Lily Li	M.A.Sc.	In progress	Thesis: Fairness in wireless mesh networks
Belal Tassi	M.A.Sc.	Congese	n/a
Shelley Lau	M.A.Sc.	Congese	n/a
Ahmad Munawar	Ph.D.	Starting Sept 2004	n/a
Kamran Jamshaid	Ph.D.	Starting Sept 2004	n/a
Ann Lee	M.A.Sc.	Starting Sept 2004	n/a

### 3.3 UNDERGRADUATE STUDENT SUPERVISION

Name	Dates	Comments
Cheng, Kelvin	Spring '03	Coop: NAT Detection
Chen, Lindsay	Spring '03 ; Fall '04	Coop: ns-2 simulation of wireless mesh networks
Cheung, Oh, Singh, and Sachithanathan	Fall '02 ; Spring '03	FYDP: Operating Room Management System
Campagna, Jina, Mahardi, and Thangirala	Fall '02 ; Spring '03	FYDP: UPPS API: The Unparalleled Parallel Processing Subsystem
Kung, Yu, Lee, and Nguyen	Fall '03 ; Spring '04	FYDP: Digital Camera Wireless Adapter
Poon, Lau, Wong, and Luthra	Fall '03 ; Spring '04	FYDP: Portable Wingman
Haines, Major, Bouchard, and Dickinson	Fall '03 ; Spring '04	FYDP: Willy Is Watching
David, Li, Jannie Mak, Phillip Woo, and Shuo Zhang	Winter & Spring '04	FYDP: Cellular Travel Guide

### 3.4 EXAMINING COMMITTEES

Name	Degree	Date	Comments
Anthony Cox	Ph.D. (CS)	2002	
Paul Lo	M.Math	2002	
Wei Wen	M.A.Sc.	2003	
Alvin Chin	M.A.Sc.	2003	
Brent Ishibashi	M.Math	2003	
Joe Capka	M.Math	2003	
Erin Ren	M.Math	2003	
Ping Xie	M.Math	2004	
Hao Chen	Ph.D. (CS)	In progress	
Katrin Hoepfer	Ph.D. (E&CE)	In progress	

### 3.5 OTHER TEACHING CONTRIBUTIONS

- ~> Created new graduate course in Pervasive Computing
- ~> Course Co-ordinator for E&CE 428 and E&CE 454.
- ~> Acquired \$22,000 US support from Microsoft Research for coursework improvements in E&CE 454
- ~> Changed text for E&CE 428, updating curriculum in the process, including offering optional programming assignments, since the course is approximately one-third electrical engineering students and two-thirds computer engineering students. Added a cross-listed version, E&CE 720-4, for graduate students to help deal with deficit of graduate courses in the computer area.
- ~> Changed text for E&CE 454, updating curriculum in the process. Made programming projects mandatory, substantially improving the quality of the course. Added a cross-listed version, E&CE 750-5, for graduate students to help deal with deficit of graduate courses in the computer area.
- ~> Member E&CE 150 Course-Review Committee.
- ~> Class prof. for Computer Engineering class of 2007.
- ~> Volunteer grader for workterm reports (10 in Spring 2004).

## 4 PROFESSIONAL ACTIVITIES AND SERVICES

### 4.1 SOCIETIES, JOURNALS, AND CONFERENCES

- ~> Member since 1984: IEEE, IEEE Computer society, IEEE Communications Society.
- ~> Professional Engineer (registered in New Brunswick), since 1994.
- ~> Member CASCON 2004 Program Committee
- ~> Referee for various conferences and journals, including PACT, IM, ICPP, Micro-32, OOPSLA, CASCON, Transactions on Parallel and Distributed Systems, IEE Electronic Letters, and IEEE Software Magazine. I have referred more than 15 papers in the first six months of 2004.
- ~> Moderator for CUTC 2002, 2003.
- ~> Organizing Autonomic Computing Enablement Workshop for CASCON 2004.

### 4.2 UNIVERSITY, FACULTY AND DEPARTMENT SERVICE

- ~> E&CE representative on Engineering Faculty Council.
- ~> EFC representative on Environmental Studies Faculty Council.
- ~> Explorations Day Co-ordinator, 2003.
- ~> Member E&CE 150 Course-Review Committee.
- ~> Representative on the Computer Group Departmental Advisory Committee on Appointments, 2002.
- ~> Graduate student representative on the University of Waterloo Computer Science Chair Selection Committee, 2001.
- ~> Graduate student representative on the Computer Science Departmental Advisory Committee on Appointments, 2000.
- ~> Course Co-ordinator for E&CE 428 and E&CE 454.
- ~> Class prof. for Computer Engineering class of 2007.
- ~> Reader for 7 masters theses and one doctoral thesis.
- ~> Faculty Consultant/Mentor for 6 fourth-year design projects (2 in 2003/4 ; 4 in 2004/5).
- ~> Volunteer grader for workterm reports (10 in Spring 2004).
- ~> Organize the weekly networks and distributed-systems seminar, 1999 to present.
- ~> Wrote numerous letters of reference.

### 4.3 COMMUNITY VOLUNTEER SERVICE

- ~> Member of the Beaverbrook Scholar Committee
- ~> Sunday school teacher
- ~> Organizer of "Refugee Awareness Week"
- ~> Publicity Coordinator for Inter-Varsity Christian Fellowship
- ~> Member of "Students Help Ethopia" which raised \$25,000 for famine relief

#### 4.4 MISCELLANEOUS DETAILS

- ~> Father of Jonathan, Rebecca, James, Sarah, and Joshua
- ~> Citizenship: British and Canadian
- ~> Study Biblical and modern Hebrew
- ~> Sunday school teacher
- ~> Avid gardener
- ~> Voracious reader, including Judaica, philosophy, history (especially history of science and technology), popular science and science fiction
- ~> Enjoy soccer, swimming and hiking